# SAS® Model Manager 14.1: User's Guide

SAS® Documentation

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**SAS® Model Manager 14.1: User's Guide**



SAS Institute Inc., SAS Campus Drive, Cary, NC 27513-2414

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# Contents

## PART 2 Working with Models, Projects, and Portfolios 45

# What's New in SAS Model Manager 14.1

## Overview

SAS Model Manager 14.1 has new features and enhancements that enable you to perform the following tasks:

- access an inventory of all models in the same category view
- add and edit model keywords
- manage model versions
- add multiple user-defined properties to a model at one time
- import generic models at the folder level
- add model dependencies and view the relationships using SAS Lineage
- manage SAS Factory Miner project segments and models
- create model input and output variables from a SAS code file

*Note:* When you apply the most recent SAS Model Manager 14.1 hot fix (V85008 or later), you must add the metadata connection system options to your SAS programs before running them in batch mode. These system options are necessary if you include macros that require you to connect to the SAS Metadata Server. For more information, see "Setting Metadata Connection System Options" on page 289.

## Access an Inventory of All Models in the Same Category View

The Inventory subcategory is added under the Models category. You can use this subcategory to access all of the models in the model repository in one place, whether they are located in a folder, portfolio, or project. As a result, you will have improved performance when you search the model inventory. You can also filter the search results by date modified, keywords, model properties, and user-defined properties. You can add user-defined properties as columns in the list in order to display the values for each model. For more information, see "Overview of Model Inventory" on page 91.

## Add and Edit Model Keywords

You can add keywords to a model and also edit existing keywords. As a result, the keywords can be used with other models. You can also use model keywords to filter the search results of the model inventory. For more information, see "Add and Edit Model Keywords" on page 81.

## Manage Model Versions

You can add new model versions and view existing versions of a model. A new version is created automatically when the model is set as champion or is published from the project level. A new version is also created when you update a model that is located within a folder. For more information, see "Managing Model Versions" on page 88.

## Add Multiple User-Defined Properties to a Model

You can now add multiple user-defined properties to a model at one time.

For more information, see "Add Model User-Defined Properties" on page 81.

## Import Generic Models at the Folder Level

You can import generic models from the SAS Workspace Server directly into a folder in the Projects category view. You can then update the models from or export the models to the SAS Workspace Server. You can duplicate these models or move them to another folder. However, you cannot move or copy them to a project version. For more information, see "Importing Models into a Folder" on page 74.

## Add Model Dependencies and View the Relationships in SAS Lineage

You can now add dependencies to models within the SAS Model Manager model repository. This includes adding dependencies between models that are located within the same project, or within another project. You can also add dependencies to generic models that are located within a folder. Then you can view the relationships by using SAS Lineage. For more information, see "Add Model Dependencies and View Lineage" on page 83.

## Manage SAS Factory Miner Project Segments and Models

If you have licensed both SAS Model Manager and SAS Factory Miner, you can register projects from SAS Factory Miner to the SAS Model Manager model repository. The SAS Factory Miner projects that are registered include their project segments and models. The SAS Factory Miner projects are managed as portfolios in SAS Model Manager. For more information, see "Overview of Portfolios" on page 95.

## Create Model Input and Output Variables from a SAS Code File

You can create input and output variables for models from a SAS Code file. This feature enables you to generate missing metadata for model variables. For more information, see "Create Input and Output Variables from a SAS Code File" on page 85.

# Accessibility

For information about the accessibility of this product, see Accessibility Features of SAS Model Manager 14.1.

# Part 1

# Getting Started

*Chapter 1*

# Introduction to SAS Model Manager



## About Managing Models

Using SAS Model Manager, you can store models, and organize them within projects or folders, validate candidate models, assess candidate models for champion model selection, and publish and monitor champion models in a production environment, and retrain models. All model development and model maintenance personnel, including data modelers, validation testers, scoring officers, and analysts, can use SAS Model Manager.

Here are some of the services SAS Model Manager provides:

- Use a single interface to access all of your business modeling projects. All models are stored in a central, secure model repository. Models can also be accessed in one place using the model inventory list in the Inventory category.
- Track the progress of your project's version by creating processes, definitions, and tests. You create custom processes, definitions, and tests to meet your business requirements and to match your business processes.
- Use data tables that are registered in the SAS Metadata Repository.
- Import SAS Enterprise Miner models, SAS/STAT linear models, SAS/ETS COUNTREG and SEVERITY models, models that you develop using SAS code, PMML models, and R models. You can also import a generic model and the model's files in to a folder. You can create custom model templates for SAS code models so that SAS Model Manager knows exactly what files and metadata are associated with a model.

- You can schedule and run scoring tests, performance monitoring, and retraining to validate models.
- Run several reports to compare and assess candidate models. You can also write your own SAS reporting programs to run and assess candidate models. The aggregated reporting facility enables you to combine multiple reports into a single report. Dashboard reports enable you to monitor the state of projects using performance monitoring reports and can be viewed in a web browser.
- Publish models to the SAS Metadata Repository or a SAS channel. You can also publish the champion model and challenger models to a database for scoring. The SAS Scoring Accelerator is used by SAS Model Manager to publish models to a database or Hadoop.

Data tables are an integral part of the modeling process. You can use project input and output prototype tables, as well as scoring input and output prototype tables to define variables. Data tables are used for scoring, testing, and performance monitoring. Performance data can be created from your operational data, provided that it has the required structure (for example, the data contains a target variable).

You can also create multiple projects in a portfolio. Additional versions can then be created for all projects within the portfolio. Champion models for all projects within the portfolio can be monitored for performance, and published to the SAS Metadata Repository. SAS Factory Miner models can also be registered to the SAS Model Manager model repository. The SAS Factory Miner projects are managed as portfolios in SAS Model Manager. The project segments and models are available within a portfolio and can be managed from the Portfolios category within SAS Model Manager.

Any user who is registered in SAS Management Console can be assigned to a SAS Model Manager group, and can then work in SAS Model Manager. For more information, see "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide*.

## Managing Preferences

### About Setting Preferences

Preferences provide a way for you to customize the user interface. Preferences for each user are stored in metadata and are retained if your deployment is migrated or reconfigured.

You can set preferences in two ways:

by using the Preferences window
: To open the Preferences window, select **File** ⇨ **Preferences**. There are two general categories of preferences: Global and Decision Manager preferences. See "Global Preferences" and "Decision Manager Preferences" on page 5 for more information.

by using SAS Preferences Manager
: SAS Preferences Manager is a web application that provides a central facility for users to manage their preferences and settings. See "SAS Preferences Manager" on page 5 for more information.

### *Global Preferences*

Global preferences apply to all SAS web applications that are displayed with the Adobe Flash Player. When you set a global preference, it applies only to the user that you are logged on as.

To set global preferences, select the **Global Preferences** page. The following global preferences are available:

**User locale**
specifies the geographic region whose language and conventions are used in the applications. This setting might also apply to some SAS web applications that are not displayed with the Adobe Flash Player. The default is the browser locale. Locale changes take effect after you log off and log back on.

*Note:* You can also set the **User locale** setting by using the SAS Preferences Manager. Select the **Regional** menu option in SAS Preferences Manager. For more information, see "SAS Preferences Manager" on page 5.

*Note:* If the user locale that you specify in the preferences is different from the user locale for the SAS Workspace Server, you might receive an error when you try to sign in to the application. You might also receive encoding errors when executing tasks in SAS Model Manager. If you receive an error, change the updated locale back to the original locale.

**Theme**
specifies the collection of colors, graphics, and fonts that appear in the applications. Your site administrator can change the default theme. A theme change might take a few seconds to apply if many items and features are open in the application.

**Invert application colors**
inverts all of the colors in the application window, including both text and graphical elements. You can also temporarily invert or revert the colors for an individual application session by pressing Ctrl+~.

**Override settings for focus indicator**
controls the appearance of the highlighting that surrounds the currently selected field in the SAS Model Manager interface.

### *Decision Manager Preferences*

Decision Manager preferences apply to SAS Model Manager only. To set these preferences, select **Decision Manager** ⇨ **General**.

**Show this number of recent items**
controls the number of items that are listed in the **Recent Work** menu. To display this menu, select **File** ⇨ **Recent Work**.

### *SAS Preferences Manager*

SAS Preferences Manager is a web application that provides a common mechanism for managing preferences for SAS web applications. The application enables users to manage their preferences and administrators to set default preferences for locale, theme, alert notification, time, date, and currency.

To launch the SAS Preferences Manager, enter the URL http://*host-name*:*port*/SASPreferences in your browser window. Replace the values for host-name and port based on the location of the configured SAS Web Infrastructure Platform. For more information, see "SAS Preferences Manager" in *SAS Intelligence Platform: Middle-Tier Administration Guide*.

### Change the Delivery Type for Alert Notifications

The default delivery type for notifications is specified in the properties for the SAS Application Infrastructure by using the Configuration Manager plug-in to SAS Management Console. For SAS 9.4, the default delivery type is `My alerts portlet`. You can use SAS Preferences Manager to change your default delivery type.

*Note:* A SAS administrator can modify the default notification type for all users. For information about modifying the default delivery type for all users, see "Configure Alert Notifications for SAS Workflow" in *SAS Model Manager: Administrator's Guide*.

To specify the notification delivery preference for an individual user:

1. Enter the URL http://*host-name*:*port*/SASPreferences in your browser window to launch the SAS Preferences Manager. Replace the values for host-name and port based on the location of the configured SAS Web Infrastructure Platform.
2. Enter the user ID and password for the user account that you use to access SAS web applications.
3. Select **General** ⇨ **Notifications**.
4. Select a format type for the e-mail notifications. The options are `HTML-formatted e-mail` and `Plain-text e-mail`.
5. Select the notification types from the **Available** list and click to add the selected notification types.

   TIP To remove a notification type, select the type from the list and click .
6. Click **Apply** to update the notification settings, and click **OK** to save the changes.

For more information, see "SAS Preferences Manager" in *SAS Intelligence Platform: Middle-Tier Administration Guide*.

## Viewing Help and Documentation

SAS Model Manager provides the following types of Help and documentation:

How-to Help
: How-to Help provides quick instructions or tips to help you complete some tasks in the application. To access how-to Help, select **Help** ⇨ **How To**.

Embedded Help
: Help pop-up menus and tooltips provide brief descriptions of various fields.

  To access a Help pop-up menu for a field, click the Help icon () when it appears next to a field. You can also place the mouse pointer over an element in the SAS Model Manager windows to view the associated tooltip.

*SAS Model Manager: User's Guide*
: This document provides detailed information about the concepts and tasks that are related to using SAS Model Manager. This document is available at http://support.sas.com/documentation/onlinedoc/modelmgr.

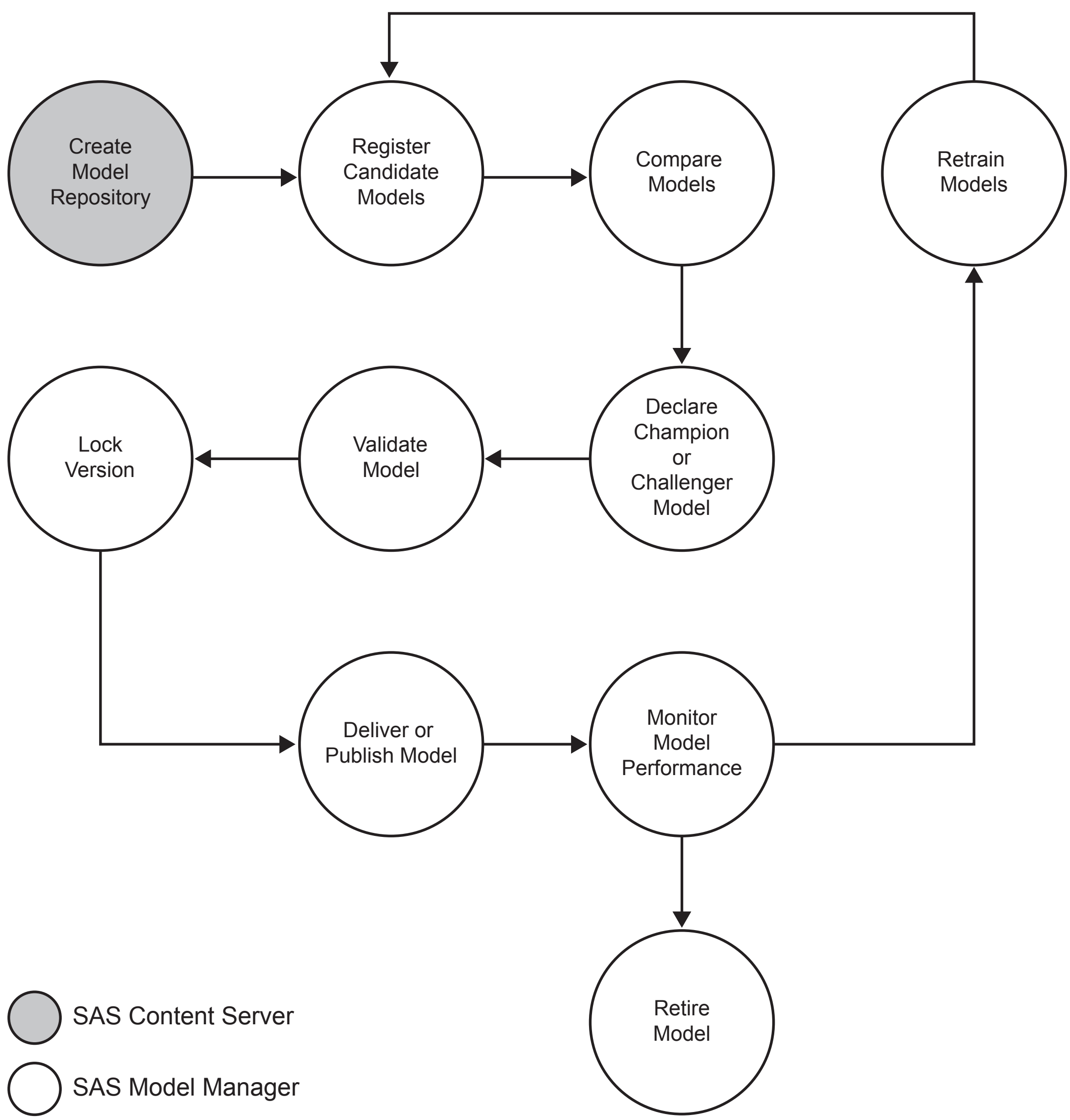
*SAS Model Manager: Administrator's Guide*
This document contains information about the administration tasks that are required to set up and configure the SAS Model Manager and is available at http://support.sas.com/documentation/onlinedoc/modelmgr.

Additional resources are available from the **Help** menu. To access these resources, select **Help** ⇨ **SAS on the Web**.

# Model Management Process

The following diagram illustrates the model management process:

***Figure 1.1*** *The Model Management Process*




Here is a summary of the model management process:

- **Create Model Repository**: create a secure model repository on the SAS Content Server where SAS code, input and output files, and metadata that is associated with a model can be stored.

- **Register Candidate Models**: register input and output files, and then import and configure a model.
- **Compare Models**: perform scoring tests and create comparison reports for the models by using test data sources.
- **Declare Champion or Challenger Model**: declare the model as champion or challenger to use for testing and production phases of the workflow.
- **Validate Model**: perform scoring tests and create validation reports for the champion model and challenger models by using test data sources.
- **Lock Version**: lock a version when the champion model is approved for production.
- **Deliver or Publish Model**: publish a champion or challenger models to a SAS publish channel, to a database, or to the SAS Metadata Repository.
- **Monitor Model Performance**: provide comparative model performance benchmarking.
- **Retrain Models**: select models to retrain in response to data or market changes.
- **Retire Model**: retire a model from production.

Here is an example of the model management process for comparing a challenger model to the champion model to determine the best champion model:

1. Register candidate models in the version that is under development.
2. Create a Dynamic Lift report and compare the model to the champion model. Flag the model as a challenger based on the results of the Dynamic Lift report.
3. Perform scoring tests with the champion and challenger models in real time or in batch. This step can be performed outside SAS Model Manager.
4. Publish the challenger model to a database or to the SAS Metadata Repository.
5. Prepare performance data sources, which include both the actual outcome variable and predicted variable.
6. Create and execute the performance monitoring for the champion and challenger models to create reports to compare and validate the champion model and challenger models. One of the reports that is available for this comparison is the Champion and Challenger Performance report.
7. Set the challenger model as the project champion if the challenger is good enough to be promoted. Go to step 3, or consider building another model as a challenger with existing or a new input training data source.
8. Publish the new project champion model with or without a new challenger model.

*Chapter 2*

# Quick Start Tutorial



## Overview of the Quick Start Tutorial

This Quick Start tutorial is an introduction to some of the primary features of SAS Model Manager. The tutorial covers basic tasks that are related to model management within an enterprise computing environment. The tutorial also shows you how to validate the installation and configuration of SAS Model Manager at your site.

In this tutorial, you import models, set and publish a champion model, score models, and monitor model performance.

*Note:* In order to complete the tasks in this tutorial, your user ID must be a member of the Decision Manager Users group or must be granted equivalent permissions. Also, to complete the steps related to model management, your ID must be a member of either the Model Manager Advanced Users group or the Model Manager Administrator Users group. See "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide* for more information.

With the exception of Step 1, the steps in this tutorial are basic steps that are required to add content to the SAS Decision Manager database and model repository. In this tutorial, you complete the following steps:

1. Make the tutorial files available on the SAS Application Server.

   *Note:* The QuickStartTutorial.zip file contains data and model files for several tutorials, including this one.

2. Sign in to SAS Model Manager.
3. Define the data source needed for the tutorial.
4. Define and create the components of the model hierarchy.
5. Import models.
6. Compare models using reports.
7. Set a champion model.
8. Create a scoring test and run model score code.
9. Monitor the performance of the champion model.
10. Publish the champion model to the SAS Metadata Repository.

# Make the Tutorial Files Available

## *About Making the Tutorial Files Available*

The tutorial is designed to use the SAS Metadata Repository. Before you use tables in the SAS Metadata Repository, the tutorial data sets and models must be on the SAS Application Server. An administrator who has Write access to the server and a valid SASApp user ID and password can put the tables there.

Some parts of this tutorial require files other than data sets and models, such as score code and templates. These files do not need to be registered in the SAS Metadata Repository. The drive where you extract the tutorial ZIP file must be accessible to the SAS Metadata Repository and to tutorial users. Tutorial users can also extract tutorial ZIP files to their local computers in order to access the other files.

You can define a data library and register the tables in the SAS Metadata Repository using the Data category view in SAS Model Manager.

## *Download the Tutorial Files*

The ZIP file QuickStartTutorial.zip contains the tutorial's data sets, models, and score code, and is available at http://support.sas.com/documentation/onlinedoc/modelmgr/. Before you begin the tutorial, extract the tutorial files to a computer that is accessible to the SAS Metadata Server and to SAS Model Manager users. If your SAS Metadata

Server is separate from the SAS Application Server, the files must be placed on the SAS Application Server. Use WinZip to extract the files. If you are using a different extraction program, follow that program's instructions for extracting the files.

To download the files:

1. Create a folder on the server machine or a network drive to store the tutorial files. The instructions refer to this folder as **`<drive>`**.

   *Note:* Users must have Read, Write, and Execute permissions to this folder and subfolders. You can create a group and add the tutorial users to that group to grant the permissions. For more information, see "Creating Operating System Accounts for Product Administrators and Users" in *SAS Model Manager: Administrator's Guide*.

2. Save the QuickStartTutorial.zip to ***`<drive>`***.

3. Open Windows Explorer to ***`<drive>`***. Right-click **QuickStartTutorial.zip** and select **Open**. Click **Open**.

4. Click the arrow on the **Unzip** button to open the Unzip from WinZip File Folder window.

   *Note:* If you are using a previous release of Windows, from the WinZip window, click the **Extract** button. The Extract dialog box appears.

5. Select **`<drive>`** from the Unzip to WinZip File Folder window.

   *Note:* If you are using a previous release of Windows, in the **Extract to** box, select **`<drive>`** and click **Extract**.

   You can find the data and models files for each tutorial in the respective tutorial folder (for example, **`<drive>\QuickStartTutorial\Data`** or **`<drive>\QuickStartTutorial\Models`**).

6. UNIX only: To complete the tutorial in a UNIX environment, locate the CPORT file. Files that you use to import the data sets into UNIX are located in the QuickStartTutorial.zip file. Instructions and the sample code for performing an import are provided in the Readme.txt file. In order for a transport file to be imported successfully, the encodings of the source and target SAS sessions must be compatible. Use either latin1 or UTF-8 for your SAS sessions. For more information, see "CIMPORT Problems: Importing Transport Files " in *Base SAS Procedures Guide*.

## Sign In

To sign in to SAS Model Manager:

1. In the address bar of your web browser, enter the URL for SAS Model Manager and press **Enter**. The Sign In page appears.

   *Note:* Contact your system administrator if you need the URL for SAS Model Manager. The default URL is http://*host_name*:*port*/SASDecisionManager.

2. Enter a user ID and password. Your user ID might be case sensitive, depending on the operating system that is used to host the application server. Your password is case sensitive.

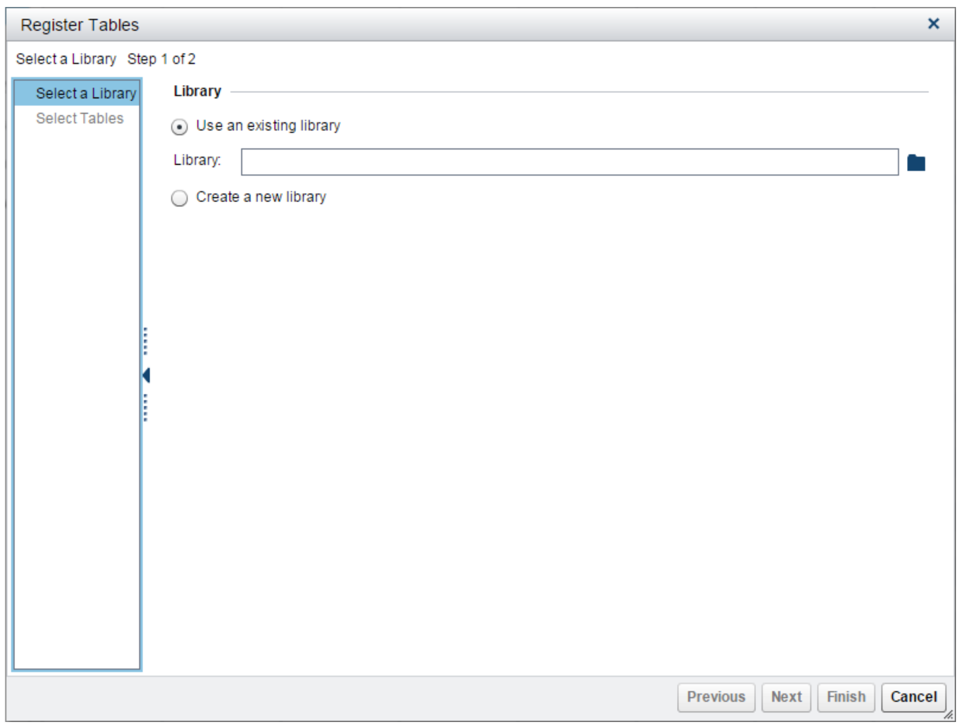
   *Note:* To schedule jobs in a Windows environment, you must include the domain name when entering your user ID (for example, *domain\myuserID*).

3. Click **Sign In**.

## Define Data Sources

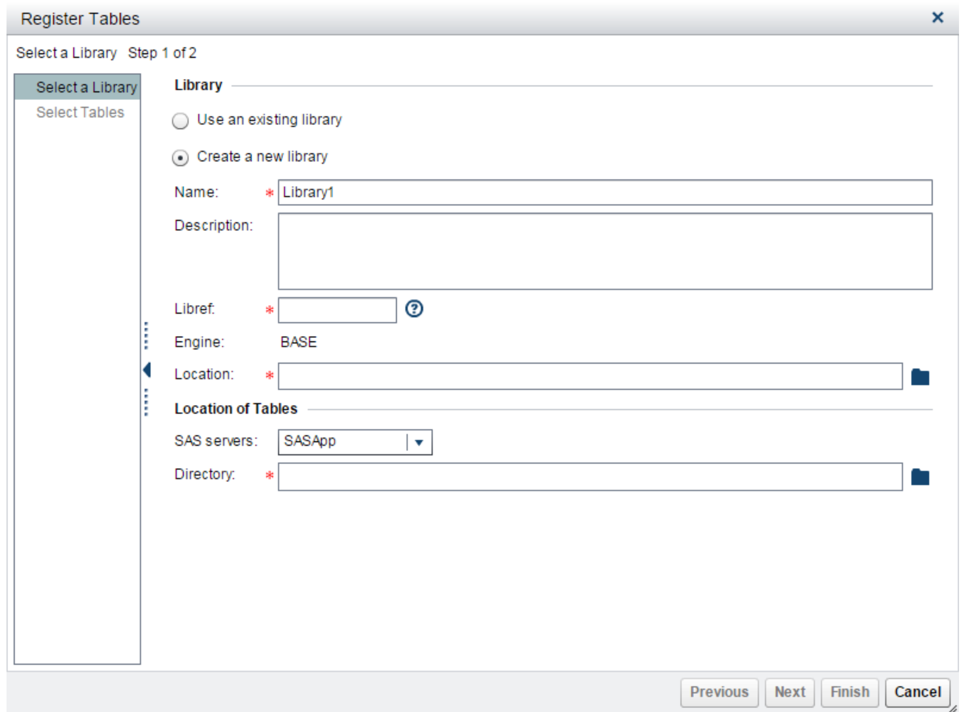
To register new tables in the SAS Metadata Repository and add them to the list of data sources:

1. Select **Data** ⇨ **Tables**.
2. Click + and select **Register Tables**. The Register Tables window appears.




*Note:* You cannot use the **Register Tables** option to add a table that has already been registered in the SAS Metadata Repository using the SAS Management Console. You must select **Add Registered Tables** instead. See "Add Tables That Are Registered in Metadata" on page 32.

3. Create a new Base SAS library.
   a. Select **Create a new library**.




b. Specify **QSTutorial** for the name of the new library. The name cannot exceed 60 characters.

c. (Optional) Specify a description for the library.

d. Specify **QSTut** for the libref.

e. Specify the location for the new library. This location is the folder in the SAS Metadata Repository where the library is stored.

f. Select the server and the directory where the data tables for the quick start tutorial reside (for example, `C:\QuickStartTutorial\Data`).

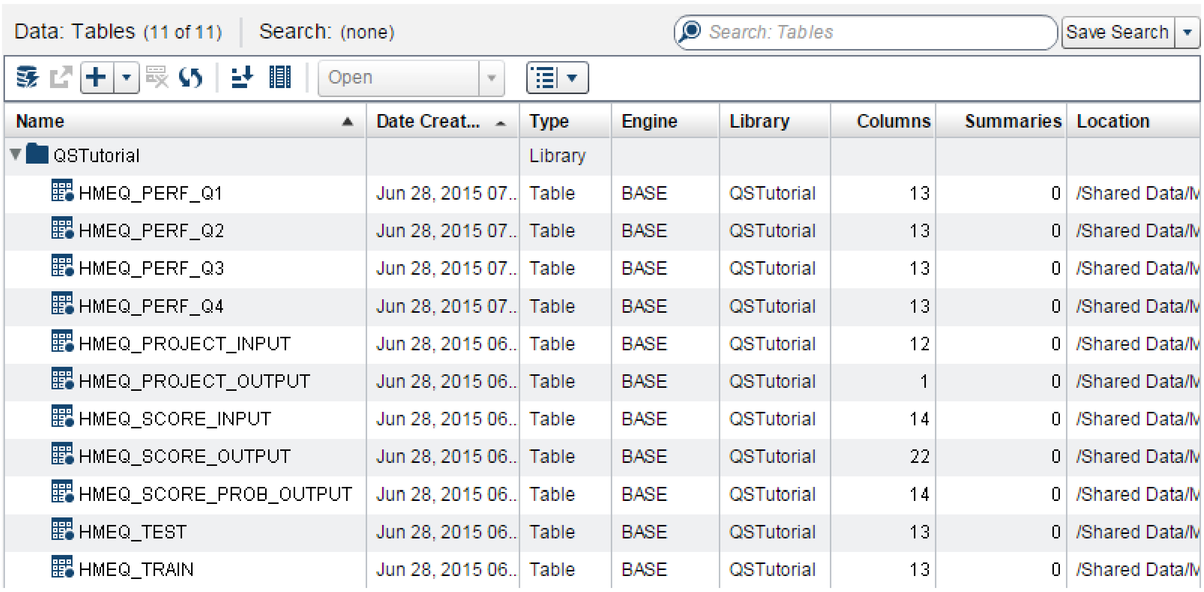
g. Click **Next**.

*Note:* If you click **Cancel** at this point, a folder for the library is created in the SAS Metadata Repository, but the folder does not appear in the list of data tables.

4. Click to add all of the tables to the **Selected tables** list.

5. Click **Finish**. The new library is now available in the list of data tables.

***Figure 2.1*** *SAS Model Manager Data: Tables List*



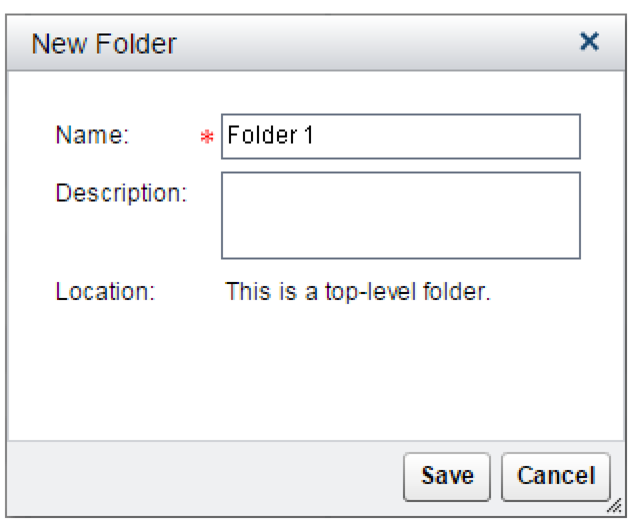

| Name | Date Creat... | Type | Engine | Library | Columns | Summaries | Location |
|---|---|---|---|---|---|---|---|
| QSTutorial | | Library | | | | | |
| HMEQ_PERF_Q1 | Jun 28, 2015 07.. | Table | BASE | QSTutorial | 13 | 0 | /Shared Data/M |
| HMEQ_PERF_Q2 | Jun 28, 2015 07.. | Table | BASE | QSTutorial | 13 | 0 | /Shared Data/M |
| HMEQ_PERF_Q3 | Jun 28, 2015 07.. | Table | BASE | QSTutorial | 13 | 0 | /Shared Data/M |
| HMEQ_PERF_Q4 | Jun 28, 2015 07.. | Table | BASE | QSTutorial | 13 | 0 | /Shared Data/M |
| HMEQ_PROJECT_INPUT | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 12 | 0 | /Shared Data/M |
| HMEQ_PROJECT_OUTPUT | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 1 | 0 | /Shared Data/M |
| HMEQ_SCORE_INPUT | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 14 | 0 | /Shared Data/M |
| HMEQ_SCORE_OUTPUT | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 22 | 0 | /Shared Data/M |
| HMEQ_SCORE_PROB_OUTPUT | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 14 | 0 | /Shared Data/M |
| HMEQ_TEST | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 13 | 0 | /Shared Data/M |
| HMEQ_TRAIN | Jun 28, 2015 06.. | Table | BASE | QSTutorial | 13 | 0 | /Shared Data/M |

# Organize the Model Hierarchy

## *Create Folders*

Create a top-level folder for the quick start tutorials:

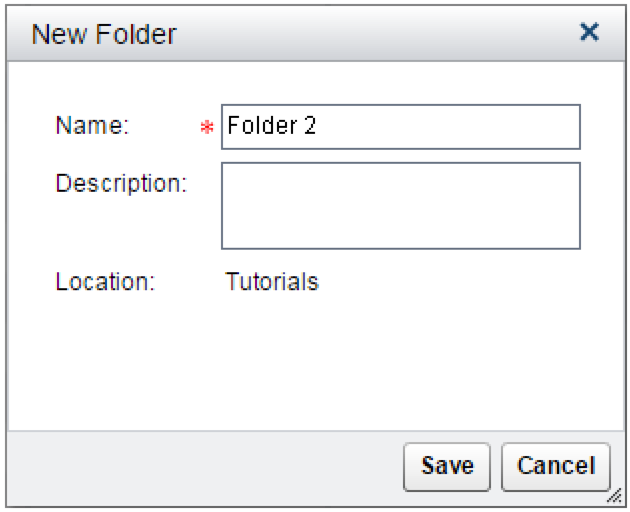
1. Select **Models** ⇨ **Projects**.
2. Click and select **New Top-Level Folder**. The New Folder window appears.




3. Enter **Tutorials** for the name of the folder.
4. (Optional) Enter a description for the folder.
5. Click **Save**.

Because multiple users might want to perform the tasks in the tutorial, it is recommended that each user create their own folder in the **Tutorials** folder. To create a new folder:

1. Select **Tutorials**, click , and select **New Folder**. The New Folder window appears.




2. Enter a name for the folder, such as **myUserID**. The examples in this tutorial use the ID **sasdemo**.
3. (Optional) Enter a description for the folder.
4. Click **Save**.

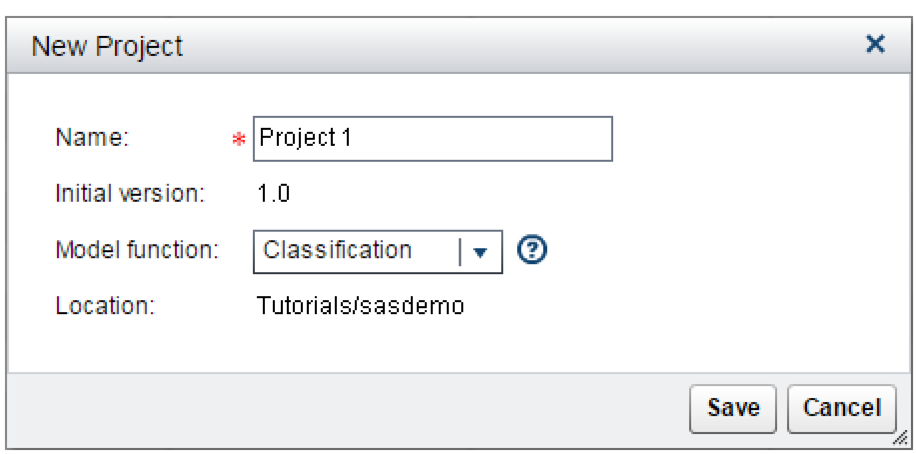
### *See Also*

"Overview of Managing Folders" on page 41

## *Create a Project*

To create a project:

1. Select a folder to store the new project (for example, **myUserID**).
2. Click  and select **New Project**. The New Project window appears.




3. Enter **HMEQ** for the name of the project.

   The initial version is displayed and reflects the level for sequential versions.

4. Select **Classification** for the model function.

   *Note:* The model function (Classification, Prediction, Segmentation, or Analytical) indicates the type of models that should be imported into the project.

5. Click **Save**.

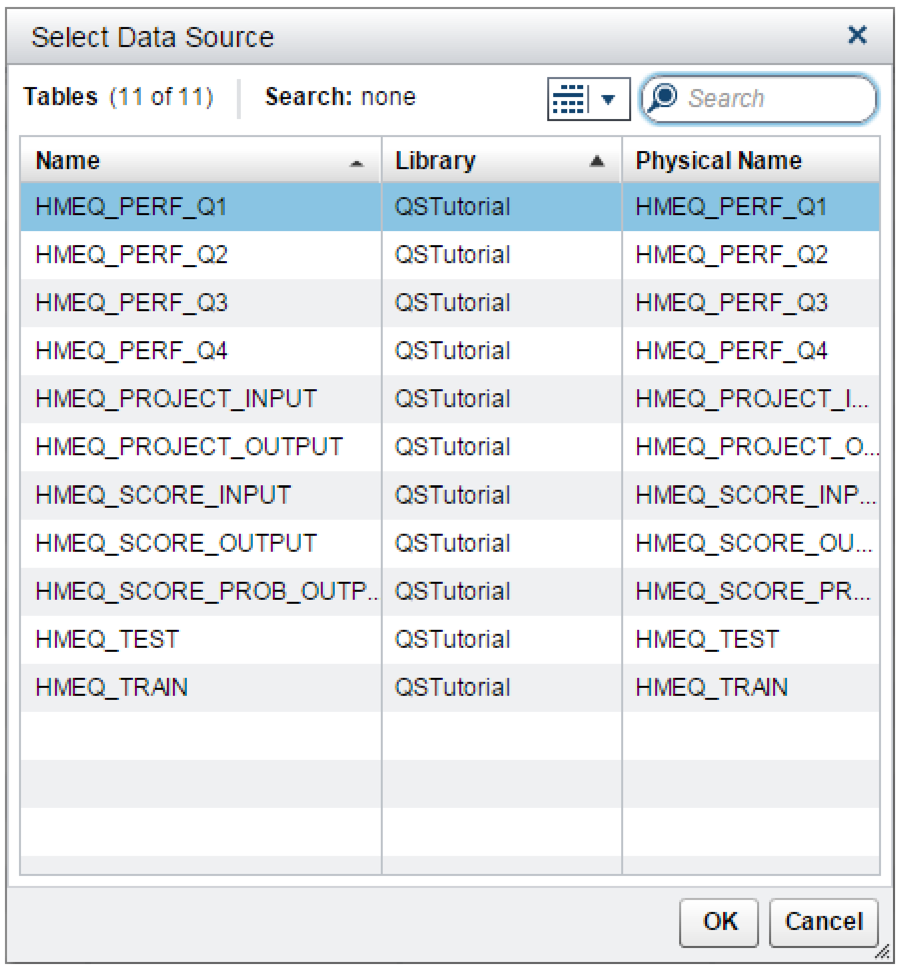
### See Also

"Overview of Projects" on page 48

## Import Project Variables

To import project variables:

1. Select **Variables** ⇨ **Input** and click . The Select Data Source window appears.




2. Select HMEQ_PROJECT_INPUT as the data source from the **QSTutorial** library. Click **OK**.

3. Select the **Output** tab and click .

4. Select the HMEQ_PROJECT_OUTPUT as the data source from the **QSTutorial** library and click **OK**.

5. Click  to make the changes effective for other pages.

6. Click **Yes** in the warning message since you have not set a champion or challenger model yet.

### See Also

"Import Variables" on page 56

## Set the Project Properties

To define the properties that SAS Model Manager uses to create reports, score, publish, and monitor models:

1. Select **Properties** ⇨ **Specific**.
2. Click **Browse** to select the default data tables from the **QSTutorial** library and specify values for the other properties:

   **Default test table**
   select **HMEQ_TEST**.

   **Default scoring input table**
   select **HMEQ_SCORE_INPUT**.

   **Default scoring output table**
   select **HMEQ_SCORE_OUTPUT**.

   **Default train table**
   select **HMEQ_TRAIN**.

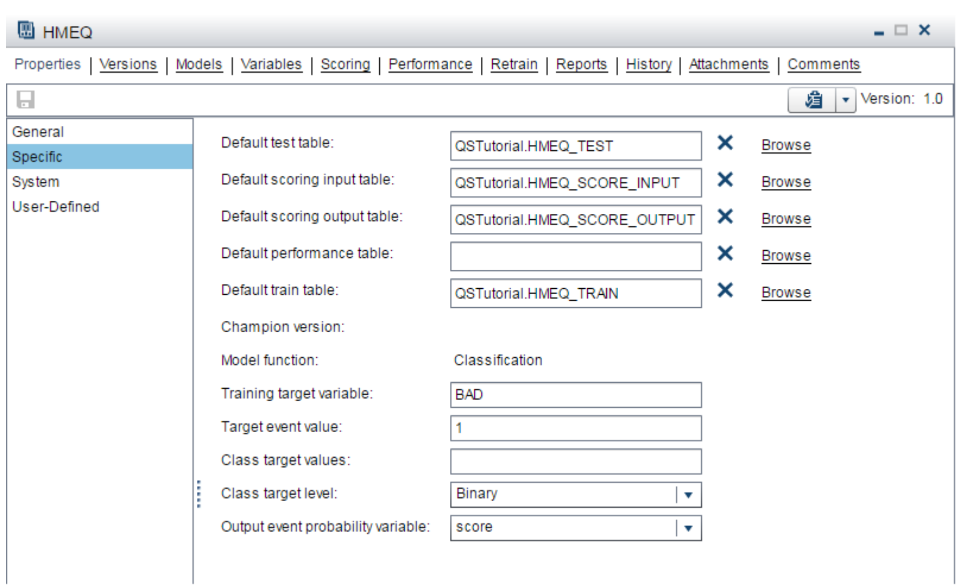
   **Training target variable**
   enter `BAD`.

   **Target event value**
   enter 1.

   **Class target level**
   select **Binary**.

   **Output event probability variable**
   select **score**.
3. Click .

Here is an example of the **HMEQ** project-specific properties:



### *See Also*

"Project Properties" on page 51

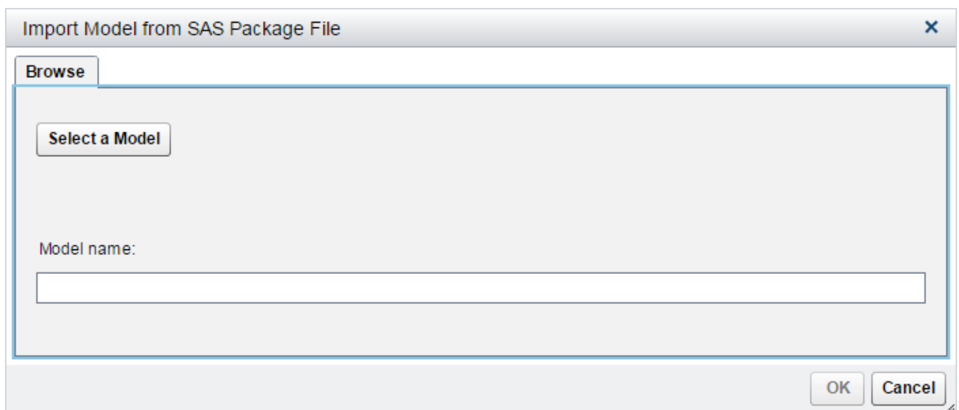
# Import Models

## *Import a SAS Package File*

*Note:* Before you import a model, verify that the model type matches the **Model function** property setting on the project's **Properties** page.

To import a model from a SAS Package File:

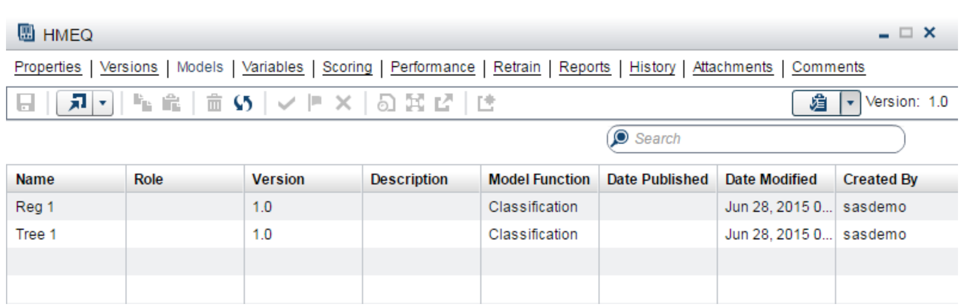
1. Select the **Models** page.
2. Click and select **from a SAS package file**.




3. On the **Browse** tab, click **Select a Model** and navigate to the location of the file (for example, use`<drive:>\QuickStartTutorial\Models\Reg1)`.

   Select the miningResult.spk file to import and click **Open**.
4. Enter **Reg 1** for the name of the model.
5. Click **OK**.
6. Click **Close**.
7. Repeat steps 2 through 6 to import the model package file located in `<drive:>\QuickStartTutorial\Models\Tree1`. Name the model **Tree 1**.

Here is an example of the **Models** page, after the models have been imported:



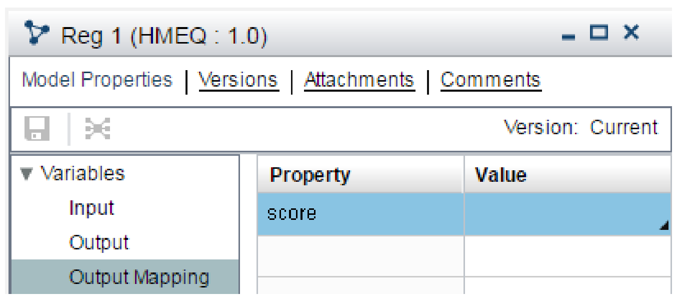
### *See Also*

"Overview of Importing Models" on page 67

### *Map Model Variables to Project Variables*

To map model variables to the project variables:

1. Select and open the **Reg 1** model.
2. On the **Model Properties** page, select **Variables** ⇨ **Output Mapping**.




3. Select **EM_EVENTPROBABILITY** from the **Value** column beside the **score** variable in the **Property** column.
4. Click .
5. Repeat steps 1 through 4 for the **Tree 1** model.

### *See Also*

"Map Model Variables to Project Variables" on page 86

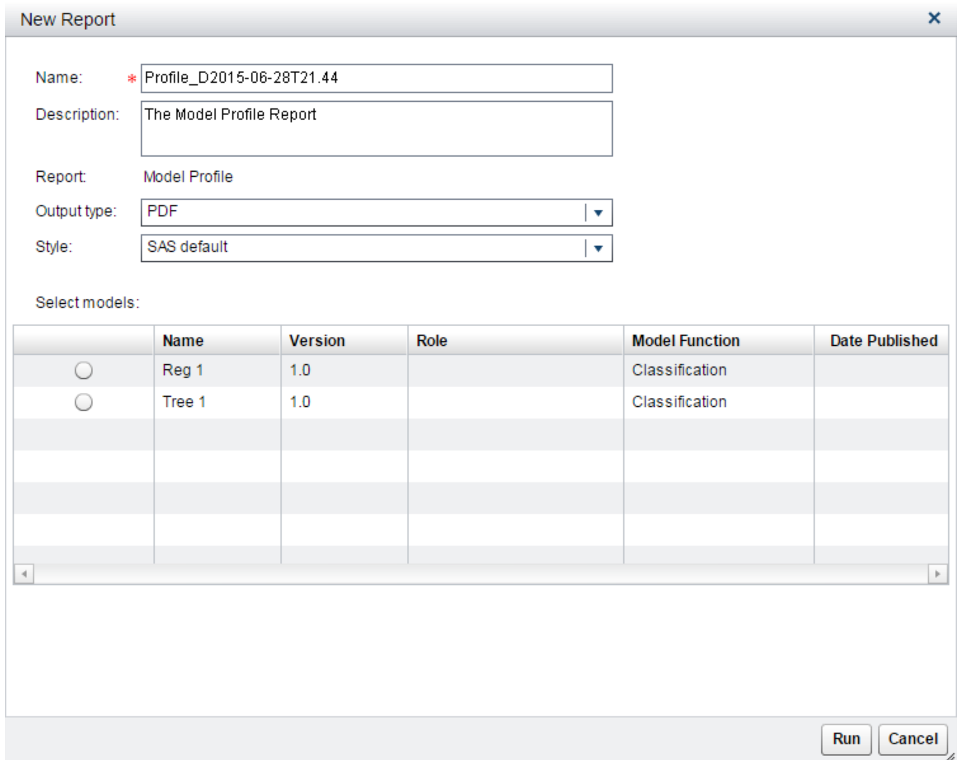
# Create Model Comparison Reports

### *Create a Model Profile Report*

The Model Profile report creates three tables to display the profile data that is associated with the model input variables, output variables, and target variables.

To create a Model Profile report:

1. Select the **Reports** page.
2. Click  and select **Model Profile**. The New Report window appears.



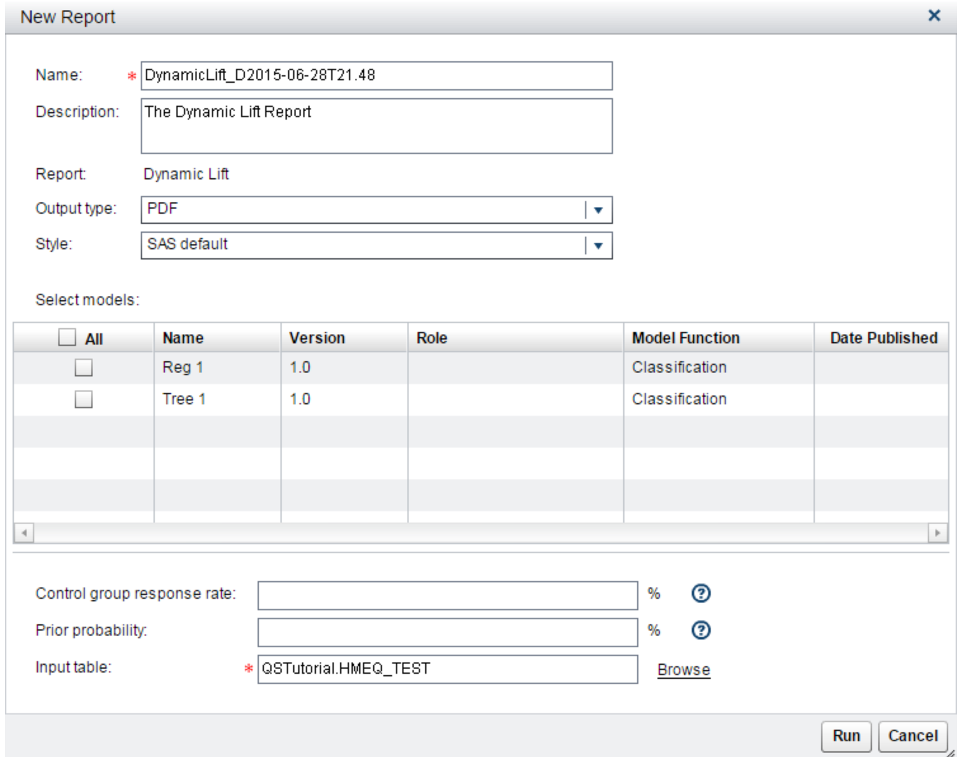

3. Enter **profile_tree1** for the name of the report.
4. Select **PDF** for the output type.
5. Select **Seaside** for the style of the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
6. Select the model **Tree 1** from the list.
7. Click **Run**. The report is generated and appears in the default viewer based on the selected output type.

### *Create a Dynamic Lift Report*

The Dynamic Lift report provides visual summaries of the performance of one or more models for predicting a binary outcome variable.

To create a Dynamic Lift report:

1. Click and select **Dynamic Lift**. The New Report window appears.




2. Enter **lift_reg1tree1** for the report name.
3. Select **HTML** for the output type.
4. Select **Seaside** for the style of the report.
5. Select the models **Reg 1** and **Tree 1** from the list.
6. (Optional) Specify the **Control group response rate**.
7. (Optional) Specify the **Prior probability**.
8. Accept the default input table of **QSTutorial.HMEQ_TEST**.
9. Click **Run**. The report is generated and appears in the default viewer based on the selected output type.

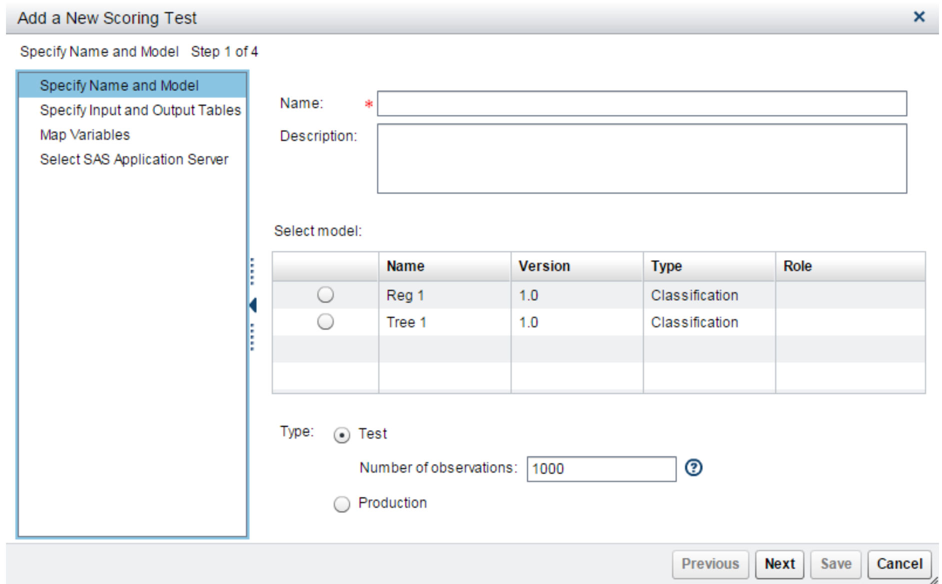
### *See Also*

"Overview of Model Comparison, Validation, and Summary Reports" on page 124

## Create a Scoring Test

To create a scoring test:

1. Select the **Scoring** page.
2. Click ✚. The Add a New Scoring Test window appears.




3. Enter **Tree1** for the name.

4. (Optional) Enter **test1** for the description.

5. Select the **Tree 1** model from the list.

6. Select **Test** for the type of scoring test. Accept the default number of observations (1000 rows) to be read from the scoring input table.

   *Note:* A best practice is to select **Test** before beginning all scoring tests. Later, when you are satisfied with the results of running the scoring test and you are ready to put the test into production, you can change the type to **Production**.

7. Click **Next**.

8. Verify that the value you previously specified for the **Default score input table** project property appears in the **Input table** box. To select a table, click **Browse** and select the table **QSTutorial.HMEQ_SCORE_INPUT**. Click **OK**.

9. Verify that the value you previously specified for the **Default score output table** project property appears in the **Output table** box. To select a table, click **Browse** and select the table **QSTutorial.HMEQ_SCORE_OUTPUT**. Click **OK**.

10. Click **Next**.

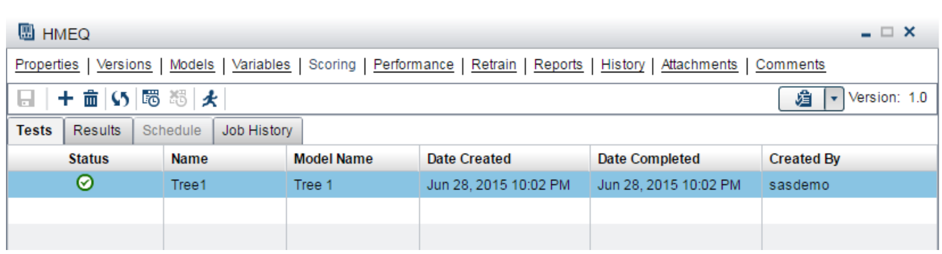
11. Verify that all of the scoring output table variables are mapped to the available variables.

12. Click **Next**.

13. Select the configured SAS Application Server (for example, **SASApp**).

14. Click **Save**.

15. Select the **Tree1** scoring test from the list and click .



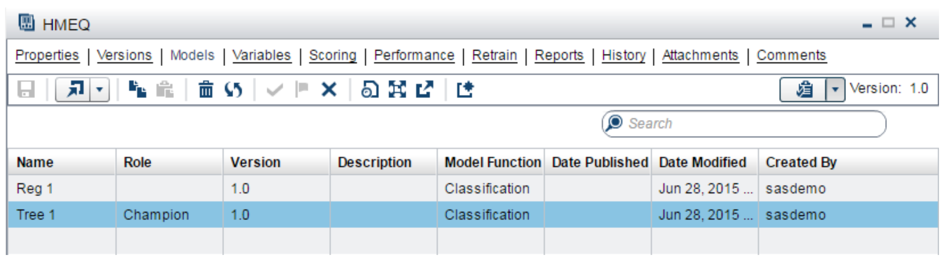
16. Click the **Results** tab or double-click the scoring test to view the scoring test results. When the job has completed without errors, a appears in the **Status** column.

    *Note:* You can check the status of a job by clicking in the **Job History** tab. A new record appears after the job has completed.

## Set the Champion Model

To set the champion model:

1. Select the **Models** page of the project.
2. Select the **Tree 1** model and click . The value in the **Role** column changes to **Champion**.




### *See Also*

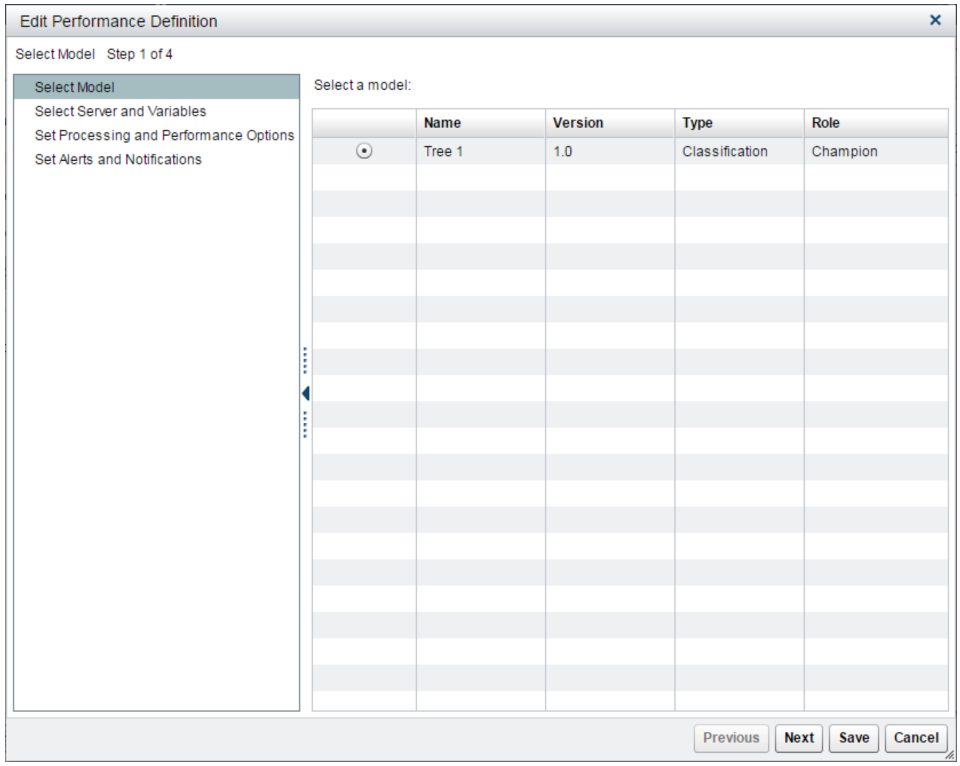
"Overview of Scoring Tests" on page 115

## Monitor the Performance of a Champion Model

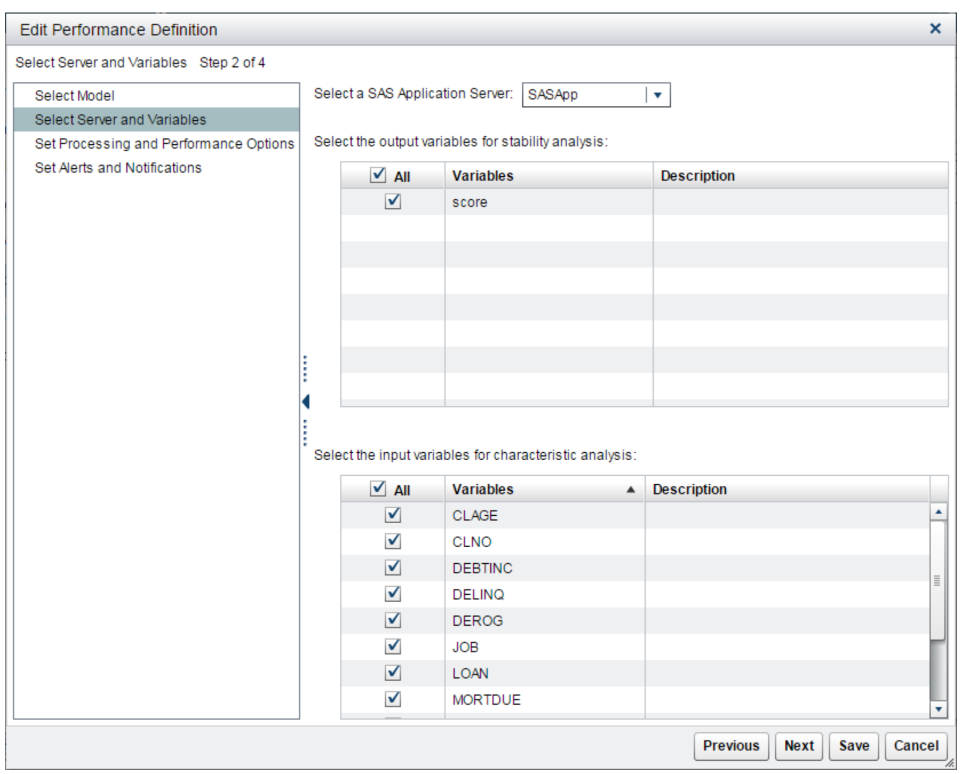
In this tutorial you use the Edit Performance Definition wizard to generate SAS code. You then execute the generated code.

To edit the performance definition:

1. Select the **Performance** page.
2. Click and select the champion model **Tree 1**. Click **Next**.




3. Select a SAS Application Server (for example, the default is SASApp).
4. Click **All** to select all output variables for stability analysis.
5. Click **All** to select all input variables for characteristic analysis.




Click **Next**.

6. Select **Standard configuration** as the data processing method and select **Run model score code** to run the score code in the performance monitor job.

7. Specify the data source information.

   a. Select **Static data sources**.

   b. Click ➕.

   *Note:* The data table whose collection date is the earliest is set as the baseline performance data table.

   c. Click the empty cell in the **Data Source** column.

   d. Click **Browse** and select the **HMEQ_PERF_Q1** performance data source from the **QSTutorial** library. Click **OK**.

   e. Click the empty cell in the **Collection Date** column and click 📅. Select the date of **March 31, 2014**. The date can be any date in the time period when the performance data was collected.

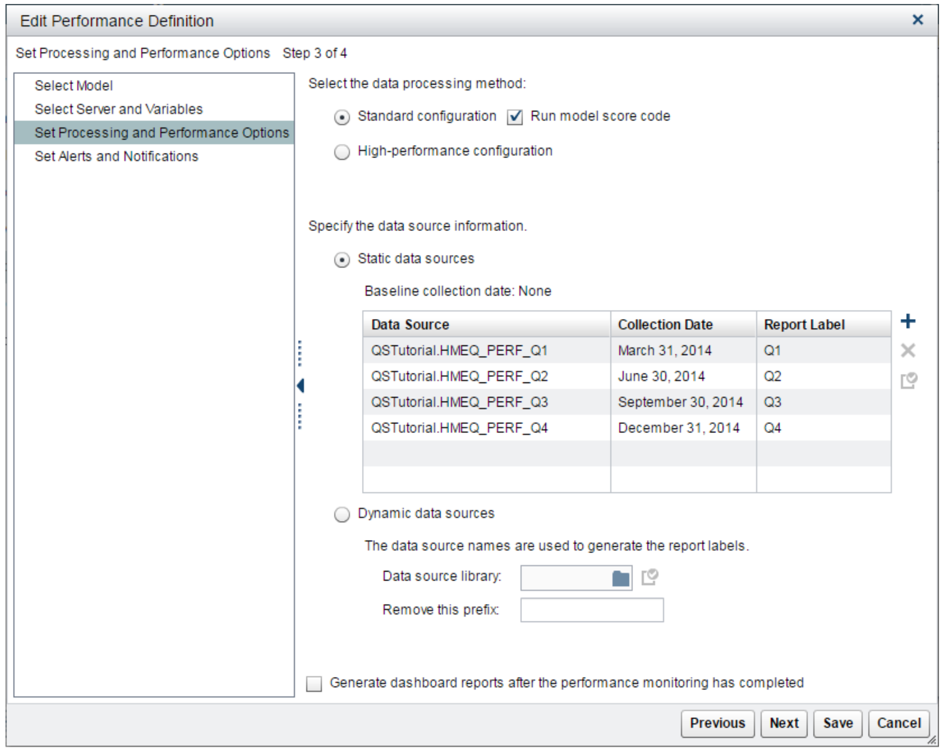
   f. Enter the label **Q1** in the **Report Label** column. The report label represents the time point of the performance data source. Because the report label appears in the performance charts, use a label that has not been used for another time period, is short, and is understandable.

   *Note:* If you duplicate report labels, the results in the previous performance results are overwritten.

   g. (Optional) Select a data source and click the verify icon to verify that the selected input variables and target variable are included in the performance data source.

   h. (Optional) Repeat the above steps to add the following performance data sources from the **QSTutorial** library to the performance definition.

| Data Source | Collection Date | Report Label |
|---|---|---|
| HMEQ_PERF_Q2 | June 30, 2014 | Q2 |
| HMEQ_PERF_Q3 | September 30, 2014 | Q3 |
| HMEQ_PERF_Q4 | December 31, 2014 | Q4 |




i. (Optional) To delete a data source from the performance definition, select the data source and click ✕.

8. Click **Next**.

   *Note:* When prompted to replace the existing performance data, click **Yes**.

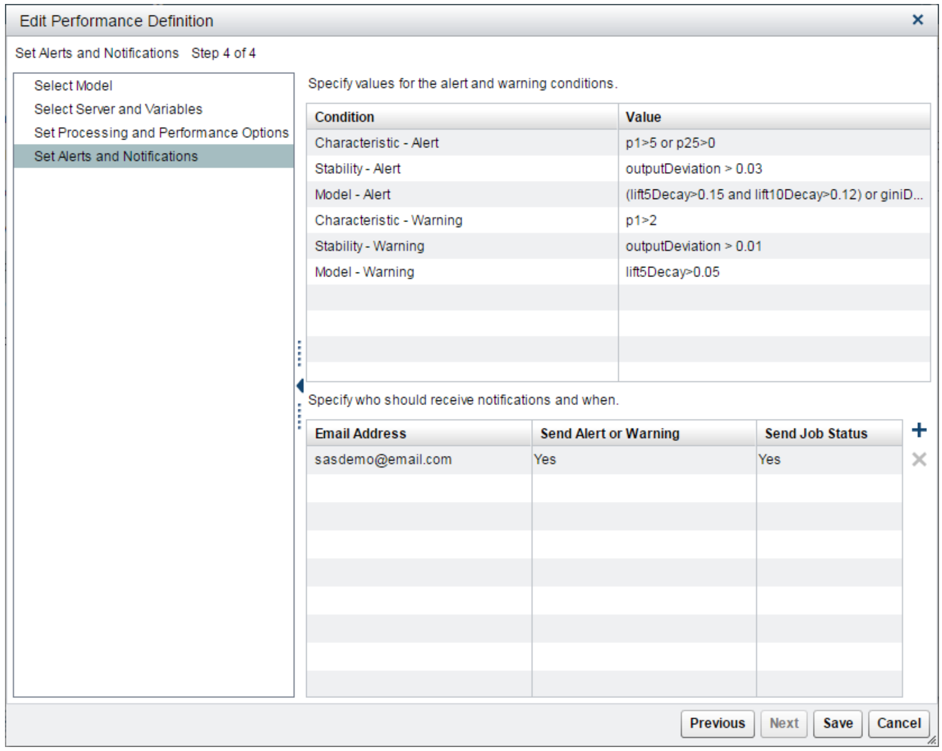
9. (Optional) Either specify values for the alert and warning conditions or accept the defaults. Click **Next**.

10. (Optional) To send the results by email, click ✚. A new row is added to the table.

    a. Enter an email address.

    b. Select either **Yes** or **No** if you want an alert or warning to be sent by email when alert or warning thresholds have been exceeded.

    c. Select either **Yes** or **No** if you want a completion notice with the job status to be sent by email every time the report runs.




11. Click **Save**.
12. Click .
13. After the performance monitoring has been completed, a confirmation message appears. Click **Close**.
14. Click the **Results** tab to view the performance results.

    *Note:* You can check the status of a job by clicking  in the **Job History** tab. A new record appears after the job has completed.

### See Also

"Edit and Execute a Performance Definition" on page 181

## Publish a Champion Model to the SAS Metadata Repository

To publish a model to the SAS Metadata Repository:

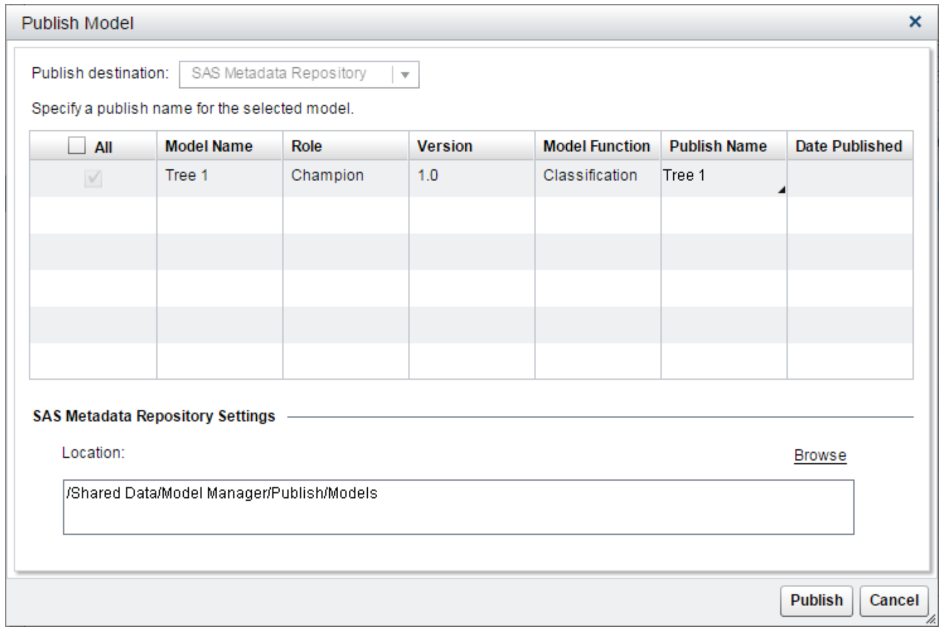
1. Select the **Models** page.
2. Select the champion model **Tree 1** and click .

    *Note:* Alternatively, you can select a project from the Projects category view and click .

3. To specify a new publish name, click in the **Publish Name** column for a selected model.

*Note:* By default, the publish name for the champion model is the project name. You cannot modify the publish name for a champion model when publishing from the Projects category view.

4. Click **Browse** to select the location to publish the model to. You must have Write permission to this location.




5. Click **Publish**.
6. Click **Close**.
7. (Optional) Select **History** ⇨ **Published** to view a list of the models that have been published.

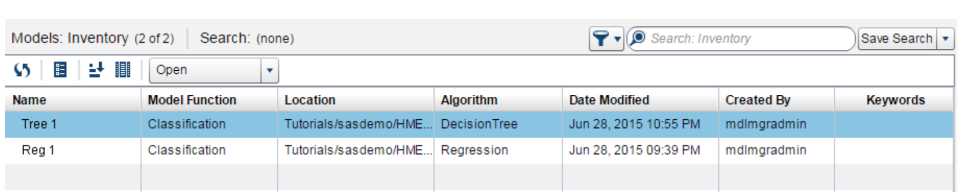
### *See Also*

"Publishing Models to the SAS Metadata Repository" on page 215

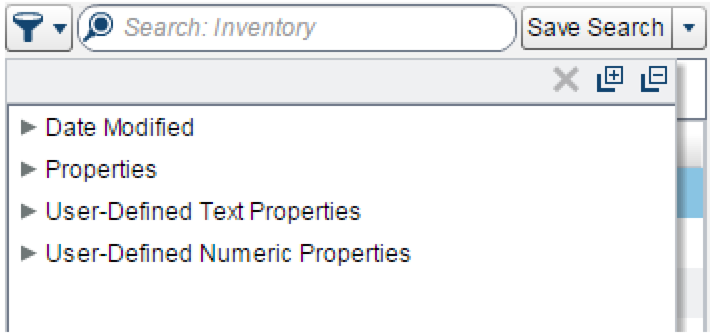
## View and Search Model Inventory

In this tutorial, you view the model inventory that you imported in the previous tutorials. You then search the model inventory to filter the results, and open a model.

1. Select **Models** ⇨ **Inventory**.

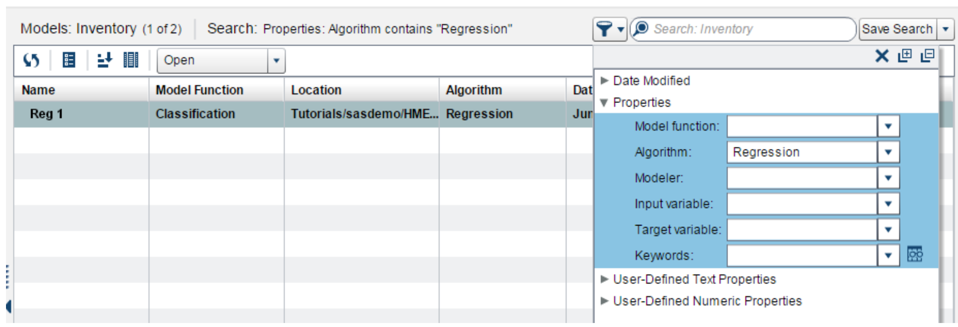



2. Click . The additional search options appear.

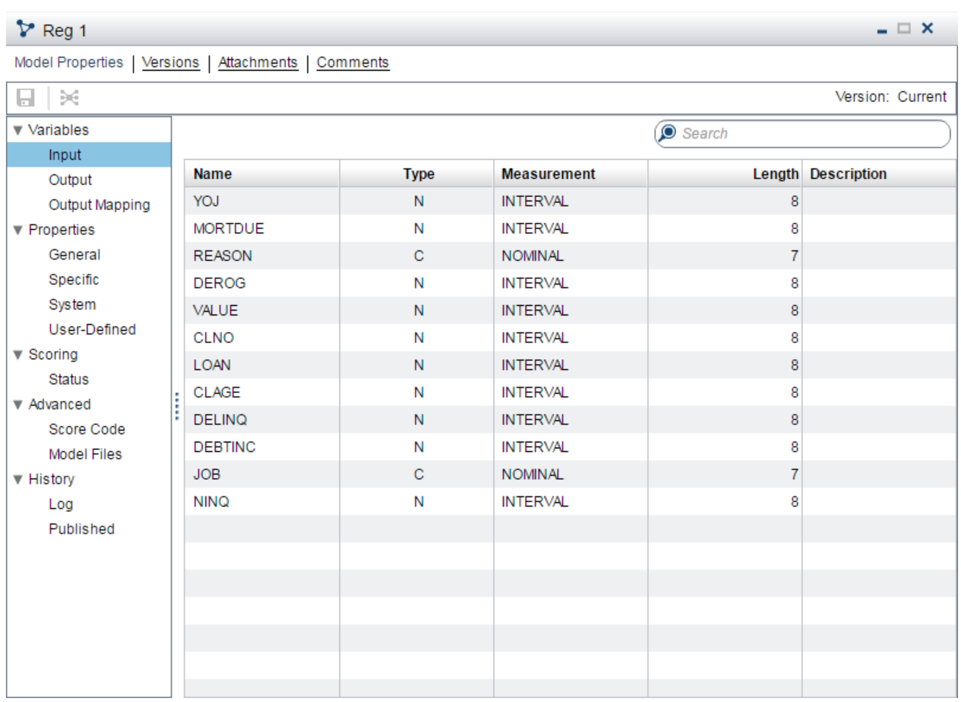



3. Expand the **Properties** search option.

4. Select **Regression** from the **Algorithm** property drop-down list. The model inventory list is filtered automatically.




5. Double-click the **Reg 1** model to view its model content.




6. Minimize or close the model object window to return to the list of models.

*Chapter 3*

# Managing Data Tables



## About Managing Data Tables

The Data category enables you to manage your list of data tables from within SAS Model Manager. You can create new Base SAS libraries, add and remove tables, view table data and metadata, create and delete table summaries, and associate attachments and comments with tables. The application uses these data tables whenever it needs to access data, such as for testing, scoring, retraining, and performance monitoring of models.

You can view the list of tables by selecting **Data** ⇨ **Tables**. There are three ways to add tables to the list.

- You can use SAS Visual Data Builder to create new tables and add them to the list. See "Adding Tables Using SAS Visual Data Builder" on page 32 for more information.
- If the table is already registered in the SAS Metadata Repository, you can add the table to the list as described in "Add Tables That Are Registered in Metadata" on page 32.

- If the table is not already registered in the SAS Metadata Repository, you can add a new table as described in "Register and Add New Tables" on page 32.

*Note:* SAS Model Manager cannot access tables in a SAS LASR Analytic Server instance.

*Note:* If you do not have the appropriate permissions to access a folder, then the tables and libraries are not listed in the Data category view.

## Adding Tables Using SAS Visual Data Builder

SAS Visual Data Builder enables analysts and data administrators to perform data preparation for analytics. You can design queries to perform joins, add calculated columns, and subset and sort data. Several productivity features speed the creation of columns based on common aggregation functions.

Once you design your queries, you can reuse them as subqueries for more sophisticated queries, export them as jobs for scheduling, or schedule them directly from the user interface.

The application has data import features that enable you to access data from spreadsheets, delimited files, and SAS data sets. Once you import the data, you can prepare it for analysis or join it with existing data.

The application provides a series of features that you can use to extract and transform data from multiple sources and create new data tables.

To access SAS Visual Data Builder, select **Data** ⇨ **Tables**. Click to start SAS Visual Data Builder. For more information about SAS Visual Data Builder, click to access *SAS Visual Analytics: User's Guide* and videos about using SAS Visual Data Builder.

## Add Tables That Are Registered in Metadata

If a data table has already been registered in the SAS Metadata Repository, you can add it to the list of data sources. To add one or more tables:

1. Select **Data** ⇨ **Tables**.
2. Click + and select **Add Registered Tables**. The Choose an Item window appears.
3. Select the tables that you want to add, and click **OK**.

## Register and Add New Tables

You can create new Base SAS libraries and register tables by using SAS Model Manager. To register new tables in the SAS Metadata Repository and add them to the list of data sources:

1. Select **Data** ⇨ **Tables**.
2. Click + and select **Register Tables**. The Register Tables window appears.

*Note:* You cannot use the **Register Tables** option to add a table that is already registered. You must select **Add Registered Tables** instead. See "Add Tables That Are Registered in Metadata" on page 32.

3. Select an existing library, or create a new Base SAS library.

   To use an existing library:

   a. Select **Use an existing library**.

   b. Click and select the library.

   c. Click **Next**.

   To create a new Base SAS library:

   a. Select **Create a new library**.

   b. Specify a name for the new library. The name cannot exceed 60 characters.

   c. (Optional) Specify a description for the library.

   d. Specify a libref. A *libref* is a name that SAS uses to refer to the library. Enter a unique name of eight characters or less.

   e. Specify the location for the new library. This location is the folder in the SAS Metadata Repository where the library is stored.

   f. Select the server and the directory where the data tables reside.

   g. Click **Next**.

   *Note:* If you click **Cancel** at this point, a folder for the library is created in the SAS Metadata Repository, but the folder does not appear in the list of data tables.

4. Select the tables that you want to add to the library, and click to add the tables to the **Selected tables** list. Click to add all of the tables to the **Selected tables** list.

5. Click **Finish**.

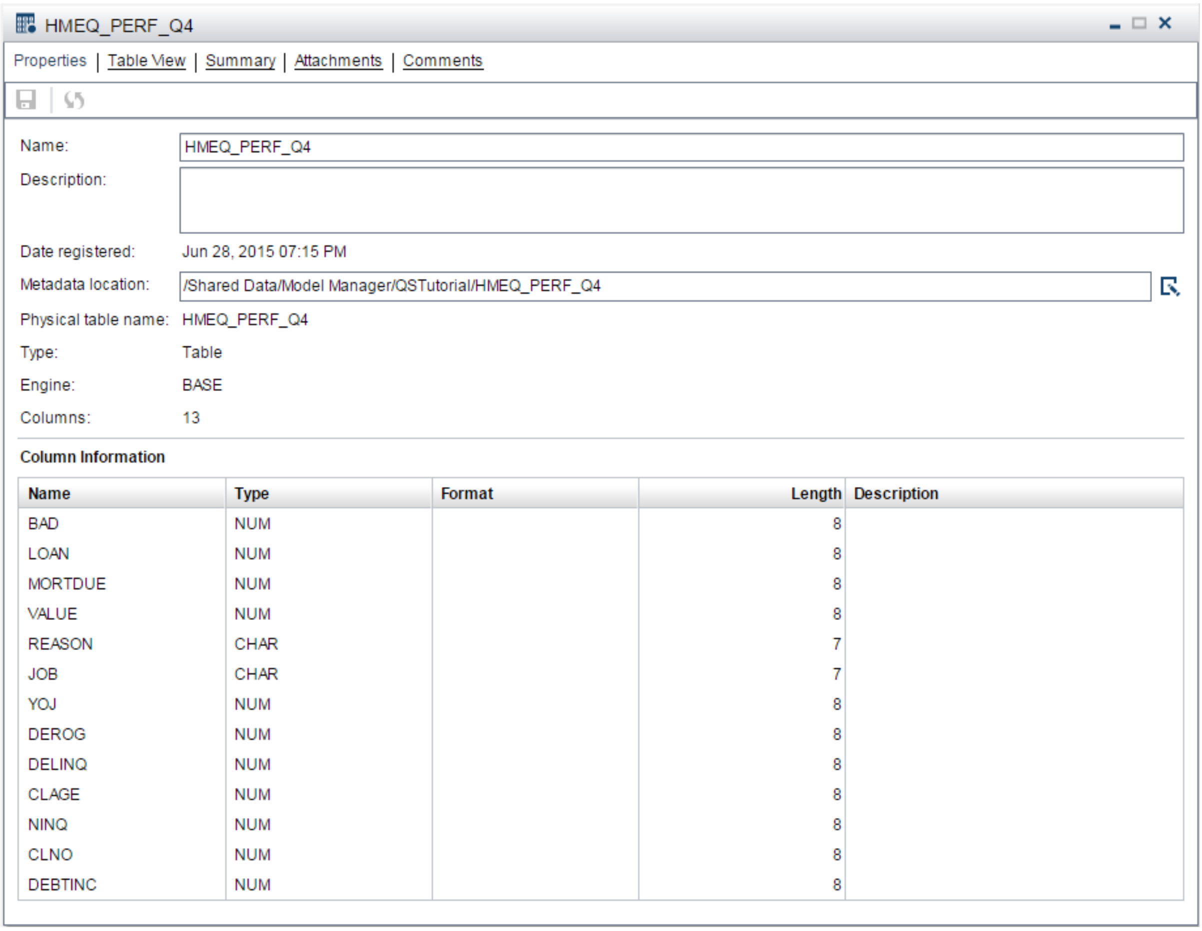
## Edit Table Properties and View Table Metadata

The **Properties** page displays table metadata. On this page, you can edit the data source name and description, and change the table associated with the data source name.

1. Select **Data** ⇨ **Tables**.

2. Double-click on the table whose properties you want to edit. The **Properties** page appears.

The **Properties** page displays table metadata such as the number of columns, the table location, and information about each column in the table.




| Name | Type | Format | Length | Description |
|---|---|---|---|---|
| BAD | NUM | | 8 | |
| LOAN | NUM | | 8 | |
| MORTDUE | NUM | | 8 | |
| VALUE | NUM | | 8 | |
| REASON | CHAR | | 7 | |
| JOB | CHAR | | 7 | |
| YOJ | NUM | | 8 | |
| DEROG | NUM | | 8 | |
| DELINQ | NUM | | 8 | |
| CLAGE | NUM | | 8 | |
| NINQ | NUM | | 8 | |
| CLNO | NUM | | 8 | |
| DEBTINC | NUM | | 8 | |

3. Edit the data source name and description, or click to select a different table as the data source.

4. Click to save the changes.

# View Table Data

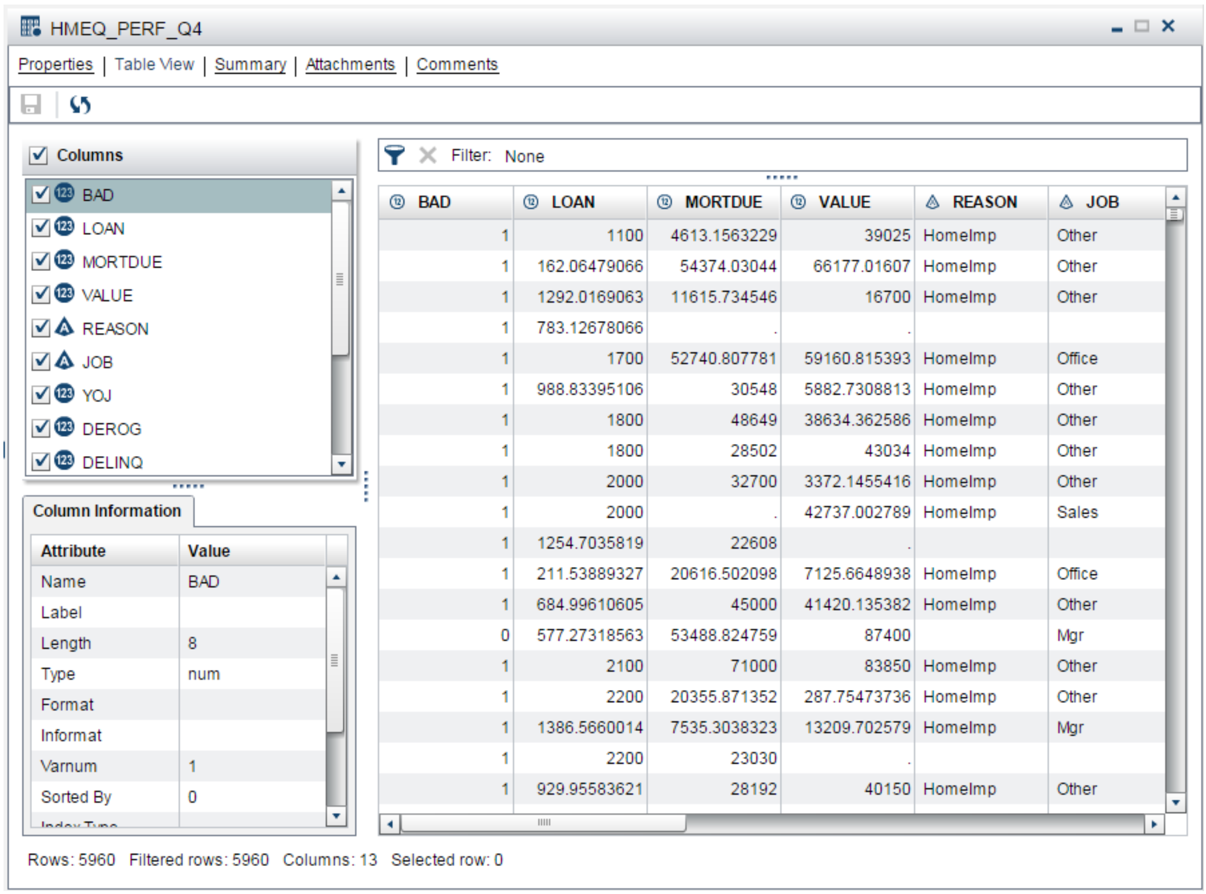
To view table data:

1. Select **Data** ⇨ **Tables**.

2. Double-click on the table that you want to view.

3. Select the **Table View** page.

On the **Table View** page, you can control the display by selecting specific columns in the **Columns** section. The **Column Information** section displays information about the currently selected column.



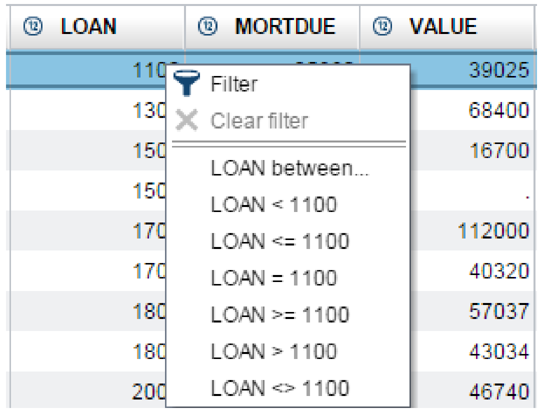

*Note:* The row count might not be displayed, depending on the database with which the table was created.

To sort the table based on the values in a particular column, click on the column heading. If the column is sorted in ascending order, a ▲ appears beside the column heading. When the column is sorted in descending order, a ▼ appears.

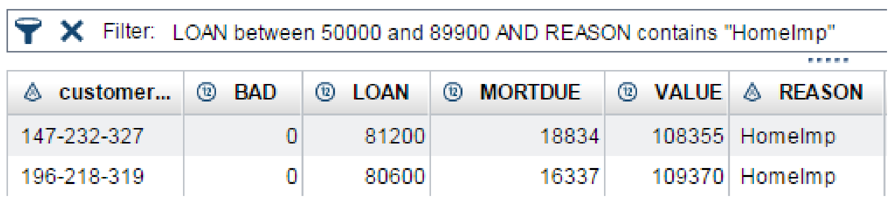
# Filter Data in the Table View

You can filter the rows that are shown on the **Table View** page in either of the following ways:

- Click the filter icon above the table. The Filter window appears. Enter a valid SQL expression, and click **Apply**.
- Right-click on a value in the table. SAS Model Manager displays several predefined filter options. You can select any of these options. Depending on which option you select, you might be prompted to enter data values for the query.




The expression that you enter is displayed above the data table, and the table is filtered accordingly.




To clear the filter and display the entire table, click ✕.

For more information about SQL expressions, see *SAS FedSQL Language Reference*.

## Create a New Table Summary

*Note:* To run a summary, you must be a member of the Decision Manager Users group. See "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide* for more information.

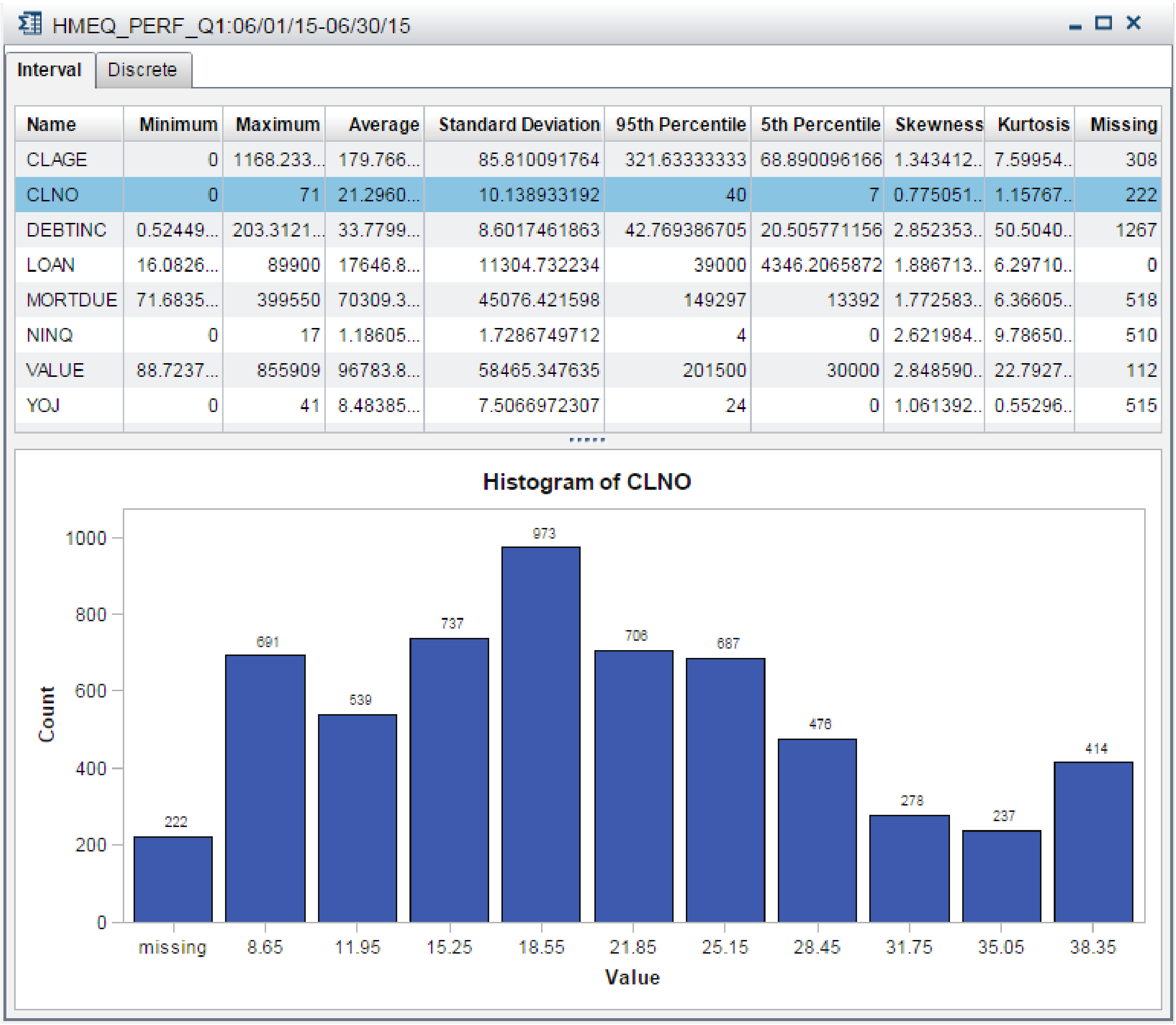
To create a new table summary:

1. Select **Data** ⇨ **Tables**.
2. Double-click on the table for which you want to add a summary.
3. Select the **Summary** page.
4. Click ✚.
5. In the New Summary window, select the **Collection period** and the specific date or time values for the collection period that is represented by the data in the table.

   *Note:* The **Collection period** is not used to filter the data.
6. (Optional) Specify a summary description.
7. Click **Run**. SAS Model Manager runs a process to summarize the data and adds the new summary to the **Summary** page.

Double-click on the summary to open it.

The following display shows the **Summary** page for the HMEQ_PERF_Q1 table. The collection period represented by the data in the table is June 2015.



| Name | Minimum | Maximum | Average | Standard Deviation | 95th Percentile | 5th Percentile | Skewness | Kurtosis | Missing |
|---|---|---|---|---|---|---|---|---|---|
| CLAGE | 0 | 1168.233... | 179.766... | 85.810091764 | 321.63333333 | 68.890096166 | 1.343412... | 7.59954... | 308 |
| CLNO | 0 | 71 | 21.2960... | 10.138933192 | 40 | 7 | 0.775051... | 1.15767... | 222 |
| DEBTINC | 0.52449... | 203.3121... | 33.7799... | 8.6017461863 | 42.769386705 | 20.505771156 | 2.852353... | 50.5040... | 1267 |
| LOAN | 16.0826... | 89900 | 17646.8... | 11304.732234 | 39000 | 4346.2065872 | 1.886713... | 6.29710... | 0 |
| MORTDUE | 71.6835... | 399550 | 70309.3... | 45076.421598 | 149297 | 13392 | 1.772583... | 6.36605... | 518 |
| NINQ | 0 | 17 | 1.18605... | 1.7286749712 | 4 | 0 | 2.621984... | 9.78650... | 510 |
| VALUE | 88.7237... | 855909 | 96783.8... | 58465.347635 | 201500 | 30000 | 2.848590... | 22.7927... | 112 |
| YOJ | 0 | 41 | 8.48385... | 7.5066972307 | 24 | 0 | 1.061392... | 0.55296... | 515 |



## Add Attachments to a Table

To add an attachment such as a document file or an image file:

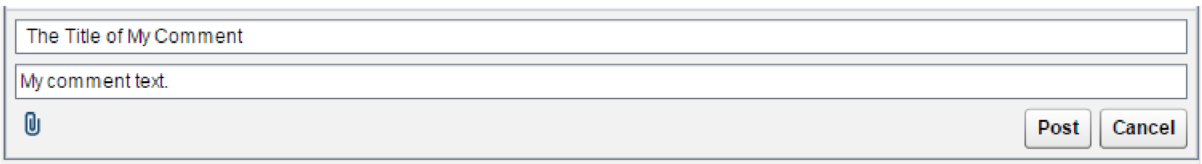
1. Select the **Attachments** page.
2. Click , and select the attachment file.
3. Click .

*Note:* You can delete an attachment by selecting the attachment and clicking .

## Add Comments to a Table

You can add new comments or reply to existing comments. To add a new comment:

1. Select the **Comments** page.
2. Enter a topic title and enter the comment. The topic title is required, and the field for comments does not appear until you enter the topic title.




3. (Optional) Click to add an attachment such as an image or a document.
4. Click **Post**.

To reply to an existing comment, enter your reply in the field immediately below the topic title for the existing comment, and click **Post**.

Click to see comments that have been posted by others.

To search for text in the comments, enter text in the search field at the top of the **Comments** page.

## Delete a Table Summary

*Note:* To delete a summary, you must be a member of the Decision Manager Users group. See "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide* for more information.

To delete a table summary:

1. Select **Data** ⇨ **Tables**.
2. Double-click on the table whose summary you want to delete.
3. Select the **Summary** page.
4. Select the summary that you want to delete.
5. Click .

## Remove a Table

Removing a table from the list of data sources does not delete the table from file system. To remove a table from the list of data sources:

1. Select **Data** ⇨ **Tables**.
2. Select the table that you want to remove from the list.

3. Click .

*Chapter 4*

# Managing Folders



## Overview of Managing Folders

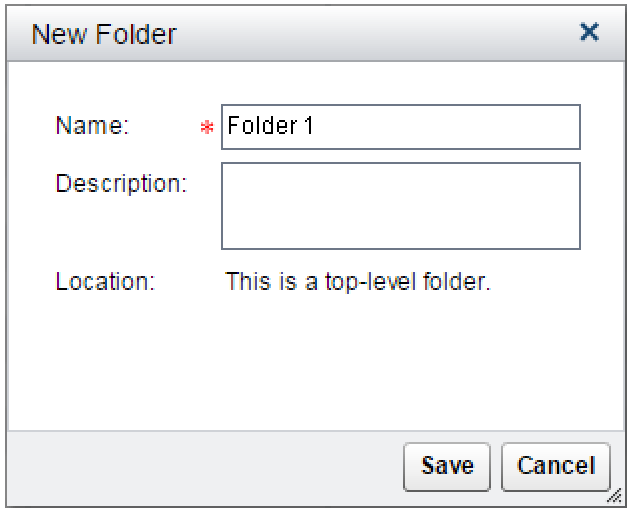
In the Projects and Portfolios category views, you can add, delete, and archive or restore folders. You must create a folder before you can create a project or portfolio. You can create subfolders within a top-level folder to organize your projects and portfolios. Designing a folder structure enables you to get summary information about the contents of the folder. This information includes the number of models, versions, and scoring tests, as well as reports for the models that contain model variables and target variables. Your folder structure could be similar to your business departmental hierarchy, or it could list individual project, portfolio, or model names.

To view the summary information, select a folder and then select **Actions** ⇨ **View Summary**.

## Create a New Folder

Before you add new projects or portfolios to manage models, you must add folders to store them in.

1. Click and select **New Folder** or **New Top-Level Folder**. The New Folder window appears.




2. Enter a name for the folder.
3. (Optional) Enter a description for the folder.
4. Click **Save**.

*Note:* Alternatively, you can right-click an item and select the menu option for the action that you want to perform.

## Rename a Folder

To rename a folder, right-click the folder, and select **Rename**. Enter the new name, and click **OK**. Folder names are case sensitive. SAS Model Manager considers **`myfolder`** and **`MYFOLDER`** to be two unique folders.

Alternatively, click on the folder and select **Rename** from the **Actions** menu.

## Delete a Folder

To delete a folder, right-click the folder, and select **Delete**. Click **OK** in the warning message.

Alternatively, click on the folder and then click .

## Archive and Restore Folders

In the Projects and Portfolios category views a folder and its contents can be archived and restored to a different system.

Using the archive and restore facilities, a SAS Model Manager administrator can back up a folder in one repository and restore it to another repository. The folder is archived as a compressed ZIP file.

*Note:* The attachments and comments at the portfolio level, project level, and model level are managed by separate services and are not stored within the portfolio, project, and model objects. Therefore, the attachments and comments are not included in the archived ZIP file.

Before you restore a folder, you should first create a folder to restore it to, since the restored projects reside at the same level that you specified. A best practice is to give the restored folder the same name as the archived ZIP file. The contents of the archived folder are restored to the new folder.

*Note:* All tables that are referenced within the projects and portfolios that are restored must be registered in the SAS Metadata Repository and made available to the **Data** ⇨ **Tables** category view. For more information, see Chapter 3, “Managing Data Tables,” on page 31.

Folders cannot be restored in these situations:

- The name of the organizational folder to be restored is the same as a project name in the archived folder.
- The same archived ZIP file has already been restored in a folder on the same WebDAV server.

To archive a folder:

1. Select a folder.
2. Select **Actions** ⇨ **Archive**.
3. Select a folder where the contents are to be saved.
4. Enter a name.
5. Click **Save**.

To restore a folder:

**TIP** Create a folder first into which to place the restored project.

1. Select a folder.
2. Select **Actions** ⇨ **Restore**.
3. Navigate to the folder where the contents are saved.
4. Select the file.
5. Click **OK**.

*Note:* After restoring a folder, verify that the following requirements have been met:

- All scheduled jobs for scoring tests, performance, and retraining for the projects within a folder must be deleted and re-created on the system where the folder was restored.
- All user-defined templates for a model, report, and properties must exist on the system where the folders were restored. If they do not exist you must re-create the templates.

For more information, see the following topics:


- “Schedule a Scoring Test” on page 119
- “Schedule a Retrain Definition” on page 201
- “Schedule Performance Definitions” on page 184
- “Creating and Managing Templates” on page 60

# Part 2

# Working with Models, Projects, and Portfolios

# Chapter 5
# Working with Projects

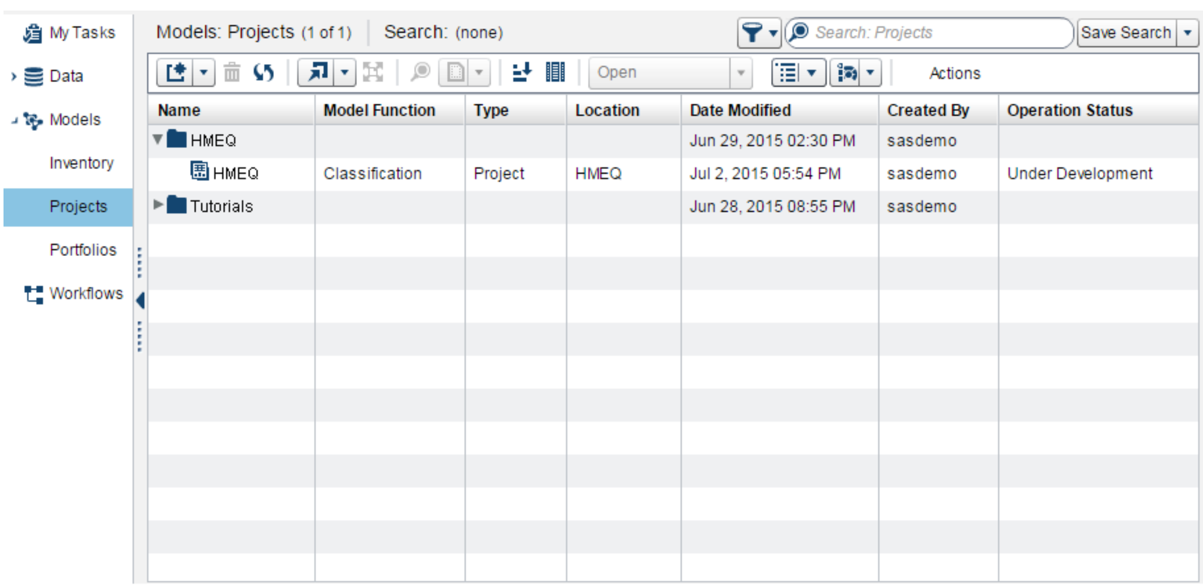
# Overview of Projects

A model project consists of the models, variables, reports, performance results, and other resources that you use to determine a champion model. For example, a banking project might include models, data, and reports that are used to determine the champion model for a home equity scoring application. The home equity scoring application predicts whether a bank customer is an acceptable risk for granting a home equity loan.

You create projects within folders. The models within a project are associated with a version. A *version* is used to organize project content and model information for a specific time period.

*Note:* If you see a folder named **FactoryMiner** it is being used in the Portfolios category to store portfolios that contain project segments and models from SAS Factory Miner. Do not remove this folder.

***Figure 5.1*** *Model Projects Category*




# Planning a Project

Before you begin a project, you must plan your project resources. Here is a list of questions to consider and conditions to meet for a modeling project:

- After you know which users are assigned to a project, an administrator must ensure that the user is assigned to the appropriate user group and role. For more information, see "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide*.
- How do you want to structure your project? A project is stored in a folder that can contain multiple levels so that you can customize the structure. For example, your project folder could be similar to your business departmental hierarchy or it could list

individual project names. For more information, see “Overview of Managing Folders” on page 41.

- What models do you want to use in the project? If the models were created using SAS Enterprise Miner, SAS/STAT, or the SAS/ETS procedures COUNTREG and SEVERITY, all model components are available when you import the model. If your model is a SAS code model that is not contained in a miningresult.spk file or a model that was created by third-party software such as R, you must ensure that you have imported all of the model component files. For more information, see “Overview of Importing Models” on page 67.
- How do you want to define your project input and output variables? When you create a project, you can import the variables using input and output prototype tables, copy the variables from an existing champion model, or define individual variables. If you use prototype tables to define the project input and output variables, the tables must be registered in the SAS Metadata Repository. For more information, see “Defining Project Input and Output Variables” on page 55.
- How do you want to track the progress of a version? The Workflows view enables you to track the progress of tasks from the version level. An authorized user can create a workflow and associate it with a version. For more information, see “Overview of Using Workflows” on page 229.
- You might have project documents that you would like to access. You can attach documents at the project or model level on the **Attachments** page. For more information, see “Add Attachments to a Project” on page 59.
- You might have comments that you would like others to see or respond to. You can add comments at the project or model level on the **Comments** page. For more information, see “Add Comments to a Project” on page 59.
- Several reports are available to help you assess candidate models. You can review the types of reports that are available and plan for which reports you want to use. Your plans might also include a custom report that you can run. For more information, see “Overview of Model Comparison, Validation, and Summary Reports” on page 124.
- After your champion model is in a production environment, you can monitor the performance of the model using your organization's performance data. For more information, see “Overview of Performance Monitoring” on page 165.
- When you define performance monitoring reports, you can set up performance index alert and warning conditions to notify users when conditions exceed the indexes. For more information, see “Performance Index Warnings and Alerts” on page 173.

## Prerequisites for Creating Projects

Projects can be created only by administrators and advanced users. Ensure that users who create projects are assigned to the group **Model Manager Administrator Users** or **Model Manager Advanced Users** in SAS Management Console.

All modeling projects require that you know the model function type before you create a project. The following model function types are available:

- Classification
- Prediction
- Segmentation

- Analytical

To determine the model function type for your project, see Table 5.1 on page 52.

If you use prototype tables to define the project input and output variables, you must create the project input and output tables and register them in the SAS Metadata Repository using the Data category view or SAS Management Console. If you use SAS Management Console, you must then add the registered tables in a library by using the Data category view to make the tables available to the application.

For more information, see the following documentation:

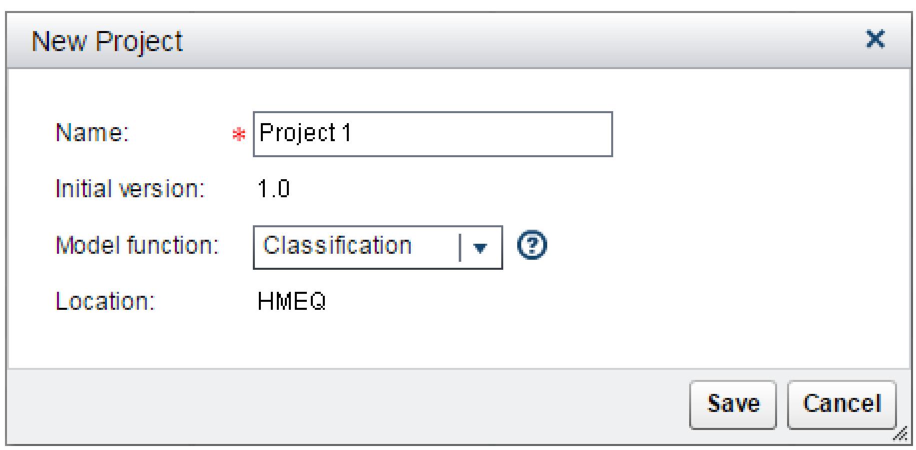
- "Defining Project Input and Output Variables" on page 55
- Chapter 3, "Managing Data Tables," on page 31

## Create a Project

To create a project:

1. Select a folder or create a new folder in which to store the new project.
2. Click and select **New Project**. The New Project window appears.

   *Note:* Alternatively, you can right-click a folder and select **New Project**.




3. Enter a name for the project.

   The initial version is displayed and reflects the level for sequential versions.

4. Select a model function (Classification, Prediction, Segmentation, or Analytical) to indicate the type of models that can be imported into the project. The location of the project is displayed.
5. Click **Save**.

To delete a project, select a project and then click .

Alternatively, you can right-click an item and select the menu option (**Publish**, **Rename**, or **Delete**) for the action that you want to perform.

# Project Properties

## *About Project Properties*

Project properties contain the project metadata. Project metadata includes information such as the name of the project, the type of project, the project owner, the project identifier, the name and path of the repository, and of the tables and variables that are used by project processes.

Project properties are organized into the following types:

- General Properties
- Specific Properties
- System Properties
- User-Defined Properties

## *General Properties*

**General Properties** are system-defined properties that you cannot modify, with the following exceptions: folder description, operation status, and lock status.

| Property Name | Description |
|---|---|
| **Model function** | Specifies the type of output that your predictive model project generates. The **Model function** property that you specify affects the model templates that are provided when you are ready to import models into a project. After it has been declared, the **Model function** property for a project cannot be changed. Ensure that the types of models that you are going to use in the project fit within the selected model function type. For more information about the types of model functions, see Table 5.1 on page 52. |

| Property Name | Description |
|---|---|
| **Operation status** | Specifies the current state of the project:<br>Under Development<br>indicates that the project has started but a champion model is not yet in production.<br>Active<br>indicates that a champion model for this project is in production.<br>Inactive<br>indicates that the champion model is temporarily suspended from production.<br>Retired<br>indicates that the champion model for this project is no longer in production.<br>To set the status, select an option from the **Operation status** drop-down list. |
| **Lock project variables** | Specifies that the project metadata is locked and the project definition cannot be modified. For more information, see "Lock or Unlock Project Variables" on page 60. |

***Table 5.1*** *Types of Model Functions*

| Model Function | Description | Example |
|---|---|---|
| **Analytical** | Function for any model that is not Prediction, Classification, or Segmentation. | None |
| **Classification** | Function for models that have target variables that contain binary, categorical, or ordinal values. | **DEFAULT_RISK** = {Low, Med, High} |
| **Prediction** | Function for models that have interval targets with continuous values. | The score output of a prediction model could estimate the weight of a person. The output of a model would be P_Weight. |
| **Segmentation** | Function for segmentation or clustering models. | Clustering models |

## *Specific Properties*

**Specific Properties** contain information about tables that are used by the project as well as various input and output variables and values that are used in scoring the models in test and production environments. This data can be added or modified after you add variables. For more information, see “Defining Project Input and Output Variables” on page 55.

| Property Name | Description |
| --- | --- |
| **Default test table** | Specifies a default SAS data set that can be used to create the New Dynamic Lift and Interval Target Variable reports. |
| **Default scoring input table** | Specifies a default SAS data set that is used as the input data table for all scoring tests within the project. If you specify a value for the **Default scoring input table** property, the value is used as the default input table in the Add a New Scoring Test window. |
| **Default scoring output table** | Specifies a default SAS data set that defines the variables to keep in the scoring results table and the scoring test output table. If you specify a value of the **Default scoring output table** property, the value is used as the default output table in the Add a New Scoring Test window. |
| **Default performance table** | Specifies the default performance table for all model performance monitoring tests within a project. |
| **Default train table** | Specifies the default train table that is used for retraining models and for the Training Summary Data Set report. The **Default train table** is also used to validate scoring functions or scoring model files when a user publishes the associated project champion model or challenger models to a database. This property is optional. |
| **Champion version** | Specifies the version that contains the champion model in a production environment. |
| **Model function** | Specifies the type of output that your predictive model project generates. The **Model function** property that you specify affects the model templates that are provided when you are ready to import models into a project. After it has been declared, the **Model function** property for a project cannot be changed. Ensure that the types of models that you use in the project fit within the selected model function type. |
| **Training target variable** | Specifies the name of the target variable that was used to train the model. |
| **Target event value** | Specifies the target variable value that defines the desired target variable event. |

| Property Name | Description |
|---|---|
| **Class target values** | For class, nominal, ordinal, or interval targets, the set of possible outcome classes, separated by commas. For example, binary class target values might be `1, 0` or `Yes`, `No`. Nominal class target values might be `Low, Medium, High`. These values are for information only. |
| **Class target level** | Specifies the class target level of binary, nominal, ordinal, or interval. |
| **Output event probability variable** | The output event probability variable name, when the **Model function** property is set to **Classification** or **Analytical**. |
| **Output prediction variable** | The output prediction variable name, when the **Model function** property is set to **Prediction** or **Analytical**. |
| **Output segmentation variable** | The output segmentation variable name, when the **Model function** property is set to **Segmentation** or **Analytical**. |

## System Properties

**System Properties** are system-defined properties (UUID, Location, and URL) that you cannot modify.

## User-Defined Properties

You can add you own project properties under **User-Defined Properties**. The property-value pair is metadata for the project.

To create a user-defined property:

1. On the **Properties** page, select **User-Defined**.
2. Click . The New User-Defined Property window appears.
3. Enter a name and value for the property. Do not include spaces or double-byte character sets.
4. Click **OK**.

To delete a user-defined property:

1. On the **Properties** page, select **User-Defined**.
2. Select a property.
3. Click . A confirmation window appears.
4. Click **OK** to delete the property.

# Defining Project Input and Output Variables

## *About Defining Project Input and Output Variables*

Project input and output variables are the variables that are used by the champion model and challenger models. Project input and output variables must be defined before a champion model can be published to a production environment. You can define the project input and output variables when you create a project or during the champion model selection process.

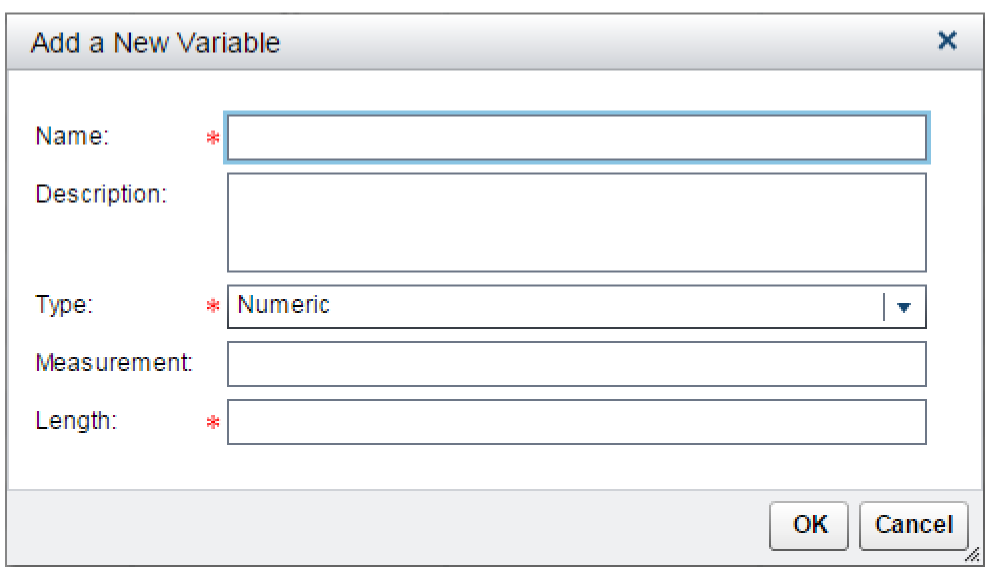
You define the project input and output variables by creating input and output prototype tables and then importing the variables using these tables, or by copying the input and output variables from another project. If you declare a champion model and the project variables have not been defined, you are prompted to add model input variables to the project and to map model output variables to project output variables.

From the **Variables** page of a project, you can add, delete, edit, copy, and import project variables.

## *Add a New Variable*

To add a new variable:

1. Click +. The Add a New Variable window appears.




2. Enter a name.
3. (Optional) Enter a description.
4. Select a type:
   - **Numeric**
   - **Character**
5. (Optional) Enter a measurement.
6. Enter a length.

7. Click **OK**.
8. Click to make the changes effective for other pages.

### Delete a Variable

To delete a variable:

1. Select a variable.
2. Click . A confirmation window appears.
3. Click **OK** to delete the variable.

### Edit a Variable

To edit a variable:

1. Select a variable.
2. Click .
3. Edit the necessary fields and click **OK**.
4. Click to make the changes effective for other pages.

### Copy Variables

To copy variables from a project:

1. Click .
2. Select a project.
3. Click **OK**.
4. Click to make the changes effective for other pages.

### Import Variables

To import variables from a table:

1. Click .
2. Select a data source.
3. Click **OK**.
4. Click to make the changes effective for other pages.

# Managing Project Versions

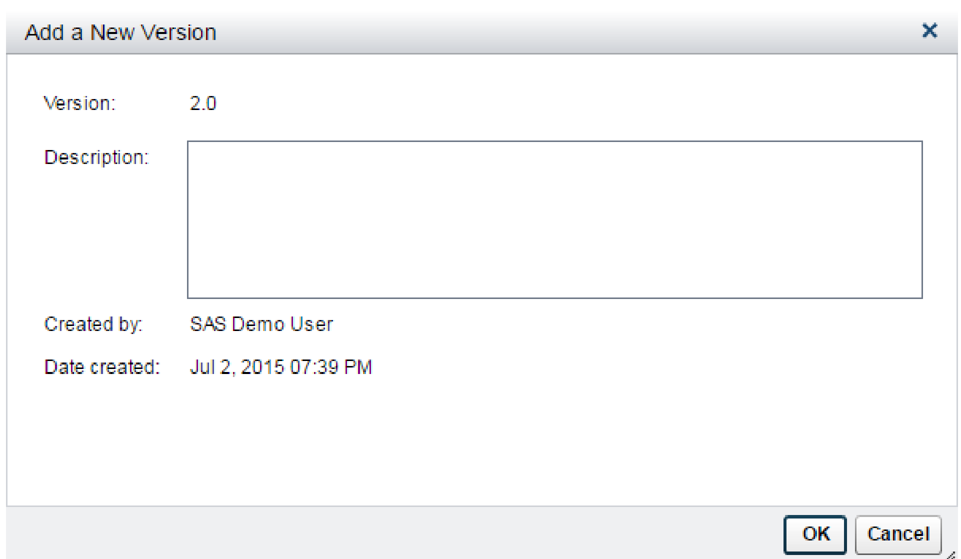
## *Overview of Project Versions*

After a project is created, you can view information about the project on the **Versions** page. An initial version is created automatically, and it functions as a time-phased container for your projects. The version is a sequential number that increments by plus one each time you add a new version. You can also specify a description for the version when adding a new one, such as a time interval for a project cycle. Your version might represent a calendar year, a retail season, or a fiscal quarter. A project can contain multiple versions. A version contains all of the candidate model resources that you need to determine a champion model as well as all champion model resources. For example, you might develop models for a scoring program that determines whether a customer is eligible for a home equity loan. The version contains all of the models, scoring tests, and reports that are used to determine the champion model. Expand **Details** to view more information about the project version.

## *Create a New Version of a Project*

To create a new version:

1. Select the **Versions** page.
2. Click . The Add a New Version window appears.




3. The next sequential number appears as the new version number for the project.
4. (Optional) Enter a description for the version.
5. Click **OK**.

You can also delete a version if it is not the current version, or if it is locked. Select a version and click

### Set the Displayed Version

To set the displayed version:

1. Select the **Versions** page.
2. Select a version and click , or double-click a version.
3. The icon indicates the version that is being displayed.

### Lock and Unlock a Project Version

You can enable or disable modifications of some version models properties and files. Locking a version restricts the activities that you can do with the project. You normally lock a version after you declare a champion model in preparation for deploying the champion model to a production environment.

To lock or unlock a version:

1. Select the **Versions** page.
2. Select a version and click to lock or unlock the version. The label **Locked** after the version name indicates the version that is being locked.

### Attach a Portable Formats File

The portable formats file contains the user-defined formats that are associated with the train table that was used to create a model. In order for the validation to be successful, the table that is selected at publish time to validate the model must be associated with the same user-defined formats. You must transform the user-defined formats SAS catalog into a portable formats file and attach it to the version. This action enables the user-defined formats to be published to the database with the model.

To attach a portable formats file:

1. Select the **Versions** page.
2. Select a version and click .
3. Navigate to the appropriate folder and select the portable formats file to attach to the selected version.
4. Click **OK**.

### View Life Cycle Status

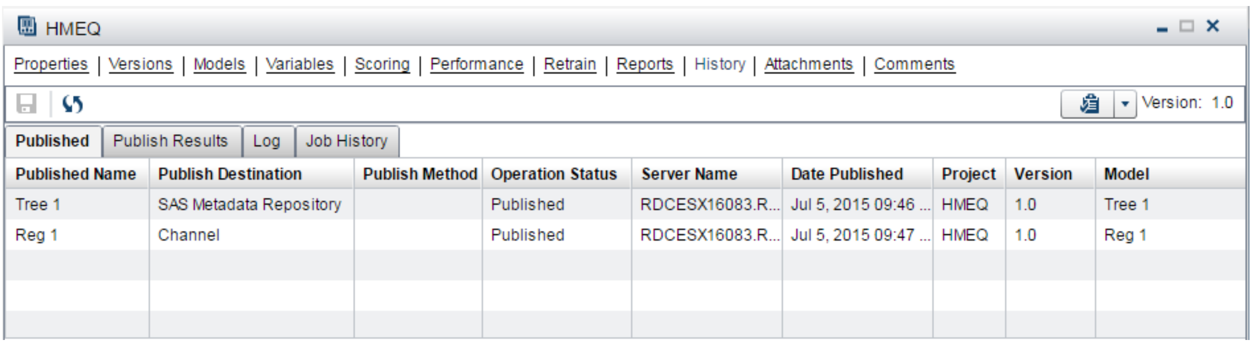
*Note:* Only life cycle content for migrated versions can be viewed.

To view the life cycle status:

1. On the **Versions** page of a project, select a version and expand **Details**.
2. Click **View Life Cycle Status**.
3. View the information and click **OK**.

## View Project History

On the **History** page, you can view the history log for changes to the project, the history of models that were published at the project and model level, and the history of scoring, performance, and retrain jobs that were executed.




## Add Attachments to a Project

On the **Attachments** page, you can view and add attachments such as images or documents. All new attachments are associated with the project. Values in the version and location columns appear only for attachments that were migrated from a previous release of SAS Model Manager. The version and location columns also appear for performance and training summary data sets that are associated with the selected version. The value for location is the directory path where the attachment is stored in the model repository. Attachments for versions within a project that were migrated now appear at the project level.

To add an attachment:

1. Click .
2. Select a file to attach and click **Open**.

*Note:* Click  to remove an attachment.

## Add Comments to a Project

On the **Comments** page, you can add new topics or respond to an existing topic. You can also search the comments.

To add a comment:

1. Enter a topic name and a comment.
2. (Optional) Click  to attach a file to the new topic. Repeat this step to attach multiple files.

*Note:* You can also click **Remove** to remove an attachment.

3. Click **Post**.

# Lock or Unlock Project Variables

You cannot modify project variables that are locked for a project. Also, you cannot set a new champion or challenger model for the project.

To lock or unlock a project:

1. In the Projects category view, select a project.
2. Select **Actions** ⇨ **Lock Project Variables**. Note that the **Lock project variables** check box is selected on the Properties page of the project.
3. To unlock the project, select **Actions** ⇨ **Lock Project Variables**. Note that the **Lock project variables** check box is deselected on the Properties page of the project.

   *Note:* You can also select or deselect the **Lock project variables** check box on the **Properties** page of a project.

# Creating and Managing Templates

## *About Creating and Managing Templates*

There are three different types of templates that you can create or edit. The template types are Model, Report, and Properties. Models are associated with a specific model template. A model template contains properties and component files that define a type of model. Report templates can be used to create user-defined reports. A report template contains report requirements such as report name and the number of required models to run the report. The properties template contains user-defined properties and values for the model and project object types. In the Projects category view, you can create a new template or manage existing templates.

*Note:* Only users who are in the Model Manager Administrator Users or Model Manager Advanced Users groups and who have Write permission to the WebDAV folder where the user-defined model and report templates are stored can save a new template or save changes to an existing template. For more information, see "Verify WebDAV Folder Permissions for User-Defined Templates " in *SAS Model Manager: Administrator's Guide*.

For more information about the different types of templates, see the following topics:

- "Model Templates" on page 339
- "Report Templates"
- "User-Defined Properties Template"

### *Manage Templates*

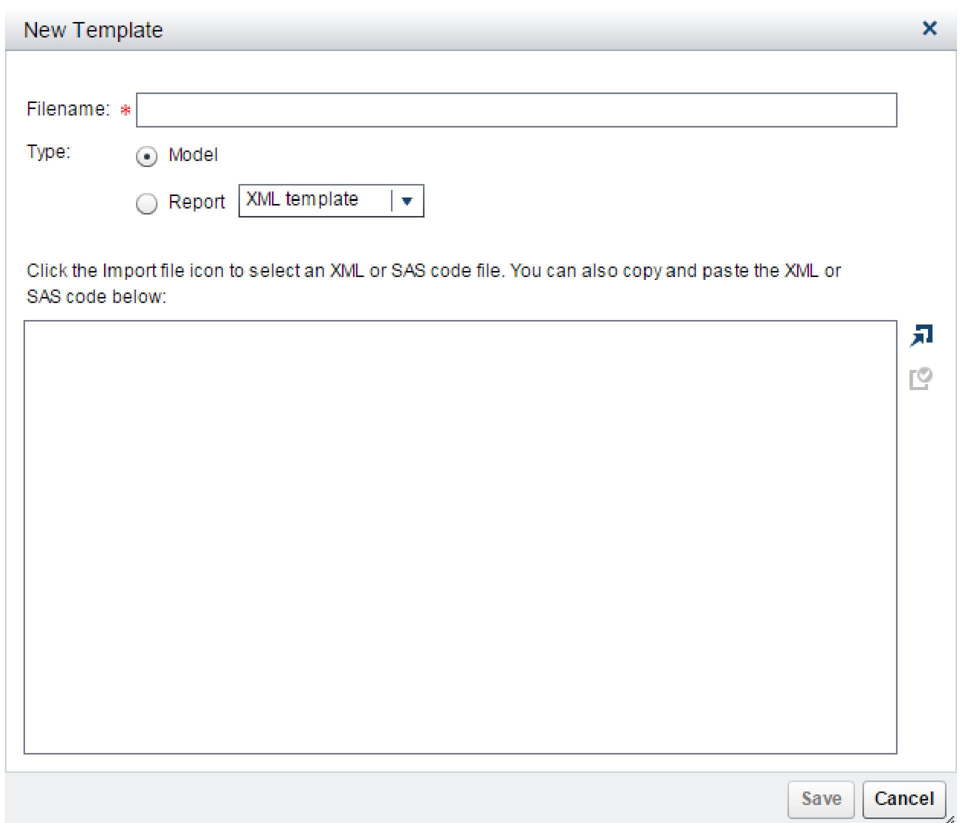
To manage templates:

1. Click and select **Manage Templates**.
2. Select an XML template or SAS code file to edit or delete. The Reserved column must be marked as No in order for the template to be editable. Life cycle templates cannot be edited but can be viewed as Read-only.
   - To edit a file, click . Make the appropriate changes and click **Save**.
   - To delete a file, click . Click **Yes**.
3. Click **Close**.

### *Create a New Template*

To add a new template:

1. Click and select **New Template**.




2. Enter a filename.
3. Select a type:
   - **Model**
   - **Report** (XML template or SAS code)

4. Click  to select an XML or SAS code file. You can also copy and paste the XML or SAS code in the text box.

   *Note:* Ensure that the selected template type matches the XML content type before importing the file.

5. Click  to validate the XML.

6. Click **Save**.

### User-Defined Properties Template

When you add a user-defined property using the UserDefinedProperties.xml file, you specify the name of the property, the initial value of the property, and the type of object in the model repository to which it applies. The user-defined property is created for the specified object type when the object is added to the model repository. For example, if the XML file specifies a user-defined property *Due date* for an object type of project, the project object has a property of **Due date** each time a project is created in the Projects category. User-supplied properties are not added to existing objects in the model repository.

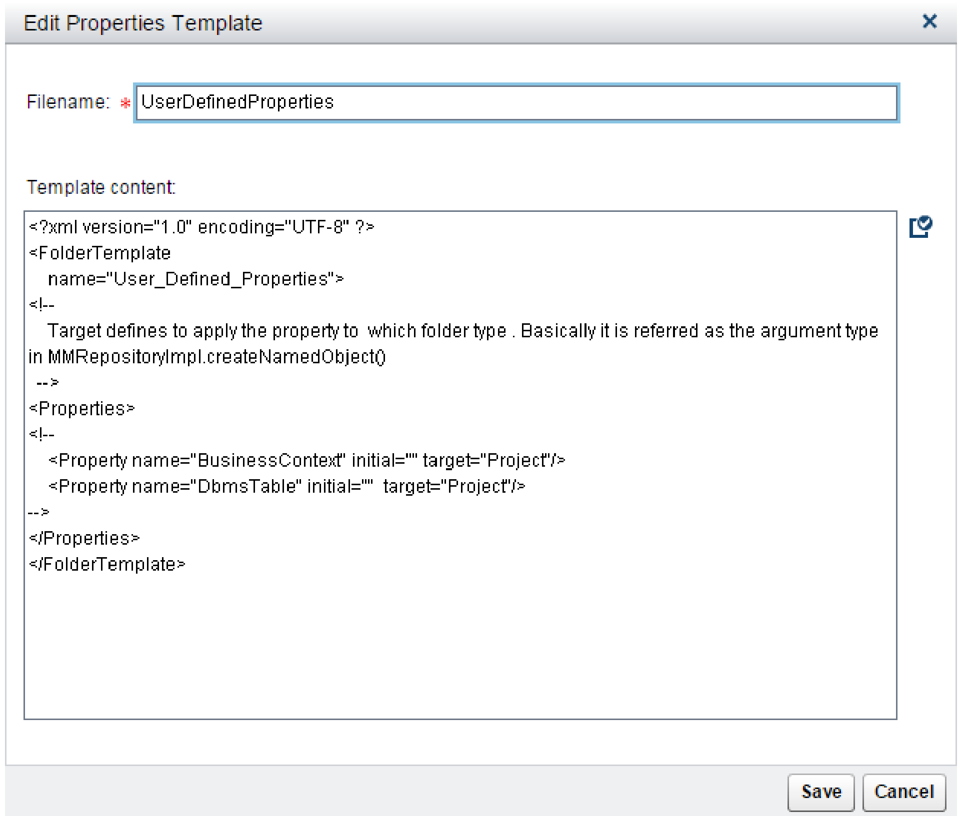
You can specify these object types in the UserDefinedProperties.xml file:

- AnalyticalModel
- ClassificationModel
- ClusteringModel
- PredictionModel
- Project

To add user-defined properties for an object type:

1. Click  and select **Manage Templates**.

2. Select the **`UserDefinedProperties.xml`** template and click .




3. Add properties using an XML property element for each property. These arguments are required:

   name="*property-name*"
   : specifies the name of the property.

   initial="*initial-value*"
   : specifies a value for the property when it is added as a property for the specified object type in the model repository. If you do not want to specify an initial value, use two double quotation marks, **`initial=""`**

   target="*object-type*"
   : specifies the object type in the model repository for which the user-supplied value applies.

   Example: **`<Property name="Due date" initial=" " target="Project"/>`**

4. Click **Save**.

5. Click **Close**.

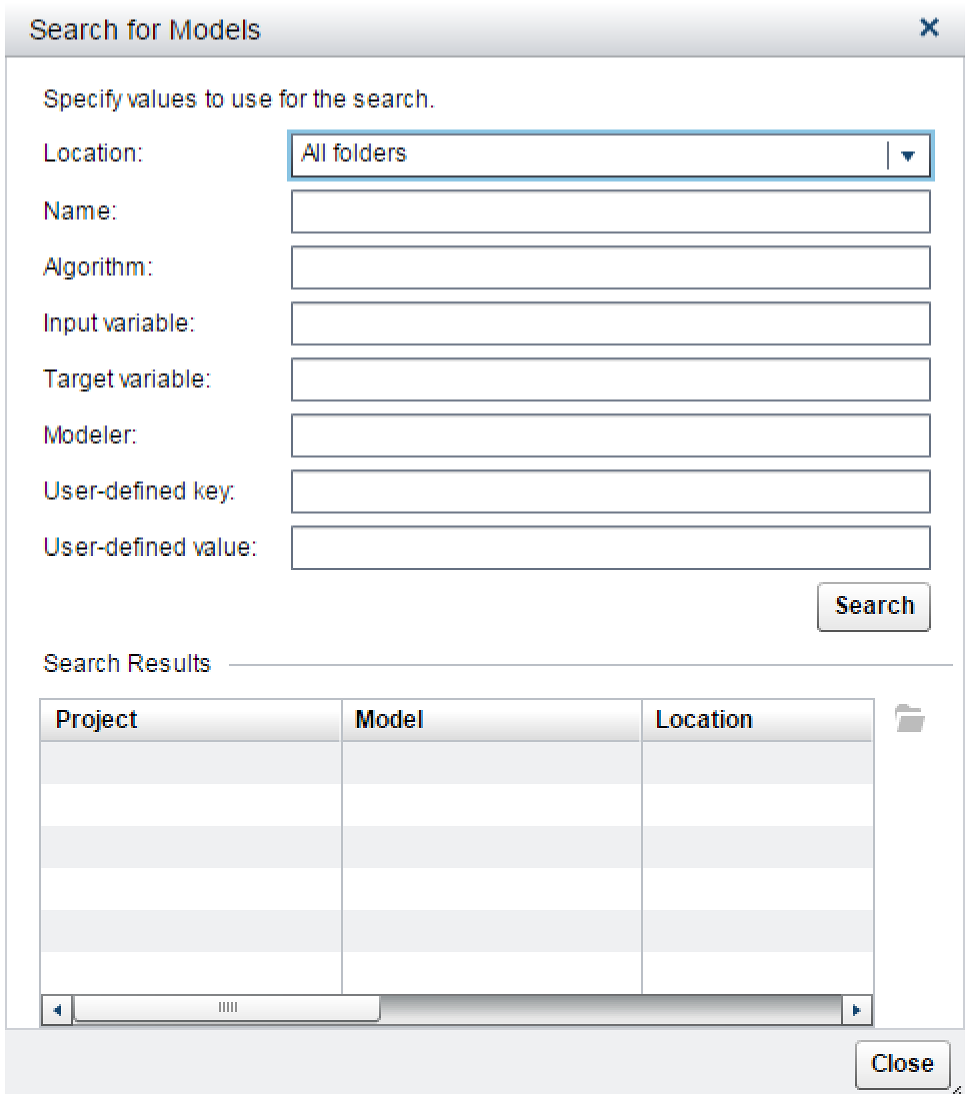
---

# Searching for Models

You can search for models based on certain criteria in the Projects and Portfolios category views. The results appear below the search criteria. You can also search all models in the model repository and filter the results in the Inventory category by using the category search options. For more information, see "Search and Filter Inventory of Models" on page 91.

To search for models:

1. Click  The default is to search **All folders**




2. Select a location:
   - **All folders** searches all folders in the category view.
   - **Current** searches only the selected object (folder, project, or portfolio) and its contents.
3. Enter a name for the model.
4. Enter an algorithm.
5. Enter an input variable. The field is case sensitive.
6. Enter a target variable. The field is case sensitive.
7. Enter a modeler.
8. Enter a user-defined key or value. The user-defined key field is case sensitive.
9. Click **Search**.

10. Select a model from **Search Results** and click or double-click to open the model. You can view or edit the model. Click **OK**.
11. Click **Close**.

The search results display the following information:

| Column | Description |
|---|---|
| Project | Specifies the name of the project. |
| Model | Specifies the name of the model. |
| Location | Specifies the location of the model. |
| Algorithm | Specifies the name of the algorithm, such as regression or logistic, that is used by the model. |
| Type | Specifies one of the model function types:<br>• Analytical<br>• Classification<br>• Prediction<br>• Cluster |

*Chapter 6*

# Importing Models

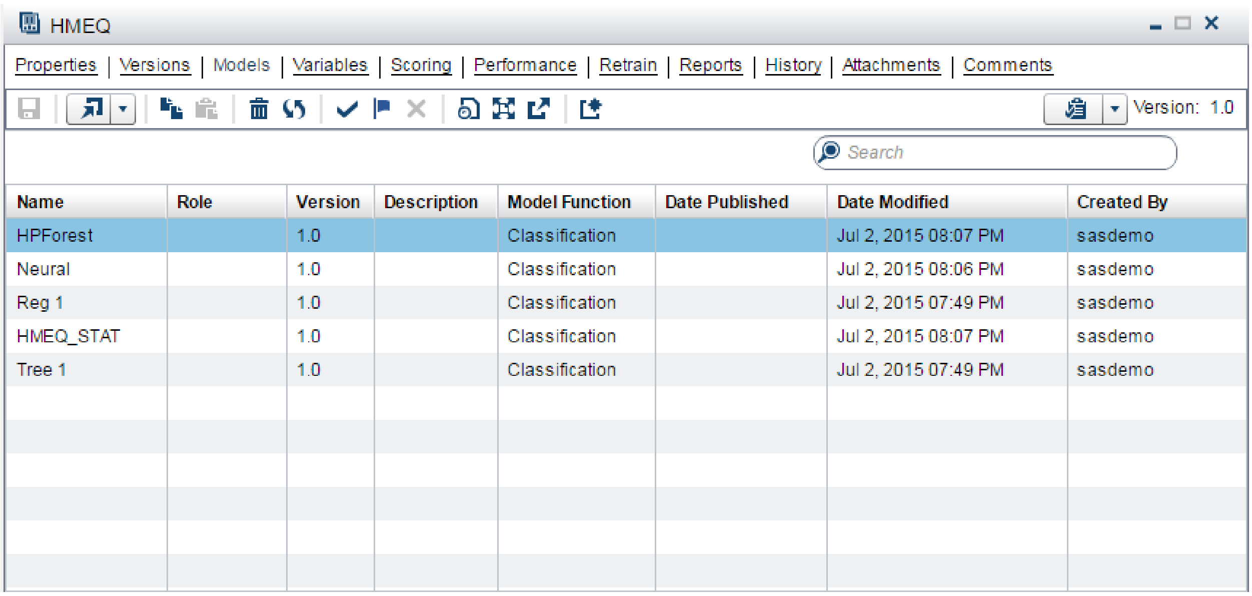


## Overview of Importing Models

After you create a project, you import models into a project version on the **Models** page. A project can contain multiple versions. You can see only the models for the selected version on the **Models** page. After model evaluation, you set one of the candidate models as the champion model.

You can also import generic models into a folder from the SAS Workspace Server. For more information, see “Importing Models into a Folder” on page 74.

***Figure 6.1*** *Models Page*




There are many methods of importing your SAS models into your project version:

- Import a Model from the SAS Metadata Repository on page 69
- Import a SAS Model Package File on page 70
- Import a Model from Local Files on page 72
- Import a PMML Model on page 71
- Add Model Files to an Existing Model on page 84

SAS macros are also provided so that you can use SAS code to import or register SAS models into your project. For more information, see "Overview of Access Macros" on page 241 and "Using Macros to Register Models Not Created by SAS Enterprise Miner" on page 285.

Keep the following details in mind:

- Scorecard models can be imported using the SAS Code Models local files method and the SAS Model Package File import method.
- HPFOREST procedure models can be imported using the SAS Metadata Repository import and the SAS Model Package File import. You cannot import PROC HPFOREST models using local files.
- High-Performance analytics models that are not created with SAS Enterprise Miner can be registered to the SAS Metadata Repository using the %AA_Model_Register. These models can then be imported to SAS Model Manager by importing the models from the SAS Metadata Repository from a SAS model package file.
- Before you can import COUNTREG procedure and SEVERITY procedure models, you must create the model score code using the %MM_Countreg_Create_Scorecode macro and the %MM_Severity_Create_Scorecode macro. After the score code is generated, you can use the %MM_Model_Register macro or the local files method to import these models. For more information about the types of model component tables, see "Generating Score Code for COUNTREG Procedure Models" on page 309.

- SAS Model Manager cannot publish models to a database whose **Score Code Type** model property is set to **SAS Program**, **PMML**, **Analytic store**, or **DS2**.
- Model component table variable names must start with a letter or underscore, and can contain letters, the underscore ( _ ), the hyphen ( - ), and the period ( . ). Variables with special characters can be used only when the administrator has set the **Valid Variable Name** option to **Yes** in the SAS Management Console or set the variable from start-up code. For more information, see the *SAS Model Manager: Administrator's Guide*.

***CAUTION:***

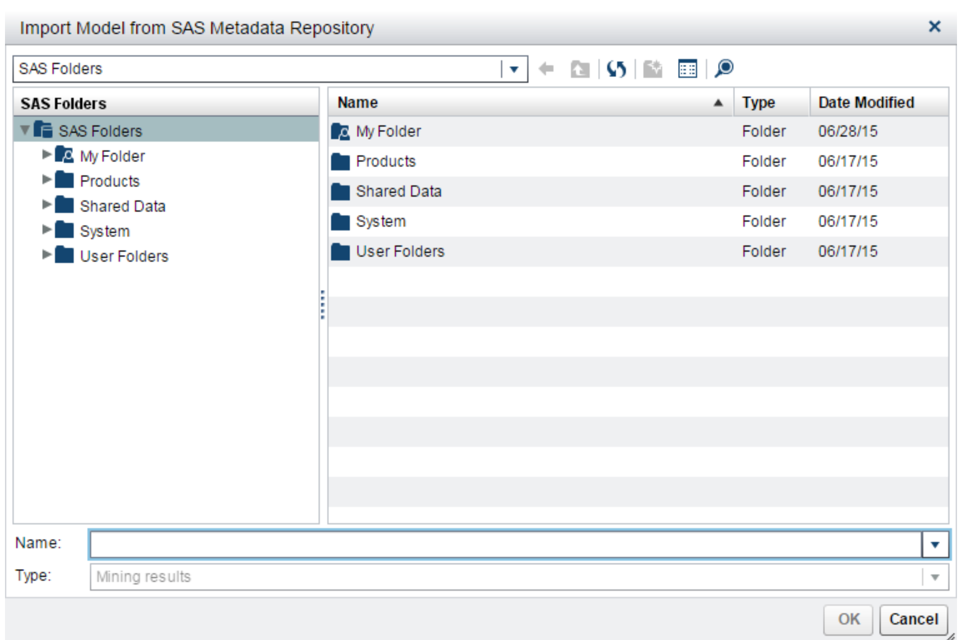
**Unexpected results might occur if you import a model that was previously exported using SAS Model Manager.** A best practice is to import models that were not previously exported by SAS Model Manager.

## Import a Model from the SAS Metadata Repository

If your SAS Enterprise Miner 5.1 (or later) model files or your models that were created by the %AA_Model_Register macro are registered in your SAS Metadata Repository, you can import them into SAS Model Manager from the repository.

To import a model from the SAS Metadata Repository:

1. Click and select **from the SAS Metadata Repository**.




2. Navigate to the location of the file and select the model file to import.
3. Enter a name for the model and click **OK**.

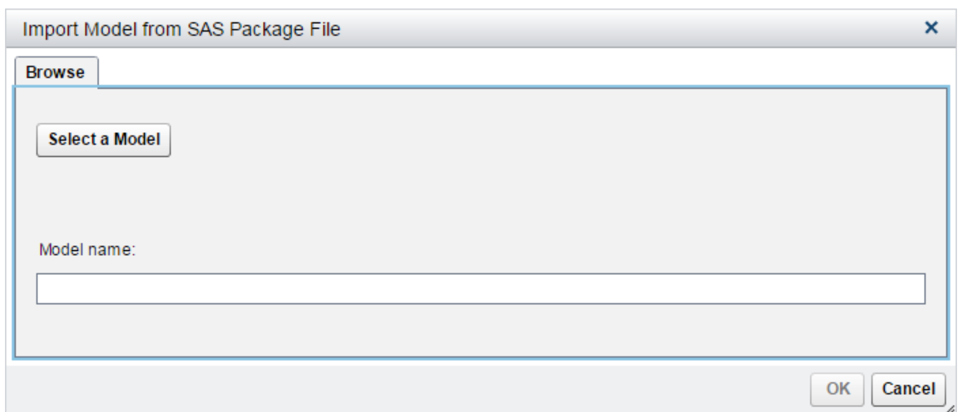
# Import a Model from a SAS Package File

## *Import a SAS Package File*

A SAS model package (SPK) file is a SAS Enterprise Miner SPK file or an SPK file that was created by using the %AA_Model_Register macro. SPK files contain complete model information. They enable you to import a complete model that is not registered in a SAS Metadata Repository.

To import a model from a SAS Package File:

1. Click and select **from a SAS package file**.




2. On the **Browse** tab, click **Select a Model** and navigate to the location of the file. Select the file to import and click **Open**.
3. Enter a name for the model.
4. Click **OK**.

## *Create SAS Package Files in SAS Enterprise Miner*

To create SAS Package Files in SAS Enterprise Miner:

1. Open the SAS Enterprise Miner diagram that contains the model, and then run the model.
2. After the model run is complete, right-click the node in the SAS Enterprise Miner Diagram Workspace, and select **Create Model Package**. The new SPK filename appears under the Model Packages folder in your SAS Enterprise Miner Project Navigator.
3. Right-click the filename and select **Save As** to copy the SPK file from the SAS Enterprise Miner server to your computer.
4. Specify a destination folder on your computer, such as, `C:\MMData`, and save the file to your workstation folder.

### *Create SAS Package Files Using the %AA_Model_Register Macro*

These models can be created by SAS procedures and are supported by SAS Model Manager:

- SAS/STAT item store models
- High-performance models
- SAS/ETS COUNTREG procedure models
- SAS/ETS SEVERITY procedure models

You can use the %AA_Model_Register macro to create an SPK file to contain these models. For more information, see “Overview of Access Macros” on page 241.

---

## Import a PMML Model

Predictive Modeling Markup Language (PMML) is an XML-based standard for representing data mining results. PMML is designed to enable the sharing and deployment of data mining results between vendor applications and across data management systems. You can import PMML models that are produced by using other applications. PMML 4.2 (or later) is supported. Models that are created using PMML 4.2 support DATA step score code.

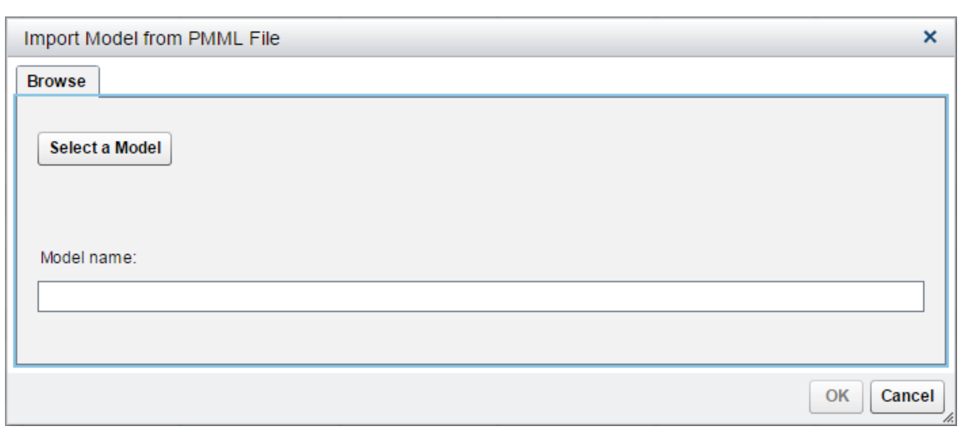
*Note:* If your PMML model contains variable names with blanks or special characters other than underscores, you must set the system option VALIDVARNAME=ANY to perform tasks such as scoring tests, performance monitoring, and reporting that use the score.sas file. For information about setting the VALIDVARNAME=“ANY”, see “Valid Variable Name Options” in *SAS Model Manager: Administrator’s Guide*.

For more information, see “PROC PSCORE and PMML Support” on page 393. If you have a license for SAS Enterprise Miner, see the topic “SAS Enterprise Miner PMML Support” in the product Help or in *SAS Enterprise Miner: Reference Help* available at http://support.sas.com/documentation/onlinedoc/miner/.

*Note:* PMML variables must be valid SAS variable names and cannot contain more than 20 characters. In addition, SAS Model Manager does not support the importing of a PMML file that contains multiple models.

To import a PMML model:

1. Click and select **from a PMML file**.



2. On the **Browse** tab, click **Select a Model** and navigate to the location of the file. Select the file to import and click **Open**.

3. Enter a name for the model.

4. Click **OK**.

## Import Models from Local Files

You can import R models, and you can also import models that you created using SAS code, but that were not created in or exported from SAS Enterprise Miner. An example of a model might be a SAS LOGISTIC procedure model, a SEVERITY model, or an R logistic model. You can also add files later that were not available when the model was originally imported.

When you import models using the local file method, keep the following in mind:

- The table names that you specify as model components must start with a letter or underscore.
- Table names can contain a period.
- Table names cannot be more than 32 characters long.
- Spaces or special characters (for example, ~`!@#$%^&*()+={}[]|\\:;'<>?/") are not valid in a table name.

For more information, see Model Template Component Files on page 339.

*Note:* HPFOREST models cannot be imported using local files.

To use the Local Files method, you must prepare model component files. Model component files provide the metadata that is used to process a model in SAS Model Manager. The model component files that you prepare are dependent upon the project's model function. You can find the model function in the project property **Model function**. The model functions for SAS code models are analytical, classification, prediction, or segmentation. The model functions for R models are analytical, classification, or prediction. For a list of component files by model function, see “Model Templates” on page 339. If you do not have all of the component files when you import the model, you can create them and add them later. For more information, see “Add Model Files to an Existing Model” on page 84.

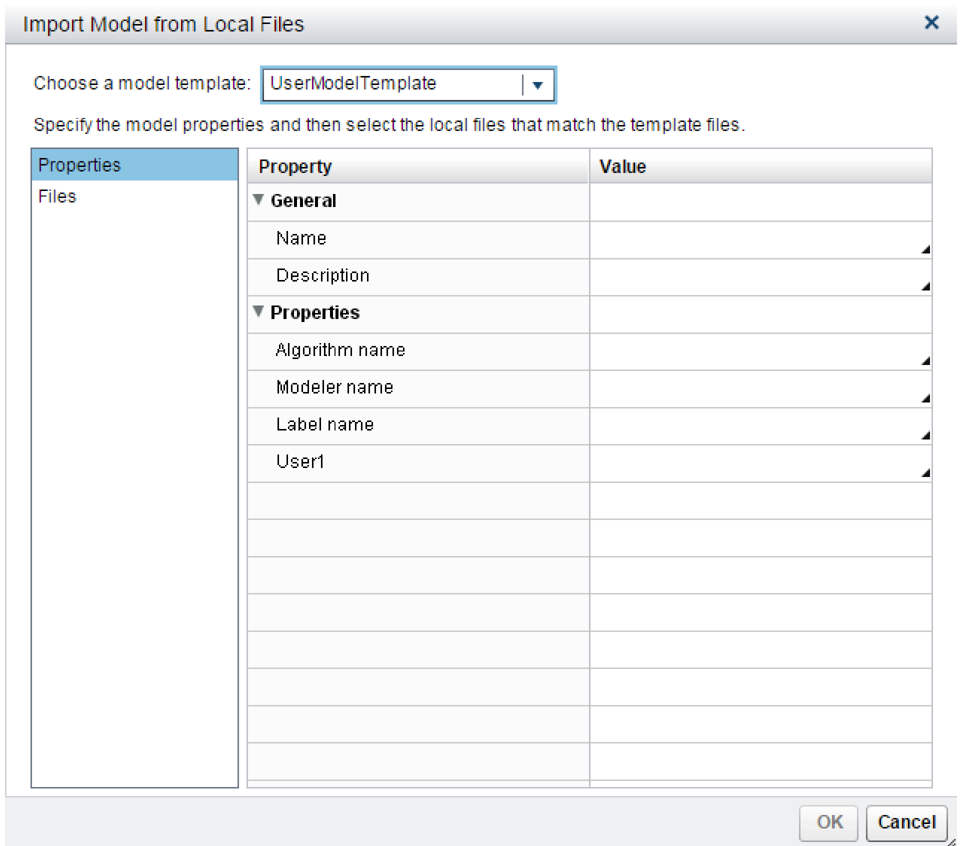
SAS code models, at a minimum, require a score code component file (score.sas) and other component files to define the model input and output variables in SAS tables. Prediction and classification models also require a component file to define target variables.

R models, at a minimum, require SAS and R score code component files, a file for the output parameter estimate, and the other component files to define the model input and output variables using either SAS data sets or XML files. Prediction and classification models also require a component file to define target variables. For more information, see “Overview of Using R Models with SAS Model Manager” on page 395.

The score code component file (score.sas) is DATA step score code and is used as input by the SAS Scoring Accelerator when publishing a model to a database. In the scoring function publish method, some SAS language elements and syntax are not supported when you create or modify your score code. Only the SAS language elements and syntax that are required to run critical data transformations and model scoring functions are available. If you use a statement or function that is not supported, your model is not published to the database. For more information, see “Considerations When Creating or Modifying DATA Step Score Code” in *SAS In-Database Products: User’s Guide*.

To import models from local files:

1. Click and select **from local files**.




2. Select a model template from the drop-down list.

   *Note:* If you specify values for the properties and then select a different template, the values are cleared.

3. Click **Properties** and specify the model properties.
4. Click **Files** and select the local files from the SAS Workspace Server that match the template files. You cannot delete a file once you have added it. To replace the file, select another file or cancel the import and start over.
5. Click **OK**.

## Export Models from a Project

To export an individual model from the **Models** page of a project to the SAS Workspace Server:

1. Select a model and click .
2. Select a location on the SAS Workspace Server.

*Note:* You cannot export a model to a location where a model with the same name already exists.

3. Click **OK**.
4. Click **Close**.

---

# Importing Models into a Folder

## *About Importing Models into a Folder*

You can import an individual model or multiple models at one time from the SAS Workspace Server into a folder. All of the model files in the selected location are imported. The folder name is used as the model name. If you have subfolders, each subfolder is considered to be a separate model. Each folder's contents are considered to be model files. A folder should not contain both model files and subfolders at the same level. If the top-level folder contains both, the subfolders are ignored and only one model is added with the files that are within the selected folder.

After you import models into a folder, you can also perform the following tasks:

- export one or more models
- update one or more models
- duplicate or move models

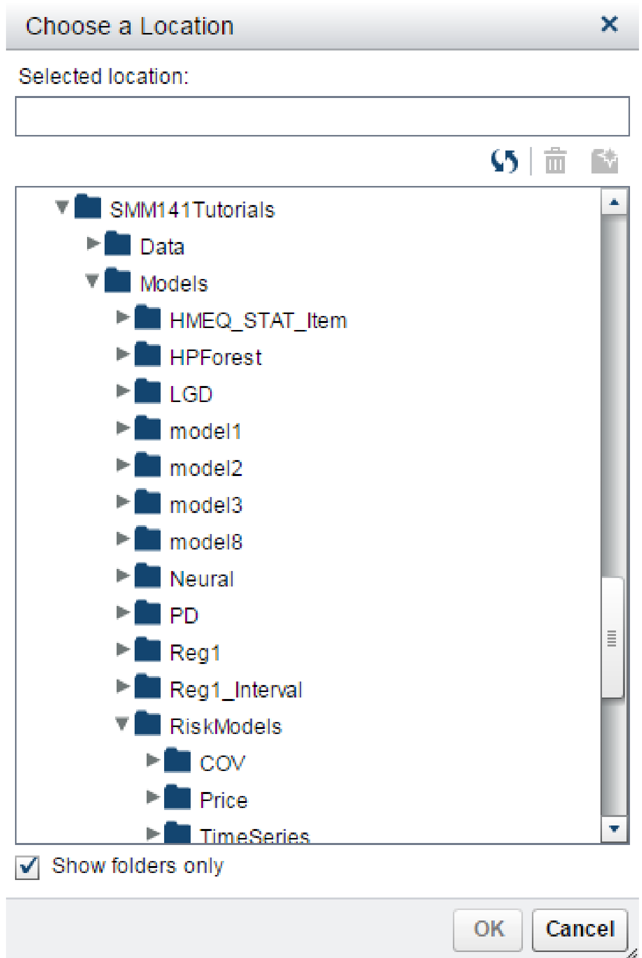
*Note:* These models cannot be moved or copied from a folder to a project within the user interface. When you export models from the folder level, models within a project are not included. Only models that reside directly within the selected folder are exported.

## *Import Models into a Folder*

To import models:

1. Select a folder, click , and select **Import models**.

   *Note:* Alternatively, right-click a folder and select **Import Models**.




2. Select the location of the model or models on the SAS Workspace Server.
3. Click **OK**.

### *Export Models from a Folder*

You can export an individual model or multiple models at one time to the SAS Workspace Server.

*Note:* When you export models from the folder level, models within a project are not included. Only models that reside directly within the selected folder are exported.

To export an individual model:

1. Right-click a model and select **Export**.
2. Select a location on the SAS Workspace Server.

   *Note:* You cannot export a model to a location where a folder with the same name already exists.
3. Click **OK**.
4. Click **Close**.

To export multiple models:

1. Right-click a folder and select **Export Models**.

2. Select a location on the SAS Workspace Server.

   *Note:* You cannot export a model to a location where a folder with the same name already exists.

3. Click **OK**.
4. Click **Close**.

### *Update Models in Folders*

You can update an individual model or multiple models at one time. Only models that have previously been exported to the SAS Workspace Server can be updated. Both new and modified model files are included in the updates to the model. A new model version is created each time you update the model.

To update an individual model:

1. Right-click a model and select **Update**.
2. Select the location of the model on the SAS Workspace Server.
3. Click **OK**.
4. Click **Close**.

To update multiple models:

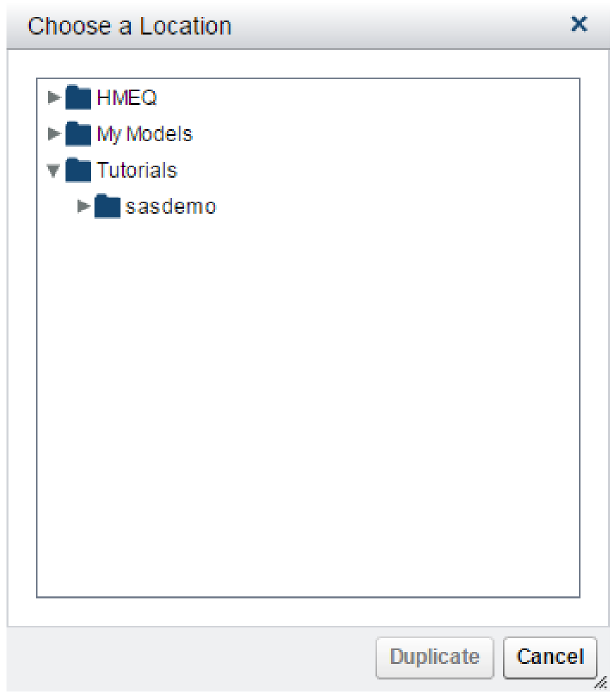
1. Click  and select **Update models**.
2. Select the location of the model or models on the SAS Workspace Server.
3. Click **OK**.
4. Click **Close**.

### *Duplicate or Move Models*

You can duplicate a model or move a model to another folder. When you duplicate a model that has multiple model versions, only the current model version is duplicated. When you move a model, all of the model versions are kept.

To duplicate a model:

1. Right-click a model and select **Duplicate**.
2. Select a location.




3. Click **Duplicate**.

To move a model:

1. Right-click a model and select **Move**.
2. Select a location.
3. Click **Move**.

*Chapter 7*

# Managing Model Content and Versions



## Overview of Managing Model Content and Versions

When you open a model, you can modify the model properties, add or view model versions, add attachments, and add comments. You can open a model from the Inventory category and from the **Models** page of a project.

## Set Model Properties

After you import a model, you can specify additional property values for your imported model. On the **Model Properties** page, you can perform the following tasks:

- View the input and output variables, and create a scoring output table

- Map model output variables to project output variables
- Specify model-specific properties and user-defined properties
- View and edit score code
- View and add model files
- Create input and output variables from the score.sas file
- View the history to see a log that shows changes to the model, and to the published models

To set the model properties:

1. Select and open a model and view the **Model Properties** page. See the below table for what types of properties can be specified.

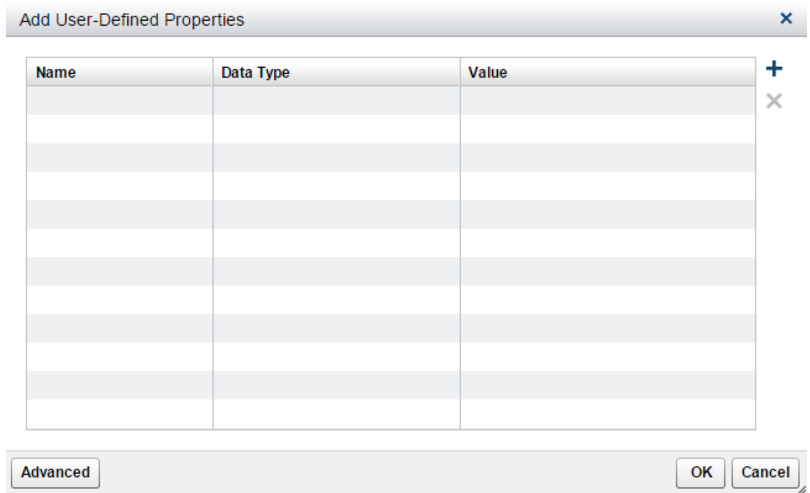
| Model Properties | Description |
|---|---|
| **General** | On this page you can view the model name, who created it, and the dates it was created and modified. The only property that you can edit is the description. For more information, see “General Properties” on page 51. |
| **Specific** | On this page you can enter information for various items. Some values are automatically populated and cannot be modified. For editable properties, click **Browse**, enter, or select a value. For more information, see “Specific Properties” on page 349. |
| **System** | This page is a Read-only and is created after a model has been imported. The system properties for models do not require any configuration after the model is imported. For more information, see “System Properties” on page 54. |
| **User-Defined** | On this page you can view the user-defined properties for a model. You can also create user-defined properties. For more information, see “User-Defined Properties” on page 54. |
| **Factory Miner** | On this page you can view the SAS Factory Miner model properties.<br>*Note:* This tab only appears for SAS Factory Miner models. |

2. Click .

To create a scoring output table, see “Create Scoring Output Tables” on page 116

# Add Model User-Defined Properties

1. On the **Model Properties** page, select **Properties** ⇨ **User-Defined**.
2. Click . The Add User-Defined Properties window appears.




3. Click  to insert a new row.

   *Note:* Alternatively, you can click **Advanced** to manually specify the name and value pairs for the new properties.

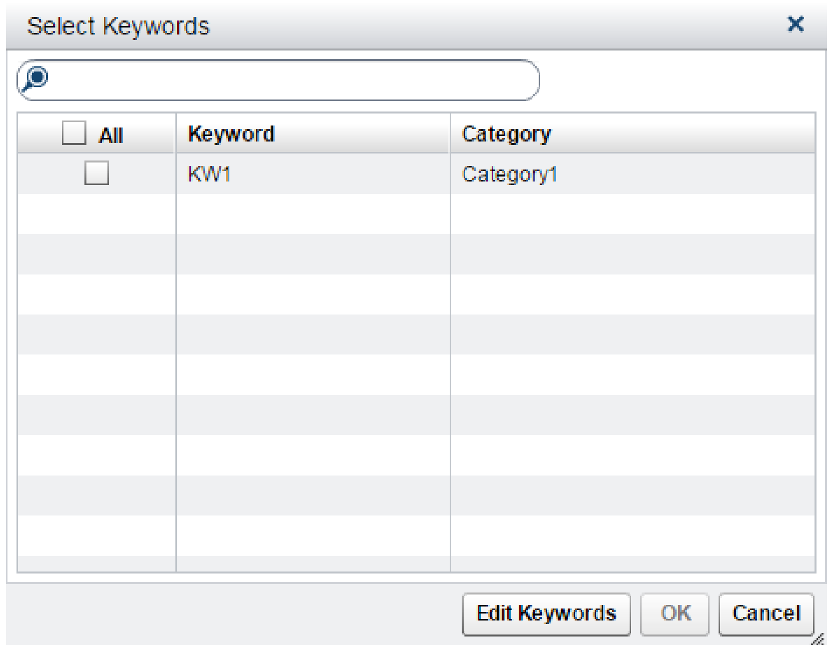
4. Specify a name and data type for the property. A value for the property is optional.
5. Click **OK**.
6. (Optional) Select a user-defined property and click  to view the history of changes for that property. Click **Close**.

# Add and Edit Model Keywords

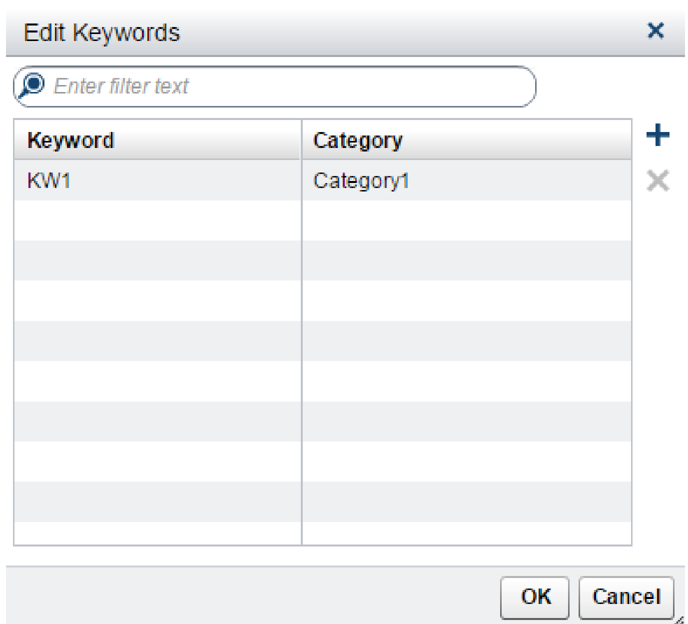
Select **Properties** ⇨ **General** to view the model keywords.

To add keywords:

1. Click . The Select Keywords window appears.




2. (Optional) Click **Edit Keywords** to add or remove keywords from the list. The Edit Keywords window appears.




   a. Click to add a keyword to the list. Enter a value for the keyword and specify a category.

   b. Select a keyword and click to remove it from the list. Click **Remove** in the confirmation message.

   c. Click **OK**.

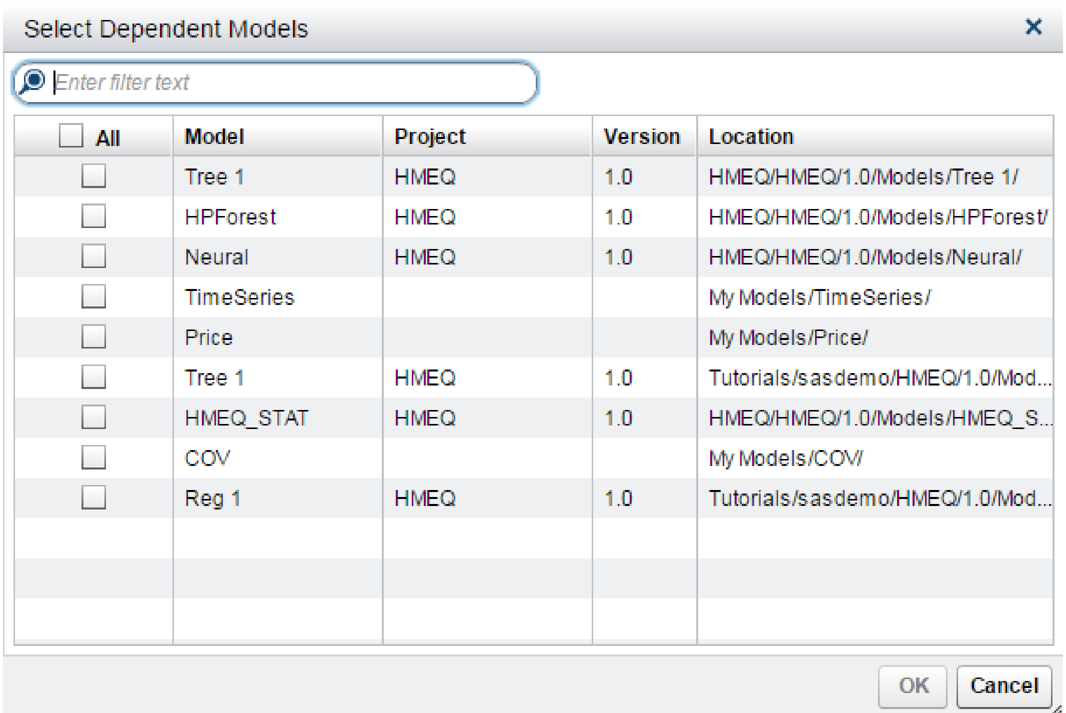
3. Select one or more keywords from the list.
4. Click **OK**.
5. Click to save the model properties.

# Add Model Dependencies and View Lineage

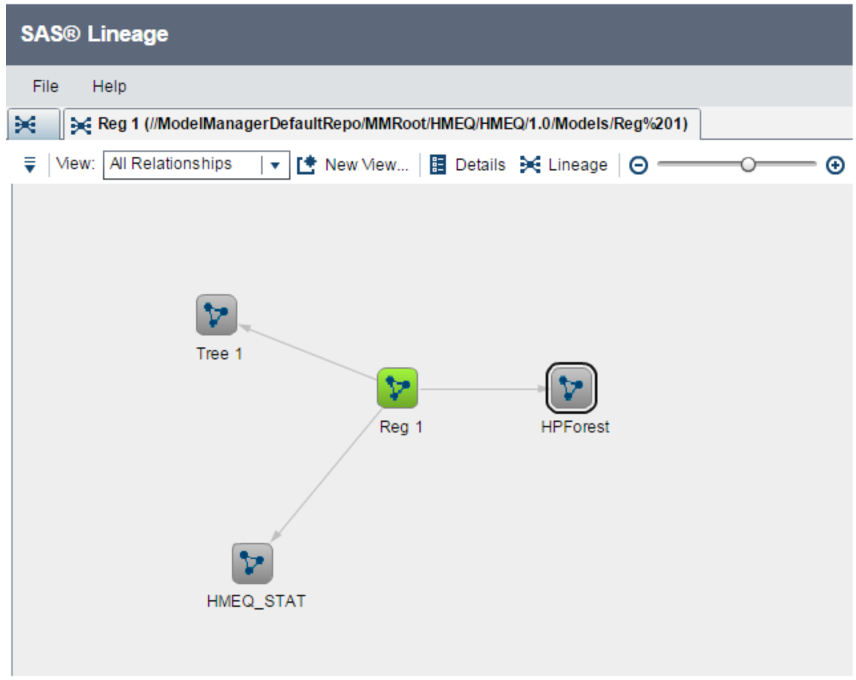
Select **Properties** ⇨ **General** to view the model dependencies.

To add model dependencies:

1. Click . The Select Dependent Models window appears.




2. Select one or more models.
3. Click **OK**.
4. Click to save the model properties.
5. Click to view the lineage of the model. The SAS Lineage application appears.




*Note:* For information about SAS Lineage and using the lineage viewer, select **Help**.

To remove model dependencies:

1. Select one or more models from the list.
2. Click .
3. Click to save the model properties.

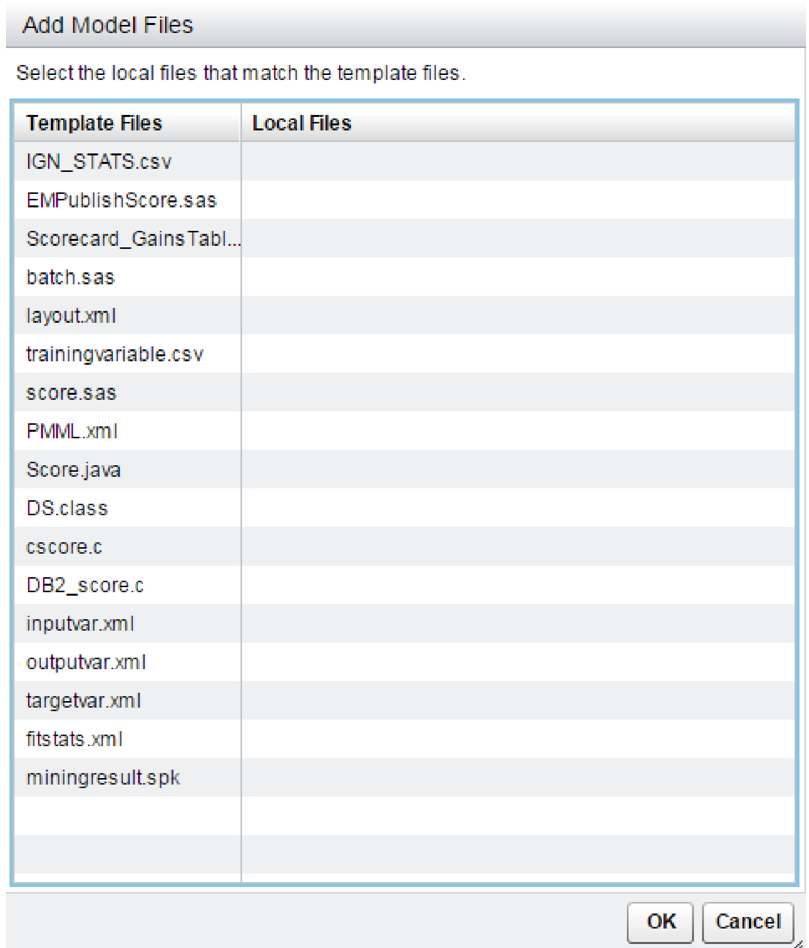
## Add Model Files to an Existing Model

Suppose you want to import a model, but you lack some of the model component files that are needed to complete a model import. The model files utility enables you to add files later that were not available when the model was originally imported.

To add a local file to an existing model:

1. Select and open a model.
2. On the **Model Properties** page, select **Advanced** ⇨ **Model Files**.
3. Click .
4. Select a row and click **Browse** to select the local files that match the template files.

   *Note:* Not all files must be specified. You can specify one or more.




*Note:* If you are adding files to a model that is locating inside a folder, the Choose Files window appears for you to select a file from the **SAS Workspace**.

5. When the update is complete, click **OK**.

6. Click . If you do not see your updates immediately, you might need to close the model and reopen it.

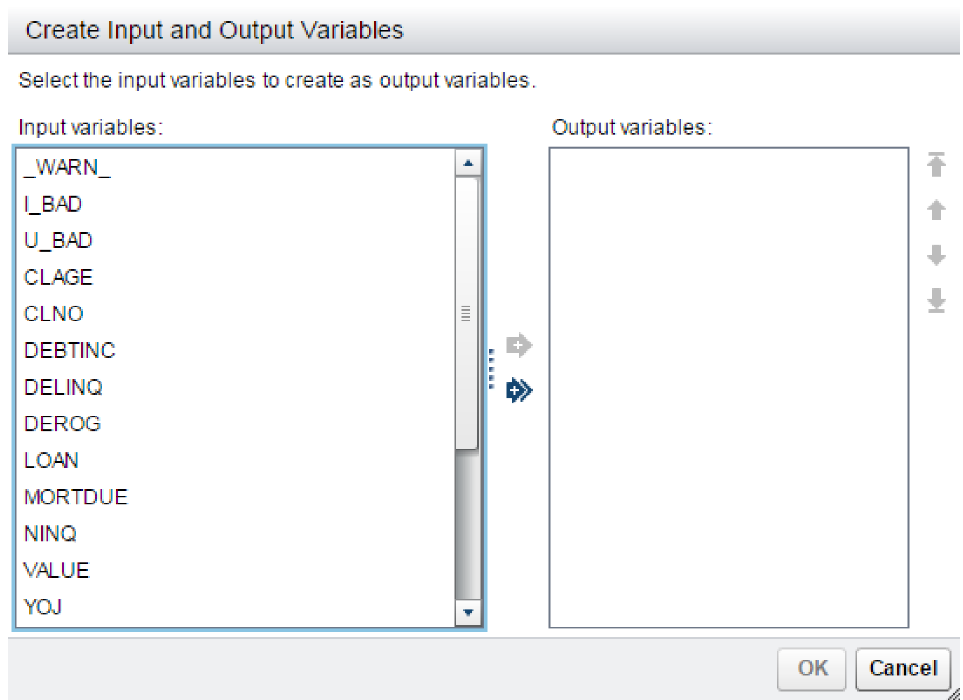
## Create Input and Output Variables from a SAS Code File

You can create model input and output variables from the score.sas file. Creating the variables enables you to generate missing metadata for model variables.

1. On the **Model Properties** page, select **Advanced** ⇨ **Model Files**.

2. Select a SAS code (.sas) file and click  (for example, score.sas).

3. Click **Yes** in the confirmation messages to replace the existing input and output variables. The Create Input and Output Variables window appears.




*Note:* If a champion is already set, you might receive another message indicating that the champion and challenger models will be cleared. Also, if you add new variables that are not project variables, you are prompted to add the model variables to the project variables when setting the model as the champion.

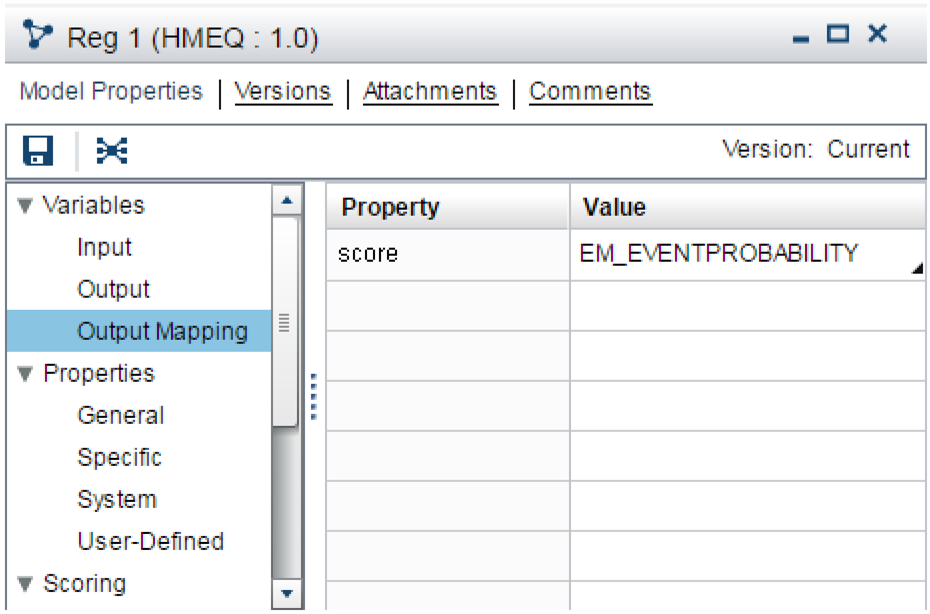
4. Select input variables that you want to add as output variables for the model.
5. Click **OK**. The inputvar.xml and outputvar.xml model files are generated.

## Map Model Variables to Project Variables

After a model has been imported and the remaining model properties are set on the **Model Properties** page, you must map the model output variables to the project output variables. For more information about project input and output tables, see Defining Project Input and Output Variables on page 55.

To map model variables to project variables:

1. Select and open a model.
2. Select **Model Properties** ⇨ **Output Mapping**.
3. Click the box in the **Value** column beside the variable in the **Property** column to display project variables.




4. Select a model output variable.
5. Repeat steps 3 and 4 for each model variable that requires mapping.
6. Click .

## User-Defined Model Templates

When you import a SAS code model or R model, you must define the component files to be used in the model and specify the properties for the model. SAS Model Manager provides model templates that you can use as an example to create your own model template. You can define model component files and specify system and user properties for your model template. The model templates that are included cannot be modified. For a list of the component files that must be created for the different model types, see "Model Template Component Files" on page 340. For a list of properties, see "Specific Properties" on page 349.

*Note:* Only users who are in the Model Manager Administrator Users or Model Manager Advanced Users groups and who have Write permission to the WebDAV folder where the user-defined templates are stored can save a new template or save changes to an existing template. For more information, see "Verify WebDAV Folder Permissions for User-Defined Templates " in *SAS Model Manager: Administrator's Guide*.

Several sample user template XML files are included with the installation package and are available to be used as a starting point for creating your own model template. For more information, see "Creating and Managing Templates" on page 60.

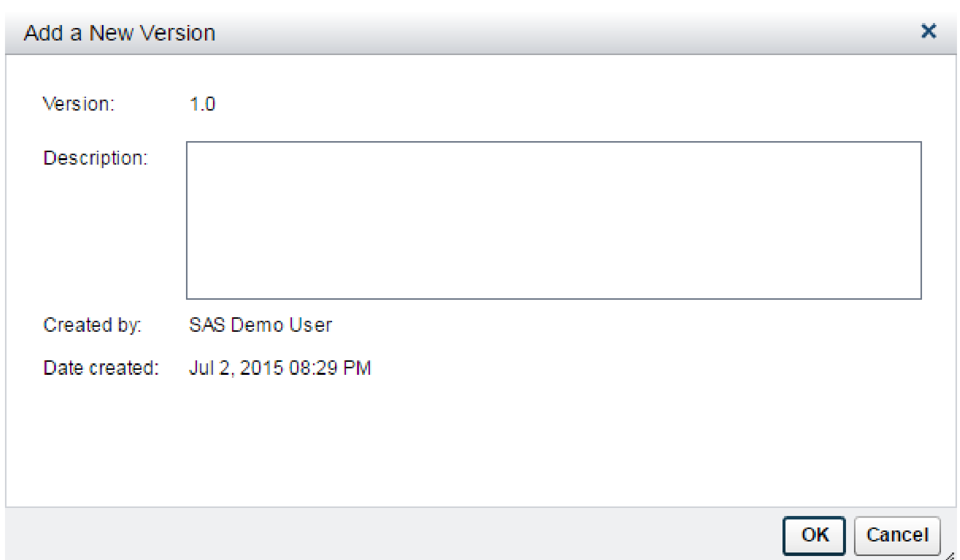
# Managing Model Versions

## About Model Versions

The current version of a model is the latest version in which the model properties and file contents are editable. If you add a new model version manually or perform an action that automatically creates a new model version (such as setting it as the champion model or publishing a champion model from the project level), a snapshot of the model's contents is taken and a version number is assigned. A new version is also created when you update a model that is located within a folder. However, the contents of the new model version that is created can no longer be edited. You can only view the contents of the new model version. Model versions cannot be deleted.

## Add a Model Version

1. Select the **Versions** page.
2. Click . The Add a New Version window appears. The next sequential number appears as the new version number.




3. (Optional) Enter a description for the version.
4. Click **OK**.

## Set the Model Version

1. Select the **Versions** page.
2. Select a version and click . The  icon indicates the version that is being displayed.

# Add Attachments

You can view and add attachments such as images or documents. Attachments can be added at the object-level for portfolios, projects, and models.

To add an attachment:

1. Select the **Attachments** page.
2. Click +.
3. Select a file to attach and click **Open**.

*Note:* Click ✕ to remove an attachment.

### See Also

"Add Attachments to a Project" on page 59

# Add Comments

You can add new topics or respond to an existing topic. You can also search the comments. Comments can be added at the object-level for portfolios, projects, and models.

To add a comment:

1. Select the **Comments** page
2. Enter a topic name and a comment.
3. (Optional) Click to attach a file to the new topic. Repeat this step to attach multiple files.

   *Note:* You can also click **Remove** to remove an attachment.
4. Click **Post**.

### See Also

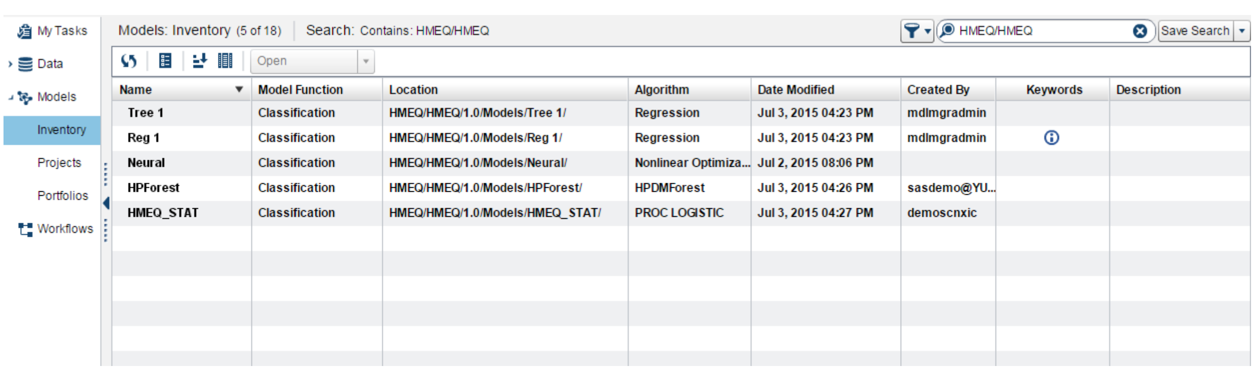
"Add Comments to a Project" on page 59

*Chapter 8*
# Working with Model Inventory



## Overview of Model Inventory

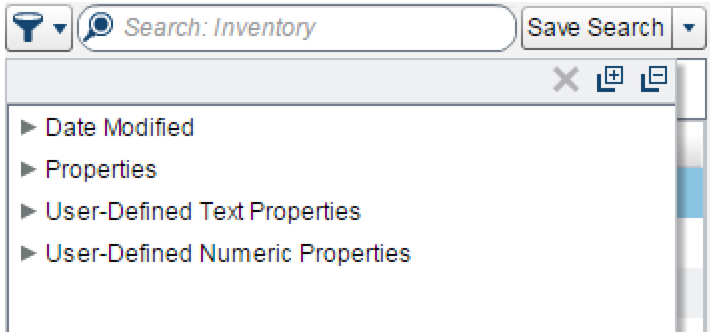
The Inventory category enables you to access all of the models in the model repository in one place, whether they are located in a folder, portfolio, or project. You can also filter the search results by date modified, keywords, model properties, and user-defined properties. You can add user-defined properties as columns in the list in order to display the values for each model.




## Search and Filter Inventory of Models

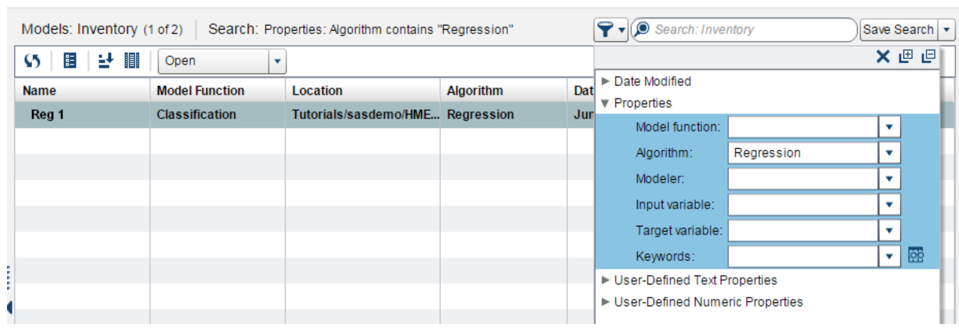
In addition to entering search terms in the search box, you can filter the search results by date modified, keywords, model properties, and user-defined properties.

1. Select **Models** ⇨ **Inventory**.
2. In the search box, enter the search terms that you want to include in the new search.
3. Click . The additional search options appear.




4. Expand one or more search options and specify values to filter the search results. The model inventory list is filtered automatically.

   For example, select `Regression` from the **Algorithm** property drop-down list.




5. (Optional) Save your search.

   *Note:* You cannot modify an existing search, but you can create a new one and replace the old one.

   a. Click **Save Search**. The Save Search window appears.

   b. In the Save Search window, enter the name of the new search or enter the same name as the saved search that you want to update.

   c. (Optional) Enter a description.

   d. Click **Save**.

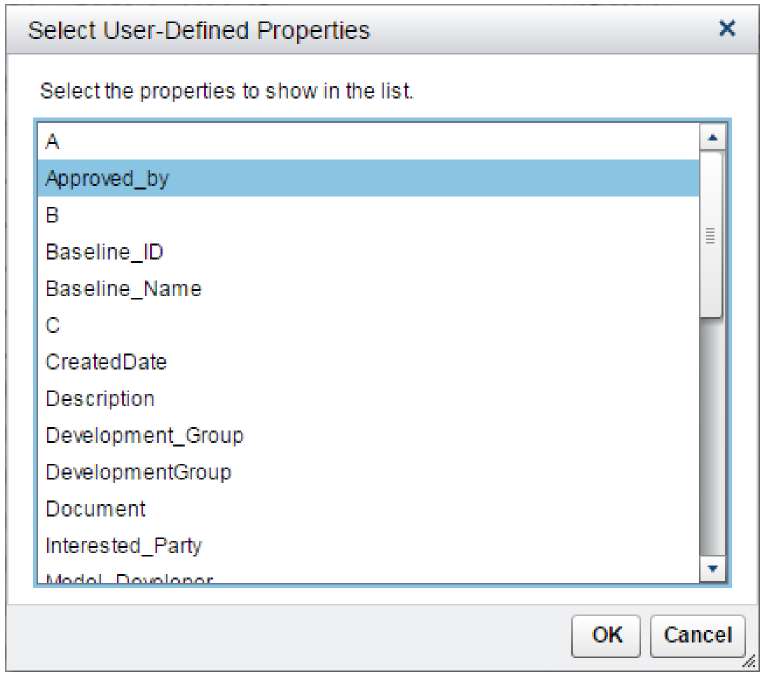
   e. In the confirmation window, click **Yes** to replace the existing search.

# Add Model User-Defined Properties to Inventory List

You can add user-defined properties as columns to the list. The values of the properties are displayed for each model.

To add user-defined properties to the list:

1. Click .




2. Select the properties that you want to appear in the list.

3. Click **OK**. The columns that are added to the list can then be used to sort the list of models.

# Chapter 9
# Working with Portfolios

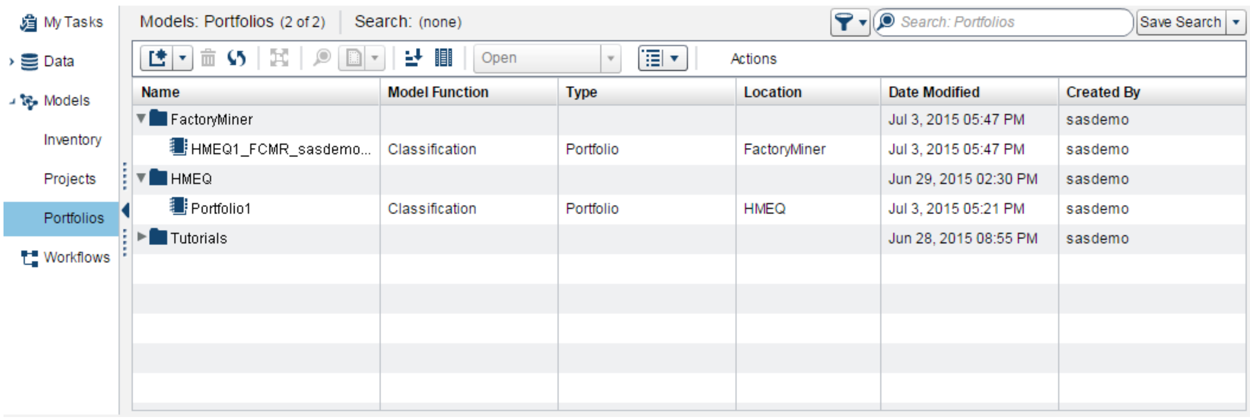


## Overview of Portfolios

SAS Model Manager enables you to create a portfolio in the model repository. You use a portfolio to manage multiple projects and models in one place. From a portfolio level, you can create multiple projects from a control table and then add new versions or new input variables to all projects within the portfolio. After you set the champion model for each project, you can monitor the performance of the champion models for all projects and publish the champion models to the SAS Metadata Repository.

Portfolios are also created when you use SAS Factory Miner to register projects to the model repository. The portfolios contain the project segments and models from the SAS Factory Miner project. For more information about how to register SAS Factory Miner project segments and models, see *SAS Factory Miner: User's Guide*

*Note:* Because of how portfolios and projects are created in the SAS Model Manager model repository, SAS Factory Miner project names, model names, and segment variable values cannot contain special characters. That is, only alphanumeric characters, the underscore, and the hyphen are allowed. Users are unable to register models when special characters are encountered.




Here are the tasks that can be performed for a portfolio:

- Create a portfolio
- Add a new version
- Add an input variable to all projects
- Publish project champion models
- Monitor performance of project champion models

## Planning a Portfolio

Before you begin a portfolio, you must plan your portfolio resources. Here are questions to consider and conditions to meet for modeling projects within a portfolio:

- After you know which users are assigned to the projects within a portfolio, a SAS Model Manager administrator must ensure that the user is assigned to the appropriate user group and role. For more information, see "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide*.
- How do you want to structure the projects within the portfolio? A portfolio is an object within a folder. The Portfolios category view enables multiple levels of folders so that you can customize how you structure the portfolios. For more information, see Chapter 4, "Managing Folders," on page 41.
- What models do you want to use in each project of the portfolio? If the models were created using SAS Enterprise Miner, SAS/STAT, or the SAS/ETS procedures COUNTREG and SEVERITY, all model components are available to SAS Model Manager when you import the model. Only models that are contained in an SPK file can be imported. At least one SPK file must be prepared for each project and the SPK files should be placed in the same location. If your model is a SAS code model or a PMML model that is not contained in an SPK file, you must import it separately into the desired project within the portfolio, after the portfolio is created. You must also ensure that you have imported all of the model component files. For more information, see "Import Models from Local Files" on page 72 and "Import a PMML Model" on page 71.
- What model function do you want to use in each project of the portfolio?

SAS Model Manager has several model function types:

- Classification
- Prediction
- Segmentation
- Analytical

After the model function is specified for the portfolio, the **Model function** property for a project cannot be changed. Ensure that the types of models that you are going to use in each project of the portfolio fit within the selected model function type. For more information, see Table 5.1 on page 52.

- How do you want to define your project input and output variables? When you create a portfolio, you can import the variables using input and output prototype tables. The project variables are set for each project within the portfolio. The prototype tables must be registered in the SAS Metadata Repository. Tables that were registered using the SAS Management Console must also be made available in the Data category view before you create the portfolio. For more information, see "Defining Project Input and Output Variables" on page 55.
- What method do you want to use to track the progress of a version? The Workflows and My Tasks category views enable you to track the progress of tasks from the version level for each individual project within a portfolio. An authorized user can create a workflow and associate it with a version. For more information, see "Overview of Using Workflows" on page 229.
- When you publish project champion models from a portfolio to the SAS Metadata Repository, you must specify a location in which to store the models. You might need to create a folder in the SAS Metadata Repository, if one does not already exist. For more information, see "Publishing Models from a Portfolio" on page 103.
- After your project champion models are in a production environment, you can monitor the performance of the project champion models within a portfolio in SAS Model Manager using your organization's operational data. If you use SAS Model Manager to monitor performance of projects within a portfolio, you must first prepare performance tables using the operational data and then register the tables in the SAS Metadata Repository using the Data category view. Tables that are registered to the SAS Metadata Repository using SAS Management Console must also be made available to the Data category view. For more information, see "Creating a Performance Table" on page 358.
- When you run performance monitoring reports, you can set up performance index alert and warning conditions to notify users if conditions exceed the indexes. For more information, see "Performance Index Warnings and Alerts" on page 173.

## Prerequisites for Creating Portfolios

After you have planned the projects and models that you want to have in your portfolio, you must create a project control table that contains the segment identifiers, projects, and models. The project control table can then be used to create a hierarchy of your portfolio.

Portfolios can be created only by authorized users who have the capability to access the Portfolios category. Ensure that users who create portfolios are assigned to the group **Model Manager Administrator Users** or **Model Manager Advanced Users** in SAS Management Console.

The project control table must contain the project names (project_name variable) to create the projects within the portfolio. At least one segment identifier variable (for example, segid) is required, and that segment identifier variable must also be in the performance data set. When you want to monitor the performance of project champion models, you must also associate the model name (model variable) with each project (project_name) and segment identifier (segid, or another name for the segments) in the table.

You must know the model function type before you create a portfolio. SAS Model Manager has several model function types:

- Classification
- Prediction
- Segmentation
- Analytical

To determine the model function type for your project, compare your model to the descriptions in Table 5.1 on page 52.

If you use prototype tables to define the project input and output variables, you must do one of the following two things before you can create a portfolio. Create the project input and output tables and register them in the SAS Metadata Repository using the **Data** category view. Tables that are registered to the SAS Metadata Repository using the SAS Management Console must then be made available to the **Data** category view of SAS Model Manager. See the following documents for details:

- For instructions about creating project input and output tables, see "Creating Project Input and Output Tables" on page 355.
- For instructions about registering tables using the Data category view, see Chapter 3, "Managing Data Tables," on page 31.

## Creating a Project Control Table

After you have planned the projects and models that you want to have in your portfolio, you must create a project control table that contains the segment identifiers, projects, and models. The project control table is then used to create the hierarchy of your portfolio when you create a new portfolio. The variable names that are required in the project control table are at least one segment identifier (for example, segid), project_name, and model. All variables other than project_name and model are treated as segment identifier variables. The segment identifier variables do not have a required naming convention.

Here is an example of the code to create a project control table.

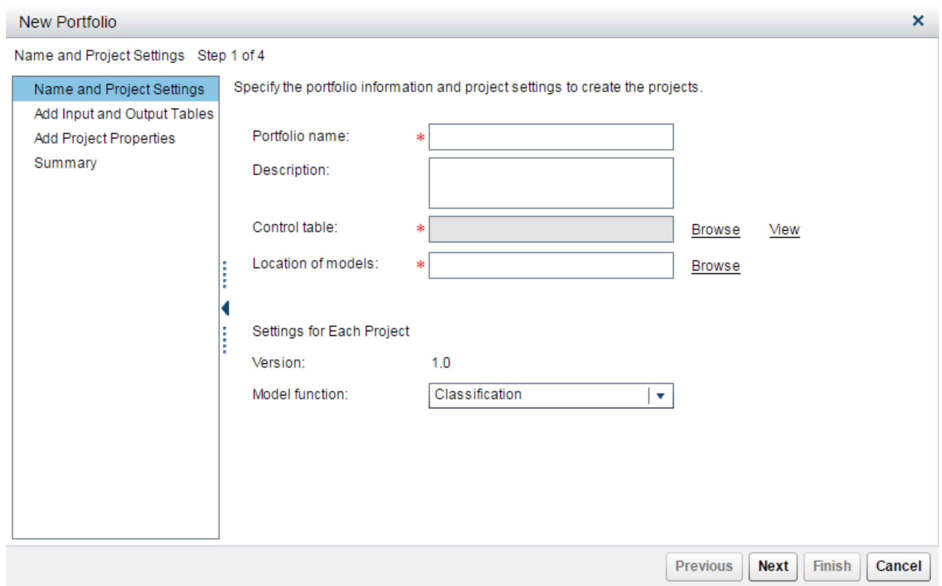
```
data control_Table;
 length segid project_name model $20;
 infile datalines dsd dlm=',' missover;
 input segid project_name model;
 datalines;
 seg01,US,reg1.spk
 seg02,Canada,tree1.spk
 seg03,Germany,hpf_class.spk
 ;
 run;
```

# Create a New Portfolio

To create a new portfolio:

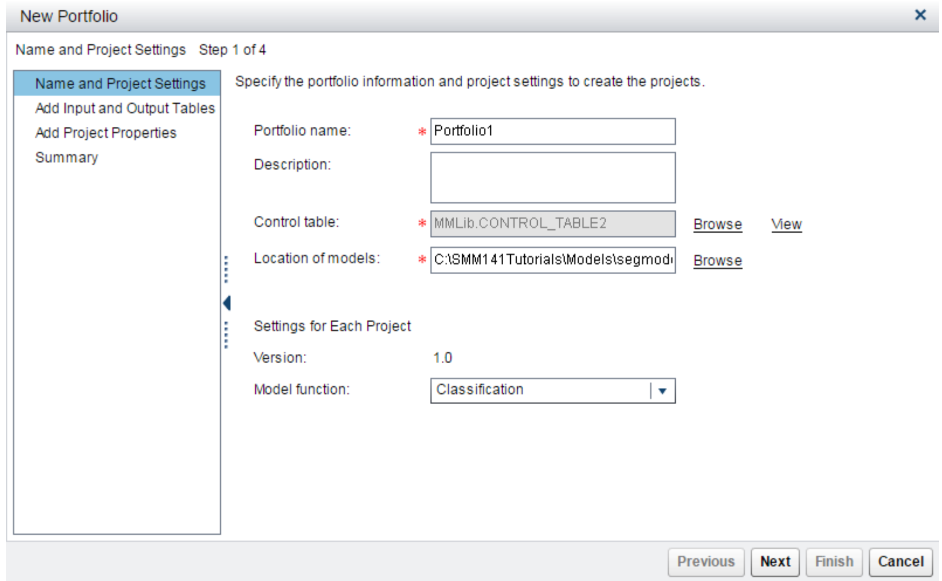
1. Verify that the project control table contains the required variables. For more information, see "Prerequisites for Creating Portfolios" on page 97.
2. Select a folder or create a new folder in which to store the new portfolio.
3. Click and select **New Portfolio**. The New Portfolio window appears.

   *Note:* Alternatively, you can right-click a folder and select **New Portfolio**.



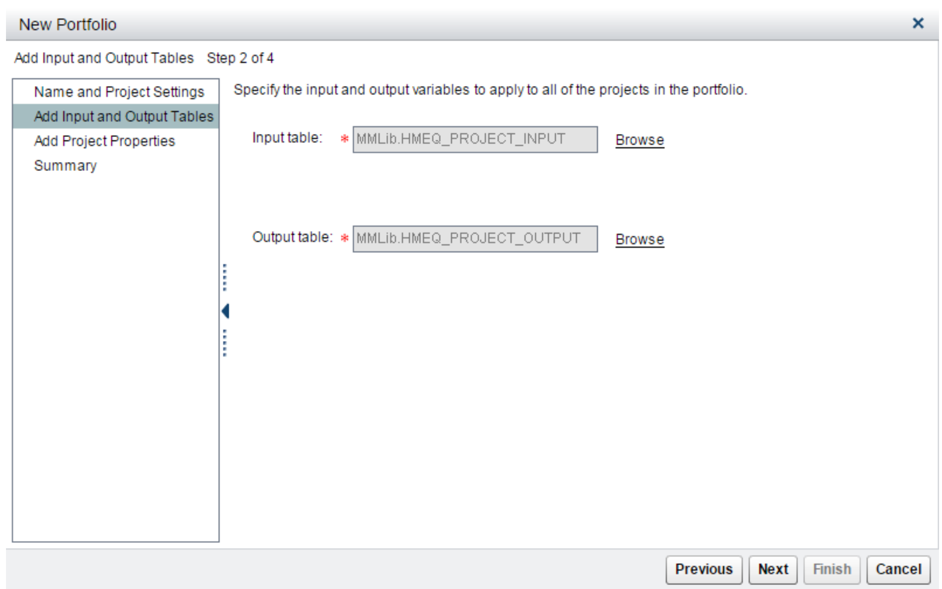

   *Note:* The value for the initial version is auto-populated and is the version name that is created within each project for the new portfolio.

4. Enter a name for the portfolio.
5. (Optional) Enter a description for the portfolio.
6. Click **Browse** to select the control table. Click **OK**.
7. Click **Browse** to select the location of the model SPK files that are specified in the control table. Click **OK**.
8. Select a model function to indicate the type of models that should be imported into each project within the portfolio.



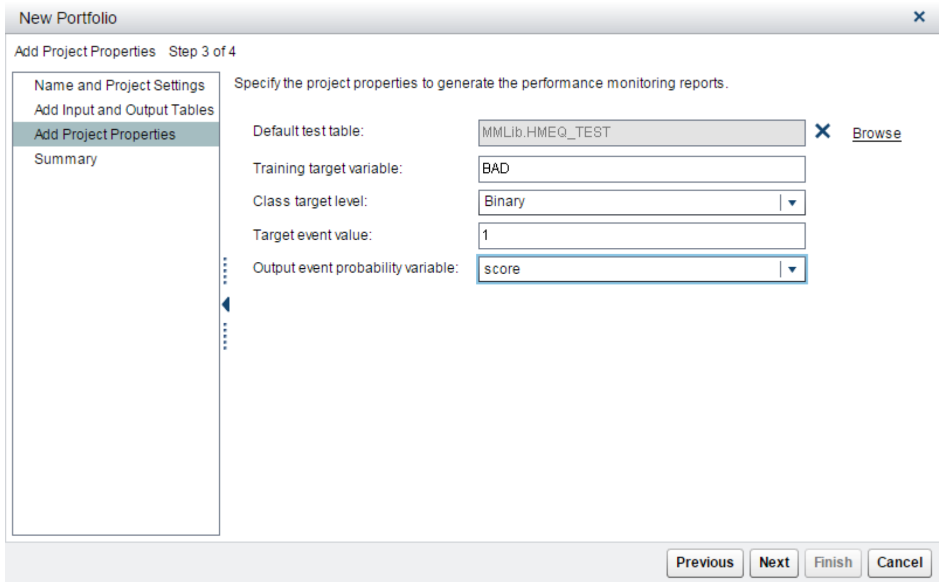

9. Click **Next**.

10. Click **Browse** to select the input and output tables. The input and output variables in the tables are applied to all of the projects.

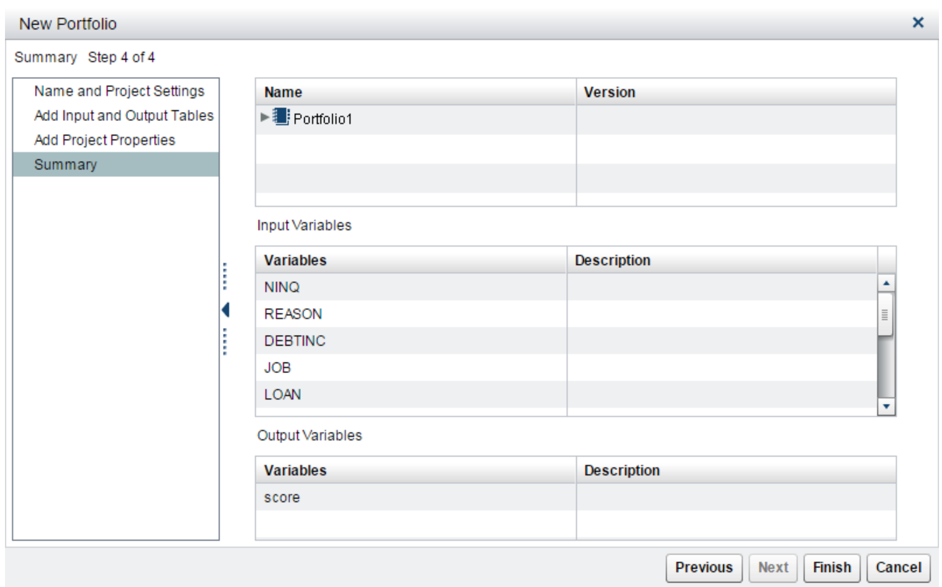



Click **Next**.

11. Specify the project properties to apply to all projects within the portfolio. The properties are used to perform tasks and generate reports.




12. Click **Next** to view the summary of information that has been specified.

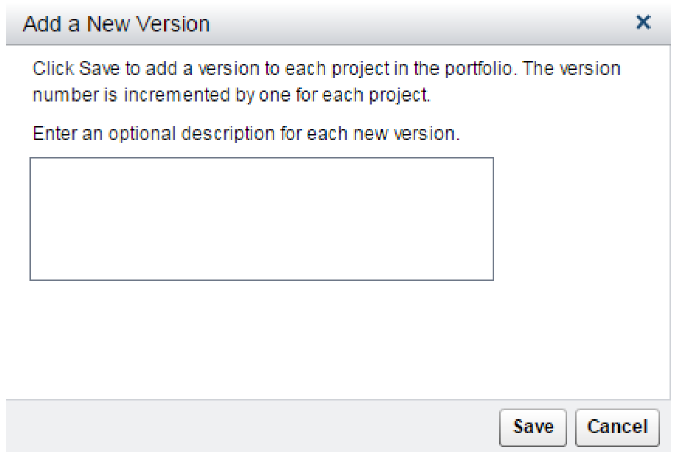



13. Click **Finish**. The new portfolio appears in the list.

# Add a New Version

You can add a new version to all projects within a portfolio.

1. Open a portfolio, select the **Projects** page, and click +. The Add a New Version window appears.

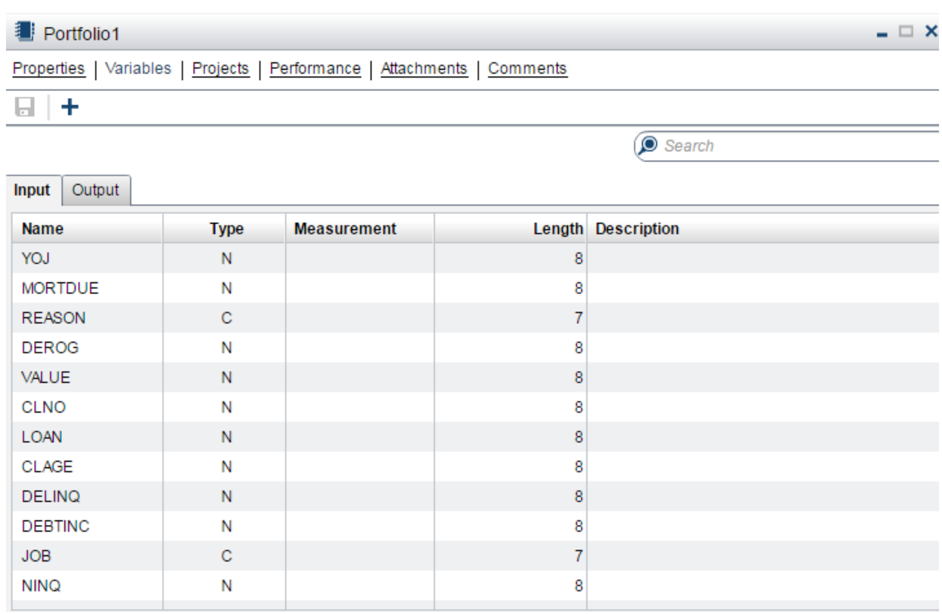



2. (Optional) Enter a description for each new version.
3. Click **Save**. The version number is incremented by one for each project within the portfolio.
4. Click **OK** for the confirmation message.

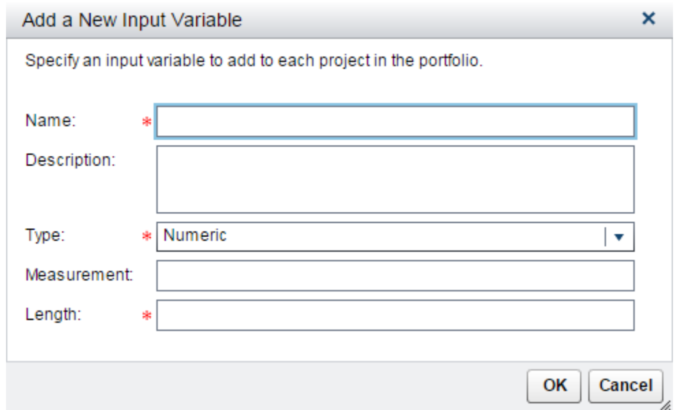
# Add an Input Variable

You can add input variables to each project within a portfolio.

1. Open a portfolio.
2. Select the **Variables** page and click the **Input** tab.




3. Click +.




4. Enter a name.
5. (Optional) Enter a description.
6. Select a type.
7. (Optional) Enter a measurement.
8. Enter a length.
9. Click **OK**. The input variable is added to the portfolio and to all projects within the portfolio.

---

# Publishing Models from a Portfolio

## *About Publishing Models*

To publish the champion models and challenger models for projects within a portfolio, you must have already set the models that you want to publish as project champion models or challengers. SAS Model Manager examines the projects and always publishes the champion models. When the champion model for a project changes and you publish the model again to the same location, the scoring application automatically uses the latest score code. In the Portfolios category view, when you select a portfolio, you only can publish the project champion models to the SAS Metadata Repository. When you open a portfolio, on the **Projects** page you have the option to publish a project champion model and its challengers to the SAS Metadata Repository, a SAS Channel. or to a configured database.

*Note:* SAS Model Manager cannot publish R models.

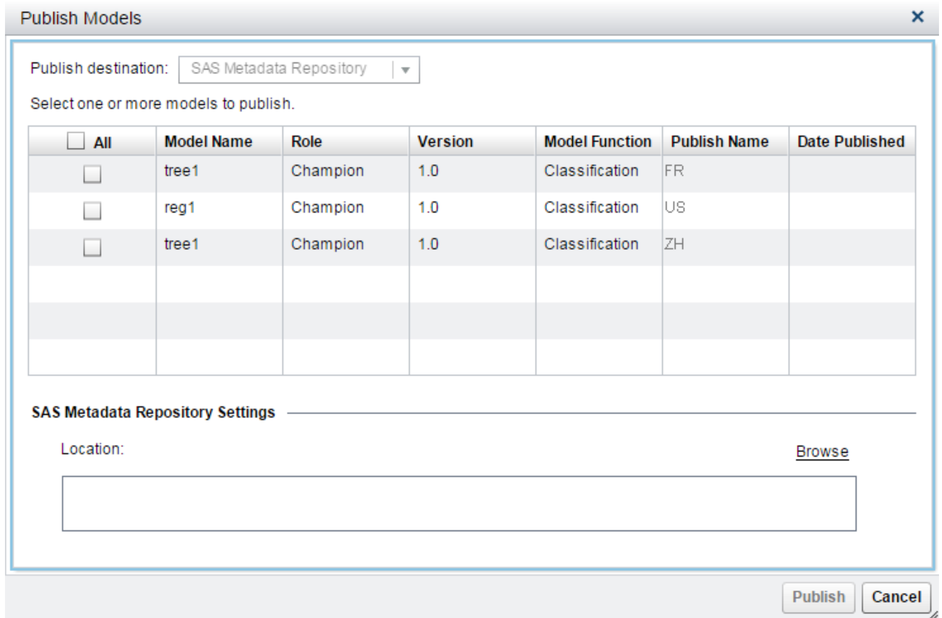
To verify that a champion model has been assigned to all of the projects within a portfolio that you want to publish. Open a project and select **Properties** ⇨ **Specific**. The **Champion version** property contains the name of the champion version. For more information, see “Champion Models” on page 208.

## *Publishing Project Champion Models*

In the Portfolios category view, you can publish the champion models for projects within a portfolio to the SAS Metadata Repository.

To publish champion models for projects in a portfolio:

1. Select a portfolio and click .




2. Select one or more champion models that you want to publish from the models list.
3. Click **Browse** and select the location to publish the model to.
4. Click **Publish**.
5. Click **Close** in the confirmation message.

*Note:* Alternatively, you can right-click a portfolio and select **Publish**.

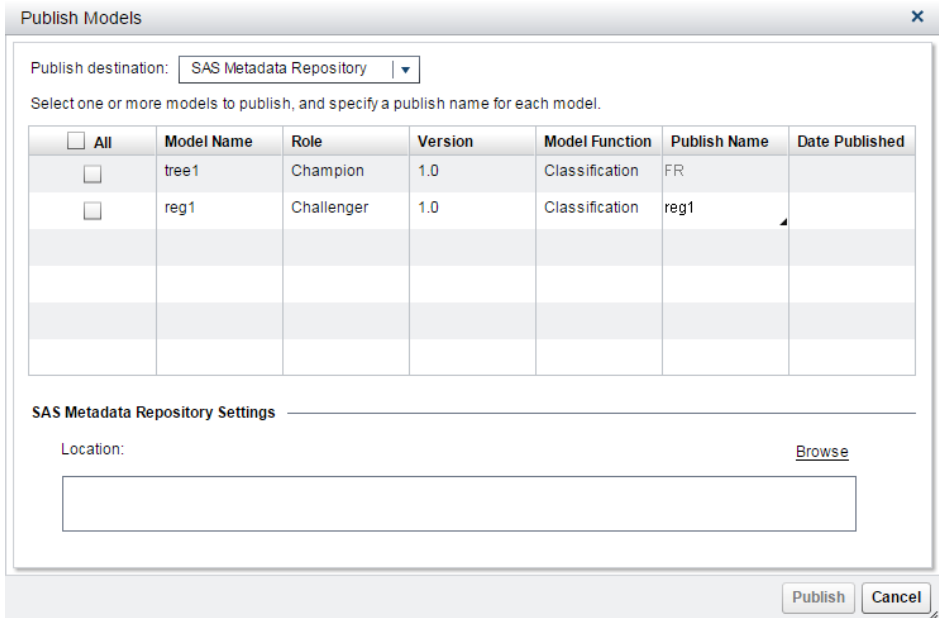
### See Also

"Publishing Models to the SAS Metadata Repository" on page 215

## Publish Champion and Challenger Models

### Publish to the SAS Metadata Repository

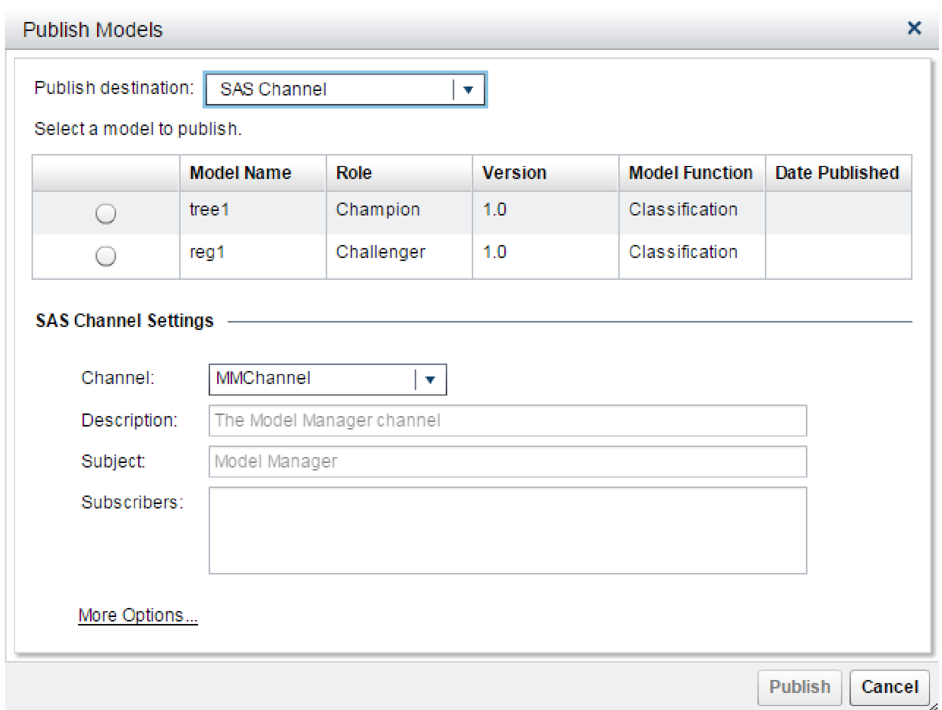
1. Open a portfolio and select the **Projects** page.
2. Select a project and click .
3. Select **SAS Metadata Repository** from the publish destination list.




4. Specify a **Publish Name** for the challenger models. The publish name for a champion model cannot be modified.
5. Click **Browse** and select the location to publish the model to.
6. Click **Publish**.

## *Publish to a SAS Channel*

1. Open a portfolio and select the **Projects** page.
2. Select a project and click .
3. Select **SAS Channel** from the publish destination list.

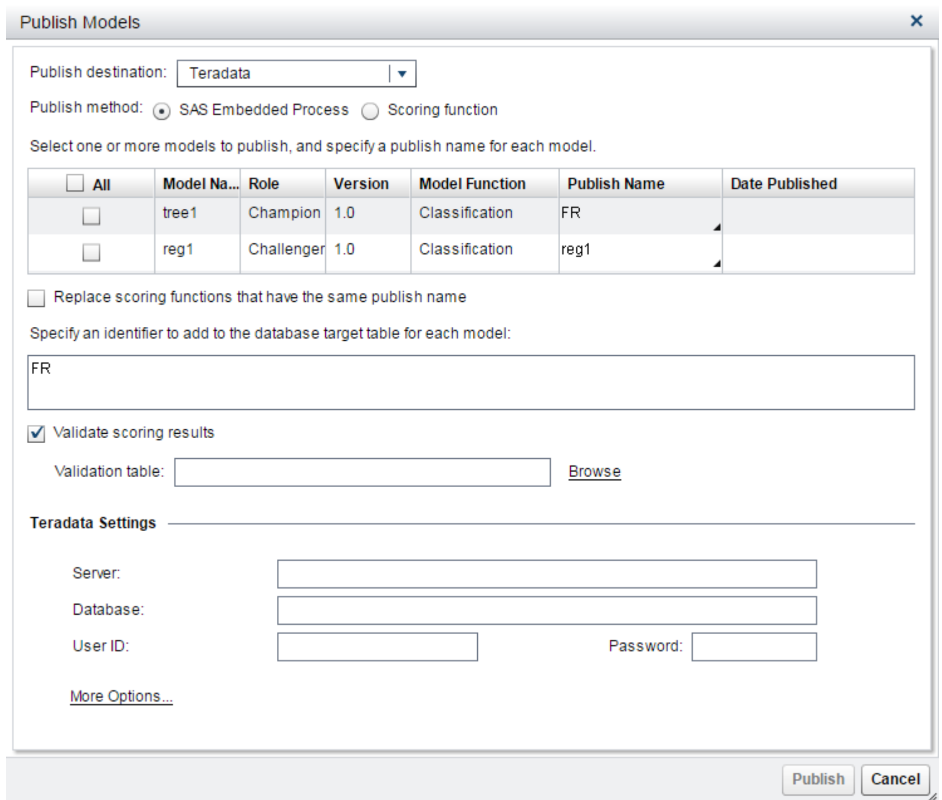



4. Select the model that you want to publish from the models list.

5. Select a publication channel from the channel drop-down list.
6. (Optional) Click **More Options** to specify a message subject, notes, and user-defined properties. Click **Save**.
7. Click **Publish**.

### Publish to a Database

1. Open a portfolio and select the **Projects** page.
2. Select a project and click .
3. Select a database from the publish destination list.




4. Select a publish method.
5. Select the model that you want to publish from the models list.
6. Specify a **Publish Name** for each model.

   *Note:* The default format of the publish name is configured by the SAS administrator.
7. (Optional) Select whether to **Replace scoring files that have the same publish name**.
8. Specify an identifier to add to the database target table for each model.
9. (Optional) Select whether to **Validate scoring results**. If selected, click **Browse** to navigate to the appropriate train table.
10. Specify the database settings.
11. Click **More Options** to specify other options for the database.
12. Click **Publish**.

### *Remove Published Models from a Database*

The SAS Embedded Process publish method enables you to replace the model scoring files, but the scoring function publish method publishes the model as a separate entry in the database each time. If you modify the previously published models or change the champion model or challenger models, the Remove Models from a Database feature enables you to remove the previously published models, so that you can clean up the test or production database.

To remove models from a database:

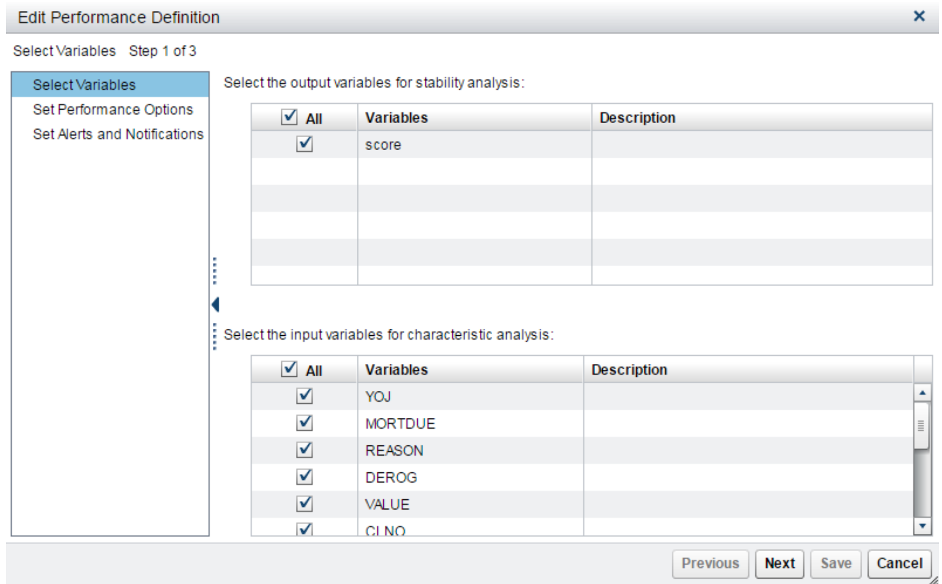
1. Open a portfolio and select the **Projects** page.
2. Select a project, and click .
3. Specify the database settings and click **Log On**.
4. Select the models that you want to remove from the database.
5. Click **Remove Models**. A warning message appears.
6. Click **Yes**.

## Monitor Performance of Project Champion Models

To create performance monitoring reports for all projects within a portfolio, you create and execute a performance definition for all projects within a portfolio. Execution of the generated code creates the SAS data sets that are used to display the performance monitoring reports on the **Performance** page of each project.

To monitor the performance of the champion models for all projects:

1. On the **Performance** page of a portfolio, click .
2. Select one or more output variables for stability analysis. To select all output variables, click **All**.
3. Select one or more input variables for characteristic analysis. To select all input variables, click **All**.




Click **Next**.

4. Specify the performance data options.

   - Click **Browse** to select the performance data source.

     *Note:* The performance data source must contain the same segment identifier variables as the control table.

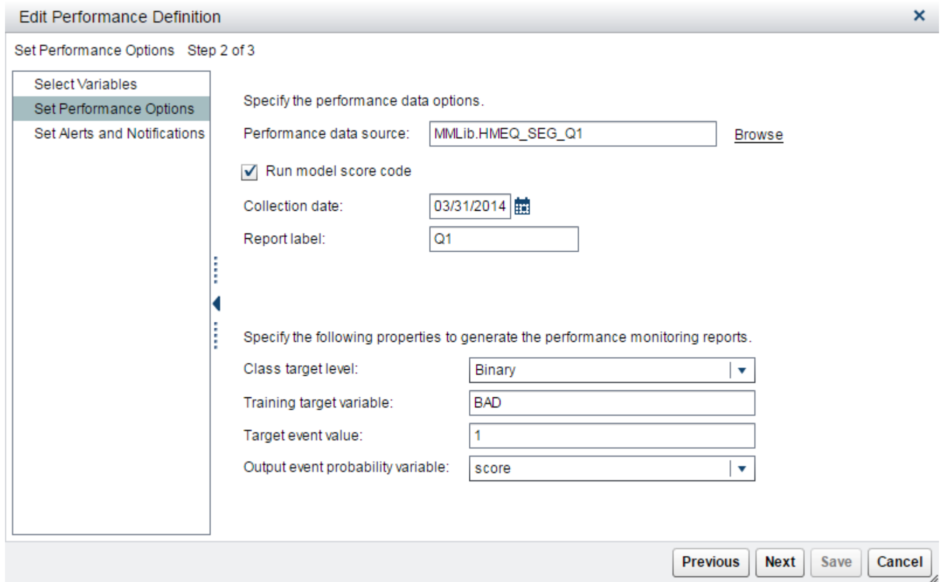
   - To run the score code in the performance monitor job, select the **Run model score code** check box. If the check box is not selected, all of the output variables for stability analysis must be in the performance data source.

   - Click and select a date. The date can be any date in the time period when the performance data was collected.

   - Enter a report label to associate with the performance data. The report label represents the time point of the performance data source. Because the report label appears in the performance charts, use a label that has not been used for another time period, is short, and is understandable (for example, Q1).

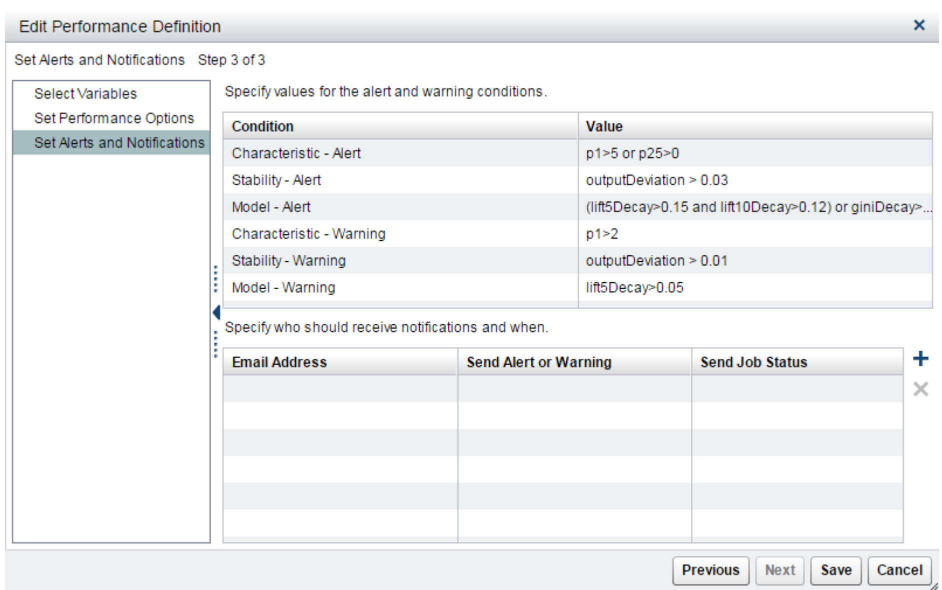
     *Note:* If you duplicate report labels, previous performance results are overwritten.

5. Specify the properties that are used to generate the performance monitoring reports. The properties default to the values that were set when you created a portfolio.

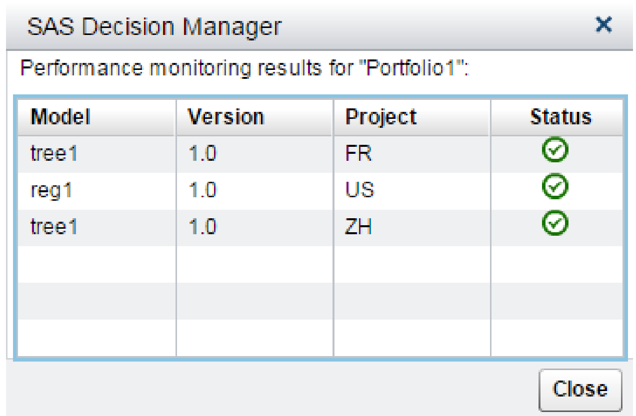



Click **Next**.

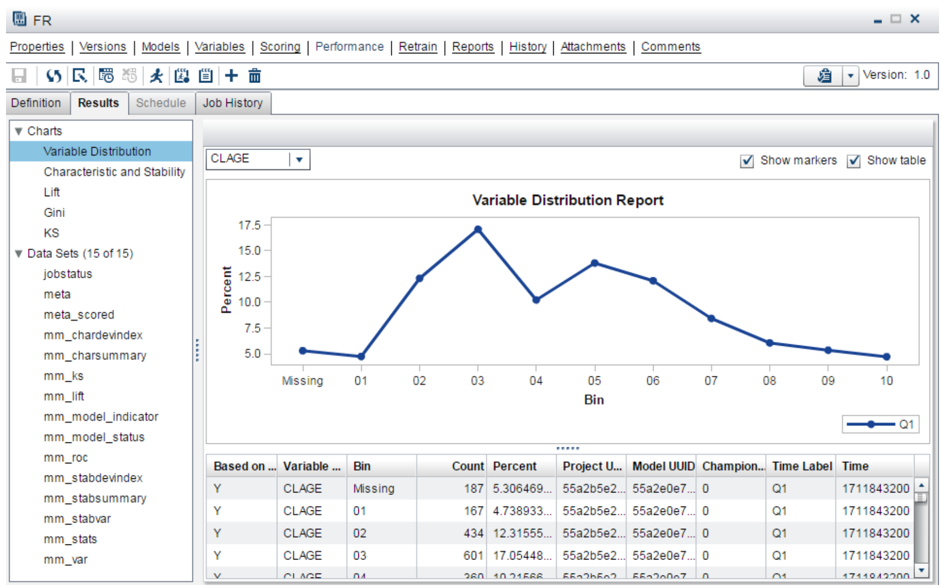
6. (Optional) Specify values for the alert and warning conditions or accept the defaults.
7. (Optional) To send the results by email, click . A new row is added to the table.
   a. Enter an email address.
   b. Select **Yes** if you want an alert or warning to be sent by email when alert or warning thresholds have been exceeded.
   c. Select **Yes** if you want a completion notice with the job status to be sent by email every time the report runs.




8. Click **Save**.
9. Click .
10. After the performance monitoring is complete, a confirmation message appears. Click **Close**.




11. To view the performance results, select the **Projects** page, and open a project. Select the **Performance** page to view results.




## *See Also*

"Prerequisites for Editing a Performance Definition" on page 179

# Add Attachments

You can view and add attachments such as images or documents. Attachments can be added at the object-level for portfolios, projects, and models.

To add an attachment:

1. Select the **Attachments** page.
2. Click **+**.
3. Select a file to attach and click **Open**.

*Note:* Click **✕** to remove an attachment.

### *See Also*

"Add Attachments to a Project" on page 59

## Add Comments

You can add new topics or respond to an existing topic. You can also search the comments. Comments can be added at the object-level for portfolios, projects, and models.

To add a comment:

1. Select the **Comments** page
2. Enter a topic name and a comment.
3. (Optional) Click  to attach a file to the new topic. Repeat this step to attach multiple files.

   *Note:* You can also click **Remove** to remove an attachment.
4. Click **Post**.

### *See Also*

"Add Comments to a Project" on page 59

# Part 3

# Evaluating Models and Monitoring Performance

# Chapter 10
# Scoring Models



## Overview of Scoring Tests

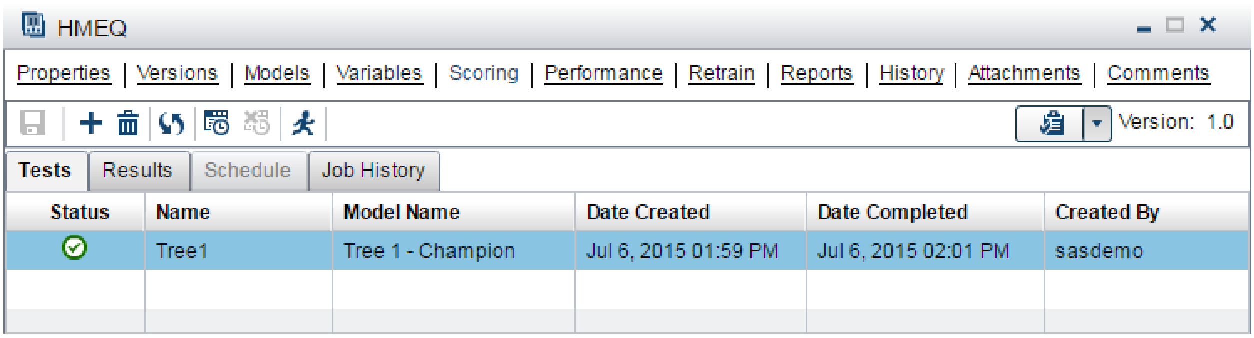
The purpose of a scoring test is to run the score code of a model and produce scoring results that you can use for scoring accuracy and performance analysis. The scoring test uses data from a scoring test input table to generate the scoring test output table. The types of score code for a model that can be imported are a DATA step fragment and ready-to-run SAS code.

If your environment has its own means of executing the score code, then your use of the SAS Model Manager scoring tests is mostly limited to testing the score code. Otherwise, you can use the scoring tests both to test your score code and execute it in a production environment. Scoring results for a model in a test environment are stored on the SAS Content Server. Scoring results for a model in a production environment are written to the location that the output table metadata specifies. In Windows, the scoring test output table in a SAS library must have Modify, Read and Execute, Read, and Write security permissions. For more information, see "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide*.

***CAUTION:***
**Executing a scoring test in production mode overwrites the scoring test output table, which might result in a loss of data.**

*Note:* In order to run scoring tests in a high-performance environment, the scoring output table must be a SAS table and not a database table.

You create a new scoring test in the **Scoring** page of your project.




These are the tests that you perform as part of the scoring test workflow:

- Before creating a scoring test, you must create and register scoring test input and output tables. For more information, see “Create Scoring Output Tables” on page 116.
- When a new scoring test is successfully created, the scoring test is selected on the **Scoring** page. The scoring test displays the various scoring test information. For more information, see “Create a Scoring Test” on page 118.
- Before you execute the scoring test, it is recommended that you verify the scoring test output variable mappings on the Scoring Output Table view. For more information, “Create Scoring Output Tables” on page 116.
- To execute a scoring test, you can select and run a test. For more information, see “Execute a Scoring Test” on page 119.
- To run a scoring test at a scheduled time, you can specify the date, time and frequency that you want the scoring test to run. For more information, see “Schedule a Scoring Test” on page 119.
- After the successful execution of the scoring test, you can view the results on the Results tab. For more information, see “Execute a Scoring Test” on page 119.

## Create Scoring Output Tables

### *What Is a Scoring Output Table?*

A scoring output table is a SAS data set that contains the data from executing a scoring test. The scoring output table cannot be a database table. You can provide a scoring output table or you can create a scoring output table definition using SAS Model Manager. When you create a scoring test, you specify either the scoring output table that you provide or the scoring test output definition as the scoring test output table. A SAS data set that you provide as a scoring output table must be registered in the SAS Metadata Repository and made available to SAS Model Manager in the Data category view.

You can create a scoring output table definition by using the Create Scoring Output Table function directly from the model. You select variables from a scoring test input table as well as variables from the model’s output. The variables in the input variables table are variables from the scoring test input table when one is specified for the **Default scoring input table** property on the **Model Properties** page for the selected model, or on the **Project Properties** page for the project that contains the selected model. Otherwise, the input variables table is empty. The output variables that appear are model output variables. You use the variables from both tables to create the scoring output table. For more information, see "Set Model Properties" on page 79.

If you create a scoring output table on the **Model Properties** page, it is automatically saved in the SAS Metadata Repository. You then have to add it to the desired library in the Data category view. If you add an existing scoring output table to a library in the Data category view, it must be available in the SAS Metadata Repository.

SAS Model Manager saves the table definition as metadata in the SAS Metadata Repository. The location of the metadata is defined by the SAS library that you specify when you create the output table definition. After the table definition is created, the table can be selected as the output table for subsequent scoring tests.

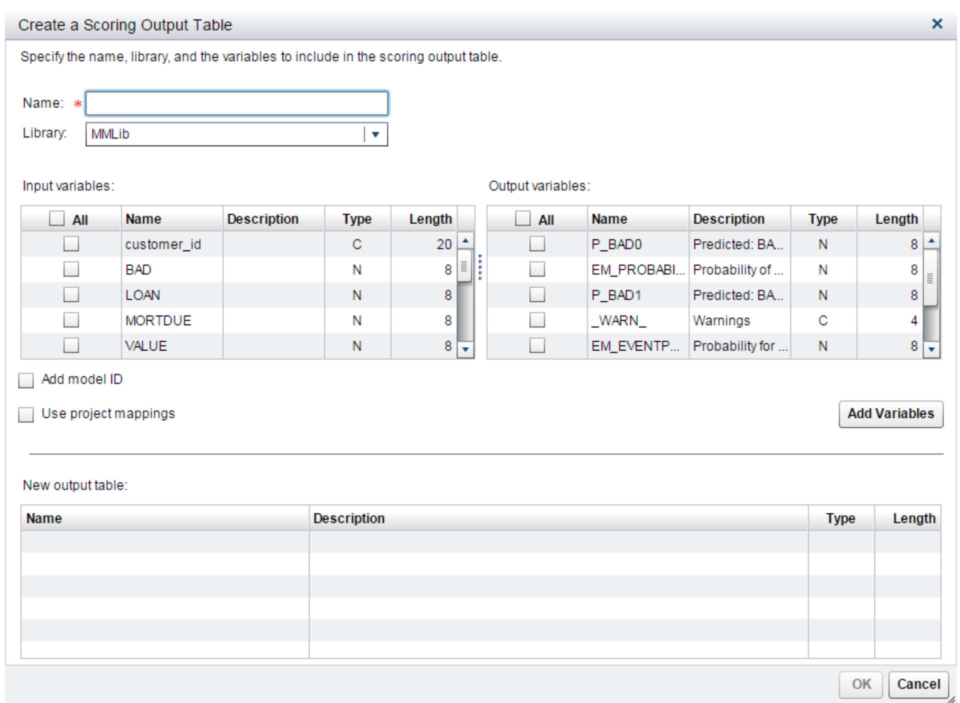
You can view a scoring output table definition in the Data category view. Scoring test results are stored in the **Results** tab on the **Scoring** page.

## *Create a Scoring Output Table*

To create a scoring output table:

1. Select a model on the **Models** page and click . The Create a Scoring Output Table window appears.

   *Note:* You can also open a model and then select **Model Properties** ⇨ **Variables** ⇨ **Output** to create a scoring output table.



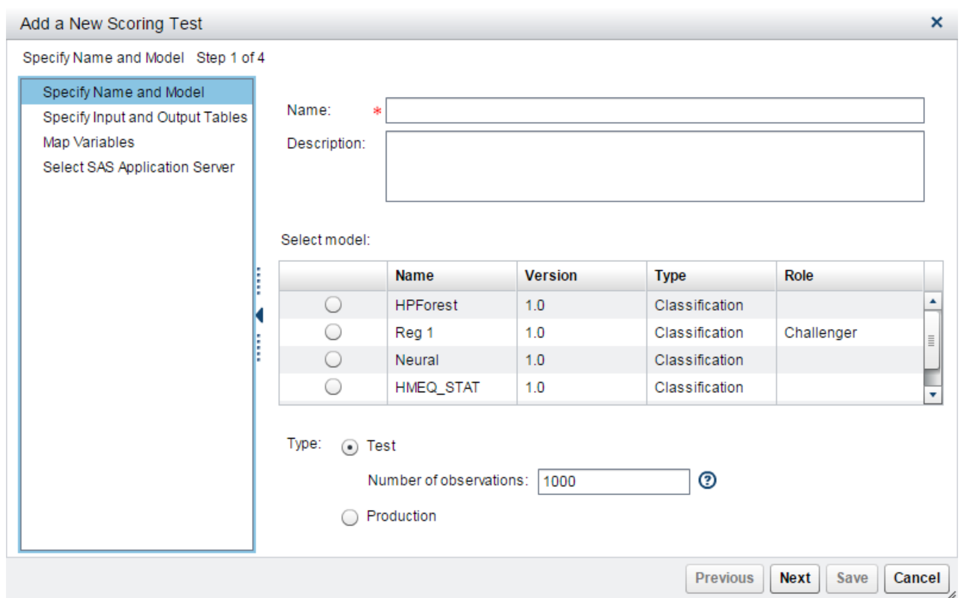

2. Enter a name for the scoring output table.
3. Select a library.
4. Select the input variables.
5. Select the output variables.
6. Select whether to add the model ID variable to the output table. The model UUID appears in all rows of the output table.

7. Select whether to use project's output variable names in the output table for model variables that are mapped to project variables.
8. Click **Add Variables**. The new output table variables appear below.
9. Click **OK**.
10. You must then make the new scoring output table available to SAS Model Manager. For more information, see "Add Tables That Are Registered in Metadata" on page 32.

## Create a Scoring Test

To create a scoring test:

1. On the **Scoring** page of a model, click . The Add a New Scoring Test window appears.




2. Enter a name for the scoring test.
3. (Optional) Enter a description of the scoring test.
4. Select a model from the list.
5. Select a type of scoring test:
   - **Test**

     Specify the number of observations to be read from the scoring input table (default is 1000 rows).
   - **Production**

   *Note:* A best practice is to select **Test** before beginning all scoring tests. Later, when you are satisfied with the results of running the scoring test and you are ready to put the test into production, you can change the type to **Production**.
6. Click **Next**.

7. Specify an **Input table**. Use the default scoring input table that is set on the **Properties** page of a project, or select a new input table. To select a table, click **Browse** and select a table. Click **OK**.
8. Specify an **Output table**. To select a table, click **Browse** and select a table. Click **OK**.
9. Click **Next**.
10. For each scoring output variable, select an available variable. The scoring output variables are mapped automatically if their names match those in the **Available Variables** column.
11. Click **Next**.
12. Select a SAS Application Server from the list.
13. Click **Save**.

## Execute a Scoring Test

To execute a scoring test:

1. Select a scoring test from the list and click .
2. Click the **Results** tab or double-click the scoring test to view the scoring test results.

   *Note:* You can check the status of a job by clicking  and then selecting the **Tests** tab, the **Results** tab, or the **Job History** tab.

## Schedule a Scoring Test

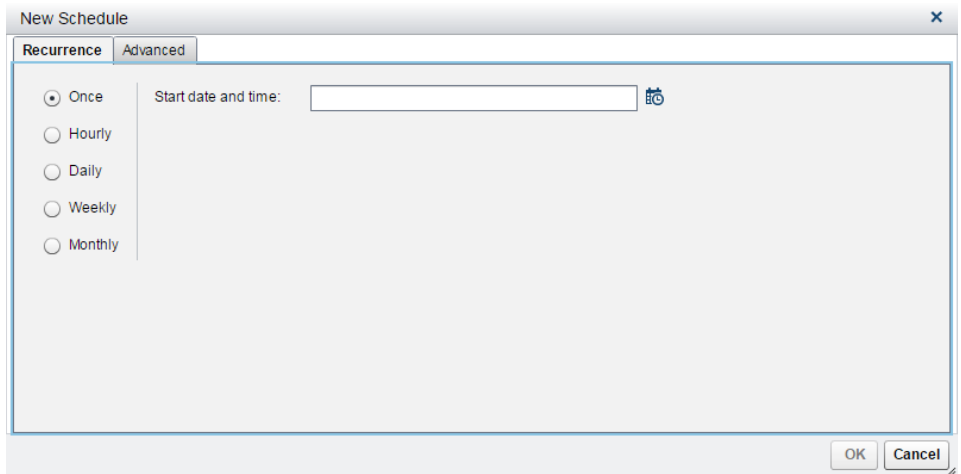
Instead of executing a scoring test, you can schedule a scoring test to run on a particular date and time. You can also schedule how often you want the scoring test to run. Advanced settings enable you to set the scheduling server, the batch server to run the scoring test, and the location of the scoring results.

Before you can schedule a scoring test, your user ID and password must be made available to the SAS Metadata Repository. You must also sign in to SAS Model Manager using your full user credentials that were specified for your user account in SAS Management Console. For user accounts where a Microsoft Windows user ID is specified, you must enter your user ID in the format of *domain\userID*. Contact your system administrator to add or update your password, and to determine the correct user credentials for your account.

*Note:* You must have already created a scoring test before you can schedule a job to run the scoring test.

To schedule a scoring test:

1. Select the scoring test that you want to schedule from the list and click .




2. On the **Recurrence** tab, select the recurrence pattern.
3. Specify the criteria for when and how often the job should be run.
4. (Optional) Click the **Advanced** tab.
   a. Select the server that schedules the job from the **Scheduling server** list box.
   b. Select the batch server that runs the job from the **Batch server** list box.
   c. Click **Browse** to select a location for the output and click **OK**.
5. Click **OK**.
6. After the job has been scheduled, a confirmation message appears. Click **Close**.
7. Click the **Job History** tab to view the job status.
8. Click the **Results** tab to view the scoring test results.

*Note:* Scoring test job schedules cannot be edited. To change the schedule, delete the schedule and create a new schedule.

To delete a schedule, select the schedule and then click .

# Scoring Model Properties

## *Scoring Test Properties*

Here is a list of the **Scoring test** properties that provide information that is specific to the scoring test.

| Property Name | Description |
|---|---|
| **Scoring test type** | Specifies a value of **Test** or **Production** for the type of scoring test. |
| **SAS Application Server** | Specifies the name of the SAS Application Server to which SAS Model Manager is connected. This value is taken from the SAS Metadata Repository. |

| Property Name | Description |
|---|---|
| **Model** | Specifies the name of the model whose score code is to be executed on the SAS Application Server. This value is set when the scoring test is created and cannot be modified. |
| **Input table** | Specifies the name of the input table (data source) to be used in scoring. This value is set when the scoring test is created and cannot be modified. |
| **Output table** | Specifies the name of the output table to be used in scoring. This value is set when the scoring test is created. If the scoring test type is **Test**, the output file is stored on the SAS Content Server. If the scoring test type is **Production**, then this setting identifies the output table where the results of the scoring are written. |

### *Result Set Properties*

The following property provides information that is specific to the scoring test.

| Property Name | Description |
|---|---|
| **Number of observations** | When **Scoring test type** is set to **Test**, this property specifies how many observations are to be read from the scoring test input table. This setting enables you to limit the number of records that are written to the scoring test output table on the SAS Content Server in order to reduce operation costs. If a value is not specified, the default value of 1000 rows is used for the number of observations.<br><br>When **Scoring test type** is set to **Production**, this property specifies how many observations are to be read from the scoring test input table and displayed when you select **Result Set** from the **Results** tab. The default value is 0, indicating that there is no limit. This value cannot be changed in SAS Model Manager. The administrator can modify the value by using SAS Management Console. For more information, see *SAS Model Manager: Administrator's Guide*. |

*Chapter 11*

# Using Reports to Evaluate and Validate Models

# Overview of Model Comparison, Validation, and Summary Reports

## *What Are Model Comparison, Validation, and Summary Reports?*

The SAS Model Manager model comparison, validation, and summary reports are tools that you can use to evaluate and compare the candidate models in a version or across versions to help you select and approve the champion model that moves to production status. The model comparison reports are analytical tools that project managers, statisticians, and analysts can use to assess the structure, performance, and resilience of candidate models. The model validation reports use statistical measures to validate the stability, performance, and calibration of risk models and parameters. The training summary data set report creates frequency and distribution charts that summarize the train table variables.

The reports present information about a number of attributes that can affect model performance. Together, the reports provide qualified information that can serve as the analytical basis for choosing and monitoring a champion model.

Here is a description of the comparison reports:

**Model Profile Report**
For a single model, this report displays the profile data that is associated with input, output, and target variables. Profile data includes the variable name, type, length, label, SAS format, measurement level, and role.

**Delta Report**
This report compares the profile data for two models and notes the differences.

**Dynamic Lift Report**
The Dynamic Lift report provides visual summaries of the performance of one or more models for predicting a binary outcome variable.

**Interval Target Variable Report**
The Interval Target Variable report creates two plots for you to view the actual versus predicted values for a model and the actual versus residual values for a model. Interval Target Variable report can be created only for prediction models.

The following are the Basel III model validation reports:

**Loss Given Default Report**
The Loss Given Default (LGD) report calculates the amount that might be lost in an investment and calculates the economic or regulatory capital for Basel III compliance.

**Probability of Default Model Validation Report**
The Probability of Default (PD) Validation report estimates the probability of defaulting on a debt that is owed. Probability of default is used to calculate economic or regulatory capital for Basel III compliance.

The model validation reports use statistical measures that report on these model validation measures:

- The model stability measures track the change in distribution for the modeling data and scoring data.
- The model performance measures check the model's ability to distinguish between accounts that have not defaulted and accounts that have defaulted, as well as report on the relationship between actual default probability and predicted default probability.
- The model calibration measures check the accuracy of the selected models for the LGD and PD reports by comparing the correct quantification of the risk components with the available standards.

This is the train table data set summary report:

**Training Summary Data Set Report**
The Training Summary Data Set report creates frequency and distribution charts for a training data set.

After you execute a performance definition, you can generate performance monitoring results and compare the champion and challenger models:

**Monitoring Report**
After you execute a performance definition, SAS Model Manager stores the output data sets in the project folder. You can format the performance monitoring results and then view the performance monitoring results report.

**Champion and Challenger Report**
After you execute a performance definition for the champion model, you can execute a performance definition for the challenger model using the same performance data sets. You can then create a Champion and Challenger Performance report that compares the performance of the two models.

You create the reports using the New Report window that you start from a project's **Reports** page.

### *Model Comparison, Validation, and Summary Report Input Files*

SAS Model Manager uses a test table as the input table for the Dynamic Lift report and the Interval Target Variable report.

Before you can create a Dynamic Lift report or the Interval Target Variable report, make sure that a test table has been added to the SAS Metadata Repository and registered in the Data Tables category or SAS Management Console. The test table can be viewed in the Data Tables category view. Then, specify the test table in the project property **Default test table**.

You specify the input table for validation reports in the New Report window. The input file for the validation reports can contain only input variables or it can contain input and output variables. If the input table contains input and output variables, the report generation does not need to run a scoring test to obtain the output variables.

When you create a train table summary report, the train table or specified input table is used to create the training summary data sets. The train table must be available in the SAS Metadata Repository. The train table must then be specified in the project property for the **Default train table**.

### *The Model Comparison, Validation, and Summary Report Output Files*

The Reports page stores the model comparison, validation, and summary report output files in the **Model Evaluation** tab. The name of the report is the value of the **Name** box that you specified in the New Report window.

Each time you create a report, these files are generated:

- the report in either HTML, PDF, or RTF format

  *Note:* The Loss Given Default and Probability of Default Model Validation reports can be created only in PDF format.

- taskCode.log
- taskCode.sas

Here is a description of the model comparison output files:

| Report File | Description |
|---|---|
| *report-name*.html | This file is the report output in HTML format. |
| *report-name*.pdf | This file is the report output in PDF format. |
| *report-name*.rtf | This file is the report output in RTF format. |
| taskCode.log | This file is the log file that contains messages from running the SAS code to create the report. |
| taskCode.sas | This file is the SAS code that is used to create the report. |

After you create a report, you can view the report from the **Reports** page.

*Note:* If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

## Model Profile Reports

### *About Model Profile Reports*

A Model Profile report displays the profile data that is associated with the model input variables, output variables, and target variables. The report creates three tables, one each for the model input, output, and target variables.

Here is a description of the model profile data:

| Profile Data | Description |
|---|---|
| Name | The name of the variable. |

| Profile Data | Description |
|---|---|
| Type | The data type of the variable: character ( C ) or numeric ( N ). |
| Length | The length of the variable. |
| Label | A label that is associated with the variable. |
| Format | The SAS format that is associated with formatting the variable. |
| Level | The measurement level: nominal, ordinal, interval, or binary. |
| Role | The type of variable: input, output, or target. |

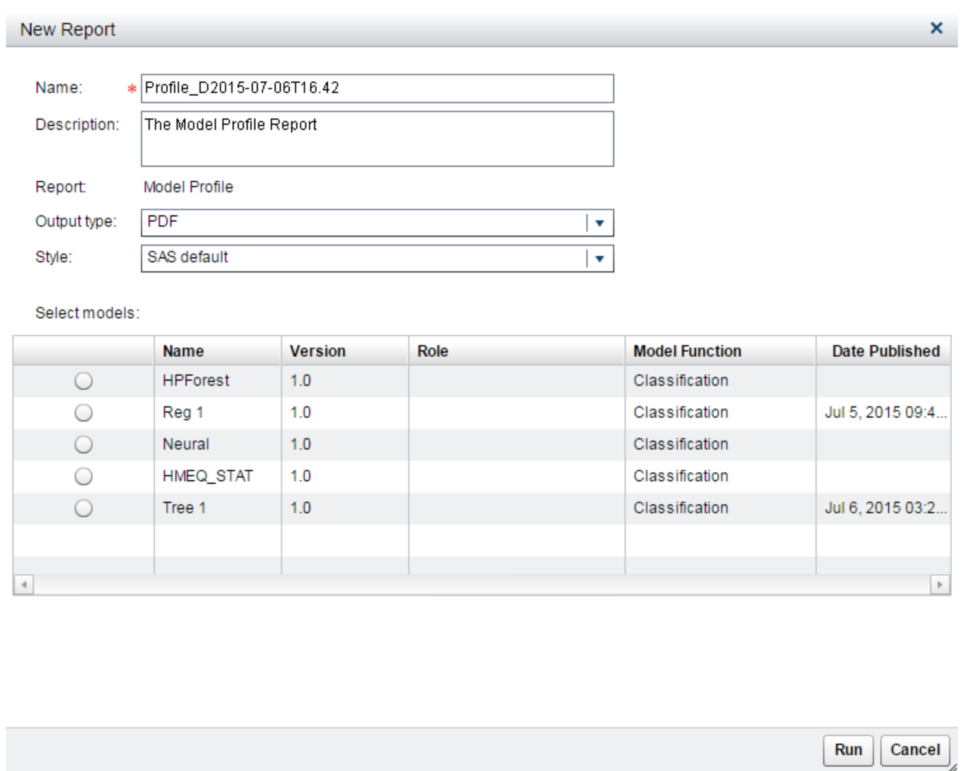
The reports are created using these auxiliary model files:

- inputvar.xml
- outputvar.xml
- targetvar.xml

### *Create a Model Profile Report*

To create a Model Profile report:

1. Click and select **Model Profile**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.

4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. From the list, select the model that you want to include in the report.
6. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### See Also

"View Reports" on page 144

# Delta Reports

## About Delta Reports

A Delta report compares the input, output, and target variable attributes for each of the variables that are used to score two candidate models. Delta reports display the differences in the variables of competing candidate models. The report output is a table that groups the variables by the variable name. For each variable, the reports lists the attribute value for each model and whether the attribute value is the same or different from the other attribute values.

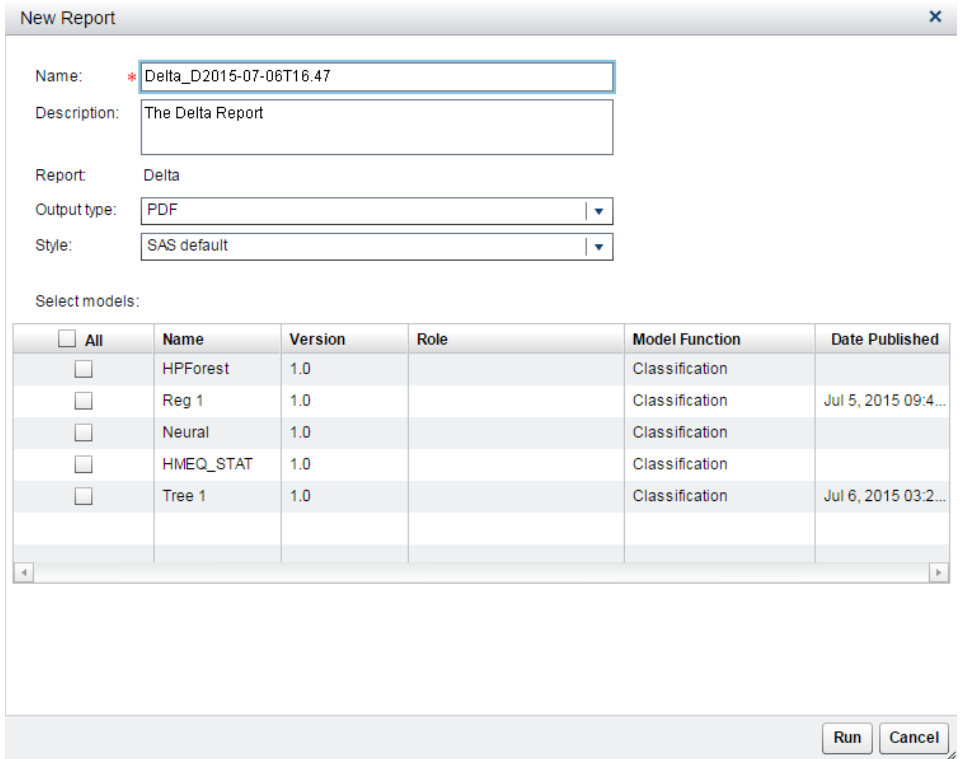
Here is a description of each of the columns in the output of a Delta report:

| Column | Description |
|---|---|
| Role | Specifies the function that a variable performs in determining a score code. |
| Name | Specifies the name of the variable that is being compared. |
| Variable Attribute | Specifies the name of the variable attribute that is being compared. |
| *Model Name-1* | Contains the value of the attribute for the first model. |
| *Model Name-2* | Contains the value of the attribute for the second model. |
| Difference | Specifies an X if the value of the variable attribute is different from the value of the variable attributes in the other model. If the value of the variable attribute is the same, this column is blank. |

## Create a Delta Report

To create a Delta report:

1. Click and select **Delta**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. From the list, select the models that you want to include in the report.
6. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### See Also

"View Reports" on page 144

## Dynamic Lift Reports

### About Dynamic Lift Reports

The Dynamic Lift report enables you to view a model's lift at a given point in time or to compare the lift performance of several models on one chart. The Dynamic Lift report creates the following charts:

- Lift
- Cumulative Lift
- Percent Response
- Cumulative Percent Response

- Captured Response
- Cumulative Captured Response

A Dynamic Lift report can be created only for classification models with a binary target.

The charts that are created for a Dynamic Lift report are also created in the Monitoring Report, which creates multiple types of model comparison reports. Before you can create a Dynamic Lift report, certain project and model property settings must be set.

For models that are created with PMML 4.2 and later, the **Valid variable name** option in SAS Management Console must be set to **Yes** by a SAS Model Manager administrator. In addition, the PMML variable names cannot be more than 20 characters. For more information, see *SAS Model Manager: Administrator's Guide*.

## *Verify Project and Model Property Settings*

### *Verify Project Properties*

Select the project name and verify that the following project properties are set:

**Training target variable**
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

**Target event value**
Specifies the value for the desired target variable event or state. For example, if a model predicts when RESPONSE=YES, then the target event value is `YES`.

**Output event probability variable**
Specifies the name of the output event's probability variable.

### *Verify Model Properties*

For each model in the Dynamic Lift report, open the model and verify the following properties on the **Model Properties** page:

**Properties**

| Property | Description |
|---|---|
| **Target variable** | Specifies the name of the target variable. For example, if a model predicts when RESPONSE=YES, then the target variable is `RESPONSE`. |
| **Score code type** | Specifies whether the score code runs using a DATA step fragment or SAS code that is not a DATA step fragment. |

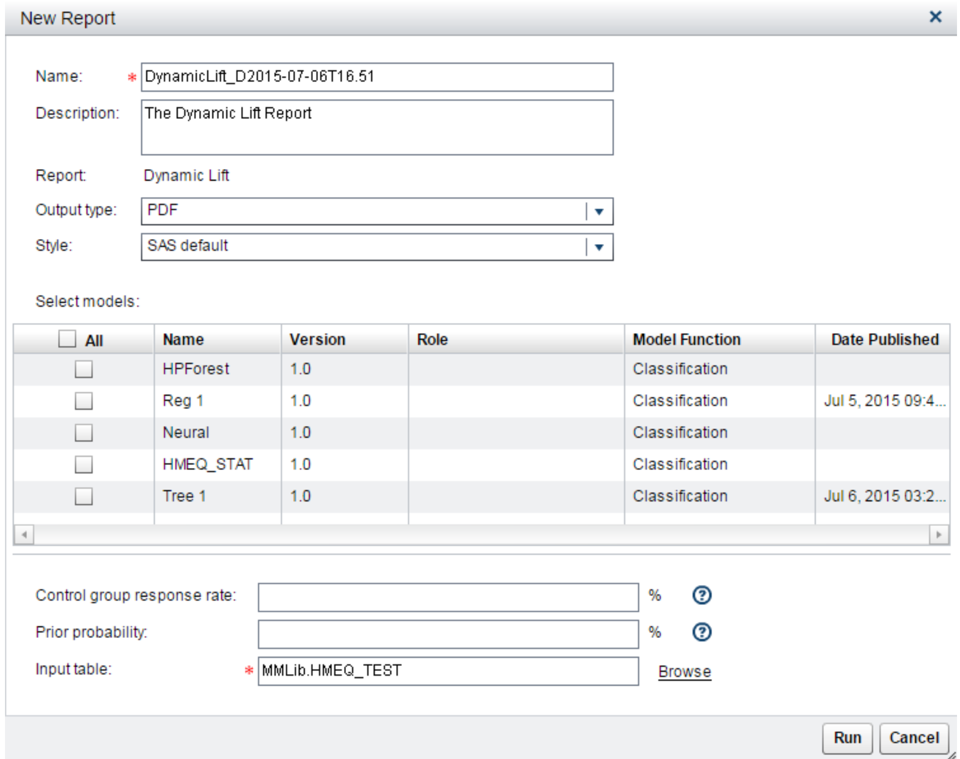
*Note:* Dynamic Lift reports are not applicable to models whose **Score code type** property has a value of PMML. For PMML 4.2 and later, a Dynamic Lift report can be created for a PMML model whose **Score code type** is DATA step.

## *Create a Dynamic Lift Report*

After ensuring that the appropriate project and model properties have been set, create the report.

To create a Dynamic Lift report:

1. Click and select **Dynamic Lift**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.

3. Select an output type. The default is PDF.

4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.

5. From the list, select the models that you want to include in the report.

6. Specify the **Control group response rate**. The control group response rate calculates the adjusted lift values for a model. If the control group response rate is not specified, the default response rate in the test table is used to calculate the adjusted lift values.

7. Specify the **Prior probability**. The prior probability is the proportion of event observations to the total observations in the whole population. In this case, the whole population is the entire train table. Specify a value for the prior probability to be used as the true event proportion when assessment values are computed for the lift of a model.

8. Accept the default value for **Input table** or click **Browse** to navigate to the appropriate folder to select an input table. Click **OK**.

9. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

## *See Also*

"View Reports" on page 144

# Interval Target Variable Report

## About Interval Target Variable Reports

The Interval Target Variable report creates two plots for you to view the actual versus predicted values for a model and the actual versus residual values for a model. The Interval Target Variable report can be created only for prediction models. Before you can create an Interval Target Variable report, certain project and model property settings must be set.

## Verify Project and Model Properties

Before you can run an Interval Target Variable report, you must set the following project properties:

**Default test table**
Specifies a test table that is registered in the SAS Metadata Repository. You can view the table in the Data category view. The test table must contain the target variable, as well as values for the variables that are defined by the project input variables.

**Training target variable**
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

**Output prediction variable**
Specifies the name of the output prediction variable.

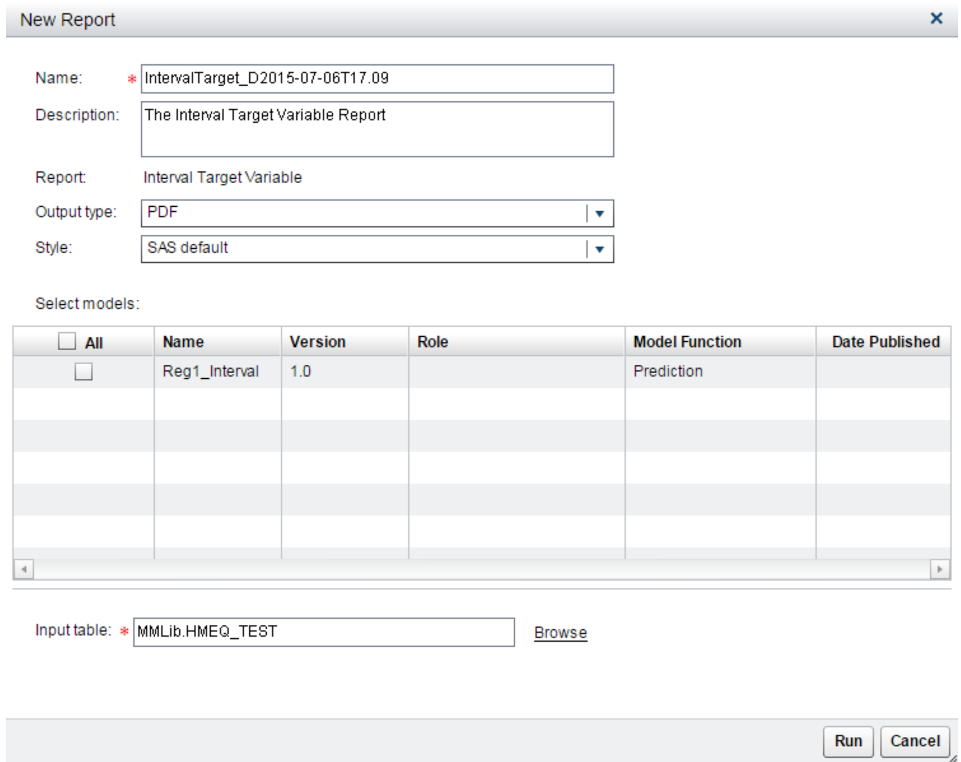
To verify the model mapping, select and open the model from the Models page. Select **Model Properties** ⇨ **Variables** to verify that the model variables are mapped to the project variables. If the variable names are the same, you do not need to map the variables. If they are not mapped, for each project variable, select the project variable and select a variable name.

## Create an Interval Target Variable Report

You must have a prediction model with an interval target variable in order to create the Interval Target Variable report. After ensuring that the appropriate project properties have been set and the model mapping is set, create the report.

To create an Interval Target Variable report:

1. Click and select **Interval Target Variable**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. From the list, select the models that you want to include in the report.
6. Accept the default value for **Input table** or click **Browse** to navigate to the appropriate folder to select an input table. Click **OK**.
7. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### *See Also*

"View Reports" on page 144

## Loss Given Default Reports

### *About Loss Given Default Reports*

Loss Given Default (LGD) models help validate the stability, performance, and calibration of models with the following statistical measures and tests:

Model stability measures
: The model stability measures track the change in distribution of the modeling data and the scoring data.

Model performance measures
The model performance measures report this information:

- The model's ability to discriminate accounts that have defaulted with those that have not defaulted. The score difference between the accounts that default and those that do not helps determine the cut-off score, which is used to predict whether a credit exposure is a default.
- The relationship between the actual default probability and the predicted probability. This information is used to understand a model's performance over a period of time.

Model calibration measures
The model calibration measures check the accuracy of the LGD models by comparing the correct quantification of the risk components with the available standards.

For a description of the statistical measures, see "Statistical Measures Used in Basel III Reports" on page 403.

### The Loss Given Default Report Properties

In order to create the reports, SAS Model Manager must know the input and output variables for the model. The input table can contain only input variables, or it can contain input and output variables. If the input table contains only input variables, a scoring test must be run to obtain the output variable. If the input table contains the input and output variables, no scoring is necessary. You specify whether a scoring test must be run by setting the **Run score code** property in the New Report window. If the input table contains the input and output variables, the value of the **Run score code** can be **No**. If the input table contains only input variables, the **Run score code** property must be set to **Yes**.

The report properties require the names of the variables from the input and output tables in order to map these variables to variables that are used to create the reports. The LGD report properties map these variables:

| | |
|---|---|
| Time period variable | specifies the variable that is used to indicate a time period. The first time period begins with 1 and typically increments by 1. The default is **period**. |
| Time label variable | (optional) specifies a label for the time period. If this variable exists in the input table, the report output contains a table that maps time periods to time labels. |
| Actual variable | specifies the actual LGD variable. The default is **lgd**. |
| Predicted variable | specifies the output prediction variable that is used only if scoring for the report is not performed by SAS Model Manager. If the report scoring is done by SAS Model Manager, this variable should be excluded by the input data set. The default is **p_lgd**. |
| Pool variable | specifies the variable that names pool IDs. The default is **pool_id**. |

### Prerequisites for Loss Given Default Reports

Before you run an LGD report, select the project name and verify that the following project properties are set:

**Training target variable**
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

**Model function**
Specifies the type of model function. For an LGD report, the model function must be Prediction.

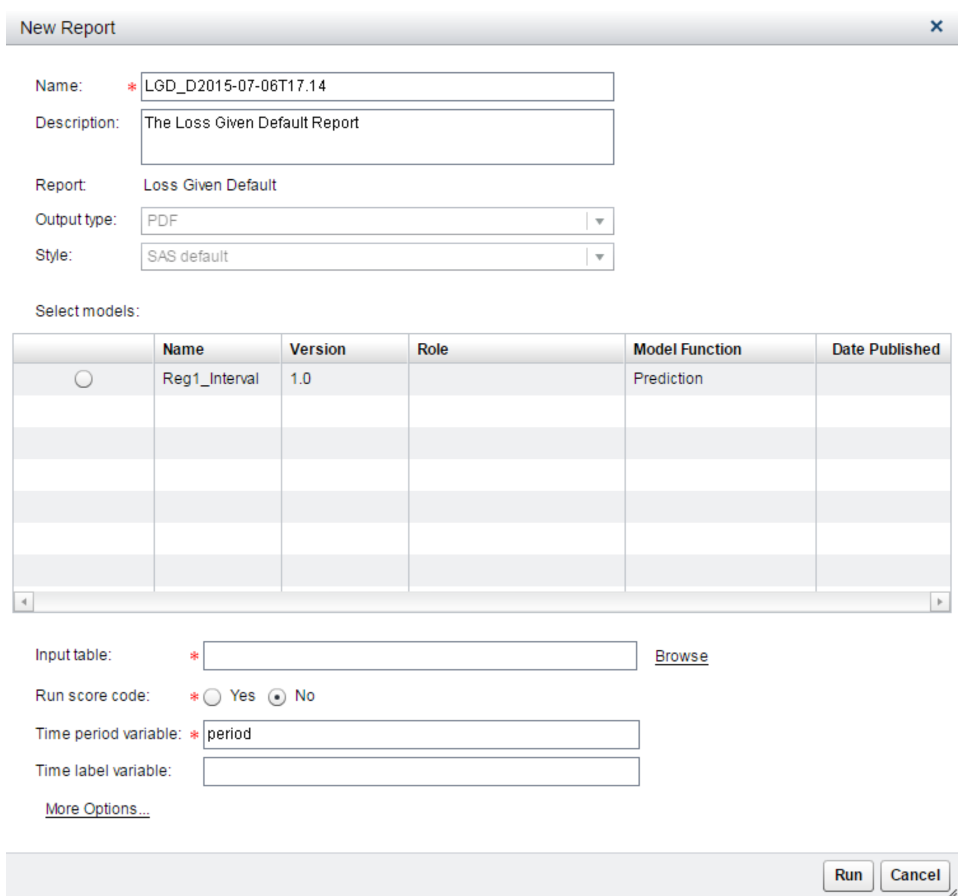
**Class target level**
Specifies an **Interval** class target level.

**Output prediction variable**
Specifies the name of the output prediction variable.

## *Create a Loss Given Default Report*

To create a Loss Given Default report:

1. Click and select **Loss Given Default**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.

   *Note:* The default output type is PDF.

3. From the list, select the model that you want to include in the report.

4. Select an **Input table**. Click **Browse** to navigate to the appropriate folder. Select an input table and click **OK**. The table can contain only input variables or it can contain input and output variables.

5. Select whether to run the score code. If the input table contains only input variables, set **Run score code** to **Yes**. If the input table contains input and output variables, set **Run score code** to **No**.
6. The **Time period variable** specifies the variable from the input table whose value is a number that represents the development period. This value is numeric. The time period for PD reports begin with 1. The default is **period**.
7. (Optional) In the **Time label variable** field, enter the variable from the input table that is used for time period labels. When you specify the time label variable, the report appendix shows the mapping of the time period to the time label.
8. Click **More Options** to set the following:

   **Actual variable**
   Specifies the actual LGD variable. The default is **lgd**.

   **Predicted variable**
   Specifies the project scoring output variable. If the scoring for the LGD report is performed outside SAS Model Manager, the input data set must include this variable. If the scoring for the LGD report is done by SAS Model Manager, the input data set should not include this variable. The default is **p_lgd**.

   **Pool variable**
   Specifies the variable from the input table that is used to identify a two-character pool identifier. The default is **pool_id**.

   *Note:* The variable names that you specify can be user-defined variables. A variable mapping feature maps the user-defined variables to required variables.
9. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### See Also

"View Reports" on page 144

## Probability of Default Model Validation Reports

### About Probability of Default Model Validation Reports

Probability of Default (PD) models help validate the stability, performance, and calibration of models with the following statistical measures and tests:

Model stability measures
The model stability measures track the change in distribution of the modeling data and the scoring data.

Model performance measures
The model performance measures report this information:

- The model's ability to discriminate accounts that have defaulted with those that have not defaulted. The score difference between the accounts that default and those that do not helps determine the cut-off score, which is used to predict whether a credit exposure is a default.
- The relationship between the actual default probability and the predicted probability. This information is used to understand a model's performance over a period of time.

Model calibration measures

The model calibration measures check the accuracy of the PD model by comparing the correct quantification of the risk components with the available standards.

For a description of the statistical measures, see "Statistical Measures Used in Basel III Reports" on page 403.

## Default Model Validation Report Properties

In order to create the reports, SAS Model Manager must know the input and output variables for the model. To run the reports, the New Report window requires the name of an input table. The input table can contain only input variables, or it can contain input and output variables. If the input table contain only input variables only, a scoring test must be run to obtain the output variable. If the input table contains the input and output variables, no scoring is necessary. You specify whether a scoring test must be run by setting the **Run score code** property in the New Report window. If the input table contains the input and output variables, the value of the **Run score code** can be **No**. If the input table contains only input variables, the **Run score code** property must be set to **Yes**.

The report properties require the names of the variables from the input and output tables in order to map these variables to variables that are used to create the reports. The report properties map these variables:

| | |
|---|---|
| Time period variable | specifies the variable that is used to indicate a time period. The first time period begins with 1 and typically increments by 1. The default is **period**. |
| Time label variable | (optional) specifies a label for the time period. If this variable exists in the input table, the report output contains a table that maps time periods to time labels. |
| Scorecard bin variable | specifies the scoring output variable that names the scorecard bins. The input table must include this variable if scoring for the PD report is performed outside SAS Model Manager. If scoring is done by SAS Model Manager, do not include this variable in the input data set. The default is **scorecard_bin**. |
| Scorecard points variable | specifies the scoring output variable that names the scorecard points. The input table must include this variable if scoring for the PD report is performed outside SAS Model Manager. If scoring is done by SAS Model Manager, do not include this variable in the input data set. The default is **scorecard_points**. |
| Cut-off value | specifies the variable that is used to derive whether a credit exposure is a default. The cut-off value is also used to compute accuracy, sensitivity, specificity, precision, and error rate measures. You can use the score difference between accounts that default on loans and those that do not default on loans to determine the cut-off value. The default is **100**. |

## Prerequisites for Probability of Default Model Validation Reports

Before you can create a Probability of Default Model Validation report, verify that the following project settings are specified and that the output variables have been mapped:

**Training target variable**
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

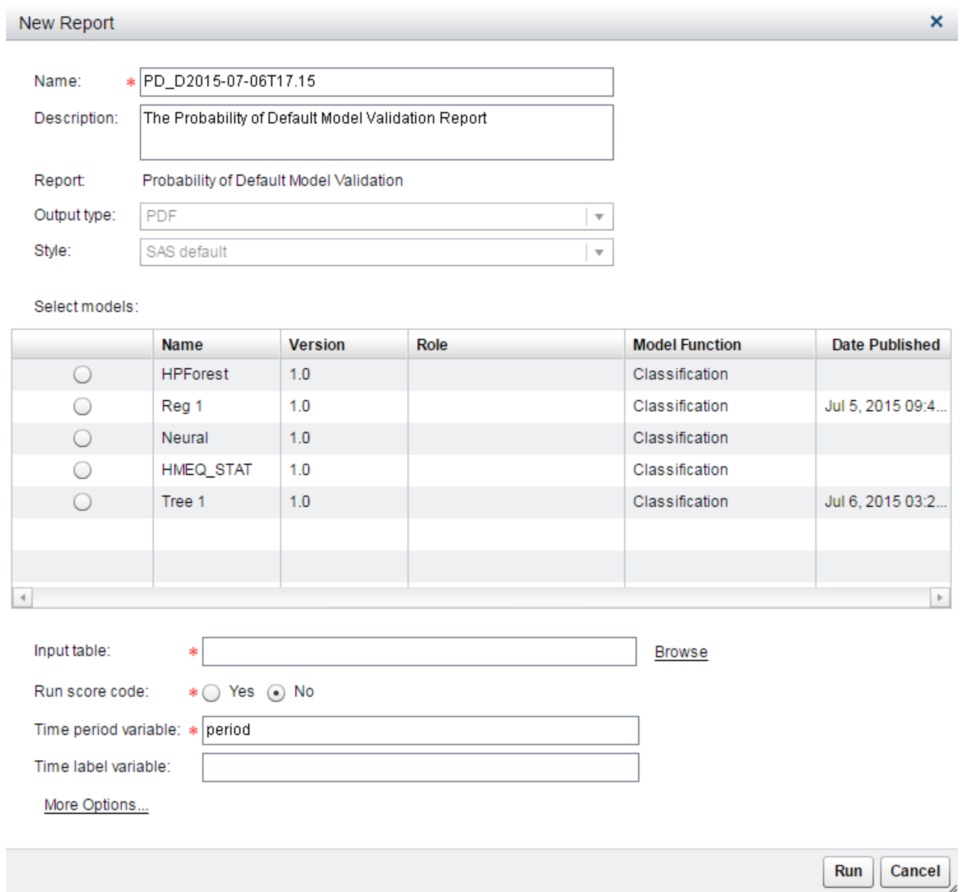
**Class target level**
Specifies a **Binary** class target level.

**Output event probability variable**
Specifies the name of the output event probability variable.

## *Create a Probability of Default Model Validation Report*

To create a Probability of Default Model Validation report:

1. Click and select **Probability of Default Model Validation**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.

   *Note:* The default output type is PDF.

3. From the list, select the model that you want to include in the report.

4. Click **Browse** to navigate to the appropriate folder and select an input table and click **OK**. The table can contain only input variables or both input and output variables.

   *Note:* When a scoring input table for a PD report contains data and one or more time periods do not contain default or non-default loan information, these time periods are not used to calculate the PD measurements. In a chart, time periods that are not used to calculate the PD measurements are represented with dashed lines.

5. Select whether to run the score code. If the input table contains only input variables, set **Run score code** to **Yes**. If the input table contains input and output variables, set **Run score code** to **No**.
6. The **Time period variable** specifies the variable from the input table whose value is a number that represents the development period. This value is numeric. The time period for PD reports begin with 1. The default is **period**.
7. (Optional) In the **Time label variable** field, enter the variable from the input table that is used for time period labels. When you specify the time label variable, the report appendix shows the mapping of the time period to the time label.
8. Click **More Options** to set the following:

   **Scorecard bin variable**
   Specifies the variable from the input table that contains the scorecard bins. If the scoring job for the PD report is run outside SAS Model Manager, the scorecard bin variable must be a variable in the input table. If scoring is done within SAS Model Manager, do not include the variable in the input table. The default is **scorecard_bin**.

   **Scorecard points variable**
   Specifies the variable that contains the scorecard points. If the scoring job for the PD report is run outside SAS Model Manager, the scorecard points variable must be a variable in the input table. If scoring is done within SAS Model Manager, do not include the variable in the input table. The default is **scorecard_points**.

   **Cut-off value**
   Specifies the maximum value that can be used to derive the predicted event and to further compute accuracy, sensitivity, specificity, precision, and error rate. The default is **100**.
9. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### *See Also*

"View Reports" on page 144

## Training Summary Data Set Reports

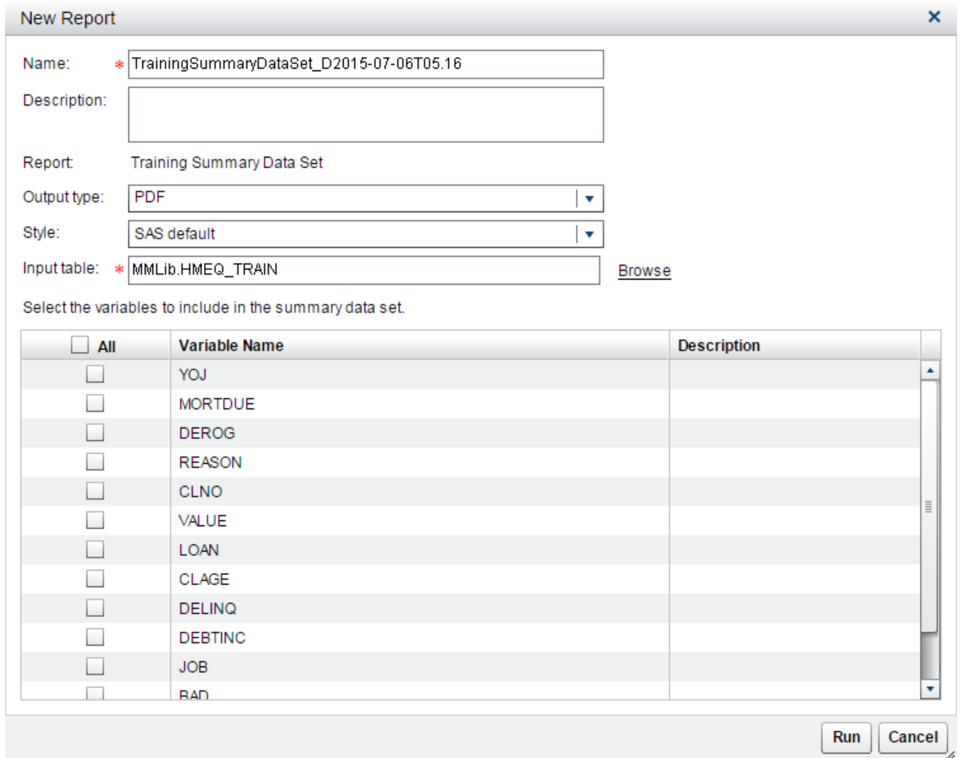
### *About Training Summary Data Set Reports*

A Training Summary Data Set report creates frequency and distribution charts that summarize the train table variables. Using the default train table, SAS Model Manager generates data sets that contain numeric and character variable summaries, and variable distributions. These data sets are used to create the summary report. Before you can create the report, you must generate the training summary data sets.

### *Create a Training Summary Data Set Report*

To generate a training summary data set report:

1. Click  and select **Training Summary Data Set**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. Select an **Input table**. Click **Browse** to navigate to the appropriate folder and select an input table. Defaults to the value of the default train table project property.
6. Select the variables to include in the summary data set.
7. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### *See Also*

"View Reports" on page 144

## Monitoring Reports

### *About Monitoring Reports*

After you execute a performance definition or run the %MM_RunReports() macro in production mode, as a batch job, SAS Model Manager stores the output data sets on the SAS Content Server. You can view the performance monitoring results on the **Performance Results** tab or on the **Attachments** page.

When you create monitoring reports using the New Report window, the report creates the following charts:

Assessment charts

Assessment charts summarize the utility that you can expect by using the respective models, as compared to using only baseline information. Assessment charts can present a model's lift at a given point in time or the sequential lift performance of a model's lift over time. A monitoring report creates the following assessment charts:

- Lift
- Cumulative Lift
- Percent Response
- Cumulative Percent Response
- Captured Response
- Cumulative Captured Response
- Actual versus Predicted for prediction models
- Actual versus Residual for prediction models
- Population Stability Trend for prediction models

Assessment charts are created for the Monitoring Report.

Lift Trend chart

A Lift Trend chart displays the cumulative lift of the champion model, over time.

Gini - ROC chart

Sensitivity is the proportion of true positive events, and specificity is the proportion of true negative events. The Gini - ROC chart plots Sensitivity on the Y axis and 1 - Specificity on the X axis.

Gini - Trend Chart

When the Gini - ROC chart is created, the Gini index for each ROC curve is also created. The Gini index represents the area under the ROC curve and is a benchmark statistic that can be used to summarize the predictive accuracy of a model. The Gini - Trend chart plots a model's Gini index scores over time, and these are used to monitor model degradation over time.

KS Chart

The KS chart uses the Kolmogorov-Smirnov statistic to measure the maximum vertical separation, or deviation between the cumulative distributions of events and non-events.

KS Trend Chart

When you create a Kolmogorov-Smirnov report, the underlying KS statistic and the corresponding probability cutoff are read from a summary data set in the Resources folder. The KS Trend chart uses a summary data set that plots the KS Statistic over time. The KS Trend chart is used to monitor model degradation over time.

Actual versus Predicted

You use the Actual versus Predicted plot to see how predicted values match actual values.

Actual versus Residual

You use the Actual versus Residual plot to determine how good the model is at predicting values by examining errors and error trending, and comparing them to the actual values.

Population Stability Trend

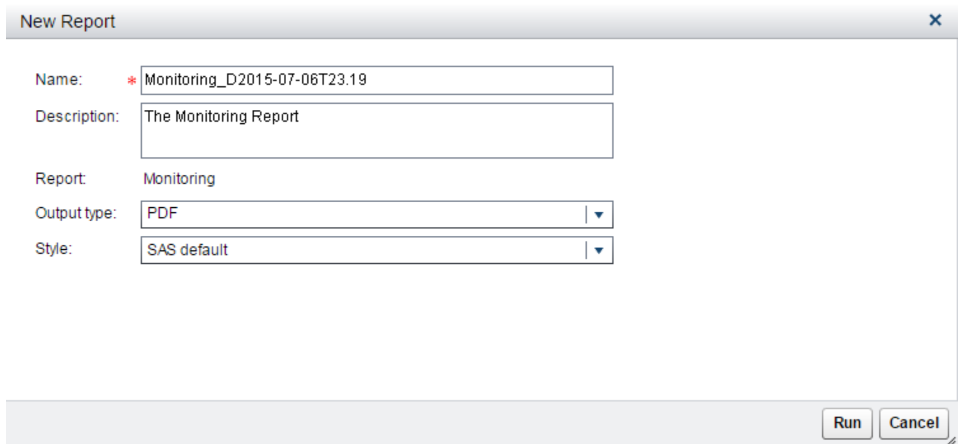
The Population Stability Trend chart measures the shift of the scoring output variable distribution over time. Scoring output that is based on a development sample is used as the baseline distribution. The deviation index is used to indicate the shift for a given point in time.

Before you create a Monitoring Report or a Champion and Challenger Performance Report, you must ensure that certain project and model properties are set. For more information, see "Verify Project and Model Property Settings" on page 130.

### Create a Monitoring Report

To create a Monitoring report:

1. Click and select **Monitoring**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

#### See Also

"View Reports" on page 144

## Champion and Challenger Performance Reports

### About the Champion and Challenger Performance Report

After you execute a performance definition for the champion model, you can execute a performance definition for the challenger model using the same performance data sets. SAS Model Manager updates the output data sets with the performance data for the challenger model. You can create a Champion and Challenger Performance report that compares the performance of the two models.

The Champion and Challenger Performance report contains these charts:

Number of Predictors Exceeding Deviation Threshold
: This characteristic report creates a chart for each index that exceeds a deviation threshold (either 0.1 or 0.25) as indicated in the define performance definition. The characteristic report detects shifts in the distribution of input variables over time.

Lift Trend Chart
: A Lift Trend chart displays the cumulative lift of the champion model over time.

Gini - Trend
: When the Gini - ROC Chart is created, the Gini index for each ROC curve is also created. The Gini coefficient represents the area under the ROC curve and is a benchmark statistic that can be used to summarize the predictive accuracy of a model. The Gini - Trend Chart plots a model's Gini index scores over time, and these are used to monitor model degradation over time.

Gini - ROC Chart
: Sensitivity is the proportion of true positive events, and specificity is the proportion of true negative events. The Gini - ROC Chart plots Sensitivity on the Y axis and 1 - Specificity on the X axis.

KS Trend Chart
: When you create a Kolmogorov-Smirnov report, the KS statistic and the corresponding probability cutoff are computed for each Kolmogorov-Smirnov table. The KS Trend Chart uses a summary data set that plots the KS Statistic and the probability cutoff values over time. The KS Trend Chart is used to monitor model degradation over time.

KS Chart
: The KS Chart uses the Kolmogorov-Smirnov statistic to measure the maximum vertical separation, or deviation between the cumulative distributions of events and non-events.

Score Histogram
: The Score Histogram compares the scoring result distribution at different time periods using a histogram.

Score Distribution Line Plot
: The Score Distribution Line Plot compares the scoring result distribution at different time periods using a line plot.

Before you create a Champion and Challenger Performance report, verify the performance data and model status.

### *Verify Performance Data and Model Status*

Before you can create a Champion and Challenger Performance report:

1. Select the **Models** page and verify that a champion model has been set. The champion model is designated as **Champion** in the **Role** column. If a champion has not been set, select a model from the list, and click to set the model as the project champion model.

2. Ensure that a challenger model is flagged. The challenger model is designated as **Challenger** in the **Role** column. If it is not, select a model from the list, and click to flag a model as a challenger to the project champion model.

3. Verify that performance monitoring data is available for the champion model and the challenger model. Performance monitoring results must exist for the same performance data using the same time periods and data labels. Navigate to **Performance** ⇨ **Results** ⇨ **Data Sets** and select the file **jobstatus.sas7bdat**. The **Content** tab displays performance monitoring status data.

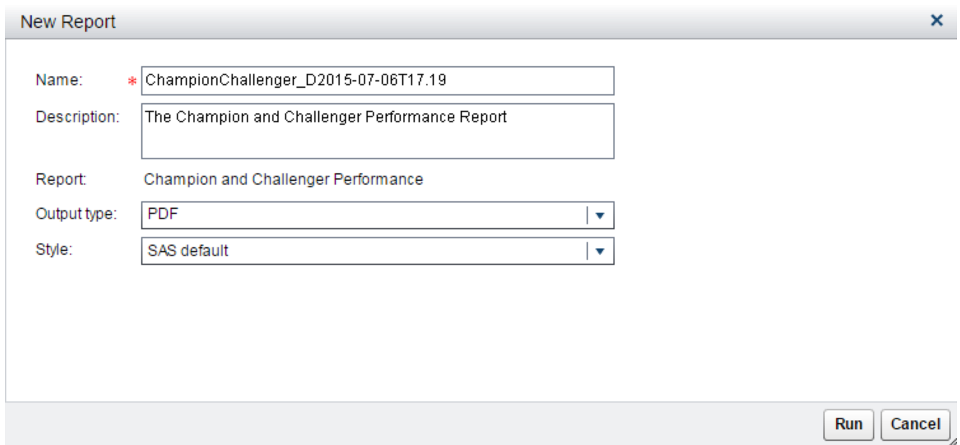
a. Verify that the UUIDs for the champion and challenger models are in the **Model UUID** column.

b. Using the **name** column and the **time** column, verify that matching date labels exist for the champion and challenger models for each type of report. If there are multiple date labels for a model for any given report, SAS Model Manager uses the most recent job.

### Create a Champion and Challenger Performance Report

To create a champion and challenger performance report:

1. Click and select **Champion and Challenger Performance**. The New Report window appears.




2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

#### See Also

"View Reports" on page 144

## View Reports

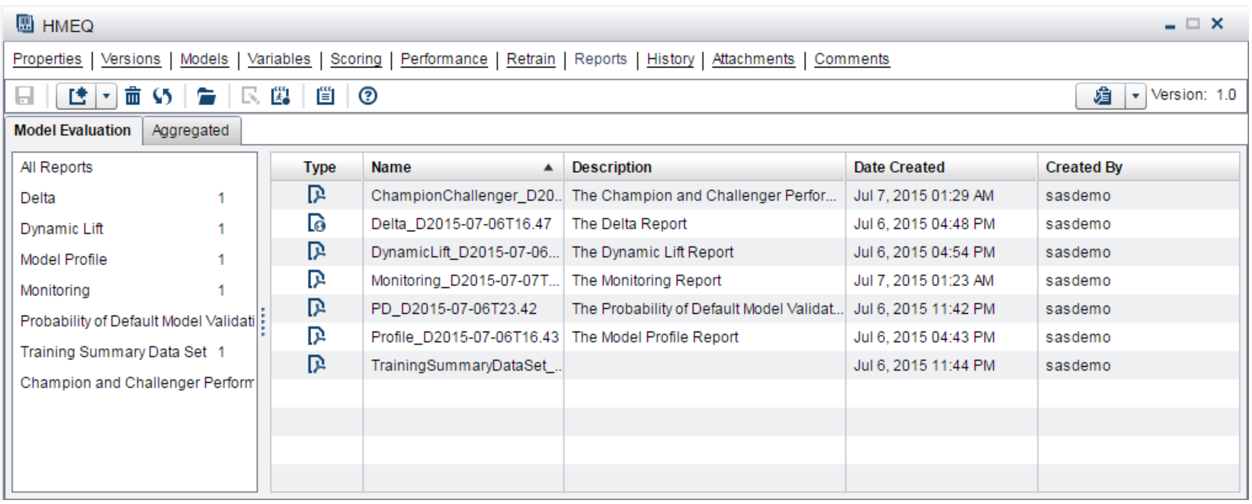
To view a report:

1. On the **Reports** page, in the **Model Evaluation** tab, select a type of report from the left navigation menu.
2. You can view a report in several ways:
   - Double-click a report in the list.
   - Select a report from the list and click .

- Right-click a report from the list and select **Open**.

*Note:* You can also view the SAS code and SAS log.

*Note:* If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.



# Chapter 12
# Validating Models Using User Reports



## Overview of User Reports

### *Ad Hoc Reports and User-Defined Reports*

User reports are SAS programs that you create and import to SAS Model Manager so that you can customize reports to meet your business requirements. The ad hoc report enables you to develop, test, and run your report within SAS Model Manager. The user-defined report can be developed either within or external to SAS Model Manager. It requires a SAS program and the associated auxiliary files to be installed in a directory that is available to SAS Model Manager. Using ad hoc reports, you modify and submit your code from the SAS Editor within the Create an Ad Hoc Report window.

A user-defined report is a report that is available for reporting on all models in SAS Model Manager. The user-defined report requires three files to be installed in your server's file structure:

- a SAS program to create the report

- a report template XML file that specifies the report requirements, such as report name and the number of required models to run the report
- a SAS program file that lists the SAS Model Manager global macro variables and macros that are used in your report

After you have these three files, you use the Manage Templates function to upload the files to the SAS Content Server.

The ad hoc report can be used to develop, test, and debug user-defined reports. When your ad hoc report is ready for a production environment, you can create the report template XML file and the macro file, and install the three files in the user-defined report file structure.

### Comparison of Ad Hoc and User-Defined Reports

| Report Difference | Ad Hoc Report | User-Defined Report |
|---|---|---|
| Version | An ad hoc report is defined and can be run only under the version where it was created. | A user-defined report can be run under any project version. |
| Report template | An ad hoc report does not require a template. | A user-defined report requires a template to define the report parameters. |
| Report results | Each time an ad hoc report is run, the existing report is overwritten. | Each time a user-defined report is run, a new report is created on the **Reports** page. |
| Location of SAS files used to generate the report | The ad hoc report SAS program is stored on the **Reports** page for the version where it was created. | The user-defined report SAS files are uploaded to the SAS Content Server. |

### Output Created by User Reports

The first time you create a report, SAS Model Manager creates a report on the **Reports** page.

Each time you create a new ad hoc report, the following files are created:

- the report in either HTML, PDF, or RTF format
- smm_userCode.sas
- taskCode.log
- taskCode.sas

Each time you create a new user-defined report, the following files are created:

- the report in either HTML, PDF, or RTF format
- taskCode.log
- taskCode.sas

***CAUTION:***

**The wizard overwrites the output files if an output file of the same name already exists.**

Here is a description of the ad hoc report output files:

| Report File | Description |
|---|---|
| *report-name*.html | This file is the report output in HTML format. |
| *report-name*.pdf | This file is the report output in PDF format. |
| *report-name*.rtf | This file is the report output in RTF format. |
| smm_userCode.sas | This file contains the SAS program report code that was submitted in the Create an Ad Hoc Report window. |
| taskCode.log | This file is the log file that contains messages from running the SAS code to create the report. |
| taskCode.sas | This file is the SAS code that is used to create the report. The file contains the user-defined report code as well as code that was generated by SAS Model Manager to create the report. |

You can see the contents of these files by selecting them on the **Reports** page. You can also see the taskCode.sas file and the taskCode.log files.

# Ad Hoc Reports

## *Overview of Ad Hoc Reports*

To create an ad hoc report, you must first write a SAS report program. When the report code is ready, you copy your code to the **SAS Editor** tab in the Create an Ad Hoc Report window. You then submit your program. Unlike the user-defined report, the ad hoc report does not require auxiliary files to be uploaded to the SAS Content Server.

To create your report output in either HTML, PDF, or RTF, or to specify a style other than the default style for your report, you modify your report with code that is provided by SAS and that enables you to specify the report output format and style. The code that you need to add to your program is included in the steps to create an ad hoc program.

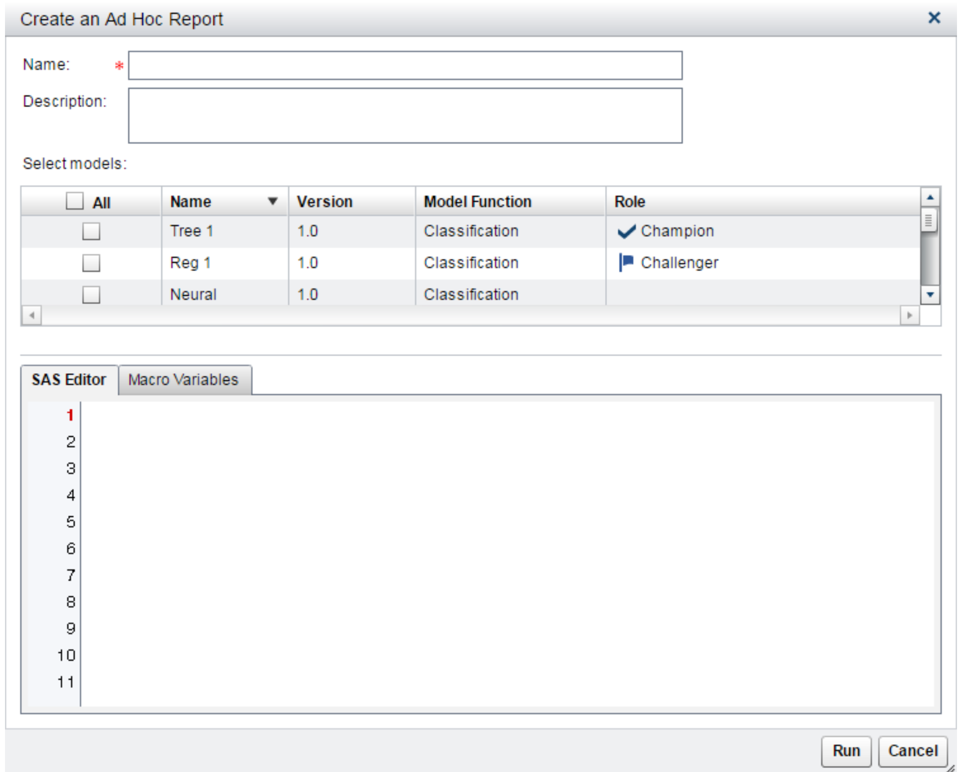
If you find an error in your report code, you must delete the report in the project, fix your code in your source file, and submit the code in the Create an Ad Hoc Report window again.

## *Create an Ad Hoc Report*

To create an ad hoc report, you must first create a SAS program. Test your program in SAS before you run your program as an ad hoc report. After the code runs successfully, you can create the ad hoc report.

To create an ad hoc report:

1. On the **Reports** page, click and select **Ad Hoc**. The Create an Ad Hoc Report window appears.




2. Enter a name and an optional description for the report.
3. Select one or more models.
4. Add or copy SAS code to the **SAS Editor** tab. Make sure that your report program is enclosed by the SAS code that defines the report output format. Click the **Macro Variables** tab to view a list of the variables that can be accessed by your program.
5. Click **Run**. The report is generated and appears in the default viewer for the selected output type.
6. The report appears in a list on the **Model Evaluation** reports tab.

## Example Ad Hoc Report

The following example code lists the score results in an HTML output format:

```
Filename mmreport catalog "sashelp.modelmgr.reportexportmacros.source";
%include mmreport;

%MM_ExportReportsBegin(reportFormat=html, reportStyle=Meadow, fileName=PerfDS);
proc print data=myTable.scoretable;
var loan delinq score;
run;
quit;


%MM_ExportReportsEnd(reportFormat=html);
```

After you click **Run**, the report is created and placed on the **Reports** page. The following HTML output displays selected rows of the output.

| Obs | LOAN | DELINQ | score |
|---|---|---|---|
| 1 | 1100.00 | 0 | 0.08918 |
| 2 | 162.06 | 2 | 0.08918 |
| 3 | 1292.02 | 0 | 0.08918 |
| 4 | 783.13 | . | 0.08918 |
| 5 | 1700.00 | 0 | 0.08918 |

# User-Defined Reports

## *Overview of User-Defined Reports*

User-defined reports require the following files to be uploaded to the SAS Content Server:

- the SAS program that creates the report.
- a SAS program file that lists the SAS Model Manager global macro variables that are used in your report.
- a report template XML file that specifies the report requirements, such as report name and the number of required models to run the report.

After these three files have been uploaded to the SAS Content Server, the user-defined report type is included as a report type in the new report drop-down list on the **Reports** page.

The New Report window includes controls to specify the type of output that the report creates, such as HTML or PDF, and a style for the report. You can modify your report to include the SAS code so that the New Report window offers the report output controls for your report.

## *Create a User-Defined Report*

To create a user-defined report:

1. Write and test your SAS program that creates a report.
2. To format the output for a user-defined report, add the SAS code below to your report code in order to select the **Output type** and the **Style** in the New Report window. The **Output type** enables you to select a report output format of HTML, PDF, or RTF. The **Style** enables you to select a report output style for your report.

   Replace *report-name* with the name of your user-defined report. The name can contain letters, the underscore ( _ ), hyphen ( - ), and the period ( . ). End your user-defined report with the %MM_ExportReportsEnd macro.

   ```
   Filename mmreport catalog "sashelp.modelmgr.reportexportmacros.source";
   %include mmreport;
   %MM_ExportReportsBegin(fileName=report-name);
   ```

```
      …
   your-user—defined-code
      …
%MM_ExportReportsEnd;
```

3. In the report XML file, add this SAS program name to the FILENAME= argument of the <Code> element (for example, **<Code filename="myUserReport.sas"/>**). For more information, see "Report Templates" on page 153.

For an example of a report, see "Example User-Defined Report" on page 157.

### Defining Macro Variables for a User-Defined Report

Executing a user-defined report requires a SAS program that lists the report code's macro variables. If you do not have macro variables in your report, create a SAS program file with a comment in it. This file is required.

Here is an example program to define macro variables:

```
%let _MM_User=miller;
%let _MM_Password=Rumpillstillskin3;
```

In the report XML file, add this SAS program name to the FILENAME= argument of the <PreCode> element (for example, **<PreCode filename="myMacroDefs.sas"/>**). For more information, see "Report Templates" on page 153.

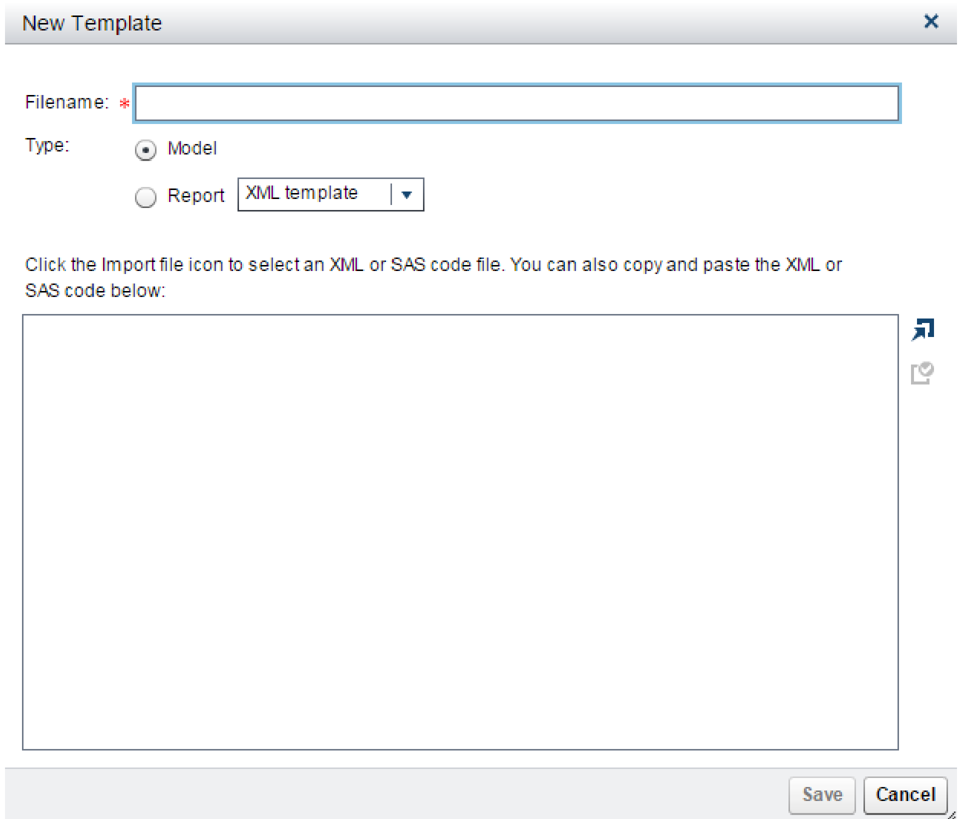
For an example of a macro variable program, see "Example User-Defined Report" on page 157.

For a list of macro variables, see "Macro Variables" on page 277.

### Upload SAS Programs to the SAS Content Server

After you have the two SAS programs for your user report, follow these steps to upload them to the SAS Content Server:

1. From the Projects category view, click , and select **New Template**.




2. Enter a filename.
3. Select **Report** (SAS code).
4. Click to select a SAS code file. Click **Open**. You can also copy and paste the SAS code in the text box.
5. Click **Save**.
6. Repeat the steps to upload the second file.

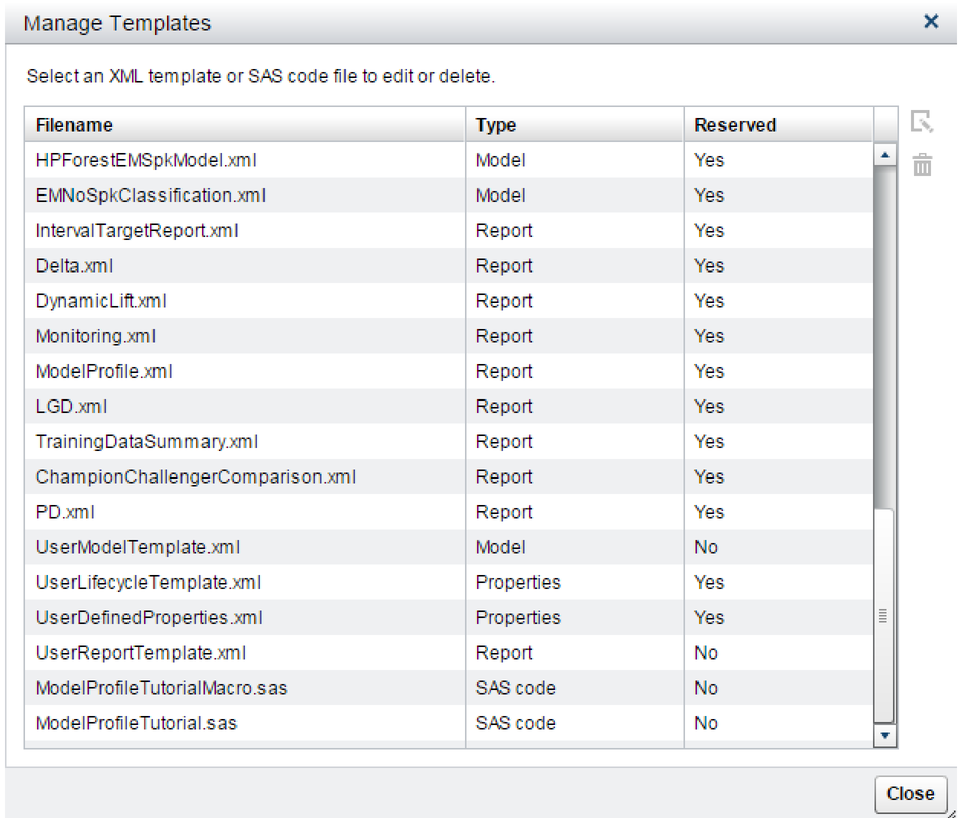
## *Report Templates*

You create a report template XML definition file to describe your user-defined report. After you create the report template, upload the template to the SAS Content Server.

SAS Model Manager provides a sample report template that you can use as a model for your XML template. You can use any template as a model or you can create an XML file with the required XML elements. A best practice is to open the model XML template and save the template using another name.

To open a sample report template:

1. From the Projects category, click , and select **Manage Templates**.




2. Select **UserReportTemplate.xml** and click . The UserReportTemplate.xml file has arguments in quotation marks that you modify for your report. Replace the text in quotation marks with values that are appropriate for your report. See the argument descriptions below. Make your changes and click **Save** to upload the report template to the SAS Content Server.

3. Click **Close**.

Here is the report template XML definition:

```
<?xml version="1.0" encoding="UTF-8" ?>
<ReportTemplate
    name="report-name"
    type="UserDefinedReport"
    displayName="display-name"
    description="model-description"
    >
    <Report>
        <Data datasetName="input-data-set-name"/>
        <Models expectedModelType="model-type"
           requiredNumberOfModels="1"
           level="level">
   </Models>
        <SourceCode>
            <PreCode filename="pre-code-filename.sas"/>
            <Code filename="score-code-filename.sas"/>
        </SourceCode>
        <Output format="output-format" filename="output-name"/>
    </Report>
    <Parameters>
```

```
        <Parameter name="parameter-name" value="parameter-value" />
    </Parameters>
</ReportTemplate>
```

<ReportTemplate> element arguments

name="*report-name*"
: specifies the name of the report. The characters @ \ / * % # & $ ( ) ! ? < > ^ + ~ ` = { } [ ] | ; : ‘ " cannot be used in the name.

displayName="*display-name*"
: specifies the name of the report that is displayed in the **Report** section of the New Report window.

description="*model-description*"
: specifies a description of the report that is displayed at the bottom of the New Report window when the report is selected in the window.

<Report> element arguments

<Data datasetName="*input-data-set-name*"/>
: specifies the name of a data source data set that is used for input to the report. The data set must be in the form *libref.filename*. You can use the following global macro variables as a value for input-data-set-name as long as the value of the macro variable is in the form of *libref.filename*:

- &_MM_InputLib
- &_MM_OutputLib
- &_MM_PerformanceLib
- &_MM_TestLib
- &_MM_TrainLib

<Models
expectedModelType="*model-type*"
requiredNumberOfModels="*number-of-models*"
level="*level*">
</Models>
: specifies information about the model.

expectedModelType="*model-type*"
: specifies the model type.

Valid values: ANALYTICAL, CLASSIFICATION, PREDICTION, SEGMENTATION, ANY

requiredNumberOfModels="*number-of-models*"
: specifies the number of models that are processed in this report.

level="folder"
: specifies where the report is to obtain a list of models. If folder is VERSION, the report creates a list of models in the version. If folder is PROJECT, the report creates a list of models from all versions in the project.

Valid values: VERSION, PROJECT

<SourceCode>
<PreCode filename="*pre-code-filename*.sas"/>
<Code filename="*report-code-filename*.sas"/>
</SourceCode>
: specifies the files that are used to execute the report.

<PreCode filename="*pre-code-filename*.sas"/>
specifies the name of the SAS program that contains macro variable definitions.

<Code filename="*report-code-filename*.sas"/>
specifies the name of the SAS program that creates the report.

<Output format="*output-format*" filename="*output-report-name*"/>
specifies the output format arguments:

format="*output-format*"
specifies the format of the report output.

Valid values: HTML, PDF, or RTF

filename="*output-report-name*"
specifies the name of the output report.

<Parameters> Element Argument

`<Parameter name="parameter-name" value="parameter-value" />`
This element is not used. It is reserved for future use.

### Edit a SAS Program on the SAS Content Server

To edit the program after the file has been uploaded to the SAS Content Server:

1. Click and select **Manage Templates**.
2. Select an XML template, SAS code file, or user-defined properties template to edit. In order for the template to be editable, the **Reserved** column must be marked as **No**. Life cycle templates cannot be edited but can be viewed.
3. Click . Make your changes and click **Save**.
4. Click **Close**.

### Delete a SAS Program from the SAS Content Server

Deleting a User Report SAS Content Server is a two-step process. You must delete the SAS program and the report template.

To delete a user report:

1. Click and select **Manage Templates**.
2. Select an XML template, SAS code file, or user-defined properties template to delete. The **Reserved** column must be marked as **No** to delete a file. The user-defined properties template file cannot be deleted.
3. Click . A confirmation window appears.
4. Click **Yes** to delete the file.
5. Click **Close**.

### Run a User-Defined Report

To run a user-defined report:

1. Click and select your user-defined report. The New Report window appears.

2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report. For example, the SAS default style for the HTML output type is HTMLBLUE.
5. From the list, select the models that you want to include in the report.
6. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

### See Also

"View Reports" on page 144

## Example User-Defined Report

### Overview of the Example User-Defined Report

The example user-defined report categorizes scoring values into score ranges and then graphs the results. The program name is Score Range Report. The following SAS programs and report template file are required to create this report:

- The SAS report program is the file ScoreRange.sas
- The SAS program file that contains macro variables is ScoreRangeMacro.sas
- The report template XML file is ScoreRangeTemplate.xml

### SAS Report Program

Here is the SAS code for a user-defined report to categorize score codes:

```
filename mmreport catalog "sashelp.modelmgr.reportexportmacros.source";
%include mmreport;

%MM_ExportReportsBegin(fileName=scoreRange);

options NOmprint NOdate;
%let _MM_PosteriorVar=P_1;


proc format;
  value score
    low - 400 = '400 and Below'
    401 - 450 = '401 - 450'
    451 - 500 = '451 - 500'
    501 - 550 = '501 - 550'
    551 - 600 = '551 - 600'
    601 - 650 = '601 - 650'
    651 - 700 = '651 - 700'
    701 - 750 = '701 - 750'
    751 - 800 = '751 - 800'
    801 - high= '801 and Above';
run;
quit;
```

```
%Macro scoreRange();

  %if &_MM_ScoreCodeType = %str(SAS Program) %then
    %do;
       %let _MM_OutputDS=work.scoreresult;
       %inc &_MM_Score;
    %end;
  %else
    %do;
       data work.scoreresult;
       set &_MM_InputDS;
       %inc &_MM_Score;
       run;
    %end;

  data work.scoreresult2;
    set work.scoreresult;
    keep score;
    if &_MM_PosteriorVar =. then delete;
    score = int (((1-&_MM_PosteriorVar) * 480) + 350 + 0.5);
  run;

  proc freq data=work.scoreresult2;
    table score/out=scoresummary;
    format score score.;
    title 'Credit Score Range';
  quit;

  proc gchart data=work.scoresummary;
    hbar score / sumvar=count discrete;
    title 'Credit Score Range';
  run;
  quit;
%Mend scoreRange;

/*   Reporting section */

ods listing close;

%getModelInfo(0);

/* Define libref and data source for _MM_InputDS */
libname MMLib 'C:\SMM141Tutorials\Data';
%let _MM_InputDS=MMLib.DELINQUENCY_SCORING_INPUT;

%scoreRange();
%closeLibsAndFiles();

%MM_ExportReportsEnd;
```

### SAS Program File for Macro Variables

The file ScoreRangeMacro.sas contains only a comment in it because macro variables are not used in the report code:

```
/* ScoreRangeMacro.sas empty file   */
```

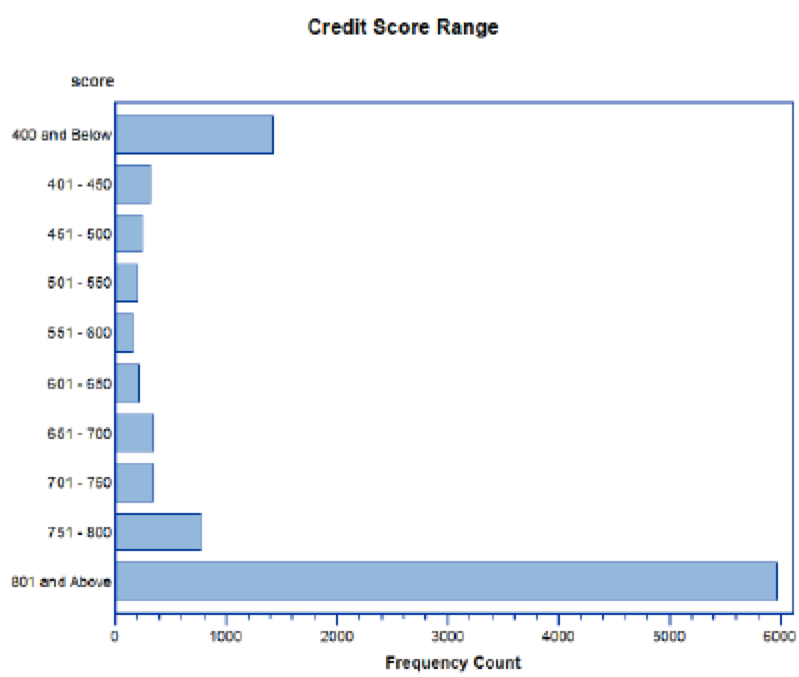
## *Report Template XML File*

Here is the report template XML file for the user-defined Score Range report:

```
<?xml version="1.0" encoding="UTF-8" ?>
<ReportTemplate
    name="Score Range Report"
    type="UserDefinedReport"
    displayName="Score Range Report"
    description="Score Range Report"
    >
    <Report>
        <Data datasetName=""/>
        <Models expectedModelType="ANALYTICAL"
           requiredNumberOfModels="1" level="VERSION">
        </Models>
        <SourceCode>
            <PreCode filename="ScoreRangeMacro.sas"/>
            <Code filename="ScoreRange.sas"/>
        </SourceCode>
        <Output format="PDF" filename="ScoreRange"/>
    </Report>
    <Parameters>
    </Parameters>
</ReportTemplate>
```

## *Score Range Report Output*

The Credit Score Range graph is one of the output pages in the PDF report output.



# *Chapter 13*
# Combining Reports



## About Aggregated Reports

SAS Model Manager administrators and advanced users can combine multiple reports from the **Reports** page to create a single, aggregated report. Using reports that reside in the **Reports** page, you select the reports that you want in your aggregated report. The format of the report can be PDF, HTML, or RTF. Aggregated reports are stored on the **Aggregated** tab.

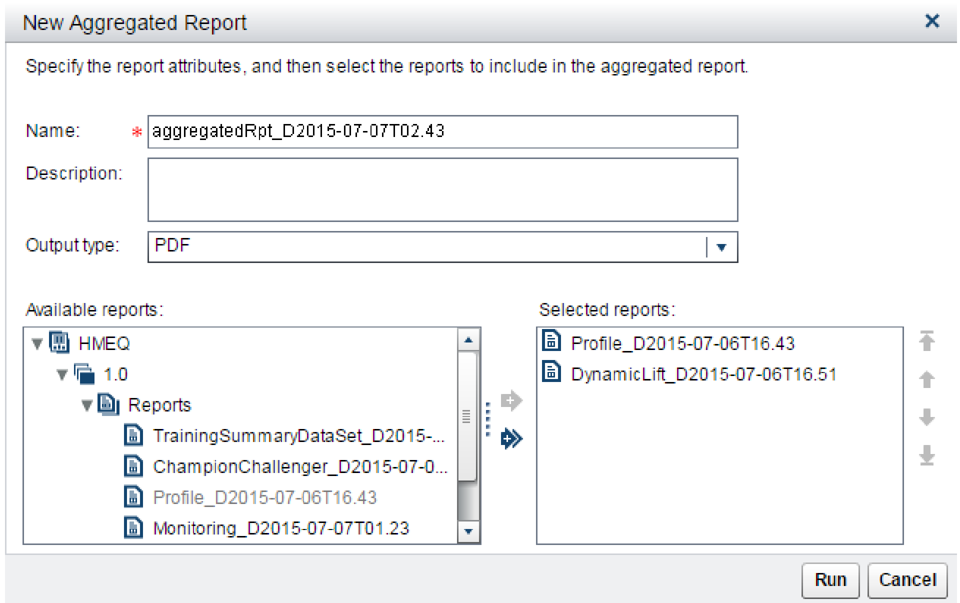
Ad hoc reports, Loss Given Default (LGD) reports, and Probability of Default Model Validation (PD) reports cannot be added to an aggregated report.

## Create an Aggregated Report

*Note:* To create an aggregated report, you must have existing reports on the **Reports** page.

To create an aggregated report:

1. On the **Aggregated** tab on the **Reports** page, click . The New Aggregated Report window appears.




2. (Optional) Enter a name and a description for the report.
3. Select an output type. The default is PDF.
4. In the **Available reports** section, expand the organizational, project, or version folders to show all of the available reports.
5. To add reports from the **Available reports** section, select a report and click to move one report or click to move all reports. The report or reports appear in the **Selected reports** section.
6. To order the reports, select a report and use the up and down arrows.
7. To remove reports from the **Selected reports** section, select a report and click to remove one report or click to remove all reports.
8. When all of the reports are in the **Selected reports** section and in the correct order, click **Run**. The report is generated and appears in the default viewer for the selected output type.
9. The report appears in a list on the **Aggregated** reports tab.

## View an Aggregated Report

To view an aggregated report:

1. On the **Aggregated** tab, select a report from the list.
2. View the report in one of several ways:
   - Double-click a report in the list.
   - Select a report from the list and click .
   - Right-click a report from the list and select **Open**.

   *Note:* You can also view the SAS code and SAS log if the report is not displayed.

*Note:* If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

## Delete an Aggregated Report

To delete an aggregated report:

1. On the **Aggregated** tab, select a report from the list.
2. You can delete the report in one of several ways:
   - To delete a file, click . Confirm the deletion.
   - Right-click a report from the list and select **Delete**. Confirm the deletion.

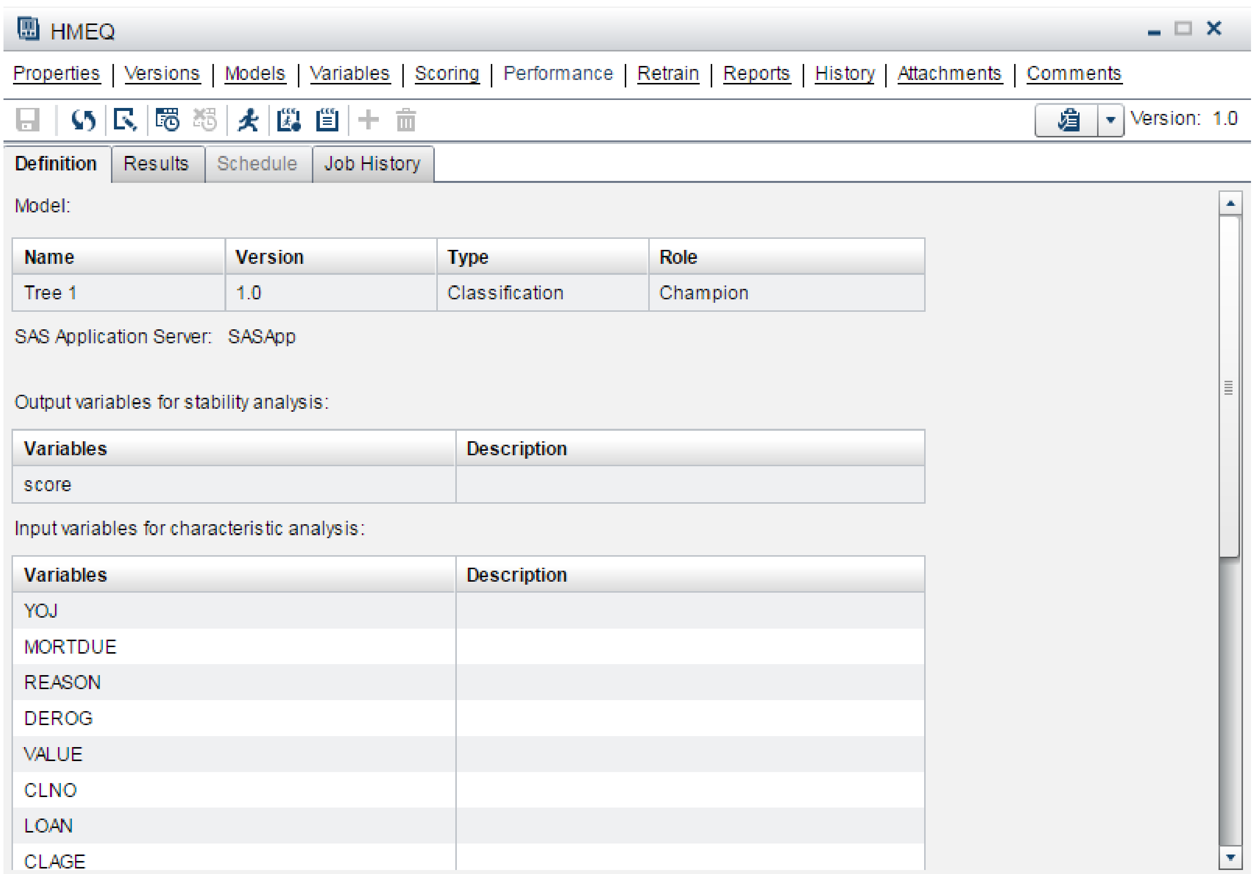
# Chapter 14
# Monitoring Performance of Models



## Overview of Performance Monitoring

To ensure that a champion model in a production environment is performing efficiently, you can collect performance data that has been created by the model at intervals that are determined by your organization. A performance data set is used to assess model prediction accuracy. It includes all of the required input variables as well as one or more actual target variables. For example, you might want to create performance data sets monthly or quarterly and then use SAS Model Manager to create a performance definition that includes each time interval. After you create and execute the performance definition on the **Performance** page, you can view the performance data through report charts in SAS Model Manager. These report charts give a graphical representation of the model's performance. SAS Model Manager also enables you to create performance monitoring reports in PDF, HTML, and RTF output formats from the **Reports** page.

*Note:* Performance monitoring is designed to work only with a project that is associated with a classification model function and has a binary target, or with a prediction model function and has an interval target. Only models that are associated with the classification and prediction model types and that are set as champion and challenger models can be monitored for performance.




The following types of output for performance monitoring are available:

- Summaries of the types of information in project folders such as the number of models, model age distribution, input variables, and target variables.
- Reports that detect and quantify shifts in the distribution of variable values over time that occur in input data and scored output data.
- Performance monitoring reports that evaluate the predicted and actual target values for a champion model at multiple points in time.

You can create the performance monitoring output, except for summaries, using either of the following methods:

- On the **Performance** page, generate the SAS code that creates the performance output and then execute the generated code.
- Write your own SAS program using the report creation macros that are provided with SAS Model Manager and submit your program as a batch job. You can run your

SAS program in any SAS session as long as the SAS session can access the SAS Content Server.

After you create and execute a performance definition, you view the report charts by selecting the **Results** tab on the **Performance** page. The report charts are interactive, and you can modify them to help you assess the champion model performance. For example, you can show markers in the charts and show tables for the different types of reports. You can also select different variables for the x-axis and display them in the chart for the Variable Distribution Report.

If you have flagged a challenger model to compare with the champion model, you can use the performance data that you collected for the champion model to create reports for the challenger model. After all of the performance monitoring definitions have been run, you can create a Champion and Challenger Performance report that compares the champion model to the challenger model.

# Types of Performance Monitoring

## *Overview of the Types of Performance Monitoring*

After a champion model is in production, you can monitor the performance of the model by analyzing the performance results. You can create the performance output interactively using the Edit Performance Definition wizard on the **Performance** page of a project or you can submit batch programs within SAS.

You can create the following types of performance output:

Summary Results
: The **Summary** results summarize the number of models, the number of versions, the number of scoring tests, and the number of reports. The summary information enables you to compare the contents of folders, projects, and versions. You view the Summary results by selecting **Actions** ⇨ **View Summary**.

Data Composition Reports
: The Variable Distribution report shows you the distributions for a variable in one or more time periods, which enables you to see the differences and changes over time. The Characteristic and Stability reports detect and quantify shifts in the distribution of variable values that occur in input data and scored output data over time. By analyzing these shifts, you can gain insights on scoring input and output variables.

Model Monitoring Reports
: The model monitoring reports are a collection of performance assessment reports that evaluate the predicted and actual target values. The model monitoring reports create several charts:

  - Lift
  - Gini - ROC (Receiver Operating Characteristic)
  - Gini - Trend
  - KS
  - MSE (Mean Squared Error) for prediction models

When you create Data Composition reports and Model Monitoring reports, you can set performance index warnings and alerts. When certain thresholds are met, SAS Model Manager can send a warning and alert notification to email addresses that you configure either in the Edit Performance Definition wizard or in a SAS program.

You view the Data Composition reports and the Model Monitoring reports on the **Results** tab on the **Performance** page.

## Summary Results

The Summary results summarizes the contents of different folders and projects.

The contents of the Summary results is dynamic and is updated according to the selected project. The scope of the information that is reported is defined by the collection of folders and objects that exist beneath the folder that is selected.

To view the Summary results, select **Actions** ⇨ **View Summary**.

Use the following sections to evaluate and compare the contents of the project:

**General**
: Use the **General** section to browse the number of models, the number of versions, and the number of scoring tests.

**Summary of Reports**
: Use the **Summary of Reports** section to browse the number of reports that are available on the **Reports** page for the selected object.

**Model Target Variable Report**
: Use the **Model Target Variable Report** to see the frequency with which target variables are used in the models that exist for the selected object. Each unique model target variable is reported, listing the number of models that use that variable as a target variable.

**Model Input Variable Report**
: Use the **Model Input Variable Report** to see the frequency with which input variables are used in the models for a folder or project. Each unique model input variable is reported, listing the number of models that use that variable as an input variable.

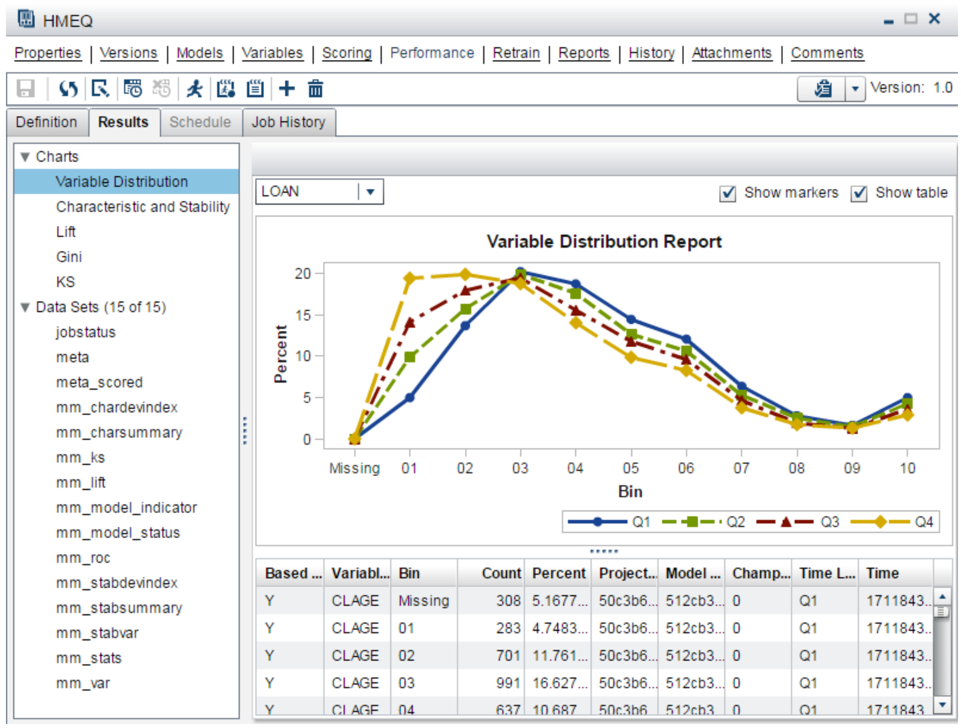
## Data Composition Reports

### Variable Distribution Report

Select the **Results** tab on the **Performance** page to view the **Variable Distribution** report. The variable distribution chart is a graphical representation of distributions over a period of time for the selected variable. Each line plot represents the data for a specific period of time. The Y-axis is the percentage of observations in a bin that is proportional to the total count.

To change the variable that appears in the chart, select a variable from the drop-down list.

Here is an example of a Variable Distribution report. By placing the cursor over a point in the chart, you can view the data for that point.




## *Characteristic and Stability Reports*

Together, the Characteristic and Stability reports detect and quantify shifts that can occur in the distribution of model performance data, scoring input data, and the scored output data that a model produces.

*Note:* For each time period that you execute a performance definition, SAS Model Manager creates a new point on the charts. Line segments between points in time do not appear on the charts unless you specify at least three data sources and collection dates as part of the performance definition.

### Characteristic Report

The Characteristic report detects and quantifies the shifts in the distribution of variable values in the input data over time. These shifts can point to significant changes in customer behavior that are due to new technology, competition, marketing promotions, new laws, or other influences.

To find shifts, the Characteristic report compares the distributions of the variables in these two data sets:

- the training data set that was used to develop the model
- a current data set

If large enough shifts occur in the distribution of variable values over time, the original model might not be the best predictive or classification tool to use with the current data.

The Characteristic report uses a deviation index to quantify the shifts in a variable's values distribution that can occur between the training data set and the current data set. The deviation index is computed for each predictor variable in the data set, using this equation:

$$\mathit{Deviation\_Index} = \sum (\%Actual - \%Expected) * \ln(\%Actual / \%Expected)$$

Numeric predictor variable values are placed into bins for frequency analysis. Outlier values are removed to facilitate better placement of values and to avoid scenarios that can aggregate most observations into a single bin.

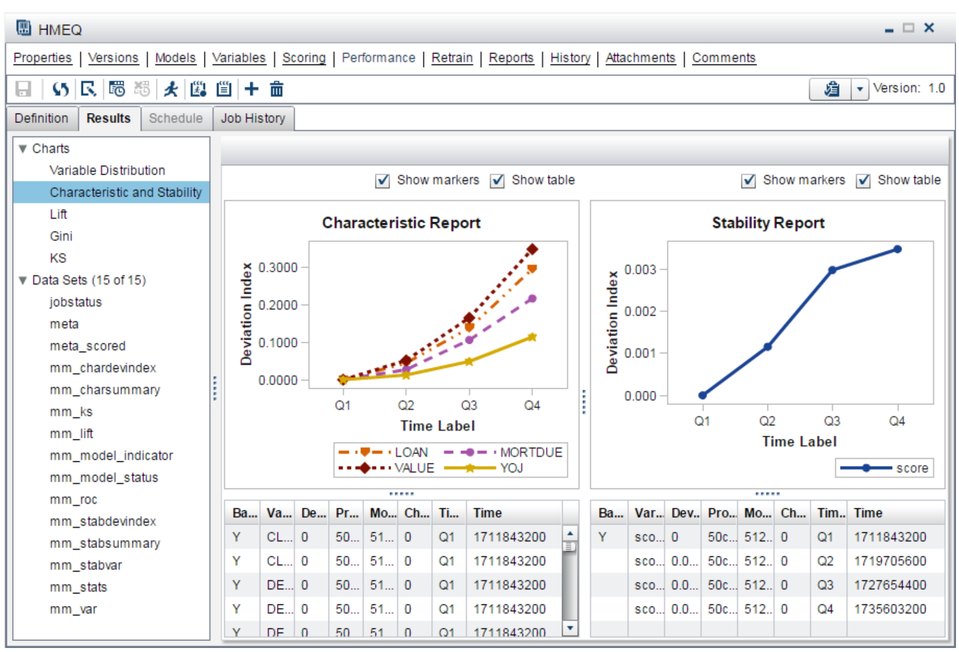
If the training data set and the current data set have identical distributions for a variable, the variable's deviation index is equal to 0. A variable with a deviation index value that is P1>2 is classified as having a mild deviation. The Characteristic report uses the performance measure P1 to count the number of variables that receive a deviation index value that is greater than 0.1.

A variable that has a deviation index value that is P1>5 or P25>0 is classified as having a significant deviation. A performance measure P25 is used to count the number of variables that have significant deviations, or the number of input variables that receive a deviation index score value that is greater than or equal to 0.25.

**Stability Report**

The Stability report evaluates changes in the distribution of scored output variable values as models score data over time, and detects and quantifies shifts in the distribution of output variable values in the data that is produced by the models. If an output variable from the training data set and the output variable from the current data set have identical distributions, then that output variable's deviation index is equal to 0. An output variable with a deviation index value that is greater than 0.10 and less than 0.25 is classified as having a mild deviation. A variable that has a deviation index value that is greater than 0.30 is classified as having a significant deviation. Too much deviation in predictive variable output can indicate that model tuning, retraining, or replacement might be necessary.

Here is an example of Characteristic and Stability reports. By placing the cursor over a point in the chart, you can view the data for that point.



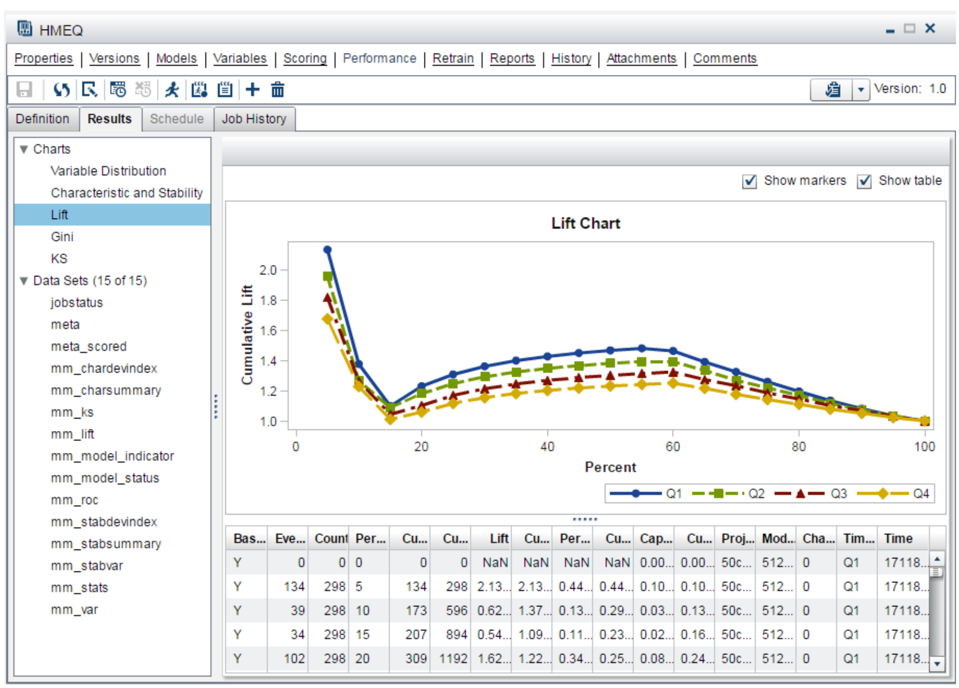
## Model Monitoring Reports

### Lift Report

The Lift report provides a visual summary of the usefulness of the information that is provided by a model for predicting a binary outcome variable. Specifically, the report summarizes the utility that you can expect by using the champion model as compared to using baseline information only. Baseline information is the prediction accuracy performance of the initial performance monitoring definition or batch program using operational data.

A monitoring Lift report can show a model's cumulative lift at a given point in time or the sequential lift performance of a model's lift over time. To detect model performance degradation, you can set the Lift report performance indexes Lift5Decay, Lift10Decay, Lift15Decay, and Lift20Decay. The data that underlies the Lift report is contained in the report file mm_lift.sas7bdat. This file is available on the **Attachments** page.

Here is an example of a monitoring Lift report. By placing the cursor over a point in the report, you can view the data for that point.



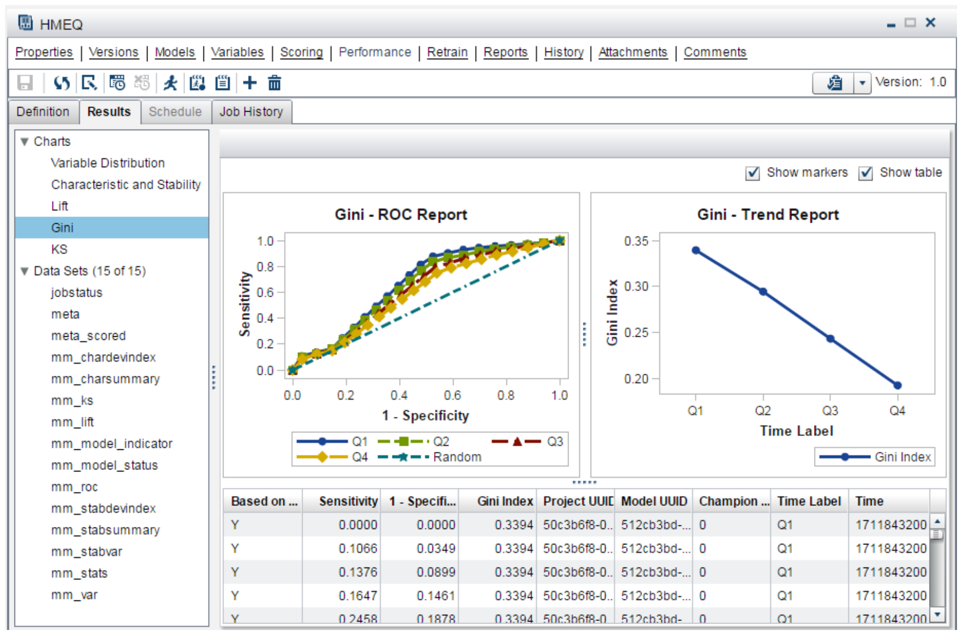

### Gini (ROC and Trend) Report

The **Gini (ROC and Trend)** reports show you the predictive accuracy of a model that has a binary target. The plot displays sensitivity information about the y-axis and 1-Specificity information about the x-axis. Sensitivity is the proportion of true positive events. Specificity is the proportion of true negative events. The Gini index is calculated for each ROC curve. The Gini coefficient, which represents the area under the ROC curve, is a benchmark statistic that can be used to summarize the predictive accuracy of a model.

Use the monitoring **Gini (ROC and Trend)** report to detect degradations in the predictive power of a model.

The data that underlies the monitoring **Gini (ROC and Trend)** report is contained in the report component file mm_roc.sas7bdat.

The following chart is an example of a monitoring **Gini (ROC and Trend)** report. By placing the cursor over a point in the chart, you can view the data for that point.




## *KS Report*

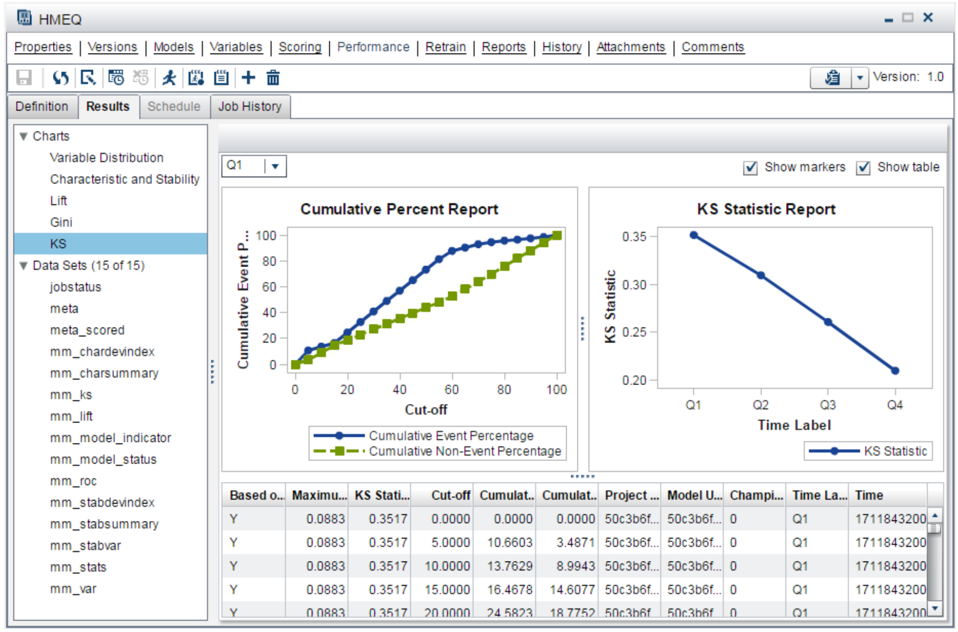
The KS report contains the Kolmogorov-Smirnov (KS) test plots for models with a binary target. The KS statistic measures the maximum vertical separation, or deviation between the cumulative distributions of events and non-events. This trend report uses a summary data set that plots the KS statistic and the KS probability cutoff values over time.

Use the KS report to detect degradations in the predictive power of a model. To scroll through a successive series of KS performance depictions, select a time interval from the **Time Interval** list box. If model performance is declining, it is indicated by the decreasing distances between the KS plot lines.

To detect model performance degradation, you can set the ksDecay performance index in the KS report.

The data that underlies the KS chart is contained in the report component file mm_ks.sas7bdat.

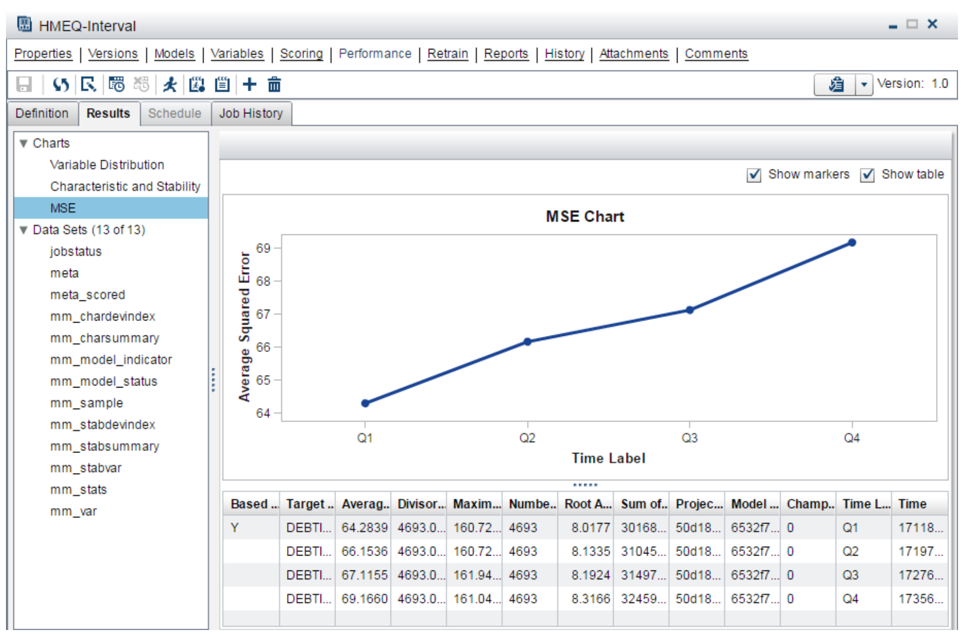
The following report is an example of a KS report. By placing the cursor over a point in the chart, you can view the data for that point.




### Mean Squared Error Report

The Mean Squared Error (MSE) report checks the accuracy of a prediction model with an interval target by comparing the estimation derived from the test data and the actual outcomes that are associated with the test data for different time periods.

The following report is an example of an MSE report.




## Performance Index Warnings and Alerts

The production model performance reports use performance measurement thresholds to benchmark and gauge the performance of a predictive model. When one of the performance measurements exceeds one or more specified indexes or thresholds, warning and alert events occur. When warning or alert events occur, warning and alert notifications are automatically sent by email to recipients whose email address is configured either in the Edit Performance Definition wizard or in the batch program that runs the reports.

Use the following assignment statements to set warning and alert conditions:

```
alertCondition='alert-condition';
warningCondition='warning-condition';
```

*Note:* The condition must be enclosed in quotation marks if you use SAS code to create the report. An error occurs if you enclose the condition in quotation marks in the Edit Performance Definition wizard.

The following indexes and thresholds can be configured in either the Edit Performance Definition wizard or in a batch program that creates the report specifications:

Characteristic report
: You can configure the thresholds for the performance indexes P1 and P25. The P1 and P25 indexes represent the count of input variables with deviation index scores exceeding 0.1 and 0.25, respectively. Here is an example of alert and warning thresholds:

```
alertCondition='p1>5 or p25>0';
warningCondition='p1>2';
```

Stability report
: You can configure output deviation index scores for a model's output variable. The output deviation index scores represent the deviation levels in the distribution of the model's scored output variables. Here is an example of alert and warning thresholds:

```
alertCondition='outputDeviation>0.03';
warningCondition='outputDeviation>0.01';
```

Model Assessment reports
: For the Lift, Gini (ROC and Trend), and KS reports, you can configure threshold values for the following decay statistics.

| | |
|---|---|
| lift5Decay | is the lift performance decay based on the top 5% of the target population of interest from time A to time B. |
| lift10Decay | is the lift performance decay based on the top 10% of the target population of interest from time A to time B. |
| lift15Decay | is the lift performance decay based on the top 15% of the target population of interest from time A to time B. |
| lift20Decay | is the lift performance decay based on the top 20% of the target population of interest from time A to time B. |
| giniDecay | is the performance decay of the Gini index from time A to time B. |
| ksDecay | is the performance decay of the KS statistic from time A to time B. |

For the prediction model MSE report, you can configure the mseDecay statistic threshold values. The mseDecay statistic is the performance decay of the MSE statistic from time A to time B.

Here is an example of alert and warning thresholds:

```
alertCondition='(lift5Decay>0.15 and lift10Decay>0.12)
```

```
                                    or giniDecay>0.1 or ksDecay>0.1';
warningCondition='lift5Decay>0.05';
```

## Monitoring Champion Models

Your project plan might include a schedule to monitor the champion model performance, or your plan might require that you monitor the performance at any time. For each time period that you monitor the champion model, you take a snapshot of the data for that time period and use that data as the performance data source for creating the monitoring reports.

You can create monitoring reports by creating and executing a performance definition, or you can submit batch programs to create the reports. Both methods require the same information. Both methods can process one or more performance data sources. When you create a performance definition, you can specify one or more data sources to process. When you use a batch program, you use a separate DATA step to process each data source.

If you run batch programs, you can find example programs in the sashelp.modelmgr.source catalog. These reports' filenames are **reportexample***x*, where *x* is a number from 1 to 4.

The following table lists the definitions that are required to create performance reports:

| Definition | Reports Created by Using the Edit Performance Definition Wizard | Reports Created Using SAS Programs That Run in Batch |
|---|---|---|
| Create a folder structure for report files | The folder structure is inherent in the Project. No action is necessary. | Create a folder structure on a local drive of the SAS Model Manager server. |
| Obtain performance data | The performance data is one or more SAS data sets that are a snapshot of model output. They can be registered in SAS Management Console or they can be accessed by using a libref that has been defined by using the Edit Start-up Code window. | The performance data is used to assess model prediction accuracy. It includes all of the required scoring input variables as well as one or more actual target variables. You can store performance data sets anywhere as long as they can be accessed by the SAS session that runs the batch program. The data sets do not need to be registered with SAS Management Console. |
| Ensure access to the champion or challenger model | This process is performed by the Edit Performance Definition wizard. No action is necessary. | Run the %MM_GetModels() macro to extract the champion model in a channel to a local drive of the SAS Model Manager server. . |

| Definition | Reports Created by Using the Edit Performance Definition Wizard | Reports Created Using SAS Programs That Run in Batch |
|---|---|---|
| Map model and project output variables. | Map the model and project output variables using the Project Tree. | Map the model and project output variables using the Project Tree. |
| Define report specifications | The report specification are derived from project data and input that you specify in the Edit Performance Definition wizard. The wizard generates the SAS code to create the performance reports. | Write the following DATA steps:<br>• mm_jobs.project<br>• mm_jobs.emailaddr<br>• mm_jobs.reportdef<br>• mm_jobs.jobtime |
| Specify the report execution operational environment | The operational environment is known to SAS Model Manager. No action is necessary. | Define the required macro variables that are used by the %MM_RunReports() macro. |
| Run the reports | Execute the code from the **Performance** page that was generated by the Edit Performance Definition wizard or schedule the performance definition from the **Performance** page. The data sets that underlie the monitoring reports are stored in the **Results** tab. | Create a DATA step that points to the performance data sets and execute the %MM_RunReports() macro. The data sets that underlie the monitoring reports are stored in the **Results** tab when the reports are created in production mode. In Test mode, the monitoring reports data sets reside in the location specified in the mm_jobs.project data set. |
| View the reports | Select the **Performance** page for the champion model to view the reports. | Select the **Performance** page for the champion model to view the reports. |

# Creating Reports Using a Performance Definition

## *Overview of Creating Reports Using a Performance Definition*

You define and execute a performance definition for a project. The model that you monitor is either the project champion model or a challenger model that is flagged in any version for the project. The process of creating performance reports is a two-step process. First, you run the Edit Performance Definition wizard to generate the code that creates the performance data results. Then, you execute the generated code. You can execute the code immediately, or you can schedule a date and time at which the definition is to run. Information about performance definitions is recorded and can be viewed on the **Results** tab of the **Performance** page.

To create performance reports:

- Ensure that one or more performance data sources are registered using SAS Management Console or that a libref has been defined for the location where the performance data sets are stored.
- Ensure that all prerequisites have been completed.
- Run the Edit Performance Definition wizard to generate the SAS code that creates the performance reports.
- Execute the generated code or schedule when the generated code is to be executed.
- To view the reports, select the **Results** tab on the **Performance** page.

### *Determine How to Use the Performance Data Sets*

Before you run the Edit Performance Definition wizard, the performance data sets must be registered in the SAS Metadata Repository. You can register the data sets in the Data category view or you can add tables to an existing library that have already been registered using SAS Management Console. For each project, you can set up your environment to use the performance data source that is most appropriate for your business process. Here are two methods of collecting performance data:

- Method 1: You periodically take a snapshot of an operational data set to create a performance data set. Each time you take a snapshot, you give the performance data set a new name. Each performance data set must be registered in the SAS Metadata Repository and it must be available in the **Data** category view. You can create and execute a performance monitoring definition each time you take a snapshot, or you can create a performance monitoring definition to execute multiple performance data sets in the same definition. The best practice is to use the dynamic data sources in the performance definition.
- Method 2: You take a snapshot of the operational data set to create a performance data set over time, and you reuse the same name for each performance data set every time you take a snapshot. You register the performance data set in the SAS Metadata Repository only once. The performance data set must be available in the **Data** category view. Each time you take a snapshot, you replace the performance data set at the location where the performance data set is registered.

  When you run the Edit Performance Definition wizard, the name of the performance data source does not change. The **Default performance table** project property is not populated in the Edit Performance Definition wizard. You modify only the **Collection Date** and **Report Label** columns in the table.

The following table summarizes the definitions that are performed if performance reports are run after six months or for reports that are run every month. Use this definition and example table to help you determine how you want to name your performance data sets and your performance data sources.

| Definition | Method 1: The Performance Data Set Name Changes | Method 2: The Performance Data Set Name Remains Static |
|---|---|---|
| Create a performance data set from model output data | Each month, take a snapshot of the operational data and create a performance data set with a different name:<br>• Jul13<br>• Aug13<br>• Sep13<br>• Oct13<br>• Nov13<br>Dec13 | Every month, take a snapshot of the operational data and name the performance data set using the same name:<br>2013perf |
| If you are registering the performance data sets in the SAS Metadata Repository, register the performance data sets using SAS Management Console | Register the data sets monthly or register them all at once before you run the reports. | Register the data sets the first month only. |
| If the performance data set is accessed by using a libref, store the data set in the SAS library. | Save the performance data set in the SAS library that is defined by a libref in SAS Model Manager. | Save the performance data set in the SAS library that is defined by a libref in SAS Model Manager. |
| Modifications to make in the Edit Performance Definition wizard | In Step 3, select one or more performance data sources. For each data source, select a data collection date and enter a date label. | In Step 3, select a data collection date and enter a date label.<br>The **Performance data source** field contains the static name of the performance data source name because it was specified for the previous execution of the definition for this project. |
| Create the reports | Run the Edit Performance Definition wizard and execute the reports from the **Performance** page or schedule when the definition is to execute.<br>Because each performance data source has a different name, you can run the performance definition as desired; the definition does not need to be run monthly. | Monthly, run the Edit Performance Definition wizard and execute the reports from the **Performance** page or schedule when the definition is to execute.<br>To ensure that you do not write over important performance data, run the performance definition before a new snapshot of the operational data is taken. |

# Prerequisites for Editing a Performance Definition

## *Overview of Prerequisites*

Before you edit a Performance Definition, the environment must be set appropriately as follows:

- Ensure that the champion model is set or the challenger model is flagged.
- Ensure that the champion or challenger model is within a project that is associated with a classification model function and has a binary target, or that is associated with a prediction model function and has an interval target.
- Ensure that the champion or challenger model contains a score.sas file. If the performance data set contains the predicted values, the score.sas file can be empty. For more information, "Monitoring Performance of a Model without Score Code" on page 187.
- Ensure that the performance data sets for the time period that you want to monitor are registered in SAS Management Console or that a libref has been defined for the SAS library where the performance data sets are saved.
- Ensure that the appropriate project and model properties are set.

After the environment is set, you can run the Edit Performance Definition wizard.

## *Ensure That Champion and Challenger Models Are Set*

The Edit Performance Definition wizard generates report code for the champion model in the champion version.

You can determine the champion version and the champion model by looking for the icon next to the champion version name and the champion model name on the **Versions** page. The status is also indicated in the **Role** column on the **Models** page.

If the champion model is not set, select a model and click or right-click the champion model name and select **Set as Champion**. The icon appears next to the champion model name and the version for the champion model.

You can determine the challenger model by looking at the **Role** column on the **Models** page. View the number of challengers on the **Details** view of the **Versions** page.

If the challenger model is not set, click or right-click the challenger model name and select **Flag as Challenger**.

## *Ensure That the Champion Model Function and Class Target Level Are Valid*

Performance monitoring is valid only for a project that is associated with a classification model function and has a binary target, or for a prediction model function that has an interval target. You should define only performance definitions for classification and prediction models. The champion model must either have a function type of classification and must contain a binary target, or have a function type of prediction and must contain an interval target.

From the Projects category view, select the champion model name and verify that the **Model function** property in the specific properties section is set to `Classification` or `Prediction`. For models that are created using SAS Enterprise Miner, verify that **Class target level** is set to `BINARY` for a classification model or to `INTERVAL` for a prediction model.

### Ensure That the Performance Data Source Is Available

The Edit Performance Definition wizard requires that the performance data be registered in the SAS Metadata Repository. You can register the data sets in the Data category view or you can add tables to an existing library that have already been registered using SAS Management Console.

If your performance table is not available for selection, contact your administrator to add the table to the Data Library Manager using SAS Management Console. For more information, see the *SAS Model Manager: Administrator's Guide*.

### Ensure That Project and Model Properties Are Set

Several properties must be defined in order to generate the model performance reports. Verify that the appropriate project and model properties are set. Here is a list of properties.

Classification Project Properties

- Training target variable
- Target event value
- Class target level
- Output event probability variable

Prediction Project Properties

- Training target variable
- Class target level
- Output prediction variable

Model Properties

- Score code type

### Map Model and Project Output Variables

In order to create the model performance reports, you must map the model output variable to the project output variable if the corresponding project variable and the model variable have different names.

To map the model variables to the project variables:

1. Select and open a model.
2. Select **Model Properties** ⇨ **Output Mapping**.
3. Click the box in the **Value** column beside the variable in the **Property** column to display a list of project variables.
4. Select a model output variable.
5. Repeat steps 3 and 4 for each model variable that requires mapping.

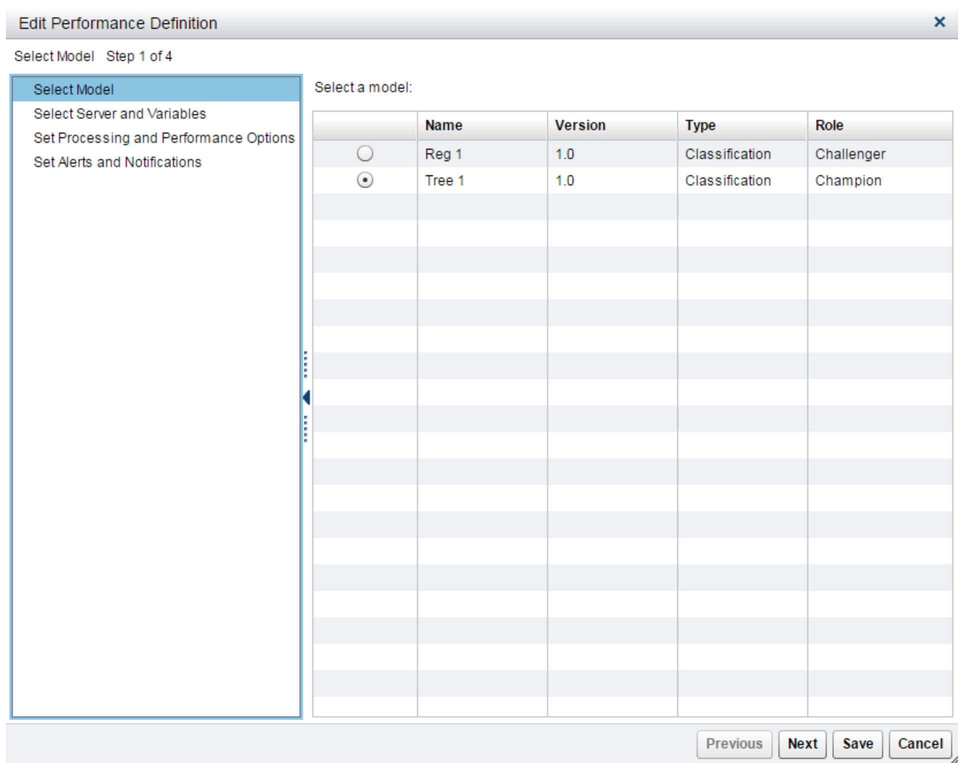
6. Click .

## Edit and Execute a Performance Definition

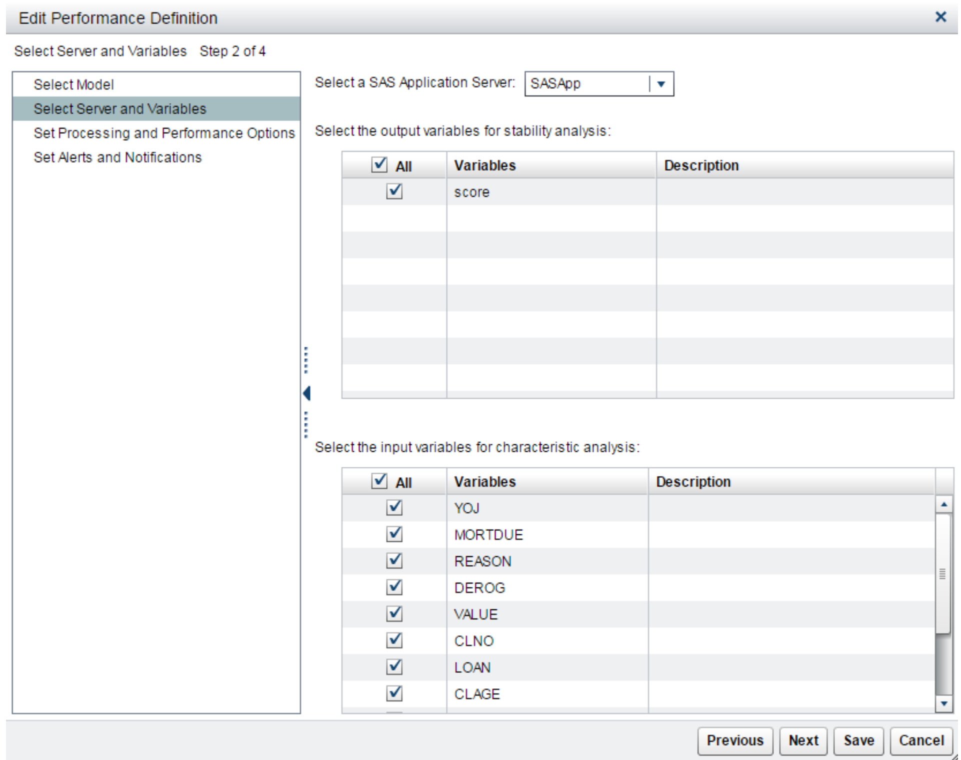
To create the monitoring reports, you specify a performance definition to generate SAS code. You then execute the generated code or create a schedule to execute the generated code on a specific day and time. Execution of the generated code creates the SAS data sets that are used to display reports: either the monitoring reports from the version **Performance** page, or the Monitoring report or Champion and Challenger Performance report that you create from the New Report window.

To edit the performance definition:

1. Click  and select a champion or challenger model. Click **Next**.




2. Select a SAS Application Server.
3. Select one or more output variables for stability analysis. To select all output variables, click **All**.
4. Select one or more input variables for characteristic analysis. To select all input variables, click **All**. Click **Next**.




5. Choose the data processing method:
   - To run a standard environment, select **Standard configuration**.

     To run the score code in the performance monitor job, select the **Run model score code** check box.
   - To run the performance monitoring definition in a High-Performance Analytics environment, select **High-performance configuration**.

     *Note:* The score code is not run when **High-performance configuration** is selected.
6. Decide to use either the static or dynamic data sources, and then specify the data source information.

   *Note:* Ensure that the data source information is complete before saving the definition. If you start adding information for static data sources and then decide to use dynamic data sources instead, be sure to delete the information added for static data sources before adding the dynamic data source information, and vice versa.

   To use static data sources:

   a. Click .

      *Note:* If you are adding multiple tables in the first performance definition, the data table whose collection date is the earliest is set as the baseline performance data table.

   b. Click the empty cell in the **Data Source** column.

   c. Click **Browse** and select a performance data source. Click **OK**.

   d. Click the empty cell in the **Collection Date** column and click . Select a date. The date can be any date in the time period when the performance data was collected.

e. To add a label for the date, enter the label name in the **Report Label** column. The report label represents the time point of the performance data source. Because the report label appears in the performance charts, use a label that has not been used for another time period, is short, and is understandable (for example, Q1).

*Note:* Duplicate report labels result in previous performance results being overwritten.

f. (Optional) Select a data source and click to verify that the selected input variables and target variable are included in the performance data source.

g. (Optional) Repeat the above steps to add multiple performance data sources to the performance definition.

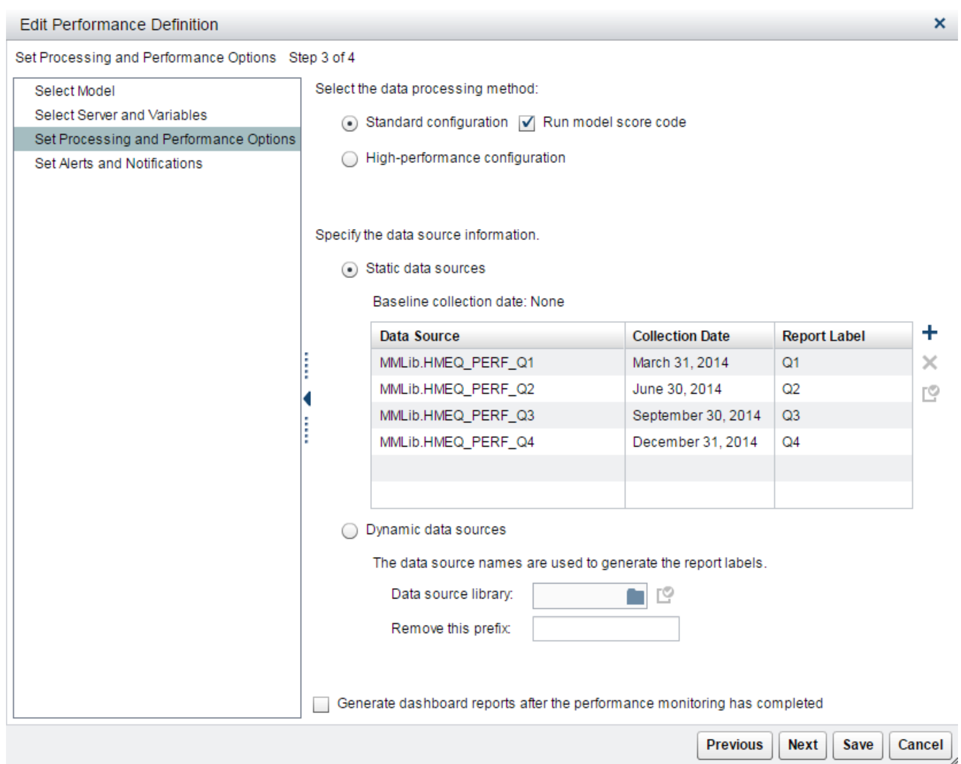
h. (Optional) To delete a data source from the performance definition, select the data source and click .

To use dynamic data sources:

a. Click to select a data source library.

b. (Optional) Specify the prefix to remove from the data source names in the selected library. The data source name is used for the report label. You can remove the prefix so that it does not show as part of a report label on the charts.

7. (Optional) Select **Generate dashboard reports after the performance monitoring has completed**. The dashboard definition must already exist for this option to work.




8. Click **Next**.

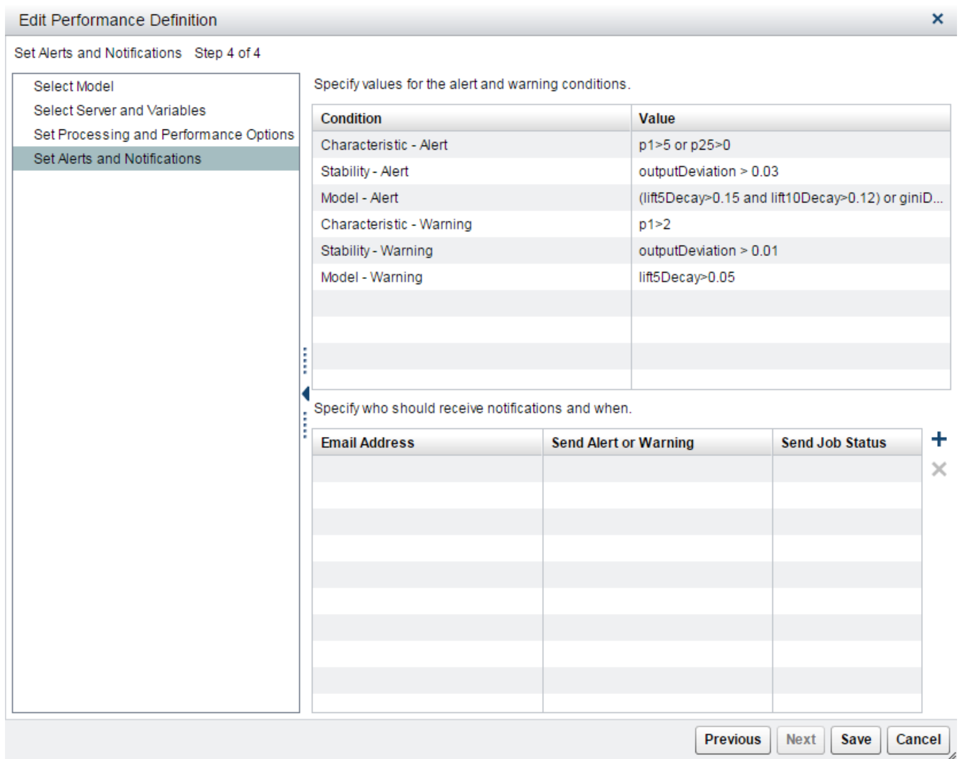
9. (Optional) Either specify values for the alert and warning conditions or accept the defaults.

10. (Optional) To send the results by email, click . A new row is added to the table.

a. Enter an email address.

b. Select either **Yes** or **No** if you want an alert or warning to be sent by email when alert or warning thresholds have been exceeded.

c. Select either **Yes** or **No** if you want a completion notice with the job status to be sent by email every time the report runs.




11. Click **Save**.

To execute a performance definition:

1. Select the **Performance** page for the project.
2. Click .
3. After the performance monitoring has been completed, a confirmation message appears. Click **Close**.
4. Click the **Results** tab to view the performance results.

   *Note:* You can check the status of a job by clicking and then selecting the **Results** tab or the **Job History** tab.

*Note:* You can overwrite or delete previously created performance data sets.

## Schedule Performance Definitions

After you create a performance definition, you can create a schedule to execute the definition to run on a specific day and at a specific time. You can schedule the definition to run hourly, daily, weekly, monthly, or yearly.

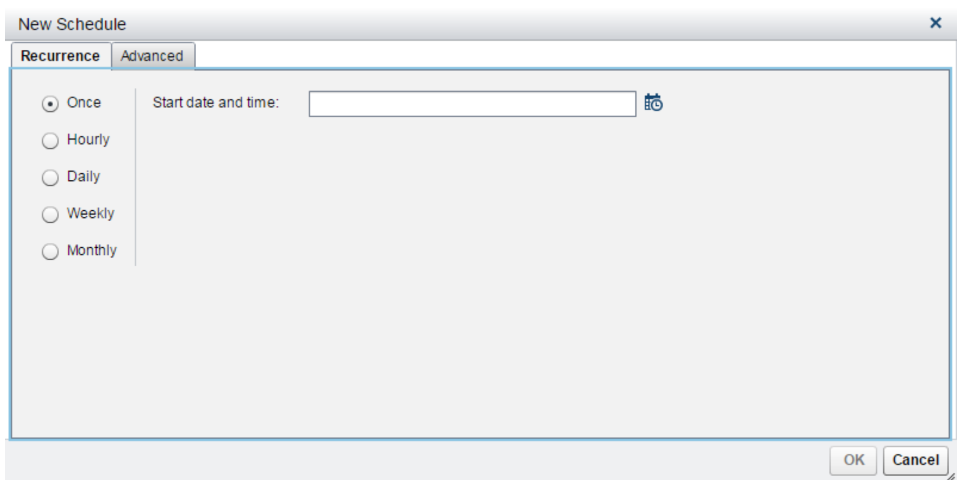
Before you can schedule a performance definition, your user ID and password must be made available to the SAS Metadata Repository. You must also sign in to SAS Model Manager using your full user credentials that were specified for your user account in SAS Management Console. For user accounts where a Microsoft Windows user ID is specified, you must enter your user ID in the format of *domain\userID*. Contact your system administrator to add or update your password, and to determine the correct user credentials for your user account.

You cannot edit a schedule for a performance definition. To modify a schedule, delete the schedule and create a new schedule.

After performance monitoring jobs execute, you can view the job history using the **Job History** tab on the **Performance** page.

To schedule a performance monitoring definition:

1. Click .




2. On the **Recurrence** tab, select the recurrence pattern.
3. Specify the criteria for when and how often the job should be run.
4. (Optional) Select the **Advanced** tab.
   a. Select the server that schedules the job from the **Scheduling server** list box.
   b. Select the batch server that runs the job from the **Batch server** list box.
   c. Click **Browse** to select a location for the performance monitoring output. Click **OK**.
5. Click **OK**.
6. After the job has been scheduled, a confirmation message appears. Click **Close**.
7. Click the **Results** tab to view the performance results.

*Note:* Performance schedules cannot be edited. To change the schedule, delete the schedule and create a new schedule.

Here is a list of the **Schedule** properties for **Performance**:

| Property Name | Description |
| --- | --- |
| **Job Name** | Specifies the name of the performance monitoring definition. This name cannot be changed. |
| **Location** | Specifies the location of the performance monitoring definition in the SAS Metadata Repository. |
| **Scheduling Server** | Specifies the name of the server that schedules the job for the performance monitoring definition. |
| **Batch Server** | Specifies the name of the server that executes the job for the performance monitoring definition. |
| **Recurrence** | Specifies how often the scheduled job for the performance monitoring definition is to be executed. |
| **SAS Application Server** | Specifies the name of the SAS Application Server where the performance monitoring definition is to be executed. |

To delete a schedule, select the schedule and then click .

## View Performance Monitoring Job History

Use the **Job History** tab on the **Performance** page to verify whether a performance monitoring task was run. The performance monitoring job appears on the **Job History** tab only after the job has begun.

To view the job history of a performance monitoring task:

1. Select a project and click the **Performance** page.
2. Click the **Job History** tab. A table appears that lists the performance monitoring jobs that have been executed.

Here is a description of the columns in the job history table:

**Job Name**
: is the name of the performance monitoring task.

**Job Status**
: specifies whether the job status is **Running** or **Completed**.

**Execution Status**
: shows a green indicator for a successful job execution. A yellow indicator shows that the performance monitoring task ran with warnings. A red indicator shows that the performance monitoring task ran with errors.

**Date Started**
is the date and time that the performance monitoring task started.

**Date Completed**
is the date and time that the performance monitoring task ended.

**Log**
is the revision number for the SAS log.

**Output**
is the revision number for the job output.

**SAS Code**
is the revision number for the performance monitoring task program.

## Manage Performance Data Sets

After a performance monitoring task has run, the summary data sets reside on the **Results** tab on the **Performance** page.

To add a performance data set:

1. Click the **Results** tab.
2. Click .
3. Navigate to the location of the data set and select the file to add.
4. Click **Open**.

*Note:* Fifteen tables are shown for the classification model function and thirteen are shown for the prediction model function. The table name must be the same as one of the shown tables; otherwise the uploaded table cannot be displayed. Tables with the same name are overwritten.

To delete the performance data sets:

1. Click the **Results** tab.
2. Click . Confirm the deletion.

## Monitoring Performance of a Model without Score Code

If you want to monitor the performance of a model for which you no longer have the score code, you can import a model without SAS score code. If the performance data set contains the predicted values, the score.sas file can be empty.

To monitor the performance of a model without score code:

1. Prepare the following model files:
   - XML file that defines the model input variables (inputvar.xml)
   - XML file that defines the model output variables (outputvar.xml)
   - XML file that defines the model target variables (targetvar.xml)

- empty SAS score code file (score.sas)

2. Select **Models** ⇨ **Projects**
3. Create a project that has a model function type of **Classification** or **Prediction**. You can skip this step if you have already created a project.
4. Open a project and verify that the project properties are set.
   a. If it is a project that has a model function property value of **Classification**, verify that the following project properties are set:
      - Training target variable (for example, *bad*)
      - Target event value (for example, *1*)
      - Class target level as `Binary`
      - Output event probability variable (for example, `score`)

   b. If it is a project that has a model function property value of **Prediction**, verify that the following project properties are set:
      - Training target variable (for example, *lgd*)
      - Class target level as `Interval`
      - Output prediction variable (for example, `p_lgd`)
5. Select the **Models** page.
6. Click and select **from local files**.

   *Note:* If the model already exists, you can open a model to add model files to an existing model. For more information, see "Add Model Files to an Existing Model" on page 84.
7. Navigate to the folder on your computer that contains the component files for your model.
8. Select a classification or prediction template from the **Choose a model template** list.
9. Enter a text value in the model **Name** field.
10. Click **Properties** and specify the model properties.
11. Click **Files** and select the local files from the SAS Workspace Server that match the template files. You cannot delete a file after you have added it. To replace the file, select another file or cancel the import and start over. The following files are required:
    - inputvar.xml
    - outputvar.xml
    - targetvar.xml
    - score.sas

    *Note:* The filenames that you created for the model do not have to match the template filenames. However, the file contents must meet the file property requirements. For more information, see "Model Template Component Files" on page 340 or "Model Template Component Files" on page 340.
12. Click **OK**.
13. Open the model, and set the model-specific properties. The value for the **Score code type** property must be set to **DATA step**.

14. Expand **Variables** and select **Output Mapping** in order to set the output variable mappings for the model. Select a value for each variable and click .
15. Click  to close the model.
16. Select the model and click  to set as the champion model. For more information, see "Ensure That Champion and Challenger Models Are Set" on page 179.
17. Before defining performance, verify that the performance data set is registered in the SAS Metadata Repository and is available in the Data category view. Make sure that the data set contains the following variables:
    - model input variables

      *Note:* You must have the variable columns in the table, but the values can be missing.
    - target variable
    - prediction variables
    - variables for characteristic analysis
18. Edit a project's performance definition on the **Performance** page. Specify the performance data set that contains the predicted values. Also, be sure to clear the **Run model score code** option for the **Data Processing Method** section of the **Edit Performance Definition** wizard. For more information, see "Edit and Execute a Performance Definition" on page 181.

*Chapter 15*
# Using Dashboard Reports



## Overview of Dashboard Reports

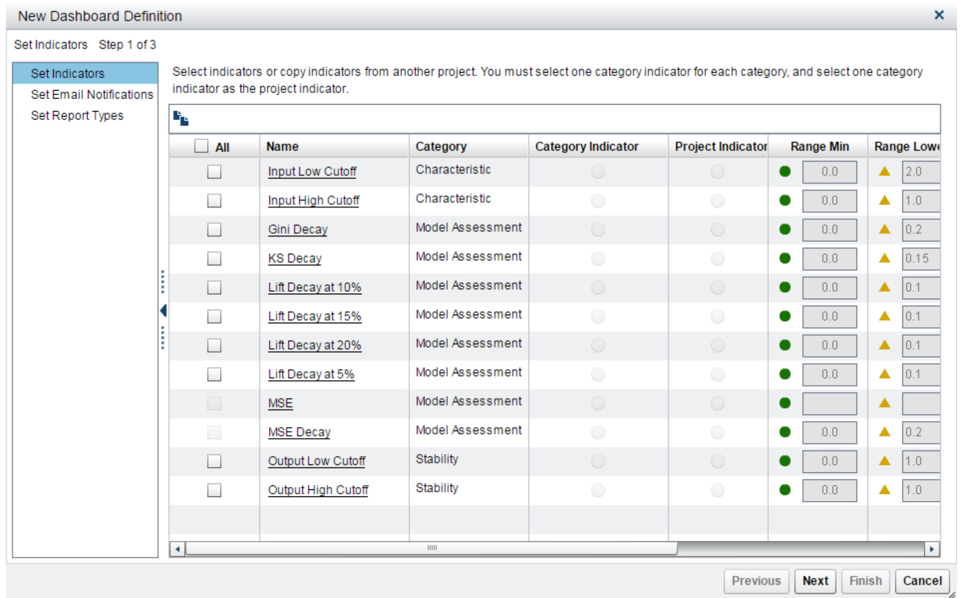
The SAS Model Manager dashboard can provide reports that show the overall state of projects that are being monitored. The dashboard reports are produced from existing performance monitoring reports. For each project, you can define dashboard report indicators by creating a dashboard report definition. The dashboard report definition is used to create the dashboard reports. You view the dashboard reports through the **Dashboard** menu. These reports are generated in HTML.

*Note:* The dashboard reports can be defined and generated only by SAS Model Manager administrators and advanced users.

## Create a Dashboard Report Definition

To create a new dashboard definition:

1. Click and select **New Definition**. The New Dashboard Definition window appears.




2. (Optional) Click to copy indicators from another project. The Copy Indicators from a Project window appears.

   Select the indicators that you want to copy and click **OK**.

3. Select the indicators for the new dashboard definition.

4. Enter normal, warning, and alert values for the range definitions for each indicator that you have selected.

5. Click **Next**.

6. Select one **Category Indicator** for each category, and one indicator as the **Project Indicator**.

   *Note:* The indicator that you select as a project indicator must also be a category indicator.

7. Click **Next**.

8. (Optional) Specify an email address for each recipient who should receive an email notification about the project status. Click , select a project status, and enter an email address. Click **Save**.

   *Note:* If you send email notifications as part of the dashboard definition, the email notification contains a ZIP file (DashboardReports.zip) with the Dashboard reports in HTML format with the contents of the reports when they were generated. It also contains a link to the latest dashboard reports and status on the SAS Content Server.

9. Click **Next**.

10. Use the default selections, or select one or more reports to include in the dashboard reports.

11. Click **Finish**.

    *Note:* You must define dashboard report indicators for all projects that you want to be included in your dashboard reports.

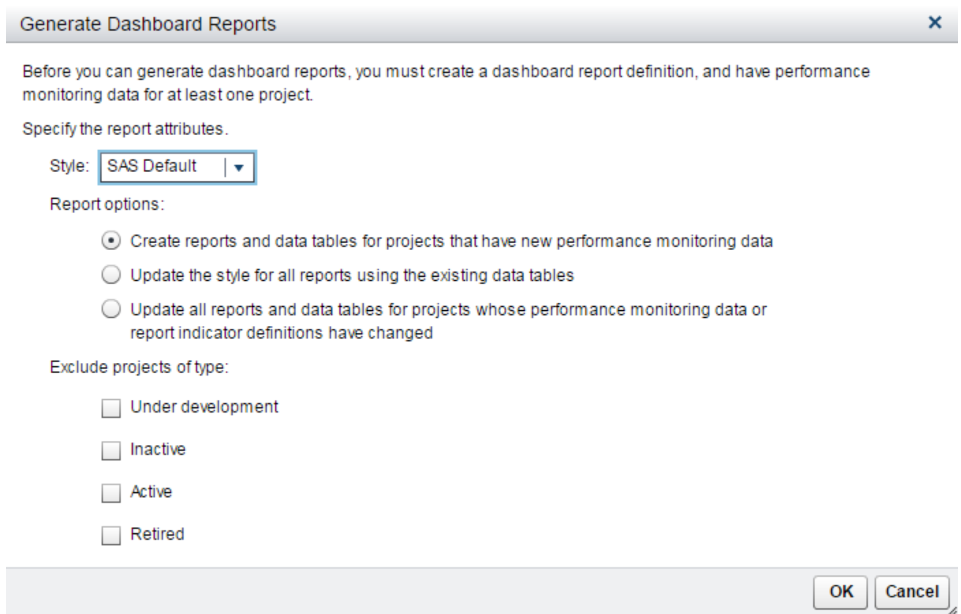
12. Click **Close**.

# Generate Dashboard Reports

*Note:* Before you execute the dashboard report, ensure that at least one project contains performance data. At least one dashboard report indicator must also be defined in that project.

To generate dashboard reports:

1. Click and select **Generate Reports**. The Generate Dashboard Reports window appears.




2. Select a style.
3. Select a report option:
   - Create reports and data tables for projects that have new performance monitoring data.
   - Update the style for all reports, using the existing data tables.
   - Update all reports and data tables for projects whose performance monitoring data or report indicator definitions have changed.

     *Note:* This option regenerates the dashboard reports, even if the performance monitoring data or report indicator definitions have not changed.
4. (Optional) Select an option if you want to exclude one or more project types from the report.
5. Click **OK**. A confirmation window appears, stating that the dashboard report was created.
6. Click **Close**.

## View Dashboard Reports

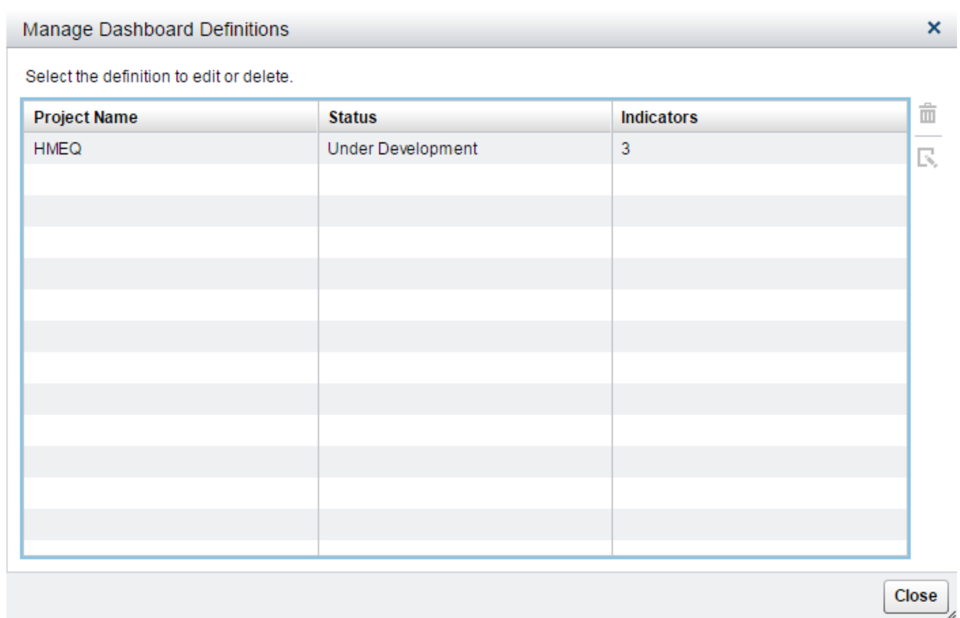
To view the dashboard reports:

1. Click and select **View Reports**. A web page displays all of the dashboard reports for each project that has a dashboard definition.
2. Select a project name or status link to view the associated dashboard report.
3. Select a link from the report column to view the report details.

*Note:* If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

## Manage Dashboard Definitions

1. Click and select **Manage Definitions**. The Manage Dashboard Definitions window appears.




2. Select a definition to edit or delete.

   To edit a definition, click .

      The Edit Dashboard Definition window appears. Make your changes. Click **Finish**.

   To delete a definition, click .

      A confirmation message appears. Click **OK** to confirm the definition.

3. Click **Close**.

# Edit a Dashboard Report Definition

To edit a dashboard definition for a specific project:

1. Select a project, click , and select **Edit Definition**. The Edit Dashboard Definition window appears.
2. Make your changes. Click **Finish**.
3. Click **Close**.

# Chapter 16
# Retraining Models

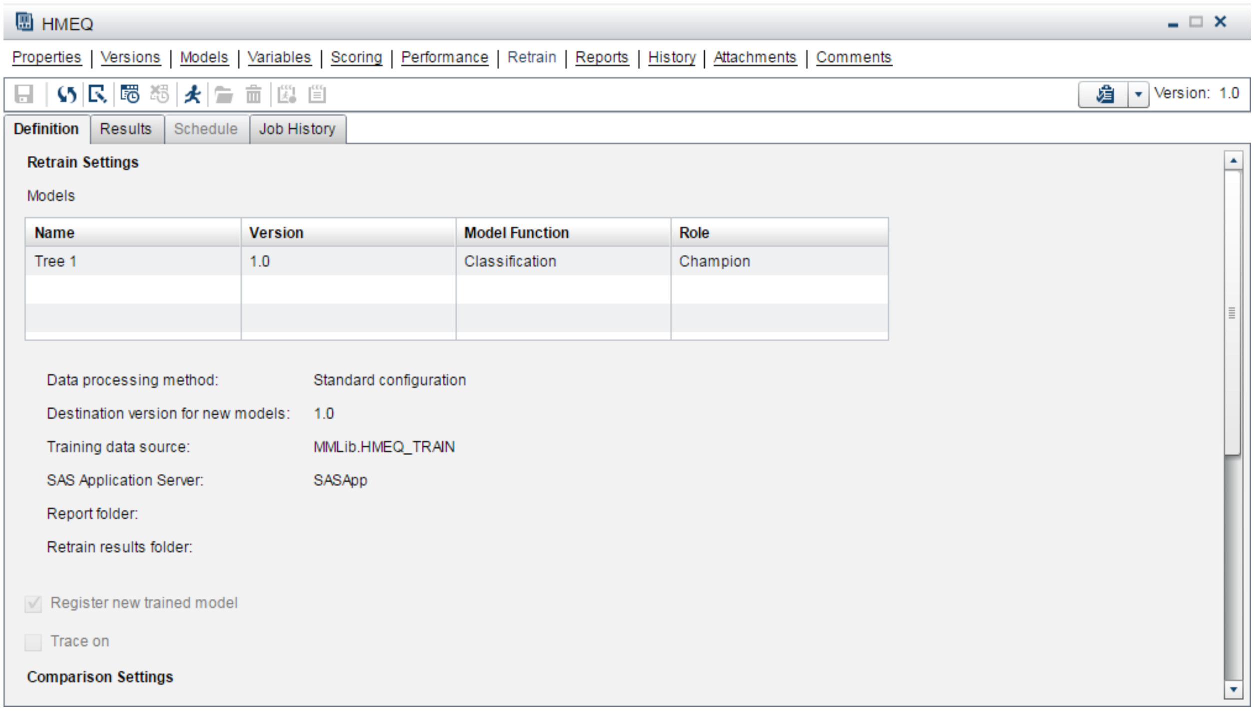


## Overview of Retraining Models

You can retrain models to respond to data and market changes. Retraining models enables you to update out-of-date models and improve model performance. When you edit a model retrain definition, you can select multiple models to be retrained at the same time. The retrain definition for a model includes the destination version and training data source. The destination version is an existing version or new version that is associated with the selected project and stores the retrained model information.

The training data source contains new data for retraining the selected models. You can also specify a location to store the comparison reports and retrain results. When you select the models to include in the comparison report, you can use the training data source or select a different data source to compare the performance of the new models. You can also specify the report options, including the name, format, and style of the comparison report. Email notifications can also be specified as part of a model retrain definition and are sent after you execute a model retrain definition.

By default, the champion model for the selected project is selected for retrain. If the **Register new trained model** option was selected after you execute a model retrain definition, the new models are registered to the destination version. The comparison report is available on the **Results** tab of the **Retrain** page. The definition is executed on the SAS Application Server that is specified. The report folder is stored on the SAS Content Server.




*Note:* Only R models and those that are created by using SAS Enterprise Miner, SAS/STAT, and SAS/ETS can be retrained. Retraining of SAS Factory Miner models is currently not supported in SAS Model Manager.

To retrain a model:

- Ensure that all prerequisites have been completed
- Edit the model retrain definition for a project to generate the SAS code that retrains models
- Execute the generated SAS code
- View the new models and comparison report

## Prerequisites for Retraining a Model

Before you can retrain a model, complete the following prerequisites:

- If you want to retrain the project champion model, ensure that the champion model is set. For more information, see "Champion Models" on page 208.
- Verify that the training data set that you want to use as the training data source has been registered in the SAS Metadata Repository, and is available in the Data category view.
- Verify that the appropriate project and model properties are set:

  Classification Model Project Properties
  - Training target variable
  - Target event value
  - Class target level
  - Output event probability variable

Prediction Model Project Properties

- Training target variable
- Class target level
- Output prediction variable

Model Properties

- Score code type

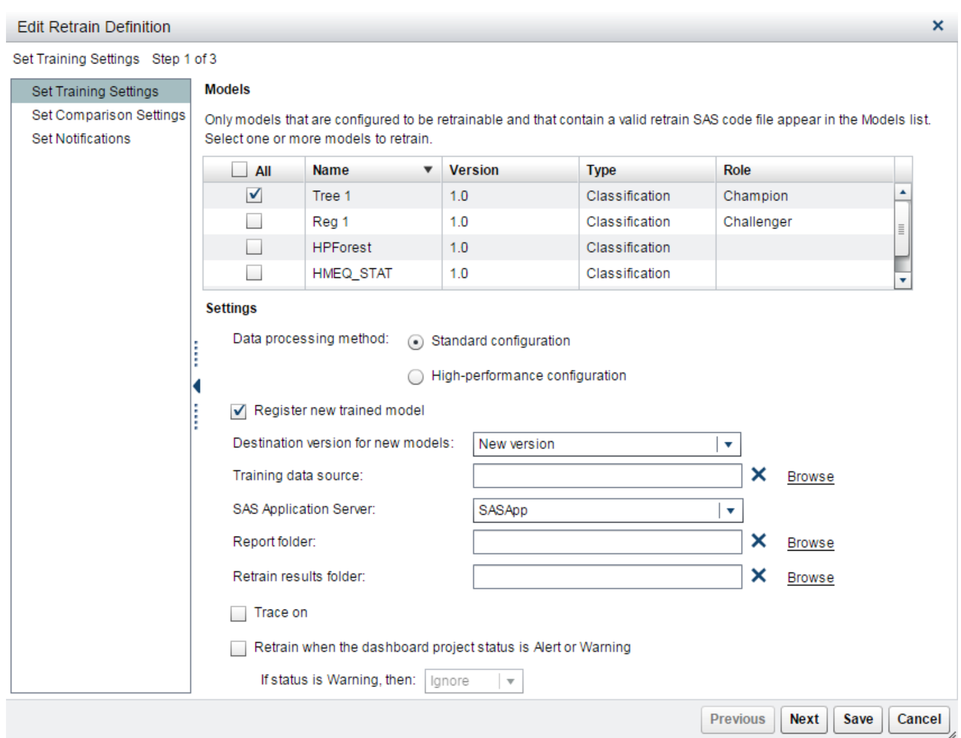
For more information, see “Project Properties” on page 51 and “Scoring Model Properties” on page 120.

- Verify that all of the project output variables are mapped to the corresponding model output variables. For more information, see “Map Model Variables to Project Variables” on page 86.
- Verify that the retrain file that is specified in the model template exists in the list of model files. The retrain file must appear on the **Model Properties** page for the model that you want to retrain. Ensure that the content is correct.

# Edit a Model Retrain Definition

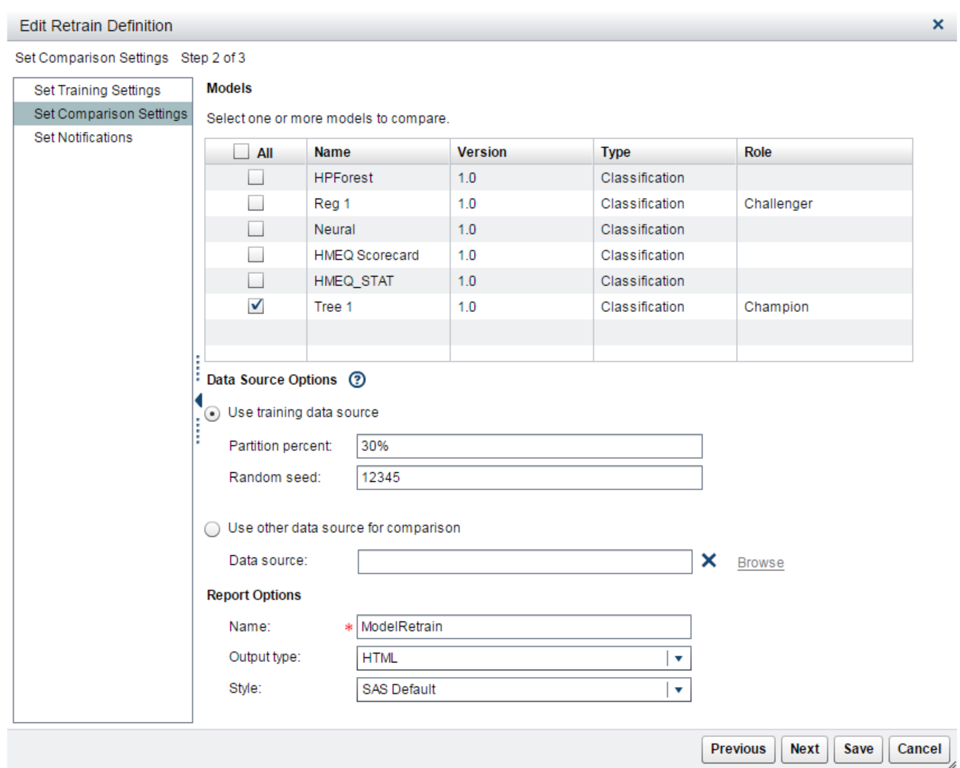
To define a model retrain definition:

1. On the **Definition** tab on the **Retrain** page, click and select one or more models to retrain. By default, the champion model is selected if it can be retrained.




2. Select a data processing method.
   - To run a standard environment, select **Standard configuration**.
   - To run the performance monitoring definition in a High-Performance Analytics environment, select **High-performance configuration**.

3. (Optional) Select **Register new trained model** to register the new models in the destination version on the SAS Content Server.
4. (Optional) If **Register new trained model** is checked, select a destination version for new models. Select **New version** from the drop-down menu to create a new version for the models.
5. Click **Browse** to select a training data source from a library. Click **OK**.
6. Click the **SAS Application Server** list and select a server.
7. (Optional) Click **Browse** to select a report folder in which to store the comparison report.
8. (Optional) Click **Browse** to select a retrain results folder to store the model training results.
9. (Optional) Select **Trace on** to print trace information to the SAS log file.
10. (Optional) Select **Retrain when the dashboard project status is Alert or Warning**. If the dashboard project status is Alert, the model is automatically retrained. If the dashboard project status is Warning, select whether to retrain the model or ignore the task. If the dashboard project status is Normal, the model will not be retrained.
11. Click **Next**.




12. Select the models to compare.

 *Note:* If you do not select a model, the champion model is used to perform the comparison.

13. Specify the data source options:

 - Select **Use training data source** to use the whole training data source to compare or partition it into two parts, based on partition percent and random seed. The percent that is specified is the percentage of data that is used for model comparison; the other part of the data is used for training. The random seed value is used to generate the training data based on the random sampling method.

- Click **Browse** to select a performance data set as the comparison data source.

14. Specify the report options:
    - Enter a report name.
    - Select a format for the report output. The standard formats that are available are **RTF**, **PDF**, and **HTML**. The default is **RTF**.
    - Select a style for the report. The available styles are **SAS default**, **Seaside**, **Meadow**, and **Harvest**. The default is **SAS default**.
15. Click **Next**.
16. (Optional) To send the retrain results by email, click and enter an email address.
17. Click **Save**.

## Execute a Model Retrain Definition

The prerequisites for retraining a model must be completed and a model retrain definition must exist before you can execute a model retrain definition.

To execute a model retrain definition:

1. Click .
2. After the models are retrained, a confirmation message appears. Click **Close**.
3. Click the **Results** tab to view the results.

*Note:* You can check the status of a job by clicking and then selecting the **Results** tab or the **Job History** tab.

## Schedule a Retrain Definition

After you create a retrain definition, you can create a schedule to execute the definition to run on a specific day and at a specific time. You can schedule the definition to run hourly, daily, weekly, monthly, or yearly.

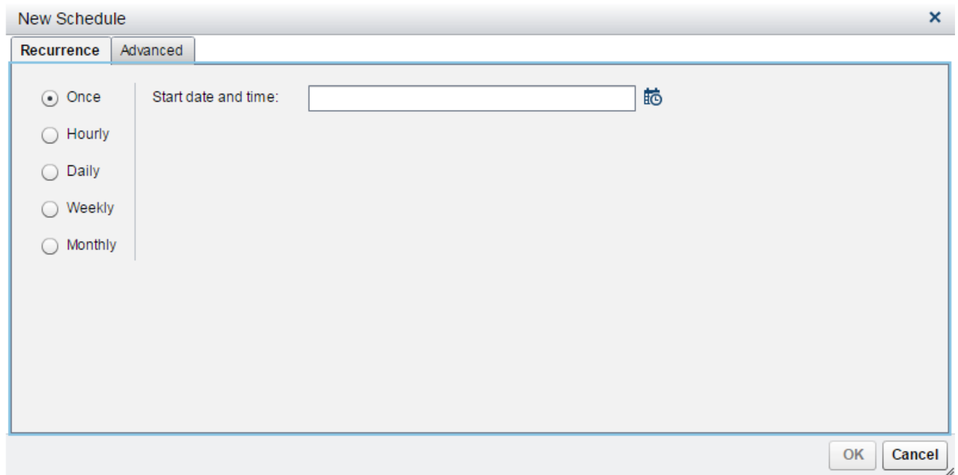
Before you can schedule a retrain definition, your user ID and password must be made available to the SAS Metadata Repository. You must also sign in to SAS Model Manager using your full user credentials that were specified for your user account in SAS Management Console. For user accounts where a Microsoft Windows user ID is specified, you must enter your user ID in the format of *domain\userID*. Contact your system administrator to add or update your password, and to determine the correct user credentials for your account.

You cannot edit a schedule for a retrain definition. To modify a schedule, delete the schedule and create a new schedule.

After retrain jobs execute, you can view the job history using the **Job History** tab on the **Retrain** page.

To schedule a retrain definition:

1. On the **Retrain** page, click .




2. On the **Recurrence** tab, select the recurrence pattern.
3. Specify the criteria for when and how often the job should be run.
4. (Optional) Click the **Advanced** tab.
   a. Select the server that schedules the job from the **Scheduling server** list box.
   b. Select the batch server that runs the job from the **Batch server** list box.
   c. Click **Browse** to select a location for the output and click **OK**.
5. Click **OK**.
6. After the job has been scheduled, a confirmation message appears. Click **Close**.
7. Click the **Job History** tab to view the job status.
8. After the job has completed, click the **Results** tab to view the retrain results.

*Note:* Schedules cannot be edited. To change the schedule, delete the schedule and create a new schedule.

To delete a schedule, select the schedule and then click .

## Viewing Retrained Models and Model Comparison Reports

After a model retrain definition is executed and if you chose to register the retrained models in the model retrain definition, the new retrained models are available in the destination version. In addition, the model retrain job creates a model comparison report, which is available in the **Results** tab on the **Retrain** page.

To view the retrain results:

1. Select the **Results** tab on the **Retrain** page.
2. You can view the model comparison reports in several ways:
   - Double-click a result in the list.

- Select a result from the list and click .

  *Note:* You can also view the SAS code and SAS log.

*Note:* If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

***Part 4***

# Deploying and Publishing Models

# Chapter 17
# Deploying Models



## Overview of Deploying Models

The goal of a modeling project is to identify a champion model that a scoring application uses to predict an outcome. SAS Model Manager provides tools to evaluate candidate models, declare champion models, and inform your scoring officer that a predictive model is ready for validation or production.

To deploy a model, you might use the following scenario:

1. Identify the model that outperforms other candidate models and declare this model to be the project champion model. You can also flag challenger models for the champion model.
2. Test and validate the model before you declare the model ready for production.
3. Lock the champion version for the project to prevent changes to the champion model.
4. Publish the champion model and challenger models (optional) so that you can deploy them to a production environment.

# Champion Models

## About Champion Models

The champion model is the best predictive model that is chosen from a pool of candidate models. Before you identify the champion model, you can evaluate the structure, performance, and resilience of candidate models. When a champion model is ready for production scoring, you set the model as the champion model. The project version that contains the champion model becomes the champion version for the project. A check mark ✔ appears next to the version on the **Versions** page. You can publish the champion model to a database, the SAS Metadata Repository, and a SAS channel.

## Requirements for a Champion Model

Before you identify a model as the champion, perform the following tasks:

- Register at least one model.
- Verify that the model is active. If the model expiration date has passed, you cannot set the model as a champion model.

  *Note:* However, an authorized user can reset the expiration date to a later date in order to set the champion model. To reset the expiration date, select the **Model Properties** page for the model.

You might use the following criteria to identify a champion model:

- model comparison reports that validate and assess the candidate models.
- business decision rules. For example, you might use a decision tree model because of difficulty interpreting results from a neural network model even when the neural network model outperforms the decision tree model.
- regulatory requirements, such as when the champion model should exclude certain specific attributes (age or race).

You can flag and publish a challenger model specifically for the purpose of comparison with the champion model. For example, your champion model for a production environment might omit restricted attributes during operational scoring because of regulatory requirements. You can use a challenger model that includes the restricted attributes in the development environment to evaluate its prediction power against the prediction of the champion model. Then you can determine the amount of predictive power that is lost because of the regulatory requirements.

## Set a Champion Model

To set a champion model:

- On the **Models** page of a project, select a model and click ✔ to set the model as the project champion model. The value in the **Role** column changes to **Champion**.

*Note:* Alternatively, you can right-click a model and select **Set as champion**.

### *Clear a Champion Model*

To clear a champion model:

- On the **Models** page of a project, select a model that is marked as Champion, and click ✖ to clear a flagged champion model.

*Note:* Alternatively, you can right-click a model that is marked as Champion and select **Clear**.

## Challenger Models

### *About Challenger Models*

You use challenger models to test the strength of champion models. The champion model for a project can have one or more challenger models. A model can be flagged as a challenger model only after a champion model for the project has been selected. A challenger model can be flagged in any version of a project.

Verify that the model is active. If the model expiration date has passed, you cannot set the model as a challenger model.

*Note:* An authorized user can reset the expiration date to a later date so that it is possible to set the challenger model.

To compare a challenger model to a champion model, you can create and run performance monitoring tasks for the champion model and any challenger models. Then, using the performance data, you can create a Champion and Challenger Performance report. You can also compare challenger models to the champion model using other reports such as the Delta report and Dynamic Lift report that are available through the **Reports** page. For more information, see "Champion and Challenger Performance Reports" on page 142.

*Note:* The batch programs for performance monitoring do not support creating challenger model performance reports.

Challenger models can be published to a database, the SAS Metadata Repository, or to a SAS channel that contains the champion model. They can also be published by themselves. If testing determines that the challenger model is the better model, you can replace the champion model by setting the challenger model as the champion model.

### *Flag a Challenger Model*

To flag a challenger model:

- On the **Models** page of a project, select a model and click to flag a model as a challenger to the project champion model. The value in the **Role** column changes to **Challenger**.

*Note:* Alternatively, you can right-click a model and select **Flag as challenger**.

### *Clear a Challenger Model*

To clear a challenger model:

- On the **Models** page of a project, select a model that is marked as Challenger, and click ✖ to clear a flagged challenger model.

*Note:* Alternatively, you can right-click a model that is marked as Challenger and select **Clear**. Challenger models can also be cleared when the champion model is cleared or replaced.

## Locking Versions

### *About Locking Versions*

You must be a SAS Model Manager administrator to lock and unlock a version. Administrators can lock a project version to prevent users from modifying some properties and files for the version's models. The champion version can be locked when the project champion model is approved for production or is pending approval. After a project version is locked, users cannot perform the following tasks:

- import, delete, or copy and paste a model
- rename a model
- change the champion model
- flag a model as a challenger

SAS Model Manager administrators remain authorized to perform these activities. If the champion model is not deployed to an operational environment, then an administrator can unlock a version so that users can change the models. Advanced users can still modify the **Attachments**, **Reports**, and **Scoring** pages after a version is locked.

When the champion model has been used in production scoring, you must unlock the model if you want to change the contents of the champion version. However, use caution in modifying the version content. If the model UUID and revision number for the score code in production scoring environments are always recorded, then you can modify a version even after the version is deployed to production environment.

If you attempt to delete a project that contains a locked version, SAS Model Manager displays a message indicating that you cannot delete a project that contains locked versions. An administrator must unlock the versions before the project can be deleted.

### *Lock a Version*

Locking a version restricts the activities that you can do with the project. You normally lock a version after you declare a champion model in preparation for deploying the champion model to a production environment.

To lock a version:

1. Open a project and select the **Versions** page.
2. Select a version and click to lock the version. The label **Locked** appears after the version name.

### *Unlock a Version*

If changes to a model are required after the version is locked, a SAS Model Manager administrator can unlock the version.

To unlock a version:

1. Open a project and select the **Versions** page.
2. Select a version and click to unlock the version.

For more information about versions, see "Lock and Unlock a Project Version" on page 58.

# Chapter 18
# Publishing Models



## Overview of Publishing Models

SAS Model Manager provides a comprehensive publishing environment for model delivery that supports sharing performance and scoring data. SAS Model Manager publishes models to different channels, and to the SAS Metadata Repository. SAS Model Manager can also publish classification, prediction, and segmentation (cluster) models with the score code type of DATA step to a database. Application software, such as SAS Data Integration Studio or SAS Enterprise Guide, enables you to access models through the SAS Metadata Server and to submit on-demand and batch scoring jobs.

SAS Model Manager publishes models to defined publication channels. Authorized users who subscribe to a channel can choose to receive email notifications when updated models are ready to deploy to testing or production scoring servers, and are published to a publication channel. From a publication channel, you can extract and validate the scoring logic, deploy champion models to a production environment, and monitor the performance of your models.

Models can also be published from the **Models** page. You can publish champion and challenger models from a model project to the SAS Metadata Repository. The publish history of models can be viewed on the **Models** page and on the **Published** tab on the **History** page. You can also remove models that have been published to a database.

## Publishing Models to a SAS Channel

SAS Model Manager uses the SAS Publishing Framework to publish models to defined channels. The SAS Publishing Framework notifies subscribers of the publication channel when the models are delivered. You can publish models in the Projects category view. SAS Model Manager creates a SAS package (SPK) file for the model in a publication channel. A user who subscribes to the publication channel can choose to receive email that includes the SAS package as an attachment.

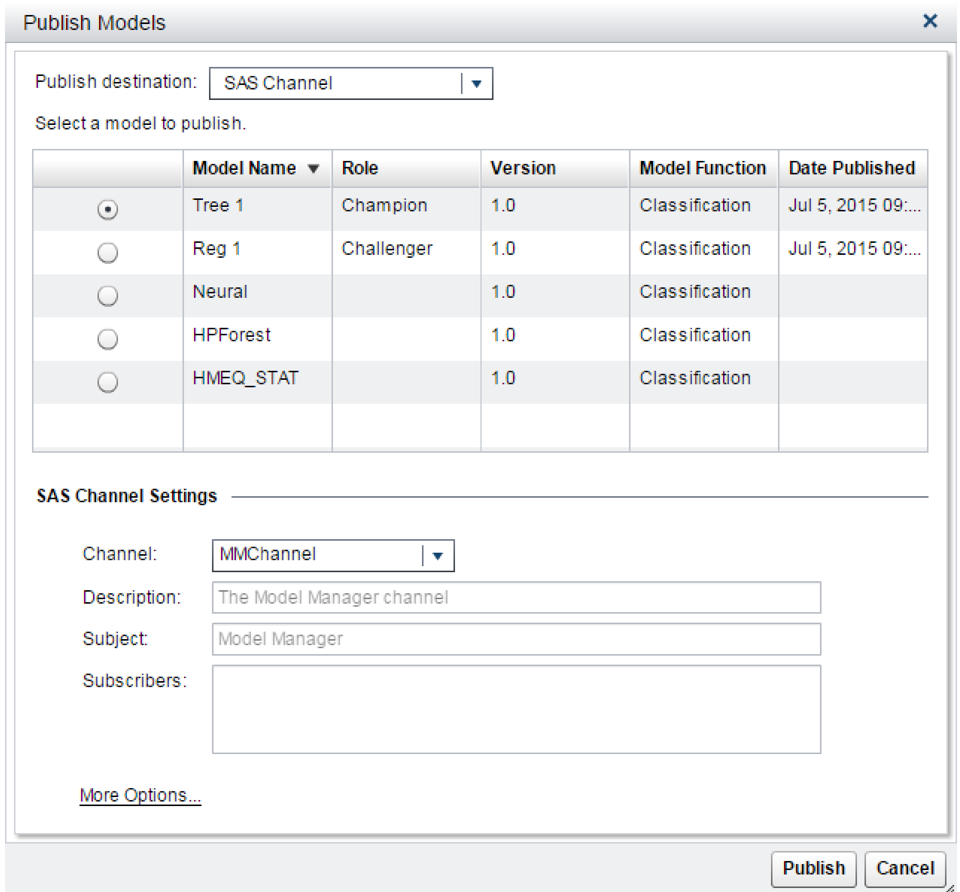
*Note:* Before you can deploy a model to a publications channel, a SAS administrator must configure the publication channel in SAS Management Console to publish models as archive (binary .SPK) files to a persistent store location. The archive persistent store location is specified as a physical file location, an FTP server, an HTTP server, or a path in WebDAV.

The **Report** attribute for a file element in a model template indicates whether SAS Model Manager includes a file in the SAS package. You use the SAS Package Reader or a file archiver and compression utility, such as WinZip, to view the contents of the SPK file. SAS Model Manager provides SAS macro programs to extract published models and deploy the models on testing and production scoring servers. The SAS package might contain additional files, depending on the number of file elements in the model template that have a Report attribute.

*Note:* The REF file contains the URL for a folder location in the project, such as **`http://`***MMServer:7980***`/SASContentServer/repository/default/ModelManager/MMRoot/`***organizational folder/project/version/Models/model_name***`/score.sas`**.

To publish a model to a channel:

1. Select a project and click .
2. Select **SAS Channel** from the publish destination list.
3. Select the model that you want to publish from the models list.
4. Select a publication channel from the channel drop-down list.




5. (Optional) Click **More Options** to specify a message subject, notes, and user-defined properties. Click **Save**.

6. Click **Publish**.

## Publishing Models to the SAS Metadata Repository

### *About Publishing Models to the SAS Metadata Repository*

SAS Model Manager publishes a model by creating a MiningResults object in the SAS Metadata Repository. You can use the model information in the MiningResults object to set up a scoring environment. A scoring application can use SAS Data Integration Studio or SAS Enterprise Guide to access the metadata and run a batch job or stored process that executes the score code. SAS Real-Time Decision Manager can also read the metadata and use it in that process environment. Therefore, when you publish a project champion model, challenger model, or other models (with proper configuration), the scoring application always uses the most current champion model. The project champion and challenger models can be published from the project level and only the project champion models can be published from the portfolio level.

*Note:* SAS Model Manager cannot publish R models.

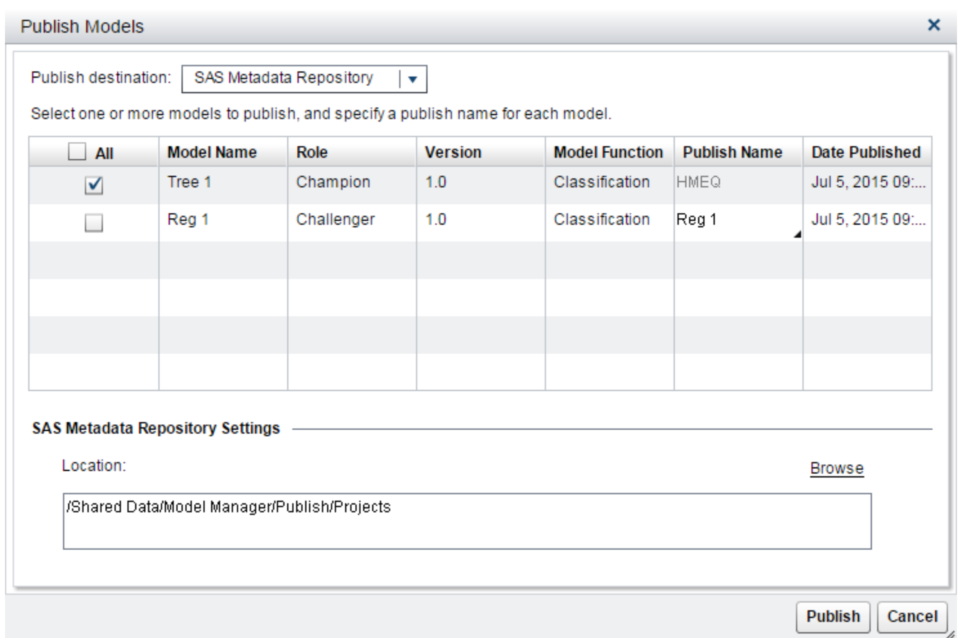
A user can publish a model to any accessible folder with Write permission, including all folders in the SAS Foundation repository and folders in custom repositories that are created in SAS Management Console to reflect the structure of your business organization.

## Publish Project Champion and Challenger Models to the SAS Metadata Repository

To publish champion and challenger models from a model project to the SAS Metadata Repository:

1. From the Projects category, select a project and click .
2. Select **SAS Metadata Repository** from the publish destination list.
3. Select one or more models to publish from the models list.
4. Specify a **Publish Name** for each model.

   *Note:* You cannot modify the publish name for a champion model.
5. Click **Browse** and select the location to publish the model to.



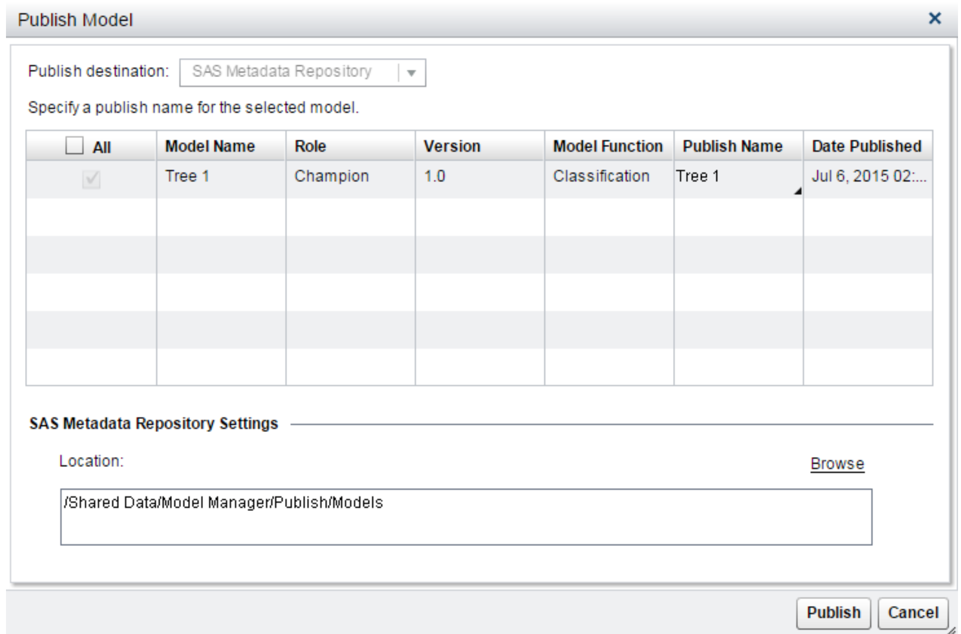

6. Click **Publish**.

## Publish a Model to the SAS Metadata Repository

To publish a model to the SAS Metadata Repository:

1. On the **Models** page, select a model and click .

   *Note:* Alternatively, you can right-click a model and select **Publish**.
2. Specify a publish name for each model.
3. Select the location to publish the models to.




4. Click **Publish**.

# Publishing Models to a Database or Hadoop

## *About Publishing Models to a Database or Hadoop*

SAS Model Manager enables you to publish the project champion model and challenger models that are associated with the **DATA Step** score code type to a configured database. SAS Model Manager uses the SAS Scoring Accelerator and SAS/ACCESS interface to the database to publish models to the database or Hadoop Distributed File System (HDFS). The Scoring Accelerator takes the models from SAS Model Manager and translates them into scoring files or functions that can be deployed inside the database. After the scoring functions are published using the SAS/ACCESS interface to the database, the functions extend the database's SQL language and can be used in SQL statements such as other database functions. After the scoring files are published, they are used by the SAS Embedded Process to run the scoring model.

If the scoring function publish method is chosen, the scoring metadata tables in the database are populated with information about the project and pointers to the scoring function. This feature enables users to review descriptions and definitions of the published model. The audit logs track the history of the model's usage and any changes that are made to the scoring project.

For more information about the SAS Scoring Accelerator, see the SAS In-Database Technology page available at http://support.sas.com.

## *Prerequisites for Publishing to a Database or Hadoop*

The following prerequisites must be completed before users can publish a model scoring function using the scoring function publish method, or publish a model's scoring files using the SAS Embedded Process publish method:

- The user must have the proper authorization to publish approved models from SAS Model Manager to the database or HDFS for SAS In-Database scoring.

  *Note:* When using the SAS Embedded Process publish method to publish models fromSAS Model Manager to a Teradata database, you must have a user database with the appropriate user permissions in order to validate the scoring results. For more information, see “Teradata Permissions for Publishing Formats and Scoring Models” in *SAS In-Database Products: Administrator’s Guide*.

  *Note:* If your system is configured for Kerberos authentication, each user must have a valid Kerberos ticket. Also, you must complete post-installation configuration steps to enable users to publish models from the SAS Model Manager application. For more information, see “Configure Users Authenticated by Kerberos” in *SAS Model Manager: Administrator’s Guide*.

- The champion model for the project must be set.
- A predictive (classification or prediction) or segmentation model must have been selected for production scoring deployment via SAS Model Manager.

  SAS Model Manager can publish to a database only the models that are associated with the **DATA step** score code type. Models with a score code type of **SAS Program**, **PMML**, **Analytic store**, or **DS2** cannot be published to a database.

  The score code component file (score.sas) is DATA step score code and is used as input by the SAS Scoring Accelerator when publishing a model to a database. When you use the scoring function publish method, some SAS language elements and syntax are not supported when you create or modify your score code. Only the SAS language elements and syntax that are required to run critical data transformations and model scoring functions are available. If you use a statement or function that is not supported, an error occurs and your model is not published to the database. For more information, see “Considerations When Creating or Modifying DATA Step Score Code” in *SAS In-Database Products: User’s Guide*.

- A database must have been configured to install scoring functions or model scoring files.
- If the model contains user-defined formats, a file that contains the user-defined formats must be attached to the version and stored in a format catalog.
- The following prerequisites are only for the scoring function publish method.
  - (Optional) A project user-defined property **DbmsTable** is defined for the champion version of the project from which to publish the scoring function.

    *Note:* The **DbmsTable** property must be defined if you plan to use a scoring application or SQL code to score your model.

  - The JDBC driver must be accessible from the middle-tier server when using the scoring function publish method.
  - The scoring function metadata tables are required in the target database if the **Metadata usage** option is enables in SAS Management Console.

### Make User-Defined Formats Available When Publishing Models to a Database

In order to publish models with user-defined formats to a database, you must make the user-defined formats available to SAS Model Manager.

To make the user-defined formats available for publishing:

1. Translate the user-defined formats SAS catalog (formats.sas7bcat) that was created with the model into a formats.cport file.

Here is an example:

```
filename tranfile "C:\formats.cport";
libname source "C:\myformats";

proc cport library=source file=tranfile memtype=catalog;
run;
quit;
```

2. Attach the formats.cport file to the version that contains the project champion model or challenger models. For more information, see "Attach a Portable Formats File" on page 58.

3. Send a request to the SAS administrator and ask them to either put the user-defined formats catalog (formats.sas7bcat) in the *SASConfigDirectory*\Lev1\SASApp \SASEnvironment\SASFormats directory or add the LIBNAME definition for the formats library to the *SASConfigDirectory*\Lev1\SASApp \appserver_autoexec_usermods file.

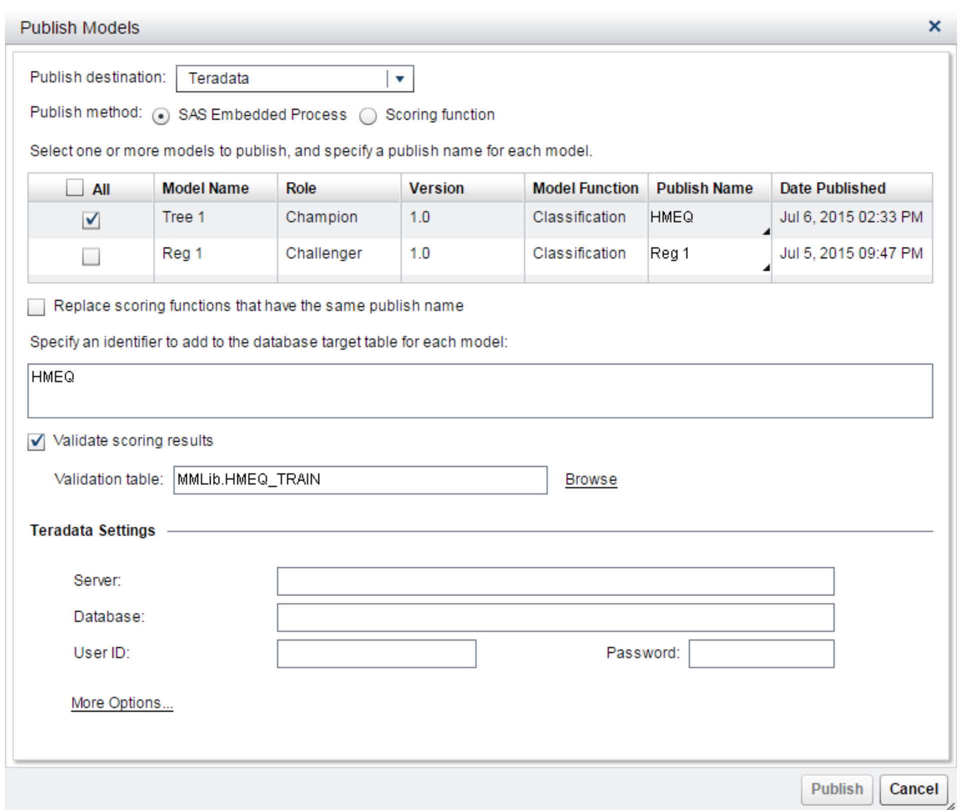
Here is an example of a LIBNAME definition:

```
libname mylib "C:\myformats";
options fmtsearch = (mylib.formats);
```

## *How to Publish Models to a Database or Hadoop*

To publish a model to a database:

1. Select a project and click .



2. Select a publish destination from the list. The publish destination can be either a database or a Hadoop Distributed File System.
3. Select a publish method. Specifies the method to use when publishing the scoring function or model files to the database.
4. Select one or more models to publish from the models list.
5. To specify a new publish name, click in the **Publish Name** column for a selected model. Specifies the name to use when publishing a scoring function or model files to the database. The publish name is a user-defined value that can be modified. The SAS Embedded Process publish method uses the **Publish Name** as the model name to publish the model files to the database. The scoring function publish method has a system-generated **Prefix** and the **Publish Name** that makes up the scoring function name. These are used to publish the model scoring function. The prefix portion of the scoring function name is 11 characters long and is in the format of `Yyymmddnnn_`:

   - `Y` is a literal character and is fixed for all prefixes.
   - `yy` is the two-digit year.
   - `mm` is the month and ranges from 01 to 12.
   - `dd` is the day and ranges from 01 to 31.
   - `nnn` is a counter that increments by 1 each time that a scoring function completes successfully. The value can range from 001 to 999.
   - _ is the underscore that ends the prefix.

   The `yymmdd` value in the prefix is the GMT timestamp that identifies the date on which you published the model. An example of a function name is `Y081107001_`*user_defined_value*. Here are the naming convention requirements:

   Here are the naming convention requirements for the publish name:

   - The user-defined value is case insensitive. The maximum length of alphanumeric characters is determined by the database type and publish method that is selected. No spaces are allowed. An underscore is the only special character that can be included in the publish name.
   - The recommended maximum lengths of the publish name for the scoring function publish method are the following:
     - 19 alphanumeric characters for Teradata
     - 32 alphanumeric characters for Netezza, Greenplum, and DB2

   *UNIX Specifics*
   The publish name (user-defined) portion of the function name in an AIX environment has a maximum length of 16 alphanumeric characters for Teradata.

   - The recommended maximum length of the publish name for the SAS Embedded Process publish method is 32 alphanumeric characters for all database types. The database types that are currently supported by SAS Model Manager are Teradata, Oracle, Greenplum, and DB2.

   The value of the publish name is validated against the target database, when the option **Replace scoring files that have the same publish name** is not selected for the SAS Embedded Process publish method. If the publish name is not unique, an error message is displayed.

   *Note:* The default format of the publish name is configured by the SAS administrator.

6. (Optional) Select whether to **Replace scoring files that have the same publish name**. Specifies to replace the model scoring files that have the same publish name when you are using the SAS Embedded Process publish method. The value of the publish name is validated against the target database when this option is not selected. If the publish name is not unique, an error message is displayed.

7. Specify an identifier to add to the database target table for each model. Specifies the value of the identifier that is added to each model in the database so that the Database administrator or other users can query the database. The default value is the project name. This option is available only for the SAS Embedded Process publish method.

8. (Optional) Select whether to **Validate scoring results**. Specifies to validate the scoring results when publishing a model scoring function or model scoring files. This option creates a benchmark scoring result on the SAS Workspace Server using the DATA Step score code. The scoring input data set is used to create an equivalent database table. Scoring is performed using the new scoring function or model scoring files and database table. The scoring results are then compared. If selected, click **Browse** to navigate to the appropriate training table. The default train table that is specified in the properties of the published model is used by default.

   *Note:* When using the SAS Embedded Process publish method to publish models from SAS Model Manager to a Teradata database, your user database must have the appropriate user permissions to validate the scoring results. For more information, see "Teradata Permissions for Publishing Formats and Scoring Models" in *SAS In-Database Products: Administrator's Guide*.

9. Specify the database settings.

   Here are the available database settings according to the publish method and database type:

| Database Settings | SAS Embedded Process | Scoring Function |
|---|---|---|
| **Server** | • Teradata<br>• Oracle<br>• Netezza<br>• Greenplum<br>• Hadoop<br>• DB2<br>• SAP HANA | • Teradata<br>• Netezza<br>• Greenplum<br>• DB2 |
| **Database** | • Teradata<br>• Oracle<br>• Netezza<br>• Greenplum<br>• DB2 | • Teradata<br>• Netezza<br>• Greenplum<br>• DB2 |
| **Instance number** | SAP HANA | Not applicable |

| Database Settings | SAS Embedded Process | Scoring Function |
|---|---|---|
| **User ID** | • Teradata<br>• Oracle<br>• Netezza<br>• Greenplum<br>• DB2<br>• Hadoop<br>• SAP HANA | • Teradata<br>• Netezza<br>• Greenplum<br>• DB2 |
| **Password** | • Teradata<br>• Oracle<br>• Netezza<br>• Greenplum<br>• DB2<br>• Hadoop<br>• SAP HANA | • Teradata<br>• Netezza<br>• Greenplum<br>• DB2 |
| **Server user ID** | Not applicable | DB2 |
| **Compile database** | Not applicable | Netezza |
| **Jazlib database** | Not applicable | Netezza |
| **Schema** | • Oracle<br>• Greenplum<br>• DB2<br>• SAP HANA | • Greenplum<br>• DB2 |
| **Initial wait time** (in seconds) | Not applicable | DB2 |
| **FTP time out** (in seconds) | Not applicable | DB2 |
| **Directory path** | Hadoop | Not applicable |

For a description of each database setting, see "Descriptions of Database Settings" on page 224.

10. Click **More Options** to specify other options for the database.

**Keep scoring function if validation fails** (scoring function) or **Keep scoring files if validation fails** (SAS Embedded Process)
: specifies to save the scoring function or model scoring files if the validation of the scoring results fails. Saving the scoring function or model scoring files is useful for debugging if validation fails.

**Sample size**
specifies the size of the sample to use for validating the scoring function or model files. The default value is 100. The maximum number of digits that are allowed is 8.

**Display detailed log messages**
provides detailed information, which includes warnings and error messages that occur when you publish a scoring function or scoring model files.

**Use model input**
specifies to use the selected model input when publishing the scoring function or model files instead of using the project input, which is the default. This is useful when the project input variables exceed the limitations for a database.

Here are the limitations for the number of model input variables when publishing a champion model or challenger model to a database:

| Database Type | SAS Embedded Process | Scoring Function |
|---|---|---|
| DB2 | The maximum depends on the page size of the database tablespace. For a 4K page size database, the limit is 500. If you have it configured for any of the larger page sizes (8K, 16K, 32K), then the limit is 1012. | 90 |
| Greenplum | 1660 | 100 |
| Hadoop | No limit | Not applicable |
| Netezza | 1600 | 64 |
| Oracle | 1000 | Not applicable |
| SAP HANA | 1000 | Not applicable |
| Teradata | If you use Teradata version 13.1 or 14.0, the maximum is 1024. If you use the SAS Embedded Process and Teradata version 14.10, the maximum is 2048. | 128 |

**Protected mode** (Teradata only)
specifies the mode of operation to use when publishing a model using the scoring function publish method. There are two modes of operation, protected and unprotected. You specify the mode by selecting or deselecting the **Protected mode** option. The default mode of operation is protected. Protected mode means that the macro code is isolated in a separate process from the Teradata database, and an error does not cause database processing to fail. You should run the Publish Scoring Function in protected mode during validation. When the model is ready for production, you can run the Publish Scoring Function in unprotected mode. You might see a significant performance advantage when you run the Publish Scoring Function in unprotected mode.

**Fenced mode** (DB2 and Netezza only)
specifies the mode of operation to use when publishing a model using the scoring function publish method. There are two modes of operation, fenced and unfenced. You specify the mode by selecting or deselecting the **Fenced mode** option. The default mode of operation is fenced. Fenced mode means that the macro code is isolated in a separate process from the DB2 database, and an error does not cause database processing to fail. You should run the Publish Scoring Function in fenced mode during validation. When the model is ready for production, you can run the Publish Scoring Function in unfenced mode. You might see a significant performance advantage when you run the Publish Scoring Function in unfenced mode.

11. Click **Publish**.

## Descriptions of Database Settings

The following are descriptions of the database settings that are used for publishing models.

**Server**
specifies the name of the server where the database resides. The port can be included as part of the server name (for example, *server-name*:*port*). When you are using the scoring function publish method, the default port is used if you do not specify the port as part of the server name.

*Note:* The port must be included as part of the server name for SAP Hana SPS09 or higher. For SAS Hana SPS08, you must use the instance number setting instead of adding the port to the server name.

**Database**
specifies the name of the database.

**User ID**
specifies the user identification that is required to access the database.

**Password**
specifies the password that is associated with the **User ID**.

**Server user ID** (DB2 only)
specifies the user ID for SAS SFTP. This value enables you to access the machine on which you have installed the DB2 database. If you do not specify a value for **Server user ID**, the value of **User ID** is used as the user ID for SAS SFTP.

**Schema** (Greenplum, Oracle, and DB2)
specifies the schema name for the database. The schema name is owned by the user that is specified in the **User ID** field. The schema must be created by your database administrator.

**Initial wait time** (DB2 only)
specifies the initial wait time in seconds for SAS SFTP to parse the responses and complete the SFTP –batch file process.

**Default:** 15 seconds

**FTP time out** (DB2 only)
specifies the time-out value in seconds if SAS SFTP fails to transfer the files.

**Default:** 120 seconds

**Compile database** (Netezza only)
specifies the name of the database where the SAS_COMPILEUDF function is published.

**Default:** SASLIB

**See Also:** For more information about publishing the SAS_COMPILEUDF function, see the *SAS In-Database Products: Administrator's Guide*.

**Jazlib database** (Netezza only)
specifies the name of the database where the SAS 9.3 Formats Library for Netezza is published.

**Default:** SASLIB

**Instance number** (SAP HANA only)
specifies the instance number.

*Note:* The instance number must be used for SAS Hana SPS08, instead of adding the port to the server name. For SAP Hana SPS09 or higher the port must be included as part of the server name and the instance number is ignored.

**Directory path** (Hadoop only)
specifies the directory path for the server.

## Remove Published Models

The SAS Embedded Process publish method enables you to replace the model scoring files, but the scoring function publish method publishes the model as a separate entry in the database each time. The Remove Published Models feature enables you to remove previously published models, so that you can clean up the test or production database. If you modify the previously published models or change the champion model or challenger models after you have published models to a database or Hadoop, you can remove them to clean up the database for future publishing of models.

To remove published models:

1. Select **Actions** ⇨ **Remove Published Models**.
2. Select the publish destination and then specify the database or Hadoop settings. Click **Log On**.
3. Select the models that you want to remove from the database.
4. Click **Remove Models**. A warning message appears.
5. Click **Yes**.

## View Publish History

To view the publish history of a model, select the **Models** page. To view the publish history of all models, select the **Published** tab on the **History** page. All models that have been published to a SAS Channel, to the SAS Metadata Repository, and to a database are displayed. Select a model from the list to view the full publish details.

To view the full publish details for a model:

1. Open a model and select the **Model Properties** tab.
2. Select **History** ⇨ **Published** to view the publish history.

To view the full publish details for all models:

1. Open a project and select the **History** page.
2. Select the **Published** tab to view the publish history.

# *Part 5*

# Using SAS Workflow with SAS Model Manager

# Chapter 19
# Starting a Workflow and Working with Tasks



## Overview of Using Workflows

SAS Model Manager uses the Workflows and My Tasks category views to use SAS Workflow. A *workflow* is a copy of a workflow template. A workflow can be used to track the progress of objects, such as model projects at the version level. An authorized user can use SAS Workflow Studio to define workflow templates and to make them available to SAS Model Manager for use. Workflow templates contain the set of tasks, participants, policies, statuses, and data objects that comprise a business task. The status that you select when completing a task determines the next task in the workflow.

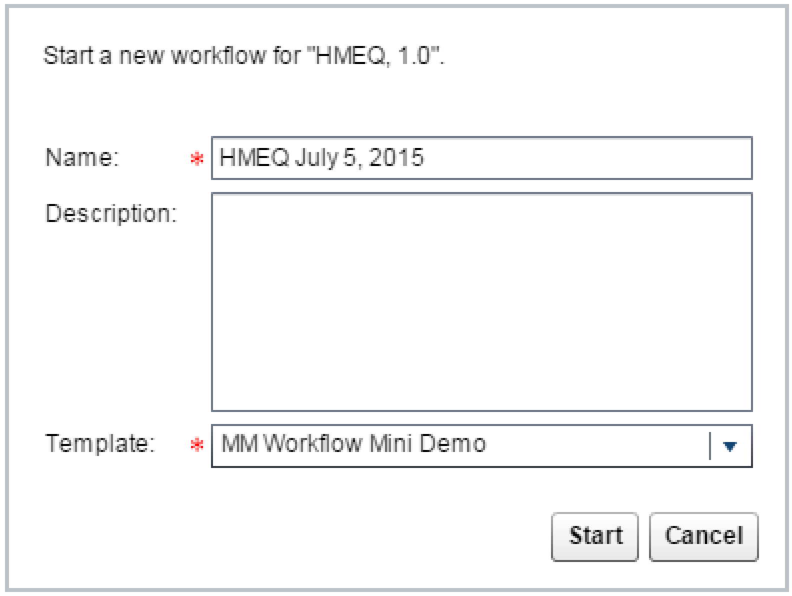
All users can access the My Tasks category view. By default, only users that are in the Decision Manager Common Administrators group can access the Workflows category view.

For more information about user permissions, see *SAS Model Manager: Administrator's Guide*.

## Start a New Workflow

When you start a new workflow, it is associated with the selected version of a project. For a specific version, only one workflow can be in progress at a time. To start another workflow for the same version, you must first complete the in-progress workflow, or terminate the in-progress workflow process.

1. Open a project.
2. Click on the right-side of the object toolbar.

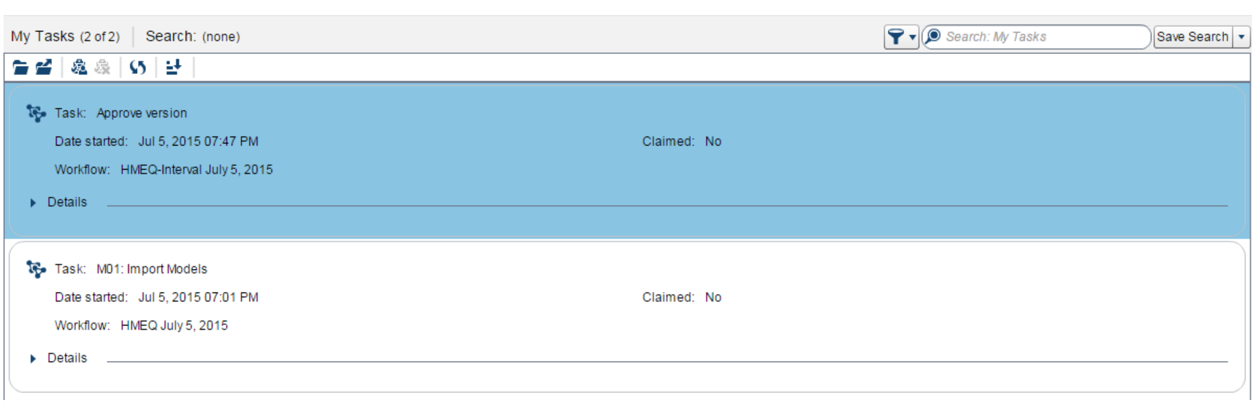



3. Enter a name for the new workflow.
4. (Optional) Enter a description for the workflow.
5. Select a template from which to create the workflow.
6. Click **Start**.

For more information, see Chapter 20, "Managing Workflows," on page 233.

## Working with Workflow Tasks

The My Tasks category view displays the tasks for In Progress workflows that you have been assigned to as a potential owner or that have been claimed by you.




From the My Tasks category view, you can perform the following:

- open a task that pertains to the associated object
- claim and open a task that pertains to the associated project
- claim a task
- release a task

- view the task details and workflow diagram

To complete a task:

1. Select a task and click in order to open the associated project and perform the task.
2. Navigate through the project's pages to perform the steps for the current task.
3. Click .
4. Select an action to take for the selected task. The actions that are available are the status values for the task in the workflow.
5. Click **Done**. The workflow process continues to the next task.

*Note:* Only a business administrator who has access to the Workflows category can release a task that has been claimed by another participant. For more information, see "Release a Task" on page 237.

# *Chapter 20*
# Managing Workflows

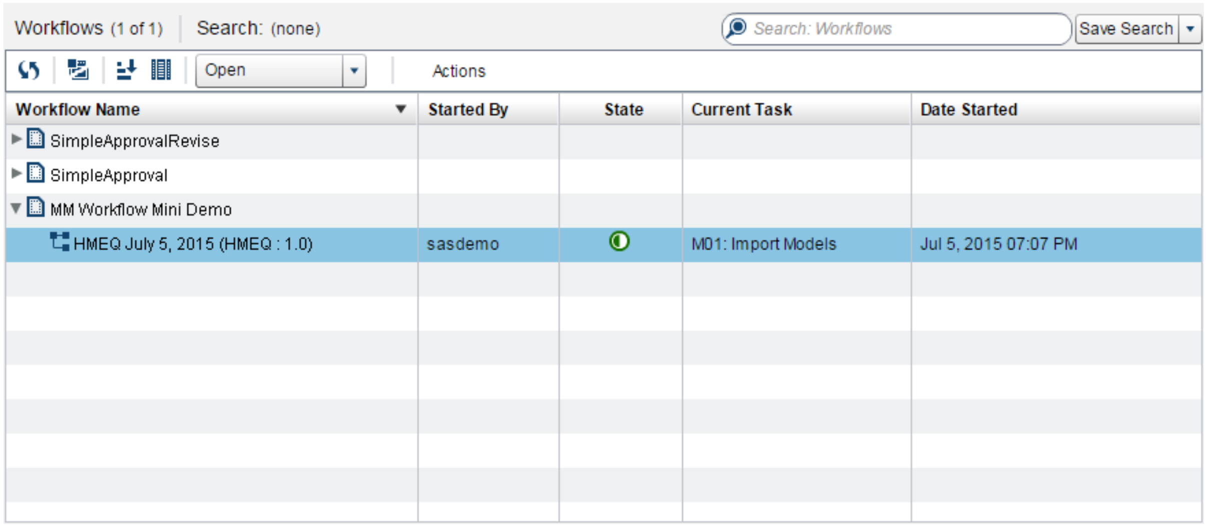


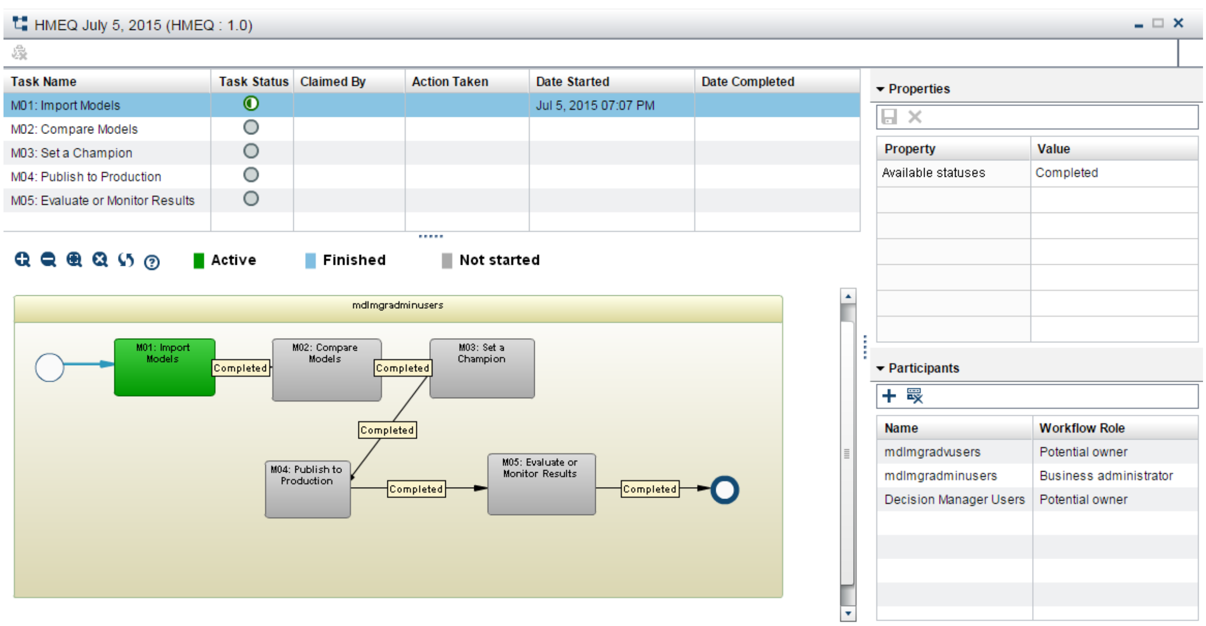
## Overview of Managing Workflows

SAS Model Manager can be used to manage workflows. You can create new workflows, view workflows, and interact with tasks that are associated with a workflow. If a user is assigned to the workflow role of business administrator, they can influence the progress of a task by actions such as assigning a task, or releasing the task that is claimed by another user, as well as specify values for properties to share information with other users. After the workflow templates are made available, an application administrator can set the object mappings using the Workflows category view. Each workflow consists of tasks.

*Note:* By default, only users that are in the Decision Manager Common Administrators group can access the Workflows category view.

Select **Workflows** to view a list of available workflows.




# Viewing Workflows

Only a user who is able to access the Workflows category view can manage workflows. Other users can view the list of tasks from the workflow task drop-down list that is accessible from the project toolbar. If a user is the actual owner of a task, or assigned as a potential owner of a task, they can view the workflow diagram and tasks that in the My Tasks category view. Workflows are associated with a project at the version-level.

From the Workflows category view, you can perform the following actions:

- set mappings
- migrate workflows from a previous version
- terminate a workflow process

To view detailed information for a workflow, double-click a workflow name. The list of tasks, the task status, and who the task is claimed by are displayed. You can then view the properties and participants that are associated with a task by selecting a task. The workflow diagram is also displayed with the current status of the workflow and its tasks.

For more information, see "Working with Workflow Participants" on page 236.

## Migrate Workflows

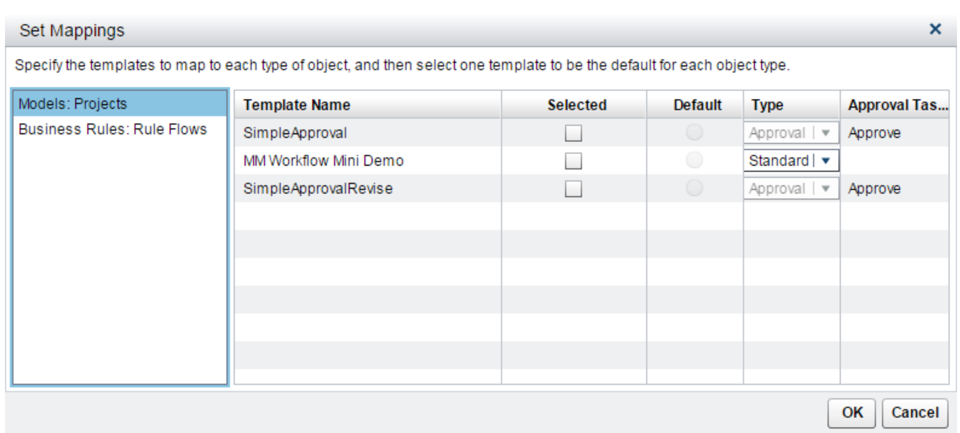
If you have migrated from a previous version of SAS Model Manager, you must migrate the workflows. All active (in progress) or completed workflows can be migrated. Terminated workflows are not migrated. The workflows must also be associated with a valid UUID for a version of a project. Only workflows that are associated with a project that still exists are migrated. If the project was deleted, the associated workflow is not migrated.

Select **Workflows** ⇨ **Actions** ⇨ **Migrate from Previous Version**. The list of workflows is refreshed after the workflows are migrated.

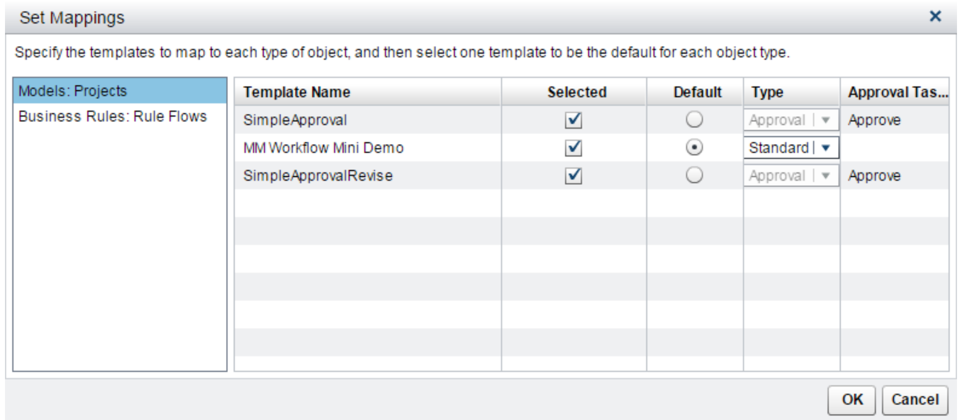
## Set Mappings

There are two different types of workflow templates that can be configured for use with SAS Model Manager. Workflow templates that contain tasks that are configured with an approval status are considered an approval workflow. Workflow templates that do not contain tasks with an approval status are considered a standard workflow. After you define your workflow template, save, and activate it using SAS Workflow Studio. You must specify the templates to map to each type of object. This enables you to start a new workflow using one of the templates that are associated with the specific object.

1. Select **Actions** ⇨ **Set Mappings**. The Set Mappings window appears.




2. Select an object and then select one or more templates to map to the object.
3. Select a type for each template. The types of templates that are available are **Approval** and **Standard**.
4. Select the default template for the object.




5. Click **OK**.

# Working with Workflow Participants

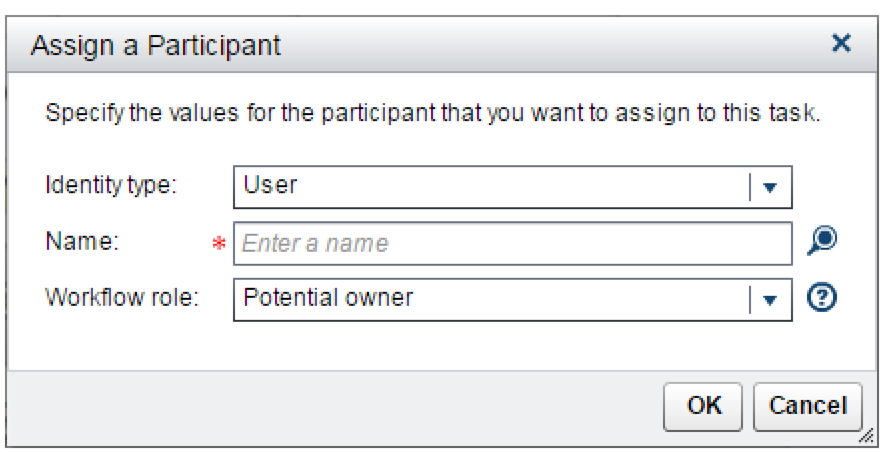
From the Workflow details view you can access the properties and participants that are associated with a task by selecting a task. If you are a user that is associated with the workflow role of business administrator, you can assign or remove participants, and release tasks that have been claimed by another user.

## *Assign Participants to Tasks*

Default participants might have been assigned already to tasks when a workflow definition was created.

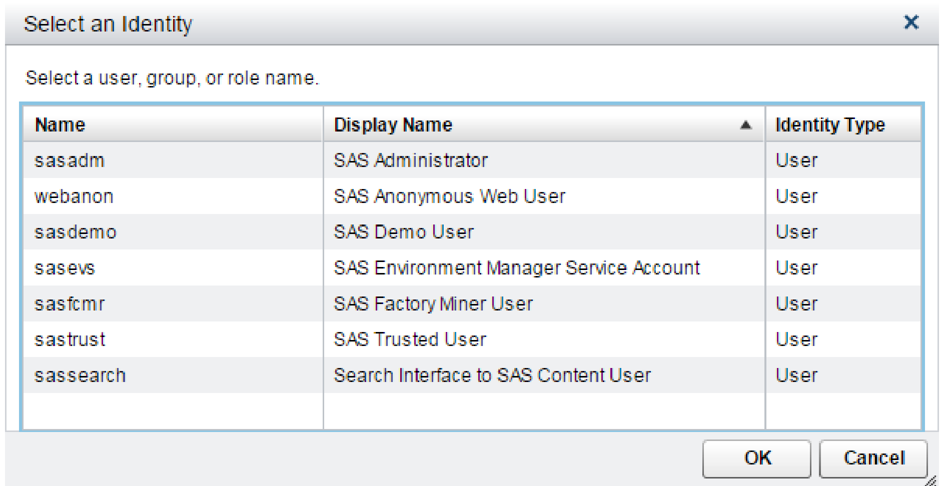
To assign an additional participant to a task:

1. From the Workflows category view, double-click a workflow. The Workflow details view is displayed.
2. Select a task, and then click + in the Participants pane. The Assign a Participant window appears.




3. Select an identity type.
4. Enter part of the user, group, or role name, and click .

*Note:* If you do not enter part of the name, all of the names for the selected identity type are displayed.




Select a name and click **OK**.

5. Select a workflow role for the participant.

   Here are the workflow roles that you can assign to participants for a workflow task:

   - **Business administrator**: a participant who can influence the progress of a task by actions such as assigning a task, or releasing the task claimed by another user.
   - **Potential owner**: a participant who can claim a task in a workflow process and who becomes the actual owner of a task.

6. Click **OK**. The new participant is added to the list in the Participants pane.

### *Remove Participants from a Task*

To remove a participant from a task:

1. From the Workflows category view, double-click a workflow name.
2. Select a task, and then select a participant from the Participants pane.

   *Note:* You cannot remove a participant who is associated with the workflow roles of business administrator or actual owner.

3. Click . A message is displayed asking if you are sure that you want to remove the participant from the task.
4. Click **Yes**. The user is removed from the list in the Participants pane.

### *Release a Task*

An authorized user with the capability to access the Workflows category view can release a task that has been claimed by a workflow participant. The name of the actual owner is displayed in the Participants pane.

To release a task:

1. In the Workflows category view, double-click a workflow name. The Workflow details view is displayed.

2. Select a task name, and click . The **Claimed By** value for the selected task is cleared.

## Edit Task Properties

A task can contain properties. Properties that are editable display a triangular icon in the bottom right corner of the property value in the data grid.

To edit the properties for a task:

1. From the Workflows category view, open a workflow, and select a task. The properties that are associated with the task are displayed to the right in the Properties pane.
2. Click on the property value, and then enter a value or change the existing value.
3. To save the changes to the properties, click .

   If you do not want to save the changes to the properties, click .

## Terminate a Workflow

When you terminate a workflow process, all tasks that have not yet been completed are changed to a state of Terminated. After you terminate a workflow process, it cannot be restarted. However, you can start a new workflow for the same version.

To terminate a workflow:

1. From the Workflows category view, select a workflow name and click .
2. Click **Yes** to terminate the selected workflow.

# *Part 6*

# Appendixes

*Appendix 1*

# Model Repository Access Macros



## Overview of Access Macros

The Model Management access macros provide a way to use SAS code to perform basic operations on a model repository. The Model Management access macros are a combination of SAS macros and Java libraries. The Model Management access macros and Java libraries are delivered with the SAS Model Manager software.

Here is a list of the Model Management access macros:

- %MM_AddModelFile adds a model component file to a model that is already registered with SAS Model Manager.
- %MM_GetModelFile retrieves a model from the model repository and saves it to a specified destination.
- %MM_GetURL retrieves the SAS Model Manager path to an object in the model repository and saves it in the global macro variable _MM_URL.
- %MM_Register registers a model in the SAS Model Manager model repository. You can use the %MM_Register macro in the same SAS program that you create models using SAS Enterprise Miner to register the model for use with SAS Model Manager.
- %MM_RegisterByFolder registers multiple models simultaneously to the SAS Model Manager model repository. Model files for a single model are contained in a subdirectory, and all subdirectories have the same parent directory.

- %MM_CreateModelDataset creates a data set that contains information for all models in a specified folder. Model information can be retrieved in a data set for all models in MMRoot, an organizational folder, a project, a version, and a single model.

*Note:* The macros are in the modelmgr.sas7bcat file. The location of this file for Windows is ***sasintalldir*\SASFoundation\9.4\mmcommon\sashelp**. The default value for ***sasinstalldir*** in Windows is **C:\Program Files \SASHome**. The location of this file for UNIX is ***/sasinstalldir/*** **SASFoundation/9.4/sashelp**. The default value for *sasinstalldir* in UNIX is **/usr/local/SASHome**.

To use the Model Management access macros, you can structure your SAS program as follows:

- Specify the metadata connection system options, if you are not already connected to the SAS Metadata Server. For more information, see “Setting Metadata Connection System Options” on page 289.
- Create a fileref to the Model Management access macro catalog and include that fileref, using the %INCLUDE statement.
- Set up librefs to access the necessary directories and filerefs to access the necessary files.
- Set up macro variables as necessary.
- Execute the macro.
- Check for successful completion.

## Using the Model Management Access Macros

### *Global Macro Variables*

Your SAS program and SAS Model Manager use global macro variables to pass information about the SAS environment and the SAS Model Manager model repository to the access macros. Some macros set these global macro variables. You can set any of these global macro variables in your SAS program. At the end of each macro execution, the global macro variable _MM_RC is set to a number that indicates either that the macro executed successfully or that there was an error.

*Note:* As part of a recent SAS Model Manager 14.1 hot fix (V85008 or later), the _MM_Service_Registry_URL macro variable is no longer used. If your SAS program contains this macro variable it will be ignored. For a list of the latest hot fixes, see SAS Model Manager 14.1 Hot Fixes.

Here is a description of the Model Management global macro variables:

_MM_CId
: contains the name of the current object identifier. _MM_CId is either the URL or the SAS Model Manager path to the object in the model repository. You can use the %MM_GetURL to obtain a URL for any object in the model repository.

  The %MM_Register macro sets _MM_CId to contain the identifier for the registered model. The %MM_AddModelFile macros sets _MM_CId to the identifier for the model to which the file was added.

_MM_RC
: contains one of the following return codes after processing a Model Management access macro:

| _MM_RC Return Value | Access Macro Status |
|---|---|
| 0 | All OK |
| 1 | Macro parameter error |

_MM_ResourceURL
: contains the URL of the **Resources** folder. the _MM_Resource URL is set by the %MM_GetURL macro when the macro returns a version URL in the _MM_URL global macro variable.

_MM_URL
: contains a URL for a SAS Model Manager object. The %MM_GetURL macro returns a URL in the _MM_URL global macro variable.

_MM_User
: contains the name of a SAS Model Manager user on the server that is specified by the _MM_MulticastAddress global macro variable.

Default: the value of SAS automatic macro variable &SYSUSERID.

_MM_Password
: contains a password for the SAS Model Manager user. If you do not encode the password using the PWENCODE procedure, the password is printed in the SAS log.

See: "Encoding SAS Model Manager User Passwords" on page 386

*Note:* The _MM_User and _MM_Password access macros need to be specified only if you want to access the SAS Content Server with FILENAME or LIBNAME statements.

For a description of these macro variables as well as their default values, see "Global Macro Variables" on page 242.

If you are running macros in a SAS session that requires a connection to the SAS Metadata Server, you must specify the metadata connection system options before you run the macros. If these options are not specified, you will be prompted for the information. If you are running the macros in batch mode, you must include the metadata connection system options. Otherwise, you will receive a failure message. For more information, see "Setting Metadata Connection System Options" on page 289.

### See Also

"Macro Variables" on page 277

## Accessing the Macros

Before you can use the access macros, your SAS program must access the catalog where the macros are located, and load the macros into memory. Here is example code to do this:

```
/********************************************/
/* Specify the macro code location         */
```

```
/*******************************************/

Filename MMAccess catalog "sashelp.modelmgr.accessmacros.source";

/*******************************************/
/* Load the Access macros                  */
/*******************************************/

%include MMAccess;
/*******************************************/
/* Unassign the filename                   */
/*******************************************/
Filename MMAccess;
```

## Identifying SAS Model Manager Model Repository Objects

The access macros use an identifier to specify a unique object such as the version or a model, in the SAS Model Manager model repository. The identifier can be in the form of a Universally Unique Identifier (UUID) or a SAS Model Manager path.

- A UUID is a case sensitive, 36-character string that uniquely identifies the repository object. An example UUID is cca1ab08-0a28-0e97-0051-0e3991080867.

  If you need to find the UUID or the exact SAS Model Manager path for an object, you can look it up in SAS Model Manager on the **System** tab of the **Models Properties** page. The UUID and path values are listed there.

- The format for a SAS Model Manager path is //*repositoryID*/MMRoot/*folder*/*project*/*version*/Models/*model*.

  The name of *repositoryID* is defined during installation. The names of the folder, project, version, and model that follow in the path are user-defined. SAS Model Manager path specifications always use the forward slash character (/) as a separator.

  For example, a version path might look like //MMModelRepository/MMRoot/HomeEquity/HMEQ/1.0.

You use the _MM_CId global macro variable to pass a model repository identifier to an access macro. For more information, see "_MM_CId" on page 242.

## Identifying Files Used by Access Macros

All Model Management access macros that accept SAS file references require the file references to point to a single physical file. File references in the form *libref.filename* must resolve to a single physical file. Specific logical library references in the form *libref* must resolve to a directory or a folder.

Concatenated library references cannot be used.

Here is a list of libraries to which you must assign a libref in your SAS programs:

- the directory that contains your model files
- the directory that contains the training data
- the directory that contains your input, output, and target data sets

Model Management access macros use the libref SMMMODEL to access model component files, as in this example:

```
libname smmmodel "c:\myModel\HMEQ\scorecode";
```

You can define the libref SMMMODEL at the beginning of your SAS program and use it to access model component files in any of the Model Management access macros that your program executes.

Here is a list of files that you can identify with a fileref in your SAS programs:

- a catalog fileref to the Model Management access macro code
- the source path and filename for a single file to be registered by the %MM_AddModelFile macro
- the source path and filename for a SAS Enterprise Miner package file to be registered by the %MM_Register macro
- the destination path and filename for the %MM_GetModelFile macro

## *Required Tables*

Whether you use SAS Model Manager or the access macros, SAS Model Manager must know the model input variables, the output variables, and the target variables to register a model. SAS Model Manager uses an XML file to describe each of these types of files. Before you can register a SAS code model, you must create a SAS data set that represents the input, output, and target variables:

- The model input table contains the variables that are used as input by the model. During model registration, SAS Model Manager uses this table to create the inputvar.xml file.
- The model output table is a table whose variables contain the model output values. During model registration, SAS Model Manager uses this table to create the outputvar.xml file.
- The model target variable table is a table whose one variable is the target variable that is used in the training data. During model registration, SAS Model Manager uses this file to create the targetvar.xml file.

Each of these tables can be a one-row table. The tables' purpose is to define and describe the variables that are used by the model.

You can create each of these tables using the training data that you used to train your model. The following example SAS program uses the training data to create all three tables:

```
/*******************************************************/
/*  Set the location for the model tables              */
/*******************************************************/

libname hmeqtabl "c:\myModel\hmeq\tables";

/********************************************************/
/*  DATA step to create the target variable table.      */
/*  Because there is only one target variable, keep only */
/*  that variable.                                      */
/********************************************************/

data hmeqtabl.target;
   set hmeqtabl.training(obs=1);
   keep bad;
run;
```

```
/********************************************************/
/*  DATA step to create the input variable table.       */
/*  Keep only the variables used for input by the model. */
/********************************************************/

data hmeqtabl.invars;
   set hmeqtabl.training (obs=1);
   keep debtinc delinq derog job loan mortdue ninq reason value yoj;
run;

/********************************************************/
/*  DATA step to create the output variable table.      */
/*  Keep only the variables used for output by the model.*/
/*  Include the score code to get the output variables.  */
/********************************************************/

data hmeqtabl.outvars;
   set hmeqtabl.training;
   %include "c:\myModel\hmeq\score.sas"   keep f_bad i_bad p_0 p_1;
run;
```

# Dictionary

## %MM_AddModelFile Macro

Add model component files to an existing SAS Model Manager model.

### Syntax

**%MM_AddModelFile** (

ModelId=*path-to-model*,

SASDataFile=*SAS-data-set-reference* | SASCatalog=*SAS-catalog-reference* |
TextFile=*fileref-to-text-file* |
BinaryFile=*fileref-to-binary-file*

<, Name=*alternateFileName*>

<, Trace=OFF | ON >

);

#### *Arguments*

**ModelId=*path-to-model***

specifies an identifier of the model in the SAS Model Manager model repository. The identifier specifies the location in the SAS Model Manager model repository where the file is to be added. *path-to-model* can be either a SAS Model Manager UUID or a SAS Model Manager path. ModelId is a required argument. The default value is the value of the _MM_CId macro variable.

**Examples** ModelId=8904daa1-0a29-0c76-011a-f7bb587be79f

ModelId=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HomeEquity/1.0/Models/HMEQ%20Loan%20Project

ModelId=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HomeEquity/1.0/Models/HMEQ Loan Project

**SASDataFile=*SAS-data-set-reference***
specifies the location of the SAS data set to add to a model in the SAS Model Manager model repository. *SAS-data-set-reference* must be a two-level SAS name in the form *libref.filename*.

**Example** SASDataFile=mysaslib.hmeqloan

**SASCatalog=*SAS-catalog-reference***
specifies the location of a SAS catalog that includes of one or more SAS code model component files to add to a model in the SAS Model Manager repository. *SAS-catalog-reference* must be a two-level SAS name in the form *libref.catalog*. Use the SASCatalog argument to add the catalog to a model.

**Example** SASCatalog=mylib.modelinput

**TextFile=*fileref-to-text-file***
specifies the file reference to the location of a SAS code model component file that is an ASCII text file. *fileref-to-text-file* is a one-level SAS reference to a model component file.

**Example** TextFile=inputxml

**BinaryFile=*fileref-to-binary-file***
specifies the file reference to the location of a SAS code model component file that is a binary file. *fileref-to-binary-file* is a one-level SAS reference to a model component file that is not a text file.

**Example** BinaryFile=gainscsv

**Name=*alternateFileName***
specifies a name for the file that you are adding. Use the Name argument when your model component filename does not follow the SAS Model Manager model component file naming convention that is specified in the model's template file or your model requires a file to have a particular filename. If Name is not specified, the filename that is registered is the name of the file.

**Example** Name=score.sas

**Trace=ON | OFF**
specifies whether to supply verbose trace messages to the SAS log.

**Default** OFF

**Example** Trace=on

## Details

For models that require model component files other than the score code, you can use the %MM_AddModelFile macro to add model component files to a registered model, one file at a time. All files that are added using the %MM_AddModelFile macro are placed in the SAS Model Manager model repository. After files have been added, you can view the files in the **Models** page of a project.

The %MM_AddModelFile macro supports two types of files, text and binary. Text files are ASCII files that contain character data. Binary files are files created by an application in a format specific to that application. If you are adding a text file, you must use the TextFile argument to specify the file. To avoid any unintentional character translations, all non-text files should be added using the BinaryFile argument.

SAS data sets and SAS catalogs are both binary files. Instead of using the BinaryFile argument to add SAS files, you can use the SASDataFile and SASCatalog arguments respectively to add files using the SAS two-level references *libref.filename* or *libref.catalog*. The TextFile and BinaryFile arguments require a single SAS filename that can be a fileref.

The ModelId argument defaults to the value of the global variable _MM_CId. For example, after a call to the %MM_Register macro, the _MM_CId variable is set to the identifier for the registered model. In this case, you can use the %MM_AddModelFile macro to add additional component files to your model without having to explicitly specify the ModelId argument.

When you use the %MM_AddModelFile macro to add a component file to your SAS Model Manager model, the name of the added component file remains unchanged by default. If you need to change the name of the component file when you save it to a SAS Model Manager model, you can use the Name argument to specify the new component filename. Whenever possible, you should try to follow the component file naming conventions that are specified in the model's template file. When you use the model template file naming conventions, you are less likely to be confused about filenames.

## Example

```
/***************************************************/
/* Adding a file to a registered model.            */
/***************************************************/

Options NOmlogic NOmprint NOspool;

/***************************************************/
/* Get the Model Management macro code.            */
/***************************************************/

Filename MMAccess catalog 'SASHELP.modelmgr.AccessMacros.source';
%include MMAccess;

/***************************************************/
/* A LIBNAME for a table.                          */
/***************************************************/

LIBNAME mtbls 'c:\mysascode';

/***************************************************/
/* Set to detect failure in case macro load fails  */
/* and add the input data source.                  */
/***************************************************/

%let _MM_RC= -1;
```

```
%MM_AddModelFile(
  ModelId=
   //ModelManagerRepo/MMRoot/HomeEquity/HMEQ/1.0/hmeqDecTree1,
  Name=modelinput.sas7bdat,
  SASDataFile=mtbls.myInputVariables,
  Trace=Off
);

/*************************************************/
/* A FILENAME for a text file.                   */
/*************************************************/

FILENAME tcode 'c:\myModel\inputvar.xml';

/*************************************************/
/* Set to detect failure in case macro load fails  */
/* and add the xml file for the input data source  */
/*************************************************/

%let _MM_RC= -1;

%MM_AddModelFile(
  ModelId=
   //ModelManagerRepo/MMRoot/HomeEquity/HMEQ/1.0/hmeqDecTree1,
  TextFile=tcode,
  Trace=on);
```

## %MM_GetModelFile Macro

Access files in the SAS Model Manager model repository. This macro copies the specified model file to the specified location on a local or network computer.

### Syntax

**%MM_GetModelFile (**

ModelId=*path-to-model* | VersionId=*path-to-version* | ProjectId=*path-to-project*,

SASDataFile=*SAS-data-set-reference* | SASCatalog=*SAS-catalog-reference* | TextFile=*fileref-to-text-file* | BinaryFile=*fileref-to-binary-file*

<, Name=*alternateFilename*>

<, Trace=ON | OFF>

);

#### *Arguments*

**ModelId=*path-to-model***

specifies an identifier to the model in the SAS Model Manager model repository. *path-to-model* can be either a SAS Model ManagerUUID or a SAS Model Manager path that describes the location of the specific model. ModelId is a required argument. The default value is the value of the _MM_CId macro variable.

**Examples** ModelId=b2341a42-0a29-0c76-011a-f7bb7bc4f1e9

ModelId=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HomeEquity/1.0/Models/HMEQ%20Loan%20Project

**VersionId**

specifies an identifier of the version to where a champion model resides in the SAS Model Manager model repository. *path-to-version* can be either a SAS Model Manager UUID or a SAS Model Manager path that describes the location of the version.

**Examples** VersionId=b23327cb-0a29-0c76-011a-f7bb3d790340

VersionId=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HomeEquity/1.0

**ProjectId**

specifies an identifier of the project object. The identifier specifies the location where the champion model under the default version resides in the SAS Model Manager model repository. *path-to-project* can be either a SAS Model Manager UUID or a SAS Model Manager path that describes the location of the project.

**Examples** VersionId=b232d766-0a29-0c76-011a-f7bb50921b42

VersionId=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HomeEquity

**SASDataFile=*SAS-data-set-reference***

specifies the library reference for the location of a SAS data set. *SAS-data-set-reference* must be a two-level SAS name in the form *libref.filename*.

**Example** SASDataFile=mylib.modelinput

**SASCatalog=*SAS-catalog-reference***

specifies the library reference for the location of the SAS catalog to store a SAS catalog file. *SAS-catalog-reference* must be a two-level SAS name in the form *libref.catalog*.

**Example** SASCatalog=mylib.format

**TextFile=*fileref-to-text-file***

specifies the file reference for the location of a component file that is an ASCII text file. *fileref-to-text-file* is a one-level SAS reference to a model component file.

**Example** TextFile=myfileref

**BinaryFile=*fileref-to-binary-file***

specifies the file reference for the location of a model component file that is a binary file. *fileref-to-binary-file* is a one-level SAS reference to a model component file that is not a text file.

**Example** BinaryFile=myfileref

**Name=*alternateFileName***

specifies a name for the model component file that you are retrieving. Use the Name argument when the name of the destination file does not match the name of the file in theSAS Model Manager model repository. The Name argument is the filename within the SAS Model Manager model repository. If Name is not specified, the filename that is registered in the SAS Model Manager model repository is the name of the file.

**Example** Name=score.sas

**Trace=ON | OFF**
specifies whether to supply verbose trace messages to the SAS log.

**Default** OFF

**Example** Trace=on

## Details

Use the %MM_GetModelFile macro to retrieve a component file for a model that has been registered in the SAS Model Manager model repository. You can retrieve a component file for any model by specifying the repository location of the model, or you can retrieve a component file for a champion model by specifying the version or project location in the SAS Model Manager model repository.

The %MM_GetModelFile macro supports two types of files, text and binary files. Text files are ASCII files that contain character data. Binary files are files that are created by an application in a format that is specific to that application. If you are retrieving a text file, you must use the TextFile argument to specify the file. To avoid any unintentional character translations, all non-text files should be retrieved by using the BinaryFile argument.

SAS data files and SAS catalogs are binary files. Instead of using the BinaryFile argument to retrieve model component files to store as a SAS file or in a SAS catalog, you can use the SASDataFile and SASCatalog arguments respectively to specify the SAS location to store the file. The TextFile and BinaryFile arguments require a single SAS filename.

You can use the optional Name argument if you want to save the model component file with a different name from the name within the SAS Model Manager model repository.

After you use the %MM_GetModelFile macro to copy a model component file to its new location, you can use the model component file for any purpose. For example, a simple application might use the %MM_GetModelFile macro to copy a registered model's score code file to the SAS WORK library. After the score code is copied to WORK, you can write SAS code that includes the score code in a SAS DATA step and is executed for experimental purposes.

If the destination file argument or the two-level SAS library reference name that is invoked in the macro uses the original filename, you do not need to specify the Name argument. In other words, the macro can use the SAS logical names to determine the name of the file in the model hierarchy. If the name of the destination file needs to be different from the name of the original file that was copied, use the Name argument to specify the new name for the model component file.

## Example

```
/*******************************************************/
/* Get the score code from a registered model and run */
/* it.                                                 */
/*******************************************************/
```

```
 Options NOmlogic NOmprint NOspool;

/****************************************************/
/* Get the Model Management macro code.             */
/****************************************************/

 FILENAME MMAccess catalog 'sashelp.modelmgr.accessmacros.source';
 %include MMAccess;

/****************************************************/
/* Specify the model component file name and        */
/* destination.                                     */
/****************************************************/

%let WorkPath = c:\myProject\1.0;
 FILENAME dest '&WorkPath.\score.sas';

/****************************************************/
/* Set to detect failure in case macro load fails.  */
/****************************************************/

%let _MM_RC = -1;

/****************************************************/
/* Get score code.                                  */
/****************************************************/

%MM_GetModelFile(ModelId=//ModelManagerRepo/MMRoot/HomeEquity/HMEQ/1.0/
DecisionTree, TextFile=dest);

/****************************************************/
/* Display Model Management set macro variables.    */
/****************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
%PUT _MM_CId = &_MM_CId;
Options source;

/****************************************************/
/* Run score code. Sepcify the LIBNAME input path.  */
/****************************************************/

LIBNAME input 'c:\mysascode\1.0\DTree';
DATA score;
 set input.dTreeInp;
 %include dest;
run;
```

## %MM_GetURL Macro

Translates a specified SAS Model Manager UUID to a URL-style path address and sets the URL as the value of the _MM_URL and _MM_ResourcesURL macro variables.

## Syntax

**%MM_GetURL**(ID=*UUID*, <Trace=ON | OFF> );

### Arguments

**ID=*UUID***
specifies the UUID of the object for which an URL is desired. A SAS Model Manager UUID is a 36-character string that identifies a single object in the SAS Model Manager model repository. The ID argument is required.

| | |
|---|---|
| Example | ID=cca1ab08-0a28-0e97-0051-0e3991080867 |

**Trace=ON | OFF**
specifies whether to supply verbose trace messages to the SAS log.

| | |
|---|---|
| Default | OFF |
| Example | Trace=on |

## Details

The %MM_GetURL macro sets the value of the global macro variable _MM_URL to the URL of the specified object’s UUID.

If the ID argument specifies a SAS Model Manager project, version, or model, then the macro sets the global macro variable _MM_ResourcesURL to the URL of that object's associated Resources folder.

The %MM_GetURL macro does not set a value for the global macro variable, _MM_CID.

## Example

```
/****************************************************/
/* Get the URL for the location of a model.         */
/****************************************************/

Options nomlogic nomprint nospool;

/****************************************************/
/* Get the Model Management macro code.            */
/****************************************************/
FILENAME MMAccess catalog 'sashelp.modelmgr.accessmacros.source';
%include MMAccess;

/****************************************************/
/* Set to detect failure in case macro load fails  */
/* and get the URL.                                 */
/****************************************************/

%let _MM_RC= -1;

%let target=aef7a78e-0a28-0e97-01c0-b8a0e5ba15c7;
%MM_GetURL(ID=&target,Trace=on);
%put _MM_URL=&_MM_URL;
%put _MM_ResourcesURL=&_MM_ResourcesURL;
```

## %MM_Register Macro

Registers a model to an existing version in the SAS Model Manager model hierarchy.

### Syntax

%MM_Register(
VersionId=*destination-version-UUID*,
ModelTemplate=*model-template-name*,
EMModelPackage=*fileref-for-EM-package-file*,
ScoreDataStepCode=*fileref-to-data-step-fragment-score-code*,
ScoreProgram=*fileref-to-SAS-program-score-code*,
InDataSamp=*SAS-data-set-reference-to-input-data-sample-table*,
InDataInfo=*SAS-data-set-reference-to-input-variable-metadata-table*,
OutDataSamp=*SAS-data-set-reference-for-output-data-sample-table*,
OutDataInfo=*SAS-data-set-reference-for-output-variable-metadata-table*,
TargetDataSamp=*SAS-data-set-reference-for-target-data-sample-table*,
TargetDataInfo=*SAS-data-set-reference-for-target-variable-metadata-table*,
TrainingDataSamp=*SAS-data-set-reference-for-training-data-sample-table*,
LogisticOutModelTable=*SAS-data-set-reference-for-PROC-LOGISTIC-outmodel-table*,
ReportDir=*path-to-EMREPORT-directory*,
KeepInVars=*keep-variable-list-for-InDataSamp*,
KeepOutVars=*keep-variable-list-for-OutDataSamp*,
KeepTargetVars=*keep-variable-list-for-TargetDataSamp*,
ModelName=*model-name*,
Description=*model-description*,
Label=*model-label*,
Subject=*model-subject*,
Algorithm=*model-algorithm*,
Function=*model-function*,
Modeler=*modeler-property*,
Tool=*model-tool-property*,
ToolVersion=*model-tool-version*,
<Trace=ON | OFF>
);

#### *Arguments*

*Note:* If a %MM_Register macro parameter contains a semicolon, comma, apostrophe, or quotation mark (; , ' ") character, you must add %bquote to the macro parameter. For example, you could specify %MM_Register(..., Description=%bquote(My Division's Model), ... );

**VersionId=*destination-version-UUID***
specifies the SAS Model Manager UUID for an existing version in the SAS Model Manager model repository.

| | |
|---|---|
| Default | the value of the _MM_CId macro variable |
| Note | This argument is required. |

**ModelTemplate=*model-template-name***
specifies the SAS Model Manager model template that was used to register and validate this model.

| | |
|---|---|
| Defaults | For models that were registered using the EMModelPackage parameter, the template is set according to the information that is contained within the named SAS Enterprise Miner model package file. |
| | Models that were registered using the LogisticOutModelTable parameter are registered with the Classification template. |
| | All other registrations default to the AnalyticalModel template. |

**EMModelPackage=*SAS-fileref-for-EM-package-file***
specifies a SAS file reference that points to the SAS Enterprise Miner model package file (SPK) that contains the model to be registered.

| | |
|---|---|
| Note | The EMModelPackage argument is required unless you use the ReportDir argument, the ScoreDataStepCode argument, or the ScoreProgram argument to specify the model code filename. If two or more of these arguments are used, the order of priority is ReportDir, EMMModelPackage, ScoreProgram, and then ScoreDataStepCode. |

**ScoreDataStepCode=*fileref-to-data-step-fragment-score-code***
specifies a SAS file reference for the model score code that is a fragment of SAS code that can be included in a DATA step. A DATA step fragment contains no DATA, PROC, or RUN statements.

| | |
|---|---|
| Note | The ScoreDataStepCode argument is required unless you use the EMModelPackage argument, the ReportDir argument, or the ScoreProgram argument to specify the model code filename. If two or more of these arguments are used the order of priority is ReportDir, EMMModelPackage, ScoreProgram, and then ScoreDataStepCode. |

**ScoreProgram=*fileref-to-SAS-program-score-code***
specifies a SAS file reference for a text file containing the SAS program, including all step code that is required for successful execution of the model score code.

| | |
|---|---|
| Note | The ScoreProgram argument is required unless you use the EMModelPackage argument, the ReportDir argument, or the ScoreDataStepCode argument to specify the model code filename. If two or more of these arguments are used the order of priority is ReportDir, EMMModelPackage, ScoreProgram, and then ScoreDataStepCode. |

**InDataSamp=*SAS-data-set-reference-to-input-data-sample-table***
specifies a two-level SAS data set reference in the form *libref.filename* that points to a model input data sample table. The input data sample table is a table that contains all model input variables and is used to create the inputvar.xml file that is required for model registration. The input data sample table is not required for models that were imported as SAS Enterprise Miner package files.

| | |
|---|---|
| Note | The InDataSamp argument is required unless you use the InDataInfo argument. |

**Tip** When you use the %MM_Register macro to register a model, the inputvar.xml file should contain only input variables for the model that you are registering. If the input data sample table includes variables that are not used by the model, use the KeepInVars argument to remove these variables. If no variables are specified by the KeepInVars argument, SAS filters the target variables from the table specified by the InDataSamp argument.

**See** KeepInVars argument on page 258

**InDataInfo=*SAS-data-set-reference-for-input-variable-metadata-table***
specifies a two-level SAS data set reference in the form *libref.filename* that points to a model input variable metadata table. The input variable metadata table should be in the form of a CONTENTS procedure output file, which has the columns NAME, TYPE, LENGTH, LABEL, FORMAT, LEVEL, and ROLE. Each row of the table is a variable. The model input variable metadata table is used to create the inputvar.xml file that is required for model registration.

**Note** The InDataInfo argument must be specified unless you use the InDataSamp argument.

**Tip** When you use the %MM_Register macro to register a model, the inputvar.xml file should contain only variables for the model that you are registering. If no variables are specified in the KeepInVars argument, SAS filters the target variables from the table specified by the InDataInfo argument.

**See** The CONTENTS Procedure in the *Base SAS Procedures Guide*

**OutDataSamp=*SAS-data-set-reference-for-output-data-sample-table***
specifies a two-level SAS data set reference in the form *libref.filename* that points to a model output data sample table. The output data sample table should contain all variables that are created or modified by the model and is used to create the outputvar.xml file that is required for model registration. The output data sample table is not required for models that were imported as SAS Enterprise Miner package files.

**Interaction** If the output data sample table includes variables that are created or modified by the model, use the KeepOutVars argument to remove these variables. If no variables are specified in the KeepOutVars argument, SAS filters the input variables and the target variables from the table that is specified by the OutDataSamp argument.

**Note** The OutDataSamp argument must be specified unless you use the OutDataInfo argument.

**See** KeepOutVars argument on page 258

**OutDataInfo=*SAS-data-set-reference-for-output-variable-metadata-table***
specifies a two-level SAS data set reference in the form *libref.filename* that points to a model output variable metadata table. The output variable metadata table should contain all of the variables that are created or modified by the model. The SAS file should be in the form of the CONTENTS procedure output file, which has the columns NAME, TYPE, LENGTH, LABEL, FORMAT, LEVEL, and ROLE. Each row of the table contains a variable. The output variable metadata table is used to create the outputvar.xml file that is required for model registration.

**Interaction** If no variables are specified by the KeepOutVars argument, SAS filters the input variables and target variables from the table that is specified by the OutDataInfo argument.

**Note** The OutDataInfo argument must be specified unless you use the OutDataSamp argument.

**TargetDataSamp=*SAS-data-set-reference-for-target-data-sample-table***
specifies a two-level SAS data set reference in the form *libref.filename*. The data set reference points to a SAS table that contains the model target variable. The SAS file should contain the variable that was used as the model target during training. The SAS file is used to create the target variable information in the targetvar.xml file that is used for SAS Model Manager model registration.

**Tip** If the target data sample table includes other variables that are not model target variables, use the KeepTargetVars argument to remove these variables.

**See** KeepTargetVars argument on page 257

**TargetDataInfo=*SAS-data-set-reference-for-target-variable-metadata-table***
specifies a two-level SAS data set reference in the form *libref.filename*. The data set reference points to a SAS table that contains the model's target variable and its metadata. The SAS file should be in the form of the CONTENTS procedure output file, which has the columns NAME, TYPE, LENGTH, LABEL, FORMAT, LEVEL, and ROLE. Each row of the table contains a variable. The metadata in the SAS file is used to create the target variable information in the target.xml file that is used for SAS Model Manager model registration.

**TrainingDataSamp=*SAS-data-set-reference-for-training-data-sample-table***
specifies a two-level SAS data set reference in the form *libref.filename*. The data set reference points to a SAS file that contains the training data that is used for a model created by the LOGISTIC procedure. The training data sample must be an exact sample of the training data that is submitted to the LOGISTIC procedure. When the TrainingDataSamp argument and the LogisticOutModelTable argument are specified, the %MM_Register macro can derive the input, output, and target variables to create the inputvar.xml file, the ouputvar.xml file, and the targetvar.xml file.

**LogisticOutModelTable==*SAS-data-set-reference-for-PROC-LOGISTIC-outmodel-table***
specifies a two-level SAS data set reference in the form *libref.filename* that points to a LOGISTIC procedure fit table that was created by using the PROC LOGISTIC OUTMODEL= statement, and is suitable for use with the PROC LOGISTIC INMODEL statement. If the TrainingDataSamp argument is specified, then SAS generates the input, output, and target variable metadata from this table. In this case, the InDataSamp and OutDataSamp arguments do not need to be specified.

**Note** This argument is required only if the model is created by the LOGISTIC procedure using the OUTMODEL statement.

**ReportDir=*path-to-EMREPORT-directory***
specifies an absolute file path to the EMREPORT directory that was created by the SAS Enterprise Miner batch code. All SAS Enterprise Miner model packages that are named miningResult.spk and that reside in a subdirectory of the EMREPORT directory are registered to the target version. The ReportDir argument is valid only for use with SAS Enterprise Miner model package files.

**Note** The ReportDir argument is required unless you use the EMModelPackage argument, the ScoreDataStepCode argument, or the ScoreProgram argument to specify the model code filename. If two or more of these arguments are used the order of priority is ReportDir, EMMModelPackage, ScoreProgram, and then ScoreDataStepCode.

**KeepInVars=*keep-variable-list-for-InDataSamp***
specifies a list of input variables or columns that are retained in the model's inputvar.xml file. Only variables from the table that is specified by the InDataSamp argument can be specified in this list.

See InDataSamp argument on page 255

**KeepOutVars==*keep-variable-list-for-OutDataSamp***
specifies a list of variables or columns that are retained in the model's outputvar.xml file. Only variables from the table that is specified by the OutDataSamp argument can be specified in this list.

See OutDataSamp argument on page 256

**KeepTargetVars=*keep-variable-list-for-TargetDataSamp***
specifies a list of variables or columns that are retained in the model's targetvar.xml file. Only variables from the tables that are specified by the TargetDataSamp argument can be specified in this list.

See TargetDataSamp argument on page 257

**ModelName=*model-name***
specifies the name of the model, which is used as the value of the model **Name** property on the **General** tab of the **Models Properties** page.

Note This argument is required.

**Description=*model-description***
specifies a description of the model, which is used as the value of the model **Description** property on the **General** tab of the **Models Properties** page.

**Label=*model-label***
specifies a model's label, which is used as the value for the model **Model label** property on the **Specific** tab of the **Models Properties** page. *model-label* is a text string that is used as the label for the selected model in the model assessment charts that SAS Model Manager creates. If *model-label* is not specified, SAS Model Manager uses the text string that is specified for the ModelName argument.

**Subject=*model-subject***
specifies the model's subject, which is used as the value for the model **Subject** property on the **Specific** tab of the **Models Properties** page. *model-subject* provide an additional description for a model, such as a promotional or campaign code. This property is not tied to any computational action by SAS Model Managerr.

**Algorithm=*model-algorithm***
specifies the model's computation algorithm, which is used as the value of the model **Algorithm** property on the **Specific** tab of the **Models Properties** page.

Example Algorithm=Decision Tree

**Function=*model-function***
specifies the model's function class, which is used as the value for the model **Function** on the **Specific** tab of the **Models Properties** page. Valid values are Classification, Prediction, Association, Clustering, Sequence, Forecasting, TextMining, Transformation, and EMCreditScoring.

**Modeler=*model-creator***
specifies the SAS Model Manager user ID for the person who created the model, which is used as the value of the model **Modeler** property on the **Specific** tab of the **Models Properties** page.

**Tool=*model-tool***
specifies the modeling tool that was used to create the model, and that is used as the value of the model **Tool** property on the **Specific** tab of the **Models Properties** page.

**ToolVersion=*model-tool-version***
specifies the version of the tool that was used to create the model, and that is used as the value of the model **Tool version** property on the **Specific** tab of the **Models Properties** page.

**Trace=ON | OFF**
specifies whether to supply verbose trace messages to the SAS log.

| | |
|---|---|
| **Default** | OFF |
| **Example** | `trace=on` |

## Details

### Overview of Using the %MM_Register Macro

The %MM_Register macro registers the following types of models to an existing version in the SAS Model Manager model repository:

- a model as a SAS Enterprise Miner package
- a SAS DATA step fragment
- a SAS program

In order to register a model using the %MM_Register macro, the macro must know the model name, the version in which the model is registered, the model source code, the model template, and the model input and output variables. If you register a SAS Enterprise Miner model, this information is included in a SAS Enterprise Miner package file (SPK file). When you register SAS code models, you must specify the model name, version, and model score code, as well as the model input and output variables in the respective macro arguments. Several %MM_Register macro arguments enable you to provide values for model property values that appear on the **Models Properties** page.

### Registering SAS Enterprise Miner Models

Models that were created in SAS Enterprise Miner and saved as a SAS Enterprise Miner SPK file contain all of the information that is needed to register a model in SAS Model Manager. Registering SAS Enterprise Miner SPK files requires you to specify the following arguments:

- ModelName
- VersionId
- EMModelPackage or ReportDir arguments

To register one SAS Enterprise Miner model, you can specify the EMMModelPackage argument. To register multiple SAS Enterprise Miner models, you use the ReportDir argument to name a directory whose subdirectories each contain a miningResult.spk file. You can register multiple models simultaneously in SAS Model Manager.

SAS Enterprise Miner generates a program, EMBatch, to create multiple models in a batch program. You can modify the EMBatch program to include the %MM_Register macro, using the macro variable &EMREPORT as the value of the ReportDir argument. By making this change to the EMBatch program, you can create and register SAS Enterprise Miner models in a batch program for use in SAS Model Manager.

**Registering SAS Code Models**

When you register SAS code models, the information that is required is not contained in an SPK file and you must specify the required information using the %MM_Register arguments. Each model that you register must specify the model name, the model version, the model template, the model code, and the SAS data sets that describe the input, output, and target variables.

Use the following table for usage information about using the %MM_Register arguments:

| Required Information | Argument | Usage |
|---|---|---|
| model name | ModelName | Specify the name of the model, which is used to identify the model in the SAS Model Manager model repository. |
| version | VersionId | Specify the name of the version in which the model is registered. |
| model score code<br>Specify one of the following arguments:<br>• ScoreDataStepCode<br>• ScoreProgram<br>• LogisticOutModelTable | ScoreDataStepCode | Specify a fileref that points to a file that contains score code that is a DATA step fragment. A DATA step fragment contains no DATA, PROC, or RUN statements.<br>When you specify the ScoreDataStepCode argument, your model input and output variables can be defined using one of the following pairs of arguments:<br>• InDataSamp and OutDataSamp<br>• InDataInfo and OutDataInfo<br>• InDataSamp and OutDataInfo |

| Required Information | Argument | Usage |
|---|---|---|
| | ScoreProgram | Specify a LOGISTIC procedure FIT table in the form *libref.filename* that was created by the PROC LOGISTIC OUTMODEL= statement. The FIT table can be used as the value in a PROC LOGISTIC INMODEL= statement.<br><br>When you specify the ScoreProgram argument, your model input and output variables can be defined using one of the following pairs of arguments:<br>• InDataSamp and OutDataSamp<br>• InDataInfo and OutDataInfo |
| | LogisticOutModelTable | Specify a *libref.filename* that points to a LOGISTIC procedure FIT table that was created by the PROC LOGISTIC OUTMODEL= statement, which can be used as the value to a PROC LOGISTIC INMODEL= statement.<br><br>If the model does not contain data transmission and you specify a value for the TrainingDataSamp argument, SAS Model Manager uses the training sample data set and the FIT table to create the model inputvar.xml file, the outputvar.xml file, and the targetvar.xml file.<br><br>If you do not specify a value for the TrainingDataSamp argument or if your program transforms the model input before running the LOGISTICS procedure, you must provide the model input and output variables using the InDataSamp or InDataInfo argument, and the OutDataSamp or OutDataInfo argument. |

| Required Information | Argument | Usage |
|---|---|---|
| input variables | InDataSamp | Specify a fileref to a SAS data set whose variables contain the input variables that are used by the SAS code model. An example would be a data set that was used for training the model.<br><br>SAS Model Manager reads one observation in the data set that is specified by the InDataSamp argument to create the inputvar.xml file for the model. The inputvar.xml file defines the model input variables and their metadata.<br><br>Based on the arguments that were specified, the %MM_Register macro uses arguments to filter variables from the data set to create the inputvar.xml file.<br><br>• You can use the KeepInVars argument to specify the variables in the InDataSamp data set that are used to create the inputvar.xml file.<br><br>• If you do not specify the KeepInVars argument, you can specify a value for the TargetDataSamp argument or the TargetDataInfo argument to filter variables based on this target data sample data set.<br><br>For more information, see KeepInVars argument on page 258. |

| Required Information | Argument | Usage |
| --- | --- | --- |
| | InDataInfo | Specify a fileref that points to a SAS data set whose variables are NAME, TYPE, LENGTH, LABEL, FORMAT, LEVEL, and ROLE. These variables define metadata for the model input variables. Each row in this data set contains the metadata for model input variables. Such a table can be created by the CONTENTS procedure.<br><br>SAS Model Manager reads the data set that is specified by the InDataInfo argument to create the inputvar.xml file for the model. The inputvar.xml file defines the model input variables and their metadata.<br><br>The variables in the data set that are specified by the TargetDataSamp argument or the TargetDataInfo argument are used as a filter to create the inputvar.xml file. |

| Required Information | Argument | Usage |
|---|---|---|
| output variables | OutDataSamp | Specify a fileref that points to a SAS data set whose variables contain the output variables that are created or modified by the SAS code model. An example is a data set that was the scored output of the model.<br><br>SAS Model Manager reads the data set that is specified by the OutDataSamp argument to create the outputvar.xml file for the model. The outputvar.xml file defines the model output variables and their metadata.<br><br>Based on the arguments that were specified, the %MM_Register macro uses arguments to filter variables from the data set to create the outputvar.xml file.<br><br>• You can use the KeepOutVars argument to specify the variables in the OutDataSamp data set that are used to create the outputvar.xml file.<br><br>• If you do not specify the KeepOutVars argument, input variables and target variables are filtered from the output table.<br><br>For more information, see KeepOutVars argument on page 258. |

| Required Information | Argument | Usage |
|---|---|---|
| | OutDataInfo | Specify a fileref that points to a SAS data set whose variables are NAME, TYPE, LENGTH, LABEL, FORMAT, LEVEL, and ROLE. These variables define metadata for the model output variables. Each row in this data set contains the metadata for model output variables. Such a table can be created by the CONTENTS procedure.<br><br>SAS Model Manager reads the data set that is specified by the OutDataInfo argument to create the outputvar.xml file for the model. The outputvar.xml file defines the model output variables and their metadata. If you do not specify the KeepOutVars argument, input variables and target variables are filtered from the output table. |
| target variable | TargetDataSamp | Specify a fileref that points to a SAS data set whose variables contain the target variable that is created or modified by the SAS code model. An example is a data set that was the scored output of the model.<br><br>SAS Model Manager reads the data set that is specified by the TargetDataSamp argument to create the targetvar.xml file for the model. The targetvar.xml file defines the target output variable and its metadata.<br><br>You can use the KeepTargetVars argument to specify the variable in the TargetDataSamp data set that is used to create the targetvar.xml file. |

| Required Information | Argument | Usage |
|---|---|---|
| | TargetDataInfo | Specify a fileref that points to a SAS data set whose variables are NAME, TYPE, LENGTH, LABEL, FORMAT, LEVEL, and ROLE. These variables define metadata for the model target variable. A row in this data set contains the metadata for the model target variable. Such a table can be created by the CONTENTS procedure.<br><br>SAS Model Manager reads the data set that is specified by the TargetDataInfo argument to create the targetvar.xml file for the model. The targetvar.xml file defines the model target variable and its metadata. |

Use the %MM_AddModelMfile macro to register other model component files that are not registered by the %MM_Register macro. For more information, see "Model Templates" on page 339 and "%MM_AddModelFile Macro" on page 246.

## Examples

### *Example 1: Registering a SAS Enterprise Miner Model Package*

```
/*****************************************************/
/* Registering a SAS Enterprise Miner Model Package. */
*****************************************************/

Options NOmlogic NOmprint NOspool;

/****************************************************/
/*  Access and load the Model Management macro code.*/
/****************************************************/

Filename MMAccess catalog 'SASHELP.modelmgr.AccessMacros.source';
%include MMAccess;

/*****************************************************/
/* Specify the path for a SAS Enterprise             */
/* Miner Model Package file miningResult.spk.        */
/*****************************************************/

FILENAME EMPak 'c:\myscorecode\EM\miningResult.spk';

/*****************************************************/
/* Set to detect failure in case macro load fails    */
/* and register the Enterprise Miner model.          */
/*****************************************************/
```

```
%let _MM_RC= -1;


%MM_Register(
  VersionId=
    //ModelManagerModelRepos/MMRoot/HomeEquity/HMEQ/1.0,
  EMModelPackage=EMPak,
  ModelName=HMEQ,
  Description=Home Equity Score Code,
  Trace=ON);

/*****************************************************/
/* Display MM_Register defined variables.            */
/*****************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
%PUT _MM_CId = &_MM_CId;
Options source;
```

### Example 2: Registering a Generic Model

```
/**************************************************/
/* Registering a generic model.                      */
/*****************************************************/

Options nomlogic nomprint nospool;

/*****************************************************/
/* Load and access the Model Management macro code. */
/*****************************************************/

Filename MMAccess catalog 'SASHELP.modelmgr.AccessMacros.source';
%include MMAccess;

/******************************************************/
/* Specify the location of the files.                 */
/******************************************************/

LIBNAME modelTbl 'c:\myModel\tables';
FILENAME Code 'c:\myModel\scoreCode';

/******************************************************/
/* Set to detect failure in case macro load fails     */
/* and register the model in the model repository        */
/******************************************************/

%let _MM_RC= -1;

%MM_Register(
  VersionId=
   //ModelManagerModelRepos/MMRoot/HomeEquity/HMEQ/1.0,
  ScoreDataStepCode=CODE,
  InDataSamp=modelTbl.HMEQInput,
  OutDataSamp=modelTbl.HMEQOutput,
```

```
  TargetDataSamp=modelTbl.HMEQTarget,
  ModelName=HMEQDTree,
  Description= Home Equity model Added with a SMM Macro,
  Trace=ON);

/*****************************************************/
/* Display the defined variables. */
/*****************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
%PUT _MM_CId = &_MM_CId;
Options source;
```

### Example 3: Registering a PROC LOGISTIC OUTMODEL-Style Model

```
/*****************************************************/
/* Registering a PROC LOGISTIC OUTMODEL-style model. */
/*****************************************************/

Options nomlogic nomprint nospool;

/*****************************************************/
/* Load and access the Model Management macro code. */
/*****************************************************/

Filename MMAccess catalog 'SASHELP.modelmgr.AccessMacros.source';
%include MMAccess;

/*****************************************************/
/* Specify the location of the files.               */
/*****************************************************/

LIBNAME modelTbl 'c:\myModel\Tables';
LIBNAME trainTbl 'c:\HomeEquity\Tables';
FILENAME ProgCode 'c:\myModel\scoreCode';

/*****************************************************/
/* Set to detect failure in case macro load fails    */
/* and register the model                            */
/*****************************************************/

%let _MM_RC= -1;

%MM_Register(
  VersionId=
   //ModelManagerModelRepos/MMRoot/HomeEquity/HMEQ/1.0,
  ScoreProgram=ProgCODE,
  LogisticOutModelTable=modelTbl.HMEQProcLogisticOutput,
  TrainingDataSamp=trainTbl.HMEQTraining,
  ModelName=HMEQLogisticOutmodel,
  Description=HMEQ Logistic OUTMODEL model added by macro,
  Trace=off);

/******************************************************/
/* Display the defined variables.   */
```

```
/****************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
%PUT _MM_CId = &_MM_CId;
Options source;
```

# %MM_RegisterByFolder Macro

Register one model or multiple models simultaneously to the model repository from a single directory. Each model is located in a subdirectory under the specified directory.

## Syntax

**%MM_RegisterByFolder** (VersionId=*path-to-version*, ReportDir=*path-to-folder*, <Trace=ON | OFF>);

### *Arguments*

**VersionId=*path-to-version***
specifies the SAS Model Manager UUID for an existing version in the SAS Model Manager model repository where the models are registered. *path-to-version* can be either a SAS Model Manager UUID or a version path.

| | |
|---|---|
| Default | the value of the _MM_CId macro variable |
| Note | This argument is required. |
| Examples | VersionId=b23327cb-0a29–0c76–011a-f7bb3d790340 |
| | VersionId=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HomeEquity/1.0 |

**ReportDir=*path-to-folder***
specifies the directory that contains the models to be registered.

| | |
|---|---|
| Note | This argument is required. |

**Trace=ON | OFF**
specifies whether to supply verbose trace messages to the SAS log.

| | |
|---|---|
| Default | OFF |
| Example | Trace=on |

## Details

You can register SAS Enterprise Miner models and SAS code models using the %MM_RegisterByFolder macro. The directory that you specify in the ReportDir argument is the parent folder. Each model has its own subfolder under the parent folder. Each type of model has requirements for the subfolder name and the contents of the subfolder:

***Table A1.1*** *Requirements for Registering Models in a Directory*

| Requirement Type | Enterprise Miner Models | SAS Code Models |
|---|---|---|
| Value of ReportDir | a valid directory name | a valid directory name |
| Model subdirectory name | the subdirectory name must be the name of the model | the subdirectory name must be the name of the model |
| Contents of the subdirectory | one file named miningResult.spk | Required files:<br>• Modelmeta.xml<br>• ModelInput.sas7bdat<br>• Score.sas<br>Optional files:<br>• ModelOutput.sas7bdat<br>• ModelTarget.sas7bdat |

Here is a description of the files that reside in the model subfolders:

miningResult.spk
: The miningResult.spk file contains the model component files for a model that was created in SAS Enterprise Miner.

Modelmeta.xml
: The Modelmeta.xml file uses XML to define the model component files and values for model properties.

ModelInput.sas7bdat
: ModelInput.sas7bdat is a table that contains the model input variables. This file is used to create the model inputvar.xml file.

Score.sas
: Score.sas contains the SAS score code, which can be a DATA step fragment or a SAS program.

ModelOutput.sas7bdat
: ModelOutput.sas7bdat is a SAS data set that contains one or more model output variables.

ModelTarget.sas7bdat
: ModelTarget.sas7bdat is a SAS data set that contains only the target variable.

The Modelmeta.xml file is an XML file that is a mapping of SAS Model Manager component filenames to user-defined component filenames. The <Model> element has two main sections:

- <ModelMetadata> to define model properties

  See: “Specific Properties” on page 349

- <FileList> to list the model component files. This list is comparable to the **Files** section of the Local Files window, which you use to import SAS code models.

  For a list of files for each model type, see “Model Template Component Files” on page 340.

  Within the <File> element, put the name of the file that is defined in the model template, in the <name> element. The contents of the <value> element is the filename under the model directory.

Here is an example Modelmeta.xml file for a classification model named HMEQ:

```
<?xml version="1.0" encoding="utf-8" ?>
<Model>
  <ModelMetadata>
    <name>hmeq</name>
    <description>Home Equity Model</description>
    <label>HMEQ</label>
    <algorithm></algorithm>
    <function>classification</function>
    <modeler></modeler>
    <tool>SASProc</tool>
    <toolversion></toolversion>
    <subject></subject>
    <modelTemplate>Classification</ModelTemplate>
    <scoreCodeType>SAS Program</scoreCodeType>
  </ModelMetadata>
  <FileList>
    <File>
       <name>score.sas</name>
       <value>myScoreFile.sas</value>
    </File>
    <File>
       <name>modelinput.sas7bdat</name>
       <value>hmeqIn</value>
    </File>
    <File>
       <name>modeloutput.sas7bdat</name>
       <value>hmeqOut</value>
    </File>
    <File>
       <name>target.sas7bdat</name>
       <value>hmeqTar</value>
    </File>
    <File>
       <name>inputvar.xml</name>
       <value></value>
    </File>
    <File>
       <name>outputvar.xml</name>
       <value></value>
    </File>
    <File>
       <name>targetvar.xml</name>
       <value></value>
    </File>
    <File>
       <name>train.sas7bdat</name>
       <value></value>
    </File>
    <File>
       <name>Training.sas</name>
       <value></value>
    </File>
    <File>
       <name>Training.log</name>
```

```
      <value></value>
   </File>
   <File>
      <name>Training.lst</name>
      <value></value>
   </File>
   <File>
      <name>outest.sas7bdat</name>
      <value></value>
   </File>
   <File>
      <name>outmodel.sas7bdat</name>
      <value>om</value>
   </File>
   <File>
      <name>Output.spk</name>
      <value></value>
   </File>
   <File>
      <name>Format.sas7bcat</name>
      <value></value>
   </File>
   <File>
      <name>Dataprep.sas</name>
      <value></value>
   </File>
   <File>
      <name>Notes.txt</name>
      <value></value>
   </File>
 </FileList>
</Model>
```

## Example

***Example Code A1.1*** *Registering a Generic Model*

```
/***************************************************/
/* Register a SAS Code Model By Folder               */
/*****************************************************/

Options nomlogic nomprint nospool;

/*****************************************************/
/* Load and access the Model Management macro code. */
/*****************************************************/

Filename MMAccess catalog 'SASHELP.modelmgr.AccessMacros.source';
%include MMAccess;

/******************************************************/
/* Specify the location of the folder.                */
/******************************************************/

%let modelFolder = c:\myModel;
%let hmeq1 = //ModelManagerModelRepos/MMRoot/HomeEquity/HMEQ/1.0;
```

```
/*****************************************************/
/* Set to detect failure in case macro load fails     */
/* and register the models in the model repository.      */
/*****************************************************/

%let _MM_RC= -1;

%MM_RegisterByFolder(VersionId=&hmeq1, ReportDir=&modelFolder, Trace=ON);

/***************************************************/
/* Display the defined variables. */
/***************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
Options source;
```

## %MM_CreateModelDataset Macro

Creates a data set that contains information about models. SAS Model Manager can provide information for the champion model or for all models that are in the specified model repository path. The repository path that you specify can be MMRoot, an organizational folder, a project, a version, or a model. The data set contains the information for models that exist under the specified path.

### Syntax

%MM_CreateModelDataset (mDatasetName = *name-of-data-set*,
smmPath=*folder-project-verion-or-model-path* <isChampion=Y | N><, Trace=ON | OFF>);

#### *Arguments*

**mDatasetName = *name-of-data-set***
specifies the name of the data set that the macro creates. The macro can be created in a data set that you specify by using a two-level name in the form *libref.filename*.

**Default** mDatasetName=work.models

**smmPath=*folder-project-version-or-model-path***
specifies the path from which to obtain the model data. If the path is a folder, the data set contains model information for all models under that folder unless isChampion=Y. If isChampion=Y, the information that is returned is for only the champion model. If the path is a project, the data set contains model information for models under that project. If the path is a version, the data set contains model information for models under that version. If the path is a model, the data set contains model information for only that model.

**Default** MMRoot

**isChampion=Y | N**
specifies whether the information that is returned contains information for only the champion model or for all models.

Y specifies that the information that is returned is for only the champion model.

N specifies that the information that is returned is for all models.

**Default** Y

**Trace=ON | OFF**
specifies whether to supply verbose trace messages to the SAS log.

**Default** OFF

**Example** Trace=on

## Details

By default, the %MM_CreateModelDataset returns data only about the champion model. If you want information about models other than the champion model, specify isChampion=N. The data set that is created contains these variables:

| | | |
|---|---|---|
| Algorithm | Name | ScoreCodeType |
| CreationDate | Owner | Template |
| Description | ProductionDate | TemplateFileName |
| ExpirationDate | ProjectName | Tool |
| FolderName | ProjectPath | UserProperties |
| Function | ProjectState | VersionName |
| ModelLabel | ProjectURL | VersionState |
| ModelUUID | ProjectUUID | isChampion |
| Modeler | PublishedDate | isDefaultVersion |
| ModificationDate | RetiredDate | isPublished |

## Example

***Example Code A1.2*** *Extracting Model Information*

```
/*****************************************************/
/* Create a data set to contain model information    */
/*****************************************************/

Options nomlogic nomprint nospool;

/*****************************************************/
/* Load and access the Model Management macro code. */
/*****************************************************/

Filename MMAccess catalog 'SASHELP.modelmgr.AccessMacros.source';
%include MMAccess;

/******************************************************/
/* Specify the location of the data set and model     */
/* path.                                              */
/******************************************************/

libname modelDS 'c:\myModel\ModelInfo';
```

```
%let hmeq1 = //ModelManagerModelRepos/MMRoot/HomeEquity/HMEQ/1.0;

/*****************************************************/
/* Set to detect failure in case macro load fails     */
/* and create the model data set.                     */
/*****************************************************/

%let _MM_RC= -1;

%MM_CreateModelDataset(mDatasetName=modelDS.models,
    smmpath=//ModelManagerDefaultRepo/MMRoot/DDHMEQ/HMEQ/1.0/Models/
              Regression,
    Trace=ON);

/***************************************************/
/* Display the defined variables. */
/***************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
Options source;
```

# *Appendix 2*
# Macro Variables

## *SAS Environment Macro Variables*

The following table lists the macro variables that are used to set the SAS environment:

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_Password | the password of the user ID that is running the macro | mdlmgrpw2 |
| _MM_User | the user ID of the user that is running the macro | mdlmgradmin |

## *Scoring Test Macro Variables*

The following table lists the macro variables that are used to run a scoring test:

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_InputDS | the location of the input data source file | http://abc123.sas.com:7980/SASContentServer/repository/default/sasfolders/Shared Data/Model Manager/MMLib/HMEQ_SCORE_INPUT.sas7bdat |
| _MM_InputLib | the libref that is associated with the location of the input data source file | inlib |
| _MM_ModelID | the UUID of the model | 4622bdda-ac1b-12d5-0196-021edec54347 |

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_OutputDS | the location of the output data source file | http://abc123.sas.com:7980/SASContentServer/repository/default/sasfolders/Shared Data/Model Manager/MMLib/HMEQ_SCORE_OUTPUT.sas7bdat |
| _MM_OutputLib | the libref that is associated with the location of the output data source file | outdslib |
| _MM_Password | the password of the user ID that is running the report | mdlmgrpw2 |
| _MM_PerformanceDS | the location of the performance data source file | http://abc123.sas.com:7980/SASContentServer/repository/default/sasfolders/Shared Data/Model Manager/MMLib/HMEQ_PERF_Q1.sas7bdat |
| _MM_PerformanceLib | the libref that is associated with the location of the performance data source file | perflib |
| _MM_TaskDir | the URL of the stored scoring test | http://myserver.mycompany:7980/SASContentServer/repository/default/ModelManager/MMRoot/DDHMEQ/HMEQ/1.0/Scoring |
| _MM_TestDS | the location of the test data source file | http://abc123.sas.com:7980/SASContentServer/repository/default/sasfolders/Shared Data/Model Manager/MMLib/HMEQ_TEST.sas7bdat |
| _MM_TestLib | the libref that is associated with the location of the test source file | testlib |
| _MM_TrainDS | the location of the train data source file | http://abc123.sas.com:7980/SASContentServer/repository/default/sasfolders/Shared Data/Model Manager/MMLib/HMEQ_TRAIN.sas7bdat |
| _MM_TrainLib | the libref that is associated with the location of the train source file | trainline |

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_User | the user ID of the user that is running the report | mdlmgradmin |

### *Validating Model Report Macro Variables*

The following tables lists the macro variables that are used to create model comparison reports, model profile reports, delta reports, dynamic lift reports, and user reports:

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_LocationInfo | the location information for a model | /MMRoot/Mortgages/HMEQ/1.0 |
| _MM_ModelFlag | the value of the champion model flag<br>0 - champion model<br>1 - challenger model | 0 |
| _MM_ModelLabel | a label for a model | reg |
| _MM_ModelName | the name of the model | Tree |
| _MM_Password | the password of the user ID that is running the report | mdlmgrpw2 |
| _MM_PosteriorVar | the model's posterior variable name | EM_EVENTPROBABILITY |
| _MM_ProjectName | the name of the project | HMEQ |
| _MM_ReportFormat | the output format of the generated report | html |
| _MM_ReportLib | the libref for the **Report** node | report |
| _MM_ResourcesLib | the libref for the **Resources** node | resources |
| _MM_SampleSize | the size of a sample | 1000 |
| _MM_SampleSeed | the sample seed | 12345 |
| _MM_ScoreCodeType | the type of score code | SAS Program |
| _MM_TargetEvent | the target event value | 1 |
| _MM_TargetVar | the target variable name | bad |

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_TaskDir | the URL of the stored report | http://myserver.mycompany:7980/SASContentServer/repository/default/ModelManager/MMRoot/DDHMEQ/HMEQ/1.0/Reports |
| _MM_User | the user ID of the user that is running the report | mdlmgradmin |

### Performance Monitoring Report Macro Variables

The following table lists the macro variables that are used to create performance monitoring reports:

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_Agg_Mail | specifies whether to send aggregated mail for performance monitoring with multiple data sources | Y or N |
| _MM_DateTime | the time that the performance task is to run | 1Sep2013:05:00:00 |
| _MM_Hpds2_Flg | enables high-performance monitoring if set it to 1, is used with the _MM_Hpdm_Performance macro variable | 1 |
| _MM_Hpdm_Performance | the configuration settings for high-performance monitoring | %nrstr(performance commit=10000 cpucount=ACTUAL dataserver='tera2650' timeout=120 host='tms2650' install='/opt/v940/laxno/TKGrid';) |
| _MM_ModelName | the name of the champion model | reg1 |
| _MM_ModelID | the UUID of the champion model | 7514d6e-ac1b-12d5-01e4-878abeb04505 |
| _MM_ModelLocalPath | the location of the SAS Work library in the SAS Application Server | C:\DOCUME~1\ADMINI~1\LOCALS~1\Temp\1\SAS Temporary Files_TD2032_BRDVM0199_ |

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_Password | the password of the user ID that is running the report | mdlmgrpw2 |
| _MM_ProjectPath | the network path to the model project in the model repository | //ModelManagerDefaultRepo/ MMRoot/DDHMEQ/HMEQ |
| _MM_ProjectURLPath | the URL to the model project in the model repository | http://myserver.mycompany.com: 7980/SASContentServer/ repository/default/ModelManager/ MMRoot/HMEQ |
| _MM_ProjectUUID | the project UUID | 27514d6e-ac1b-12d5-01e4-878abeb04505 |
| _MM_Seg_Filter | filters the performance data for each sub-project from the top level performance datasource by using this macro variable | %nrstr(Location='USA') |
| _MM_ScoreCodeType | the type of score code | SAS Program |
| _MM_VersionName | the name of the default version | 1.0 |
| _MM_ReportDatasrc | the project's performance data set | jun13perf.sas7bdat |
| _MM_PreCode | one or more macro variables that set values to performance variables | `%let _MM_EventProbVar=score;` `%let _MM_TargetVar=bad;` |
| _MM_ResultURLPath | the URL to the version's **Resources** node | http://myserver.mycompany.com: 7980/SASContentServer/ repository/default/ModelManager/ MMRoot/HMEQ/1.0/Resources |
| _MM_TimeLabel | the label that is used in reports to represent the time period of the data in the performance data set | Q1 |
| _MM_Trace | indicates whether to write a trace log | ON or OFF |
| _MM_User | the user ID of the user that is running the report | mdlmgradmin |

### *Dashboard Report Macro Variables*

The following table lists the macro variables that are used to create dashboard reports:

| Macro Variable Name | Description | Example Value |
|---|---|---|
| _MM_Dashboard_Dir | the path to the directory where the dashboard report is stored | C:\SAS\Config\Lev1\AppData\SASModelManager12.3\Dashboard |
| _MM_Force_Run_Dash_Reports | whether to force running the report and updating all tables | Y or N |
| _MM_Password | the password of the user whose user ID is running the report | mdlmgrpw2 |
| _MM_ReportFormat | the output format of the generated report | html |
| _MM_Report_Style | the style used in the generated report | Seaside |
| _MM_SAS_Locale | the SAS session locale | en_US |
| _MM_User | the user ID of the user who is running the report | mdlmgradmin |

### *Model Retrain Report Macro Variables*

The following table lists the macro variables that are used to retrain models:

| Macro Variable | Description | Example Value |
|---|---|---|
| _MM_Hpds2_Flg | enables high-performance monitoring if set it to 1, is used with the _MM_Hpdm_Performance macro variable | 1 |
| _MM_Hpdm_Performance | the configuration settings for high-performance monitoring | %nrstr(performance commit=10000 cpucount=ACTUAL dataserver='tera2650' timeout=120 host='tms2650' install='/opt/v940/laxno/TKGrid';) |

| Macro Variable | Description | Example Value |
|---|---|---|
| _MM_Password | the password of the user ID that is running the report | mdlmgrpw2 |
| _MM_User | the user ID of the user who is running the report | mdlmgradmin |

*Appendix 3*

# Macros for Registering Models to the SAS Metadata Repository



## Using Macros to Register Models Not Created by SAS Enterprise Miner

### *About the %AA_Model_Register Macro*

You can use the %AAModel macro and the %AA_Model_Register macro to register the SAS Metadata Repository models that are not created by SAS Enterprise Miner. These models are created by SAS procedures and are supported by SAS Model Manager:

- SAS/STAT item store models
- High-performance models
- PROC COUNTREG models
- PROC SEVERITY models

If you do not want to register the model, you can create SAS package files (SPK) without registering the model. After the model is registered to the SAS Metadata Repository, you can import the model to SAS Model Manager using the import from SAS Metadata Repository method. If you create an SPK file, you would import the model using the import from SAS Model Package File method.

The %AAModel macro is an autocall macro that loads the %AA_Model_Register macro. This macro must be submitted before you submit the %AA_Model_Register macro.

You specify these types of arguments in the %AA_Model_Register macro:

- The model identification argument's name. You must also describe a model and identify a SAS/STAT item store.
- Action arguments specify whether to create an SPK file and whether to register the model in the SAS Metadata Repository.
- You specify model component arguments when a SAS/STAT procedure does not create an item store, if a model is created using high-performance analytic procedures, or if you are registering PROC COUNTREG or PROC SEVERITY models. The model component arguments identify the train data set, the model level, and the score code file. The arguments also identify whether the score code is only DATA step code or a SAS program that includes DATA step code, macros, procedures.
- The Lookup=Select option if a SAS/STAT model's input variable includes non-latin1 characters. This option ensures the generation of correct score code.
- Other options are available to add information to the model or to specify whether to keep or delete the data sets that the macro produces.

For more information, see "%AA_Model_Register Autocall Macro" on page 292.

If you are running macros in a SAS session that requires a connection to the SAS Metadata Server, you must specify the metadata connection system options before you run the macros. If these options are not specified, you will be prompted for the information. If you are running the macros in batch mode, you must include the metadata connection system options. Otherwise, you will receive a failure message. For more information, see "Setting Metadata Connection System Options" on page 289.

These SAS/STAT procedures can create an item store using the STORE statement:

| **Procedure** | **Item Store Restrictions** |
|---|---|
| GENMOD | Training code is not included |
| GLIMMIX | Training code is not included |
| GLM | Training code is not included |
| GLMSELECT | Fit statistics are not included |
| LOGISTIC | None |
| MIXED | Training code is not included |
| PHREG | Training code is not included |
| REG | Training code or fit statistics are not included |

*Note:* Item store restrictions have not been evaluated for other SAS/STAT procedures that have a STORE statement. Using the %AA_Model_Register macro might cause undesirable results.

### *Register a Model in the SAS Metadata Repository Using a SAS/STAT Item Store*

After you run a SAS/STAT procedure using the STORE statement, you use the %AA_Model_Register macro to register the model to the SAS Metadata Repository.

In the following example program, the PROC LOGISTICS STORE statement creates an item store in work.logisticStore. The %AA_Model_Register macro uses the item store in work.logisticStore to create the register file.

```
/* PROC LOGISTIC specifies the STORE statement to create an item store. *
/
proc logistic data=sampsio.hmeq;
   class job;
   model bad = loan value job;
   store work.logisticStore;
run;

/* Set up the meta data connection system options. */

options metaPort=8561
      metaServer=server-address
      metaRepository=Foundation
      metaUser=user-ID
      metaPass=password;

/* Load the macros. */

%aamodel;

/* Register the model in the SAS Metadata Repository. */

%aa_model_register(modelname=LogisticTest,
                   modeldesc=%nrbquote(Logistic Test),
                   itemstore=work.logisticstore,
                   register=Y,
                   mrPath=%NRBQUOTE(/User Folders/user-ID/My Folder/),
                   spk=N,
                   spkfolder=c:\temp\,
                   data=sampsio.hmeq)
                   ;
```

The model can now be imported to SAS Model Manager using the import from SAS Metadata Repository method.

*Note:* When you are using the SAS Metadata Repository method to import a SAS/STAT item store model into SAS Model Manager, the batch.sas file is empty. Therefore, you cannot retrain the model. To retrain a SAS/STAT item store model, make sure that the model has all of the required files and contents. To avoid missing files or data that is required for retraining a model, create a SAS model package file (SPK) on your local or network drive, and then import it directly into the model repository using SAS Model Manager.

## Create a SAS Package File Using a SAS/STAT Item Store

To create a SAS package (SPK) file without registering it to the SAS Metadata Repository, you specify the Register=Y, SPK=Y, and the SPKFolder= arguments. This example shows these modifications using the previous example:

```
/* PROC LOGISTIC specifies the STORE statement to create an item store. *

proc logistic data=sampsio.hmeq;
   class job;
   model bad = loan value job;
   store work.logisticStore;
run;

/* Set up the meta data connection system options. */

options metaPort=8561
      metaServer=server-address
      metaRepository=Foundation
      metaUser=user-ID'
      metaPass=password;

/* Load the macros. */

%aamodel;

/* Create an SPK file; do not register the model in the SAS Metadata Repository. */

%aa_model_register(modelname=LogisticTest,
                   modeldesc=%nrbquote(Logistic Test),
                   itemstore=work.logisticstore,
                   register=N,
                   spk=Y,
                   spkfolder=c:\temp\,
                   data=sampsio.hmeq)
                   ;
```

The macro creates a folder for the model in the **`c:\temp`** folder. The folder name is the UUID of the model. The name of the SPK file is miningResults.spk. The SPK file can be imported to SAS Model Manager using the import from SAS Model Package File method.

## Register a Model in the SAS Metadata Repository Using Model Component Files

If you do not have an item store, or if you have the information and files that you need for a model, you can use the %AA_Model_Register macro to register the model in the SAS Metadata Repository. In addition to the macro's model identification arguments and the action arguments, you can use these arguments to register the model:

- Data=*training-data-set-name*
- Level=Binary | Ordinal | Nominal | Interval
- ScoreCodeFile=*filename*
- ScoreCodeFormat=Datastep | Program

- Target=*target-variable*

The following SAS program uses model component arguments to register the model to the SAS Metadata Repository. Other arguments identify the mining function and mining algorithm.

```
/* Train high-performance model */

proc hplogistic data=gplib.hmeqid; class job reason;
   id value;
   class bad ;
   model bad = clage clno debtinc delinq derog mortdue job reason;
   output out=gplib.hpregid_score pred;
   code file='c:\temp\score.sas';
run;

/* Set up metadata connections */

options metaPort=8561
        metaServer=server-address
        metaRepository=Foundation
        metaUser=user-ID
        metaPass=password;

/* Load the macros. */

%aamodel;

/* Register the model in the SAS Metadata Repository */

%aa_model_register
   (modelname=Model1,
    modeldesc=%nrbquote(First Model for registration),
    register=Y,
    mrPath=%NRBQUOTE(/User Folders/user-ID/My Folder/),
    spk=N,
    spkfolder=c:\temp\,
    data=sampsio.hmeq,
    target=bad,
    level=BINARY,
    miningfunction=Classification,
    miningalgorithm=Regression,
    scorecodefile=c:\temp\score.sas)
;
```

The model can now be imported to SAS Model Manager using the import from SAS Metadata Repository method.

## Setting Metadata Connection System Options

Before running macros in a SAS program that requires a connection to the SAS Metadata Server, specify the metadata connection system options. If these options are not specified, you will be prompted for the information. If you are running the macros in batch mode, you must specify the metadata server connection system options. Otherwise, you will receive a failure message.

Here is a sample OPTIONS statement that specifies these options:

```
options metaPort=8561
        metaServer=server-address
        metaRepository=Foundation
        metaUser=user-ID
        metaPass=password;
```

For more information, see "Connection Options " in *SAS Language Interfaces to Metadata*.

Example 1: Specifying the metadata server connection system options when registering models to the SAS Metadata Repository using the %AAMODEL and %AA_MODEL_REGISTER macros.

```
options mlogic mprint symbolgen;

/* Set up the metadata connection system options. */

options metaPort=8561
      metaServer=a123.us.company.com
      metaRepository=Foundation
      metaUser=myuserID
      metaPass=sasuser1;

libname mmlib "!sasroot\mmcommon\sample";

proc logistic data=mmlib.hmeq_train;
class bad job reason;
model bad = CLAGE CLNO DEBTINC DELINQ DEROG JOB NINQ REASON VALUE YOJ;
store work.itemstore;
run;QUIT;

%aamodel;
%aa_model_register(
ModelName=model_1,
itemstore=work.itemstore,
spk=Y,
register=Y,
spkfolder=c:\temp,
mrPath=%NRBQUOTE(/Shared Data/Model Manager/Publish/Models)
);
```

Example 2: Using the metadata connection system options when accessing files in the SAS Model Manager model repository. This macro copies the specified model file to the specified location on a local or network computer.

```
/*******************************************************/
/* Get the score code from a registered model and run */
/* it.                                                 */
/*******************************************************/

 Options NOmlogic NOmprint NOspool;

/**************************************************/
/*Set up the metadata connection system options. */
/**************************************************/
```

```
options metaPort=8561
      metaServer=a123.us.company.com
      metaRepository=Foundation
      metaUser=myuserID
      metaPass=sasuser1;

/*****************************************************/
/* Get the Model Management macro code.            */
/*****************************************************/

 FILENAME MMAccess catalog 'sashelp.modelmgr.accessmacros.source';
 %include MMAccess;

/*****************************************************/
/* Specify the model component filename and         */
/* destination.                                      */
/*****************************************************/

%let WorkPath = c:\myProject\1.0;
 FILENAME dest '&WorkPath.\score.sas';

/*****************************************************/
/* Set the return code to detect failure in case the */
/* macro load fails.                                 */
/*****************************************************/

%let _MM_RC = -1;

/*****************************************************/
/* Get score code.                                   */
/*****************************************************/

%MM_GetModelFile(ModelId=//ModelManagerRepo/MMRoot/HomeEquity/HMEQ/1.0/
DecisionTree, TextFile=dest);

/*****************************************************/
/* Display Model Management set macro variables.    */
/*****************************************************/

Options nosource;
%PUT _MM_RC = &_MM_RC;
%PUT _MM_CId = &_MM_CId;
Options source;

/*****************************************************/
/* Run score code. Specify the LIBNAME input path.   */
/*****************************************************/

LIBNAME input 'c:\mysascode\1.0\DTree';
DATA score;
 set input.dTreeInp;
 %include dest;
run;
```

# Dictionary

## %AAModel Autocall Macro

Loads the %AA_Model_Register macro.

### Syntax

**%AAModel**

### Details

The %AAModel macro loads the %AA_Model_Register macro. You must specify **`%aamodel;`** before you use the %AA_Model_Register macro. The %AAModel macro produces these messages in the SAS log:

```
NOTE: Loading the aa_model_eval macro
NOTE: Loading the aa_model_register macro
```

*Note:* The %AA_Model_Eval macro is used internally by SAS Model Manager.

## %AA_Model_Register Autocall Macro

Creates an SPK package file and registers models to the SAS Metadata Repository.

### Syntax

**%AA_Model_Register**(
ModelName *model-name*,
ModelDesc=*description*,
Register=Y | N,
MRPath=*SAS-Metadata-Repository- folder*,
SPK=Y | N,
SPKFolder=*SPK-folder-path*,
ItemStore=*item-store-name*,
Data=*training-data-set-name*,
Target=*target-variable*,
Level=Binary | Ordinal | Nominal | Interval,
ScoreCodeFile=*filename*,
ScoreCodeFormat=Datastsep | Program,
<Score=*scored-data-set-name*>,
<PMMLFile=*filename*>,
<TrainFile=*train-program-filename*>,

<MiningAlgorithm=*algorithm*>,
<MiningFunction=*mining-function*>,
<Segment=*segment-variable-name*>,
<Lookup=*lookup-method*>,
<Debug=Y | N>)

### Model Identification Arguments

**ModelName=*model-name***
specifies the name of the model.

**Default** aa_model_&sysuserid, where &sysuserid contains the user ID or login of the current SAS process.

**ModelDescr=description**
is a description of the model.

**ItemStore=*item-store-name***
specifies the name of the item store that is created by some SAS/STAT procedures. The item store is used to retrieve input and target variable metadata, data set names, score code, training code, the mining algorithm, and the mining function.

**Note** Item store data is not available from these SAS/STAT procedures: REG, GLM, GENMOD, GLIMMIX, PHREG, and SURVEYPHREG.

**Tip** If you do not specify the ITEMSTORE= option, you must specify these options: DATA=, TARGET=, SCORECODEFILE=, SCORECODEFORMAT=. If you specify the ITEMSTORE= option, you do not need to specify these options.

### Action Arguments

**Register=Y | N**
specifies whether to register the model in the SAS Metadata Repository.

Y indicates to register the model in the SAS Metadata Repository.

N indicates not to register the model in the SAS Metadata Repository.

**Default** Y

**MRPath=*SAS-Metadata-Repository-Folder***
specifies a folder, using **SAS Folders** as the root node in the SAS Metadata Repository, where the model is registered.

**Default** /Shared Data/

**Note** The forward slash ( / ) after the last folder in the path is not required.

**Example** `/Shared Data/Model Manager/Models/`

**SPK=Y | N**
specifies whether to create a SAS package file:

Y indicates to create a SAS package file.

N indicates not to create a SAS package file.

**Requirement** If SPK=Y, you must use the SPKFOLDER= option to specify a location to store the SPK file.

**SPKFolder=*SPK-folder-path***
specifies the location to store the SPK file.

**Requirement** The option is required when you specify SPK=Y.

### *Model Component Arguments*

These arguments must be specified if you do not specify the ITEMSTORE= option:

**Data=*training-data-set-name***
specifies the name of the training data set for the model.

**Level=Binary | Ordinal | Nominal | Interval**
specifies the class target level of the model.

| | |
|---|---|
| Binary | the variable can contain two discrete values (for example, Yes and No). |
| Ordinal | the variable can contain discrete values that have a logical order (for example, 1, 2, 3, 4). |
| Nominal | the variable contains discrete values that do not have a logical order (for example, car, truck, bus, and train). |
| Interval | the variable contains values across a range. For example, temperature ranges could be between 0–100. |

**ScoreCodeFile=*filename***
specifies the name of the file, including the full path to the location where the score code file is stored.

**Tip** If you specify the ITEMSTORE= option, you do not need to specify this option.

**ScoreCodeFormat=Datastep | Program**
specifies the format of the score code.

| | |
|---|---|
| DATASTEP | the score code contains only DATA step statements |
| PROGRAM | the score code contains DATA step statements, procedures, or macros. |

**Target=*target-variable***
specifies the name of the target variable for model.

### *Optional Arguments*

**Debug=Y | N**
specifies whether to prevent deletion of the generated data sets:

| | |
|---|---|
| Y | indicates to keep the generated data sets. |
| N | indicates not to keep the generated data sets. |

**Lookup=*lookup-method***
specifies the algorithm for looking up CLASS levels in SAS/STAT models. Here are the valid lookup methods:

**Auto**
selects the LINEAR algorithm if a CLASS variable has fewer than five categories. Otherwise, the Binary algorithm is used. This is the default.

**Binary**
specifies to use a binary search. This method is fast, but it might produce incorrect results. The normalized category values might contain characters that collate in different orders in ASCII and EBCDIC, if you generate the code on an ASCII machine and execute the code on an EBCDIC machine, or vice versa.

**Linear**
uses a linear search with IF statements that have categories in the order of the class levels. This method is slow if there are many categories.

**Select**
uses a SELECT statement.

**Requirement** Use Lookup=Select when a SAS/STAT model contains non-latin1 characters to ensure the generation of the correct score code. If a model with non-latin1 characters is published to a database and Lookup=Select is not specified, the scoring results might be incorrect.

**MiningAlgorithm=*algorithm***
specifies the type of algorithm that is used to create the mode (for example, DecisionTree or logistic).

**MiningFunction=*mining-function***
specifies one of the following mining functions:

- classification
- prediction
- segmentation

**PMMLFile=*filename***
specifies the name of the file that contains the PMML score code, including the full path to the location of the file. This option is optional.

**Score=*scored-data-set-name***
specifies the name of the scored training data set. This data set is used when there is no score code available to determine the output variables.

**Segment=*variable***
specifies the name of the segment variable.

**TrainFile=*train-program-filename***
specifies the name of the training program file, including the full path to the location of the file.

*Appendix 4*

# Macros for Adding Folders, Projects, Versions, and Setting Properties



## Adding Folders, Projects, Versions, and Properties Using Macros

### *Overview of Using a SAS Program to Add Folders, Projects, Versions, and Properties*

*Note:* You must make sure that you can access the SAS Model Manager web application before using these macros. If you cannot access the web application, contact your SAS application administrator for assistance. For instructions on how to access the web application, see "Sign In" on page 11.

SAS Model Manager provides four macros that you can use in a SAS program to add folders, projects, and versions, and to set properties:

%mdlmgr_AddFolder( )
: Adds a folder under **MMRoot** or adds a subfolder.

%mdlmgr_AddProject( )
: Adds a project under a folder or a subfolder.

%mdlmgr_AddVersion( )
: Adds a version to a project.

*Note:* When you use the %mdlmgr_AddProject( ) to create a new project, an initial version is automatically created within the new project. The default version is 1.0. In order to add a new version to an existing project, use the %mdlmgr_AddVersion( ) macro.

%mdlmgr_SetProperty( )
: Sets project properties that appear in the **Specific** section of the project **Properties** tab in SAS Model Manager.

After you have added the project objects or set properties, you refresh the folder or project object to see the new objects and property settings in the SAS Model Manager. You can then use these objects in SAS Model Manager to further define your projects and versions.

To delete a folder, project, or version, you use SAS Model Manager.

### Writing Your SAS Program

Include these language elements in your SAS program:

If you are setting properties, use a DATA step to create a table that contains property and value pairs.
: One of the %mdlmgr_SetProperty( ) arguments is the name of a table that contains property-value pairs. "Creating the Properties Table" on page 299 lists the properties that you can include in the table. When you create the table, the first column must be Name and the second column must be Value. Both columns must be character. See "Example: Creating a Properties Table" on page 301.

Access the macros by using the FILENAME and %INCLUDE statements.

```
filename file1 catalog 'sashelp.modelmgr.accessmacros.source';
%include file1;
filename file1;

filename file2 catalog 'sashelp.modelmgr.mdlmgr_addfolder.source';
%include file2;
filename file2;

filename file3 catalog 'sashelp.modelmgr.mdlmgr_addproject.source';
%include file3;
filename file3;

filename file4 catalog 'sashelp.modelmgr.logtrace.source';
%include file4;
filename file4;

filename file5 catalog 'sashelp.modelmgr.mdlmgr_addversion.source';
%include file5;
filename file5;

filename file6 catalog 'sashelp.modelmgr.mdlmgr_setproperty.source';
%include file6;
filename file6;
```

You can change the fileref name.

Call the macros:

```
%mdlmgr_AddFolder(ParentId=, Name=, Desc=, NewFolderId=, Trace=);

%mdlmgr_AddProject(ParentId=, Name=, Desc=, ModelFunction=,
                  InputVarTable=, OutputVarTable=, NewProjectId=, Trace=);

%mdlmgr_AddVersion(ParentId=, Desc=, NewVersionId=, Trace=);
```

```
%mdlmgr_SetProperty(FolderId=, Table=, PropertyType=, FolderType=, Trace=);
```

There is no requirement to call all of the macros in the same SAS program.

When SAS returns from a macro call that adds a node, the value of NewFolderId=, NewProjectId=, and NewVersionId= is used to create a global macro variable that can be referenced by other macros in the same SAS session. The value of the macro variable is the UUID or the model repository path for the node that is added. You can then use that macro reference as a value for the ParentId= argument of another macro or for the %mdlmgr_SetProperty( ) macro FolderId= argument. For example, in the %mdlmgr_AddProject( ) macro, if you set **`NewProject=projectId`**, the variable name projectId is used to create the global macro variable %projectId. The &projectId macro reference can now be used as the value of the ParentId= argument in the %mdlmgr_AddVersion( ) macro, **`ParentId=&projectId`**. The same macro reference can be used as a value for the FolderId= argument in the %mdlmgr_SetProperty( ) macro, **`FolderId=&projectId`**.

If you are running macros in a SAS session that requires a connection to the SAS Metadata Server, you must specify the metadata connection system options before you run the macros. If these options are not specified, you will be prompted for the information. If you are running the macros in batch mode, you must include the metadata connection system options. Otherwise, you will receive a failure message. For more information, see "Setting Metadata Connection System Options" on page 289.

## Creating the Properties Table

### Property Table Requirements

To set project properties, you use a DATA step to create a data set that contains property-value pairs. The data set variables must be Name and Value, and they must be character variables.

In the data set, property names can be mixed case. The required appended text, **`:sas-libraries`**, must be lowercase. For more information, see "Specifying Data Sets" on page 299.

### Specifying Data Sets

Some property values specify the name of a default table, such as the default train table or the default performance table. You specify tables using the form *SMRLibrary.table* for libraries in the SAS Metadata Repository and *libref.table* for SAS libraries. See the Data Sources category view for valid library and table names. In the **SAS Metadata Repository** tab, *SMRLibrary* is the folder-name where the data set in stored. In the **SAS Libraries** tab, *libref* can be one of the librefs under the **SAS Libraries** node.

### Properties That You Can Set

Use a property in the following Property Name column as a value for the Name variable in the property table.

***Table A4.1*** *Project and Version Properties That Can Be Set by %mdlmgr_SetProperty( ) Macro*

| Property Name | Property Name As It Appears in the SAS Model Manager | Valid Values |
| --- | --- | --- |
| ClassificationRole | Output Event Probability Variable | A text string that specifies the output event probability variable.<br>Set for a project with a model function of classification. |
| ClassTargetEvent | Class Event Value | A number that represents the target event value.<br>Set for a project. |
| ClassTargetEventValues | Class Target Values | A text string that represents the class target values.<br>Set for a project. |
| ClassTargetLevel | Class Target Level | One of the following text strings:"BINARY", "NOMINAL", "ORDINAL", or "INTERVAL"<br>Set for a project. |
| ClassTargetVar | Training Target Variable | A text string that indicates the training target variable<br>Set for a project. |
| EventProbabilityRole | Output Event Probability Variable | A text string that specifies the output event probability variable.<br>Specify this property only if you specify the outputVarTable= argument in the %mdlmgr_AddProject( ) macro. The value of EventProbabilityRole must be a variable in the project output table.<br>Set for a project. |
| Function | Model Function | A text string that specifies the model function. Valid values are "CLASSIFICATION", "PREDICTION", "SEGMENTATION", and "ANALYTICAL".<br>Set for project, |
| InterestedParty | Interested Party | A text string that specifies a person or group that has an interest in the project.<br>Set for a project. |

| Property Name | Property Name As It Appears in the SAS Model Manager | Valid Values |
|---|---|---|
| MetadataLock | Lock Project Metadata | Specify "YES" or "NO" to indicate whether the project metadata is locked.<br>Set for a project. |
| PredictionRole | Output Prediction Variable | A text string that specifies the output prediction variable.<br>Set for a project with a model function of prediction. |
| ScoreInputDS | Default Scoring Input Table | The default scoring test input table in the form *libref.table*.<br>Set for projects and versions. |
| ScoreOutputDS | Default Scoring Output Table | The default scoring test output tablet in the form *libref.table*.<br>Set for projects and versions. |
| SegmentRole | Output Segmentation Variable | A test string that specifies the output segmentation variable.<br>Set for a project with a model function type of segmentation. |
| State | State | Select one:<br>0 Under Development<br>1 Active<br>2 Inactive<br>3 Retired<br>Set for a project. |
| TestDS | Default Test Table | The default test table in the form *libref.table*.<br>Set for projects and versions. |
| TrainDS | Default Train Table | The default train table in the form *libref.table*.<br>Set for projects and versions. |

### Example: Creating a Properties Table

Here is a sample DATA step to create a properties table:

```
data HMEQProp;
   length name $20;
   length value $40;
   input name value;
   datalines;
```

```
TestDS MMLIB.HMEQ_TEST
ScoreInputDS MMLIB.HMEQ_SCORE_INPUT
ScoreOutputDS MMLIB.OUTPUT
TrainDS MMlib.HMEQ_TRAIN
ClassTargetEvent 1
ClassTargetLevel BINARY
EventProbabilityRole SCORE
ClassTargetVar BAD
;
run;
```

# Dictionary

## %mdlmgr_AddFolder Macro

Adds a folder to the model repository.

### Syntax

**%mdlmgr_AddFolder(**

ParentId=*parent-UUID-or-path*

Name=*folder-name*

<Desc=*description*>

NewFolderId=*folder-Id-variable*

<Trace=On | Off>

);

#### *Required Arguments*

**ParentId=*parent-UUID-or-path***

specifies the UUID or the model repository path of the parent folder.

If the folder that you are creating is a subfolder, you can use the value of NewFolderId= that was specified during the macro call of parent folder as the value for *parent-UUID-or-path*. For example, if a parent folder exists and **`NewFolderId=&folderId`** was set in the macro call for the parent folder, then you can specify **`ParentId=&folderId`** in the subfolder macro call.

If you specify the repository path, use one of these forms:

```
//ModelManagerDefaultRepo/MMRoot/
//ModelManagerDefaultRepo/MMRoot/folder-name/
```

Restriction: A folder can be added only to the **MMRoot** node or a folder in the Projects category.

**Name=*folder-name***

specified the name of the folder. The name can contain letters, spaces, the underscore ( _ ), the hyphen ( - ), and the period ( . ).

**NewFolderId=*folder-Id-variable***

specifies a variable that is used to identify the new folder.

SAS Model Manager creates a global macro variable, %*folder-Id-variable* whose value is the folder UUID or the path in the SAS Metadata Repository. You can use &*folder-Id-variable* as the value of a ParentId= argument in the %mdlmgr_AddFolder( ) or %mdlmgr_AddProject( ) macros. For example, if **`NewFolderId=folderId`**, then you can use **`ParentId=&folderId`** in the %mdlmgr_AddProject( ) macro.

### Optional Arguments

**Desc=*description***
specifies a description of the folder.

**Trace=On | Off**
specifies whether to supply verbose trace messages to the SAS log.

**Default** Off

## %mdlmgr_AddProject Macro

Adds a project to a folder.

**Note:** When you use the %mdlmgr_AddProject( ) macro to create a new project, an initial version is automatically created within the new project. The default version is 1.0. To add a new version to an existing project, use the %mdlmgr_AddVersion( ) macro.

### Syntax

**%mdlmgr_AddProject(**
ParentId=*parent-UUID*
Name=*folder-name*
<Desc=*description*>
ModelFunction=*model-function*
<InputVarTable=*project-input-variable-table*>
<OutputVarTable=*project-output-variable-table*>
NewProjectId=*project-Id-variable*
<Trace=On | Off>
);

### Required Arguments

**ParentId=*parent-UUID-or-path***
specifies the UUID of the parent folder or the model repository path for the parent folder.

You can use &*folder-Id-variable* that is set for the NewFolderId= argument in the %mdlmgr_AddFolder( ) macro as the value of *parent-UUID-or-path*.

The model repository path is in this form:

`//ModelManagerDefaultRepo/MMRoot/`*`folder-name`*`/`

**Name=*project-name***
specified the name of the project. The name can contain letters, spaces, the underscore ( _ ), the hyphen ( - ), and the period ( . ).

**ModelFunction=*model-function***
specifies the project model function type. These are the valid values:

- Classification
- Prediction
- Segmentation
- Analytical

**Default** Classification

**NewProjectId=*project-Id-variable***
specifies a variable or a macro variable that is used to identify the new project.

SAS Model Manager creates a global macro variable, %*project-Id-variable* whose value is the project UUID or the path in the SAS Metadata Repository. You can use &*project-Id-variable* as the value of a ParentID= argument in the %mdlmgr_AddVersion( ) macro or the FolderId= argument in the %mdlmgr_SetProperty( ) macro. For example, if you set `NewProjectId=projectId`, you can use `ParentId=&projectId` in the %mdlmgr_AddVersion( ) macro.

The SAS Model Manager path is in this form:

```
//ModelManagerDefaultRepo/MMRoot/folder-name/project-name
```

## *Optional Arguments*

**Desc=*description***
specifies a description of the project.

**InputVarTable=*project-input-variable-table***
specifies a data set that must include the input variables that are used by the champion model. If you have several candidate models for your project, make sure that all candidate model input variables are included in the project input table. The data set does not need to contain data. If you use the train table as a project input table, be sure to exclude the target variable.

The input variable table is used to create the inputvar.xml file, which describes all of the model input variables.

| | |
|---|---|
| **Requirement** | The data set must be a local or network file. This macro does not support project input tables in the SAS Metadata Repository. |
| **Tip** | The project input table can be defined after the project is created. It must be defined before the project champion model is set. |
| **See** | "Create a Project Input Table" on page 355 |

**OutputVarTable=*project-output-variable-table***
specifies a data set that includes only output variables that are created or modified by the champion model. If you have several candidate models for your project, you must make sure that all project output variables are mapped to the champion model output variables. If you use the train table as the project output table, use the SET statement to specify the training table, and use the KEEP statement to specify the variables from the training table that you want in the project output table.

The output variable table is used to create the outputvar.xml file, which describes all of the model output variables.

| | |
|---|---|
| Requirement | The data set must be a local or network file. This macro does not support project output tables in the SAS Metadata Repository. |
| Tip | The project output table can be defined after the project is created. It must be defined before the project champion model is set. |
| See | "Create a Project Output Table" on page 356 |

**Trace=On | Off**
specifies whether to supply verbose trace messages to the SAS log.

Default Off

## %mdlmgr_AddVersion Macro

Adds a version to a project.

**Note:** The **`Name=`*`version-name`*** argument was deprecated with the release of SAS Model Manager 13.1. It is no longer supported in SAS Model Manager 13.1 and later. If you have migrated from a previous release the value of the version name appears in the **Description** field. You must remove this argument from your existing macro code to avoid errors. When you use the %mdlmgr_AddProject( ) macro to create a new project, an initial version is automatically created within the new project. In order to add a new version to an existing project, use the %mdlmgr_AddVersion( ) macro.

### Syntax

**%mdlmgr_AddVersion(**
ParentId=*parent-UUID-or-path*
<Desc=*description*>
NewVersionId=*version-Id-variable*
<Trace=On | Off>
);

#### *Required Arguments*

**ParentId=*parent-UUID-or-path***
specifies the UUID of the project for which the version is to be created.

You can use &*project-Id-variable* that is set for the NewProjectId= argument in the %mdlmgr_AddProject( ) macro as the value of *parent-UUID-or-path*. For example, if **`NewProjectId=projectId`**, you can specify **`ParentId=&projectId`**.

The SAS Model Manager path is in the form

`//ModelManagerDefaultRepo/MMRoot/`*`folder-name`*`/`*`project-name`*

**NewVersionId=*version-Id-variable***
specifies a variable name that is used to identify the new version.

SAS Model Manager creates a global macro variable, %*version-Id-variable* whose value is the version UUID or the path in the SAS Metadata Repository. You can use &*version-Id-variable* as the value of the FolderId= argument in the %mdlmgr_SetProperty( ) macro. For example, if you set

**NewVersionId=versionId**, then you can specify **FolderId=&versionId** in the %mdlmgr_SetProperty( ) macro.

The version path is in this form:

`//ModelManagerDefaultRepo/MMRoot/`*`folder-name`*`/`*`project-name`*`/`*`version-name`*

### *Optional Arguments*

**Desc=*description***
specifies a description of the version.

**Trace=Of | Off**
specifies whether to supply verbose trace messages to the SAS log.

**Default** Off

## %mdlmgr_SetProperty Macro Function

Sets project properties in the model repository

### Syntax

**%mdlmgr_SetProperty(**
FolderId=*folder-UUID-or-path*
Table=*property-value-table-name*
PropertyType=System | User
FolderType=*UUID-or-folder-type*
<Trace=On | Off>

### *Required Arguments*

**FolderId=*folder-UUID-or-path***
specifies the project folder UUID or path.

To add a project property, you can use &*project-Id-variable* that is set for the NewProjectId= argument in the %mdlmgr_AddProject( ) macro as the value of *project-folder-UUID-or-path*. For example, if **NewProjectId=projectId**, then you can specify **FolderId=&projectId**.

To add a version property, you can use &*version-Id-variable* that is set for the NewVersionId= argument in the %mdlmgr_AddVersion( ) macro as the value of *project-folder-UUID-or-path*. For example, if **NewVersionId=versionId**, then you can specify **FolderId=&versionId**.

**Table=*property-value-data-set***
specifies the data set that contain the properties to set. *property-value-table-name* must be in the form *libref.data-set*.

**See** "Creating the Properties Table" on page 299

**PropertyType=System | User**
specifies whether the property is a SAS Model Manager property or if the property is user-defined. Specify **system** for all SAS Model Manager properties.

**Default** System

**FolderType=*folder-type***
specifies the folder type for the properties that are being set. If FolderId is a UUID, this argument is optional. The valid value for *folder-type* is **`Project`**.

### *Optional Argument*

**Trace=On | Off**
specifies whether to supply verbose trace messages to the SAS log.

**Default** Off

## Example: Add a Folder, Project, and Version; Set Properties

```
libname temp 'your-path';
data temp.property;
   length name $ 30 value $ 40;
   input name value;
   infile datalines;
datalines;
ScoreInputDS MMLIB.HMEQ_SCORE_INPUT
ScoreOutputDS MMLIB.HMEQ_SCORE_OUTPUT
TrainDS MMLIB.HMEQ_TRAIN
TestDS MMLIB.HMEQ_TEST
ClassTargetEvent 1
ClassTargetLevel BINARY
ClassTargetVar BAD
EventProbabilityRole SCORE
;
run;

/* Access the macros  */

filename file1 catalog 'sashelp.modelmgr.accessmacros.source';
%include file1;
filename file1;

filename file2 catalog 'sashelp.modelmgr.mdlmgr_addfolder.source';
%include file2;
filename file2;

filename file3 catalog 'sashelp.modelmgr.mdlmgr_addproject.source';
%include file3;
filename file3;

filename file4 catalog 'sashelp.modelmgr.logtrace.source';
%include file4;
filename file4;
```

```
filename file5 catalog 'sashelp.modelmgr.mdlmgr_addversion.source';
%include file5;
filename file5;

filename file6 catalog 'sashelp.modelmgr.mdlmgr_setproperty.source';
%include file6;
filename file6

/*add folder*/
%mdlmgr_AddFolder( parentId=//ModelManagerDefaultRepo/MMRoot,
                     name=Bank3,
                     desc=,
                     newFolderId=newFolderIdVar,
                     Trace=on);
/*add project*/
%mdlmgr_AddProject( parentId=&newFolderIdVar,
                      name=HMEQ,
                      desc=Home Equity,
                      modelFunction=classification,
                      inputVarTable=,
                      outputVarTable=,
                      newProjectId=newProjectIdVar1,
                      Trace=on);

/*set properties*/
%mdlmgr_SetProperty( folderId=&newProjectIdVar1,
                       table=temp.property,
                       propertyType=system,
                       folderType=Project,

/*add version*/
%mdlmgr_AddVersion( parentId=&newProjectIdVar1,
                      desc=,
                      newVersionId=newVersionIdVar1,
                      Trace=off);
```

*Appendix 5*

# Macros for Generating Score Code



## Generating Score Code for COUNTREG Procedure Models

The %MM_Countreg_Create_Scorecode macro creates DATA step statements to compute the predicted values of a model that you create using the COUNTREG procedure. Input to the macro is the ODS output data set ParameterEstimates that is created by the COUNTREG procedure. You can also specify the location to save the score code and other macro output files. You can specify a location for prefix values for the dependent variable and the variable for the probability of having a zero-generating process.

*Note:* SAS Model Manager does not support PROC COUNTREG models when VALIDVARNAME="ANY".

The score code generation supports the following COUNTREG procedure features:

| PROC COUNTREG Feature | Supported Functionality |
|---|---|
| Categorical predictor | Character and numeric class variables |
| Continuous predictor | Variable values are used as is. |
| MODEL specification | Effect specifications that are allowed by the MODEL statement, including main effects, interactions, and powers of continuous predictors. Only one MODEL statement can be specified. |
| ZEROMODEL specification | Effect specifications that are allowed in the MODEL statement, including the intercept, main effects, interactions, and powers of continuous predictors. |

| PROC COUNTREG Feature | Supported Functionality |
|---|---|
| OFFSET variables | The offset variables in the MODEL and ZEROMODEL statements are retrieved from the FitSummary table. |
| ZEROMODEL statement LINK function | The LOGISTIC and NORMAL link distribution functions that are allowed in the ZEROMODEL statement. |

BY-group processing is not supported. For more information, see the “COUNTREG Procedure” in *SAS/ETS User's Guide*.

After you have created the score code, you can register the score code and other COUNTREG procedure model component files by using the $AA_Model_Register macro or you can import the model using the local files method. For more information, see “Using Macros to Register Models Not Created by SAS Enterprise Miner” on page 285 and “Import Models from Local Files” on page 72.

# Generating Score Code for SEVERITY Procedure Models

The %MM_Severity_Create_Scorecode macro generates score code for PROC SEVERITY models. Inputs to the macro are the ODS output data sets ParameterEstimates and ModelInformation that are created by the SEVERITY procedure. You can also specify the location to save the score code and other macro output files, and the prefix value for the dependent variable.

Custom distributions and BY-group processing are not supported by the macro. For more information, see the “SEVERITY Procedure” in *SAS/ETS User's Guide*.

After you have created the score code, you can register the score code and other SEVERITY procedure model component files by using the $AA_Model_Register macro or you can import the model using the local files method. For more information, see “Using Macros to Register Models Not Created by SAS Enterprise Miner” on page 285 and “Import Models from Local Files” on page 72.

# Dictionary

## %MM_Countreg_Create_Scorecode Autocall Macro

Generates score code for a model that is created by the COUNTREG procedure.

### Syntax

**%MM_Countreg_Create_Scorecode (**

ParamEst=*countreg-parameter-estimate-data-set*
<FileRef=*output-fileref*>
<PredPrefix=*dependent-variable-prefix*>
<PZPrefix=*probability-zero-variable-prefix*>

);

### Arguments

**ParamEst=*countreg-parameter-estimate-dataset***
specifies the name of the parameter estimations ODS output data. This ParameterEstimates data set is created when PROC COUNTREG executes. To capture this data set, use the ODS OUTPUT statement before PROC COUNTREG executes.

Tip In the PROC COUNTREG code, include the PREDICTION= and PREOBZERO= options in the OUTPUT statement.

**FileRef=*output-fileref***
specifies the fileref that defines the location of the macro output files.

Default The SAS log

**PredPrefix=*dependent-variable-prefix***
specifies a prefix for the predicted dependent variable. The variable is named in the PRED= option of the PROC COUNTREG OUTPUT= statement. When is prefix is applied to the dependent variable, this new name becomes the prediction variable.

Default P_

**PZPrefix=*probability-zero-variable-prefix***
specifies a prefix for a particular variable. This variable indicates the probability that the response variable will take on the value of zero as a result of the zero-generating process. The variable is named in the PROBZERO= option of the PROC COUNTREG OUTPUT= statement. When the prefix is applied to the probability zero variable, this new name becomes the probability zero variable.

Default PHI_

## Details

To create score code for a model that you create with PROC COUNTREG, include the following SAS code:

1. Use a LIBNAME statement to identify the location of the output that you create using PROC COUNTREG.
2. Before PROC COUNTREG, use the ODS OUTPUT statement to capture the ParameterEstimates output data set. Here is an example:

   ```
   ods output ParameterEstimates=CntReg.ParameterEstimates;
   ```
3. Build your model using PROC COUNTREG and close the ODS OUTPUT destination.
4. Use the FILENAME statement to define a fileref for the macro output location.
5. Invoke the %mm_countreg_create_scorecode macro.
6. Execute the score code within a DATA step.

# Example: Generate the PROC COUNTREG Score Code for Insurance Risk

### Create the Sample Insurance Data

The following SAS program creates sample data that resembles an automobile policy history file for a property and casualty insurance program:

```
%let MyProj = C:\Users\sasdemo;
libname CntReg "&MyProj.\CountReg\Test";
options fmtsearch = (CntReg.formats);
proc format library = CntReg cntlout = phf_fmt;
   value $ Gender_fmt
   'Male' = 'Man'
   'Female' = 'Woman';
   value HO_fmt
   0 = 'No'
   1 = 'Yes';
run;

data CntReg.phf;
   length CarType $ 5;
   label CarType = 'Type of Car';
   length Gender $ 6;
   format Gender $ Gender_fmt.;
   label Gender = 'Gender Identification';

   /* This variable name will test how the macro will resolve name conflicts */
   length Estimate $ 6;
   label Estimate = 'Gender Identification (Copy)';
   label AgeDriver = 'Driver Age';
   format HomeOwner HO_fmt.;
   call streaminit(27513);

   do PolicyId = 00001 to 00099;
     StartYr = 2000 +
               rand('table', 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1);
       do ExpYr = StartYr to 2011;
          EExp = rand('uniform');
          MyOffset = 0;
          select (rand('table', 0.499, 0.299, 0.199, 0.003));
             when (1)
             do;
                CarType = 'SEDAN';
                fCarType = 0;
             end;
             when (2)
             do;
                CarType = 'TRUCK';
                fCarType = 0.5;
             end;
             when (3)
```

```
            do;
               CarType = 'SPORT';
               fCarType = 1.0;
            end;
            otherwise CarType = ' ';
      end;

    AgeDriver = 18 + rand('binomial',0.375, 72);
    fAgeDriver = 0.0123 * (AgeDriver - 17);

    HomeOwner = rand('bernoulli', 0.25);
    if (HomeOwner eq 0) then fHomeOwner = 0.7;
       else if (HomeOwner eq 1) then fHomeOwner = 0;
    if (HomeOwner eq 1) then
       do;
          IS = round(rand('uniform') * 5) - 2.5;
          fIS = -0.0456 * IS * IS;
       end;
    if (EExp lt 0.5) then
       do;
          Gender = 'Male';
          fGender = 0;
       end;
       else if (EExp lt 0.9) then
          do;
             Gender = 'Female';
             fGender = -1.5;
          end;
              else Gender = ' ';
    Estimate = Gender;
    if (missing(HomeOwner) eq 0 and missing(IS) eq 0)
       then mu_zero = 0.987 + fHomeOwner + fIS;
       else mu_zero = 0.987;
    phi = cdf('normal', mu_zero, 0, 1);
    if (rand('bernoulli', phi) eq 0) then
      do;
        if (missing(CarType) eq 0 and missing(AgeDriver) eq 0 and
            missing(Gender) eq 0)
           then mu = 2 + fCarType + fAgeDriver + fGender;
           else mu = 2;
        nClaim = rand('poisson', exp(mu));
      end;
      else nClaim = 0;
    output;
  end;
  end;
  drop fCarType fAgeDriver fHomeOwner fGender;
  drop mu_zero mu;
run;
```

### Run the Sample Program

Here is the sample program:

```
%let MyProj = C:\Users\sasdemo;
libname CntReg "&MyProj.\CountReg\Test";
```

```
options fmtsearch = (CntReg.formats);

/* Original Model */
%let model = 1;

/* Build the model and deliver the required ODS datasets */
ods output ParameterEstimates = CntReg.ParameterEstimates_&model.;

proc countreg data = CntReg.phf;
   class CarType Gender HomeOwner;
   model nClaim = CarType AgeDriver Gender / dist = poisson;
   zeromodel nClaim ~ HomeOwner IS * IS / link = normal;
   output out = CntReg.phf_pred_&model.
   predicted = Pred_nClaim probzero = Phi_nClaim;
run;

ods output close;


/* Define the fileref for the output syntax */
filename ThisFile "&MyProj.\CountReg\Test\ScoreCode_&Model..sas";

/* Invoke the macro */
%mm_countreg_create_scorecode(
   ParamEst = CntReg.ParameterEstimates_&Model.,
   FileRef = ThisFile,
   PredPrefix = MyPred_,
   PZPrefix = MyPhi_
);

/* Execute the score codes within a DATA STEP */
data CntReg.phf_pred_compare;
   set CntReg.phf_pred_&Model.;
   %include ThisFile;
   IsMiss_Pred_nClaim = missing(Pred_nClaim);
   IsMiss_Phi_nClaim = missing(Phi_nClaim);
   IsMiss_MyPred_nClaim = missing(MyPred_nClaim);
   IsMiss_MyPhi_nClaim = missing(MyPhi_nClaim);
   if (IsMiss_Pred_nClaim eq 0 and IsMiss_MyPred_nClaim eq 0)
     then MyDiffPred = MyPred_nClaim - Pred_nClaim;
   if (IsMiss_Phi_nClaim eq 0 and IsMiss_MyPhi_nClaim eq 0)
     then MyDiffPhi = MyPhi_nClaim - Phi_nClaim;
run;

proc contents data = CntReg.phf_pred_compare;
run;

/* If the score codes work correctly, then the MyDifference variable should be
   a constant variable of all zero values */
proc freq data = CntReg.phf_pred_compare;
   tables _WARN_;
run;

proc tabulate data = CntReg.phf_pred_compare;
   class IsMiss_Pred_nClaim IsMiss_MyPred_nClaim
   IsMiss_Phi_nClaim IsMiss_MyPhi_nClaim;
```

```
   var Pred_nClaim MyPred_nClaim MyDiffPred Phi_nClaim
       MyPhi_nClaim MyDiffPhi;
   table IsMiss_Pred_nClaim * IsMiss_MyPred_nClaim *
         (n nmiss mean*f=e22. stddev*f=e22. min*f=e22. max*f=e22.),
         (Pred_nClaim MyPred_nClaim MyDiffPred);
   table IsMiss_Phi_nClaim * IsMiss_MyPhi_nClaim *
         (n nmiss mean*f=e22. stddev*f=e22. min*f=e22. max*f=e22.),
         (Phi_nClaim MyPhi_nClaim MyDiffPhi);
run;
quit;
```

## The Generated Score Code and Output Tables

***Output A5.1*** *Generated Score Code*

```
/*******************************************************************/
/* Begin scoring code for COUNTREG                                 */
/* Model: ZIP                                                      */
/* Created By: sasdemo                                             */
/* Date: April 26, 2013                                            */
/* Time: 09:27:39                                                  */
/*******************************************************************/

LENGTH _WARN_ $ 4;
_WARN_ = '    ';
LABEL _WARN_ = "Warnings";

_nInputMiss = 0;

/*******************************************************************/
/* Check the continuous predictors                                 */
/*******************************************************************/

IF ( MISSING( AgeDriver ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

IF ( MISSING( IS ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

_nInputOutRange = 0;

/*******************************************************************/
/* Check the CLASS predictors                                      */
/*******************************************************************/

LENGTH _UFormat_1 $ 5 ;
LABEL _UFormat_1 = &quot;Formatted Value of CarType&quot; ;
IF ( MISSING( CarType ) EQ 0 ) THEN DO;
   _UFormat_1 = STRIP( PUT( CarType , $5. ) );
   IF ( _UFormat_1
        NOTIN ( &quot;SEDAN&quot;
              , &quot;SPORT&quot;
              , &quot;TRUCK&quot;
              )
      ) THEN _nInputOutRange = _nInputOutRange + 1;
END;
ELSE _nInputMiss = _nInputMiss + 1;

LENGTH _UFormat_2 $ 5 ;
LABEL _UFormat_2 = &quot;Formatted Value of Gender&quot; ;
IF ( MISSING( Gender ) EQ 0 ) THEN DO;
   _UFormat_2 = STRIP( PUT( Gender , $GENDER_FMT5. ) );
   IF ( _UFormat_2
        NOTIN ( &quot;Man&quot;
              , &quot;Woman&quot;
              )
      ) THEN _nInputOutRange = _nInputOutRange + 1;
END;
ELSE _nInputMiss = _nInputMiss + 1;
```

```
LENGTH _UFormat_3 $ 3 ;
LABEL _UFormat_3 = &quot;Formatted Value of HomeOwner&quot; ;
IF ( MISSING( HomeOwner ) EQ 0 ) THEN DO;
   _UFormat_3 = STRIP( PUT( HomeOwner , HO_FMT3. ) );
   IF ( _UFormat_3
        NOTIN ( &quot;No&quot;
              , &quot;Yes&quot;
              )
      ) THEN _nInputOutRange = _nInputOutRange + 1;
END;
ELSE _nInputMiss = _nInputMiss + 1;

/*********************************************************************/
/* Set _WARN_ value                                                  */
/*********************************************************************/

_VALID2SCORE = 1;
LABEL _VALID2SCORE = &quot;Is this record valid to be scored? 1=Yes, 0=No&quot; ;

IF ( _nInputMiss GT 0 ) THEN DO;
   SUBSTR(_WARN_,1,1) = 'M';
   _VALID2SCORE = 0;
END;
IF ( _nInputOutRange GT 0 ) THEN DO;
   SUBSTR(_WARN_,2,1) = 'U';
   _VALID2SCORE = 0;
END;

/*********************************************************************/
/* Calculate scores only if current record contains valid values     */
/*********************************************************************/

IF ( _VALID2SCORE EQ 1 ) THEN DO;

   _NU_MODEL = 0 ;
   _NU_ZEROMODEL = 0 ;

   _NU_MODEL = _NU_MODEL + 7.889048183464800E-01
      ;

   IF ( _UFormat_1 EQ &quot;SEDAN&quot;
      ) THEN DO;
      _NU_MODEL = _NU_MODEL - 4.983426513164500E-01
      ;
   END;

   IF ( _UFormat_1 EQ &quot;SPORT&quot;
      ) THEN DO;
      _NU_MODEL = _NU_MODEL + 4.985885591940500E-01
      ;
   END;

   _NU_MODEL = _NU_MODEL + 1.227923016048900E-02
         * AgeDriver
      ;

   IF ( _UFormat_2 EQ &quot;Man&quot;
      ) THEN DO;
      _NU_MODEL = _NU_MODEL + 1.503894036936300E+00
      ;
   END;

   _NU_ZEROMODEL = _NU_ZEROMODEL + 9.925866013120000E-01
      ;
```

```
   IF ( _UFormat_3 EQ &quot;No&quot;
      ) THEN DO;
      _NU_ZEROMODEL = _NU_ZEROMODEL + 6.905739218180000E-01
      ;
   END;

   _NU_ZEROMODEL = _NU_ZEROMODEL - 4.346588113784800E-02
         * IS
         * IS
      ;

   _LOG_TAIL_P_ = LOGSDF( 'NORMAL' , _NU_ZEROMODEL );

   IF ( (_NU_MODEL + _LOG_TAIL_P_) LE 709.780 )
   THEN MyPred_nClaim = EXP( _NU_MODEL + _LOG_TAIL_P_ );
   ELSE MyPred_nClaim = .;

   MyPhi_nClaim = 1 - EXP( _LOG_TAIL_P_ );

END;   /* END (_VALID2SCORE EQ 1) IF BLOCK */

LABEL MyPred_nClaim = &quot;Predicted value of nClaim&quot; ;
LABEL MyPhi_nClaim = &quot;Probability of nClaim being zero as a result
of the zero-generating process&quot; ;

DROP _nInputMiss _VALID2SCORE _NU_MODEL;
DROP _NU_ZEROMODEL _LOG_TAIL_P_;
DROP _nInputOutRange
     _UFormat_1
     _UFormat_2
     _UFormat_3
     ;

/*********************************************************************/
/* End scoring code for COUNTREG                                     */
/*********************************************************************/
```

***Output A5.2*** *The Tables Created by the Sample Program*

The SAS System

The COUNTREG Procedure

| Class Level Information | | |
|---|---|---|
| Class | Levels | Values |
| CarType | 3 | SEDAN SPORT TRUCK |
| Gender | 2 | Man Woman |
| HomeOwner | 2 | No Yes |

| Model Fit Summary | |
|---|---|
| Dependent Variable | nClaim |
| Number of Observations | 582162 |
| Missing Values | 67258 |
| Data Set | CNTREG.PHF |
| Model | ZIP |
| ZI Link Function | Normal |
| Log Likelihood | -283522 |
| Maximum Absolute Gradient | 0.00229 |
| Number of Iterations | 9 |
| Optimization Method | Newton-Raphson |
| AIC | 567066 |
| SBC | 567190 |

**The SAS System**

**The COUNTREG Procedure**

| Class Level Information | | |
|---|---|---|
| Class | Levels | Values |
| CarType | 3 | SEDAN SPORT TRUCK |
| Gender | 2 | Man Woman |
| HomeOwner | 2 | No Yes |

| Model Fit Summary | |
|---|---|
| Dependent Variable | nClaim |
| Number of Observations | 582162 |
| Missing Values | 67258 |
| Data Set | CNTREG.PHF |
| Model | ZIP |
| ZI Link Function | Normal |
| Log Likelihood | -283522 |
| Maximum Absolute Gradient | 0.00229 |
| Number of Iterations | 9 |
| Optimization Method | Newton-Raphson |
| AIC | 567066 |
| SBC | 567190 |

Algorithm converged.

**Parameter Estimates**

| Parameter | DF | Estimate | Standard Error | t Value | Approx Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | 0.788905 | 0.015473 | 50.99 | <.0001 |
| CarType SEDAN | 1 | -0.498343 | 0.003396 | -146.76 | <.0001 |
| CarType SPORT | 1 | 0.498589 | 0.003280 | 151.99 | <.0001 |
| CarType TRUCK | 0 | 0 | . | . | . |
| AgeDriver | 1 | 0.012279 | 0.000329 | 37.27 | <.0001 |
| Gender Man | 1 | 1.503894 | 0.003976 | 378.23 | <.0001 |
| Gender Woman | 0 | 0 | . | . | . |
| Inf_Intercept | 1 | 0.992587 | 0.004642 | 213.84 | <.0001 |
| Inf_HomeOwner No | 1 | 0.690574 | 0.004973 | 138.87 | <.0001 |
| Inf_HomeOwner Yes | 0 | 0 | . | . | . |
| Inf_IS*IS | 1 | -0.043466 | 0.001068 | -40.70 | <.0001 |

The SAS System

| Obs | NAME | _LABEL_ | _VALUE_1 | _VALUE_2 | _VALUE_3 | MacVar |
|---|---|---|---|---|---|---|
| 1 | CARTYPE | Type of Car | SEDAN | SPORT | TRUCK | CarType |

The SAS System

| Obs | NAME | _LABEL_ | _VALUE_1 | _VALUE_2 | MacVar |
|---|---|---|---|---|---|
| 1 | GENDER | Gender Identification | Man | Woman | Gender |

The SAS System

| Obs | NAME | _VALUE_1 | _VALUE_2 | MacVar |
|---|---|---|---|---|
| 1 | HOMEOWNER | No | Yes | HomeOwner |

The SAS System

The CONTENTS Procedure

| | | | |
|---|---|---|---|
| Data Set Name | CNTREG.PHF_PRED_COMPARE | Observations | 649420 |
| Member Type | DATA | Variables | 25 |
| Engine | V9 | Indexes | 0 |
| Created | 04/25/2013 16:49:55 | Observation Length | 192 |
| Last Modified | 04/25/2013 16:49:55 | Deleted Observations | 0 |
| Protection | | Compressed | NO |
| Data Set Type | | Sorted | NO |
| Label | | | |
| Data Representation | WINDOWS_64 | | |
| Encoding | wlatin1 Western (Windows) | | |

| Engine/Host Dependent Information | |
|---|---|
| Data Set Page Size | 65536 |
| Number of Data Set Pages | 1911 |
| First Data Page | 1 |
| Max Obs per Page | 340 |
| Obs in First Data Page | 321 |
| Number of Data Set Repairs | 0 |
| ExtendObsCounter | YES |
| Filename | C:\Users\emdew\CountReg\Test\phf_pred_compare.sas7bdat |
| Release Created | 9.0401B0 |
| Host Created | X64_S08R2 |

**Alphabetic List of Variables and Attributes**

| # | Variable | Type | Len | Format | Label |
|---|---|---|---|---|---|
| 6 | AgeDriver | Num | 8 | | Driver Age |
| 3 | CarType | Char | 5 | | Type of Car |
| 11 | EExp | Num | 8 | | |
| 5 | Estimate | Char | 6 | | Gender Identification (Copy) |
| 10 | ExpYr | Num | 8 | | |
| 4 | Gender | Char | 6 | $GENDER_FMT. | Gender Identification |
| 7 | HomeOwner | Num | 8 | HO_FMT. | |
| 13 | IS | Num | 8 | | |
| 23 | IsMiss_MyPhi_nClaim | Num | 8 | | |
| 22 | IsMiss_MyPred_nClaim | Num | 8 | | |
| 21 | IsMiss_Phi_nClaim | Num | 8 | | |
| 20 | IsMiss_Pred_nClaim | Num | 8 | | |
| 25 | MyDiffPhi | Num | 8 | | |
| 24 | MyDiffPred | Num | 8 | | |
| 12 | MyOffset | Num | 8 | | |
| 19 | MyPhi_nClaim | Num | 8 | | Probability of nClaim being zero as a result of the zero-generating process |
| 18 | MyPred_nClaim | Num | 8 | | Predicted value of nClaim |
| 2 | Phi_nClaim | Num | 8 | | Probability of nClaim being zero |
| 8 | PolicyId | Num | 8 | | |
| 1 | Pred_nClaim | Num | 8 | | Predicted value of nClaim |
| 9 | StartYr | Num | 8 | | |
| 17 | _WARN_ | Char | 4 | | Warnings |
| 14 | fIS | Num | 8 | | |
| 16 | nClaim | Num | 8 | | |
| 15 | phi | Num | 8 | | |

## The SAS System

### The FREQ Procedure

| Warnings | | | | |
|---|---|---|---|---|
| _WARN_ | Frequency | Percent | Cumulative Frequency | Cumulative Percent |
| M | 67258 | 100.00 | 67258 | 100.00 |
| Frequency Missing = 582162 | | | | |

### The SAS System

| | | | Predicted value of nClaim | Predicted value of nClaim | MyDiffPred |
|---|---|---|---|---|---|
| IsMiss_Pred_nClaim | IsMiss_MyPred_nClaim | | | | |
| 0 | 0 | N | 582162 | 582162 | 582162 |
| | | NMiss | 0 | 0 | 0 |
| | | Mean | 9.429365968097200E-01 | 9.429365968097100E-01 | -2.495081706328000E-14 |
| | | StdDev | 1.064955276559700E+00 | 1.064955276559700E+00 | 4.181980199999600E-14 |
| | | Min | 9.128948368471800E-02 | 9.128948368471800E-02 | -3.437250484239400E-13 |
| | | Max | 7.825944704397700E+00 | 7.825944704397300E+00 | 3.053113317719100E-16 |
| | 1 | N | 67258 | 0 | 0 |
| | | NMiss | 0 | 67258 | 67258 |
| | | Mean | 3.362464926679000E-01 | . | . |
| | | StdDev | 3.193524985874900E-01 | . | . |
| | | Min | 9.128948368471800E-02 | . | . |
| | | Max | 4.525549373539800E+00 | . | . |

### The SAS System

| | | | Probability of nClaim being zero | Probability of nClaim being zero as a result of the zero-generating process | MyDiffPhi |
|---|---|---|---|---|---|
| IsMiss_Phi_nClaim | IsMiss_MyPhi_nClaim | | | | |
| 0 | 0 | N | 582162 | 582162 | 582162 |
| | | NMiss | 0 | 0 | 0 |
| | | Mean | 9.104499873516800E-01 | 9.104499873516800E-01 | -8.436792562164200E-16 |
| | | StdDev | 5.836674095312900E-02 | 5.836674095312900E-02 | 3.895804002996700E-16 |
| | | Min | 7.645221218601200E-01 | 7.645221218601200E-01 | -1.443289932012700E-15 |
| | | Max | 9.527668240990100E-01 | 9.527668240990000E-01 | -2.220446049250300E-16 |
| | 1 | N | 67258 | 0 | 0 |
| | | NMiss | 0 | 67258 | 67258 |
| | | Mean | 9.105934041870400E-01 | . | . |
| | | StdDev | 5.811672446138200E-02 | . | . |
| | | Min | 7.645221218601200E-01 | . | . |
| | | Max | 9.527668240990100E-01 | . | . |

## %MM_Severity_Create_Scorecode Autocall Macro

Creates DATA step statements to compute the predicted values of a model that you create using the SEVERITY procedure.

### Syntax

**%MM_Severity_Create_Scorecode (**

ParamEst=*severity-parameter-estimate-data-set*
ModelInfo=*model-info-data-set*<FileRef=*output-fileref*>
<PredPrefix=*dependent-variable-prefix*>
) / store secure;

#### *Arguments*

**ParamEst=*severity-parmeter-estimate-dataset***
specifies the name of the parameter estimations output data. This data set is created when you specify the OUTEST= option in the PROC SEVERITY statement.

**ModelInfo=*model-info-data-set***
specifies the name of the model information output data set. This data set is created when you specify the OUTMODELINGINFO= option in the PROC SEVERITY statement.

**FileRef=*output-fileref***
specifies the fileref that defines the location of the macro output files.

**Default** The SAS log

**PredPrefix=*dependent-variable-prefix***
specifies a prefix for the predicted dependent variable. The variable is named in the PROC SEVERITY LOSS= statement. When is prefix is applied to the dependent variable, this new name becomes the prediction variable.

**Default** P_

### Details

To create score code for a model that you create with PROC SEVERITY, include the following SAS code:

1. Use a LIBNAME statement to identify the location of the output that you create using PROC SEVERITY.
2. Build your model using PROC SEVERITY. Specify the OUTEST= option to create the ParameterEstimates data. Specify OUTMODELINFO= option to create the ModelInformation data set. Close the ODS OUTPUT destination.
3. Use the FILENAME statement to define a fileref for the macro output location.
4. Invoke the %MM_Severity_Create_Scorecode Macro.

# Example: Generate the PROC SEVERITY Score Code for Insurance Risk

### Create the Sample Insurance Data

```
%let MyProj = C:\Users\sasdemo;
libname Severity "&MyProj.\Severity\Test";

data Severity.phf;

   /* Regression Coefficient for the Intercept Term */
   retain fIntercept 6.8024;

   /* Regression Coefficient for continuous AgeDriver */
   retain fAgeDriver 0.01234;

   /* Regression Coefficient for the three dummy indicators for nominal CarType */
   retain fCarType_SEDAN 0;
   retain fCarType_SPORT 1.0;
   retain fCarType_TRUCK 0.5;

   /* Regression Coefficient for the two dummy indicators for nominal Gender */
   retain fGender_Female -1.5;
   retain fGender_Male 0;

   /* Regression Coefficient for the two dummy indicators for nominal HomeOwner */
   retain fHomeOwner_NO 0;
   retain fHomeOwner_YES 0.7;

   /* Regression Coefficient for continuous IS */
   retain fIS -0.00456;

   /* Regression Coefficient for continuous MileageDriven */
   retain fMileageDriven 0.013579;

   /* Variable Labels */
   label AgeDriver = 'Age of Driver';

   label AmountLoss = 'Amount of Loss in Dollars';
   format AmountLoss dollar.;

   label CarType_SEDAN = 'Indicator of Car Type is Sedan';
   label CarType_SPORT = 'Indicator of Car Type is Sport';
   label CarType_TRUCK = 'Indicator of Car Type is Truck';

   label EExp = 'Earned Exposure in Units of One Year';

   label ExpYr = 'Exposure Year';

   label Gender_Female = 'Indicator of Gender is Female';
   label Gender_Male = 'Indicator of Gender is Male';
```

```
label HomeOwner_NO = 'Indicator of Home Ownership is No';
label HomeOwner_YES = 'Indicator of Home Ownership is Yes';

label IS = 'Insurance Score of Driver';

label MileageDriven = 'Mileage Driven in Units of 1,000 Miles';

label PolicyId = 'Policy Identifier';

call streaminit(27513);
  do PolicyId = 00001 to 00099;
    StartYr = 2000 +
              rand('table', 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1);
      do ExpYr = StartYr to 2011;
         EExp = rand('uniform');

         AgeDriver = 18 + rand('binomial',0.375, 72);

         CarType_SEDAN = 0;
         CarType_SPORT = 0;
         CarType_TRUCK = 0;
         select (rand('table', 0.4999, 0.2999, 0.1999, 0.0003));
            when (1) CarType_SEDAN = 1;
            when (2) CarType_SPORT = 1;
            when (3) CarType_TRUCK = 1;
            otherwise
            do;
               CarType_SEDAN = .;
               CarType_SPORT = .;
               CarType_TRUCK = .;
            end;
      end;

      Gender_Female = 0;
      Gender_Male = 0;
      if (EExp lt 0.4999) then Gender_Female = 1;
        else if (EExp lt 0.9999) then Gender_Male = 1;
         else
         do;
            Gender_Female = .;
            Gender_Male = .;
         end;

         HomeOwner_NO = 0;
         HomeOwner_YES = 0;
         if (rand('bernoulli', 0.25) eq 1) then HomeOwner_YES = 1;
         else HomeOwner_NO = 1;

         IS = round(rand('gamma', 600));
         if (IS gt 800) then IS = 800;
         else if (IS lt 1) then IS = 1;

         MileageDriven = rand('gamma', 12);
         /* Annual Mileage Driven in unit of 1000 miles */

         if (nmiss(MileageDriven,AgeDriver,CarType_SEDAN,CarType_TRUCK,
```

```
                CarType_SPORT,
                Gender_Male,Gender_Female,
                HomeOwner_YES,HomeOwner_NO,IS) eq 0)
              then
            do;
               mu = fIntercept
                    + fAgeDriver * (28 - AgeDriver)
                    + fCarType_SEDAN * CarType_SEDAN + fCarType_SPORT
                    * CarType_SPORT
                    + fCarType_TRUCK * CarType_TRUCK
                    + fGender_Female * Gender_Female + fGender_Male
                    * Gender_Male
                    + fHomeOwner_NO * HomeOwner_NO + fHomeOwner_YES
                    * HomeOwner_YES
                    + fIS * IS
                    + fMileageDriven * (MileageDriven - 12);
               AmountLoss = exp(mu) * rand('gamma', 25);
            end;
            else AmountLoss = .;
            output;
     end;
    end;
   drop fAgeDriver fCarType_SEDAN fCarType_TRUCK fCarType_SPORT fGender_Male
        fGender_Female fHomeOwner_YES fHomeOwner_NO fIntercept fIS fMileageDriven;
      drop mu StartYr;
run;
```

### Run the Sample Program

```
%let MyProj = C:\Users\sasdemo;
libname Severity "&MyProj.\Severity\Test";

title "SCALEMODEL and all applicable distributions";

%let model = 1;
%let predlist = AgeDriver CarType_SEDAN CarType_TRUCK CarType_SPORT
     Gender_Male Gender_Female HomeOwner_YES HomeOwner_NO IS MileageDriven;

/* Build the model and obtain the required datasets */
proc severity data = Severity.phf
              outest = Severity.ParamEst_&Model.
              outmodelinfo = Severity.ModelInfo_&model.;
   loss AmountLoss;
   dist _predefined_ stweedie;
   scalemodel &predlist.;
   nloptions maxiter = 1000;
run;

/* Define the fileref for the output syntax */
filename ThisFile "&MyProj.\Severity\Test\ScoreCode_&Model..sas";

/* Invoke the macro */
%mm_severity_create_scorecode
   (
     ParamEst = Severity.ParamEst_&Model.,
     ModelInfo = Severity.ModelInfo_&model.,
```

```
        FileRef = ThisFile,
        PredPrefix = MyPred_
     );

   /* Execute the score codes within a DATA STEP */
   data Severity.phf_wPrediction;
      set Severity.phf;
      %include ThisFile;
   run;

   proc contents data = Severity.phf_wPrediction;
   run;
```

### The Generated Score Code and Output Tables

***Output A5.3*** *Generated Score Code*

```
/**********************************************************************/
/* Begin scoring code for SEVERITY                                    */
/* Created By: sasdemo                                                */
/* Date: June 30, 2015                                                */
/* Time: 12:06:28                                                     */
/**********************************************************************/

LENGTH _WARN_ $ 4;
_WARN_ = '    ';
LABEL _WARN_ = "Warnings" ;

_nInputMiss = 0;

/**********************************************************************/
/* Check the SCALEMODEL regression variables                          */
/**********************************************************************/

IF ( MISSING( MileageDriven ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

IF ( MISSING( IS ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

/* NOTE: HomeOwner_NO is not checked for missing values because it is a redundant
regressor. */

IF ( MISSING( HomeOwner_YES ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

/* NOTE: Gender_Female is not checked for missing values because it is a
redundant regressor. */

IF ( MISSING( Gender_Male ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

IF ( MISSING( CarType_SPORT ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

IF ( MISSING( CarType_TRUCK ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;

/* NOTE: CarType_SEDAN is not checked for missing values because it is a
redundant regressor. */

IF ( MISSING( AgeDriver ) EQ 1 ) THEN _nInputMiss = _nInputMiss + 1;
```

```
/*********************************************************************/
/* Calculate scores only if current record contains valid values      */
/*********************************************************************/

IF ( _nInputMiss EQ 0 ) THEN DO;

   /*********************************************************************/
   /* Distribution: BURR                                                */
   /*********************************************************************/

   _XBETA_ = 0;
   _XBETA_ = _XBETA_ + 1.401229993940100E-02 * MileageDriven ;
   _XBETA_ = _XBETA_ - 4.744055757460300E-03 * IS ;
   /* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 7.381815343018200E-01 * HomeOwner_YES ;
   /* NOTE: Gender_Female is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 1.495958484730900E+00 * Gender_Male ;
   _XBETA_ = _XBETA_ + 9.886615491163800E-01 * CarType_SPORT ;
   _XBETA_ = _XBETA_ + 4.731784863675400E-01 * CarType_TRUCK ;
   /* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ - 1.066440552950800E-02 * AgeDriver ;

   MyPred_AmountLoss_BURR = 6.236121394142300E+03 * EXP(_XBETA_);

   /*********************************************************************/
   /* Distribution: EXP                                                 */
   /*********************************************************************/

   _XBETA_ = 0;
   _XBETA_ = _XBETA_ + 1.364239152005100E-02 * MileageDriven ;
   _XBETA_ = _XBETA_ - 4.739639251429400E-03 * IS ;
   /* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 7.307690977221500E-01 * HomeOwner_YES ;
   /* NOTE: Gender_Female is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 1.496025385765200E+00 * Gender_Male ;
   _XBETA_ = _XBETA_ + 9.916620991492000E-01 * CarType_SPORT ;
   _XBETA_ = _XBETA_ + 4.644249484904200E-01 * CarType_TRUCK ;
   /* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ - 1.151946645256000E-02 * AgeDriver ;

   MyPred_AmountLoss_EXP = 6.506747031895200E+03 * EXP(_XBETA_);

   /*********************************************************************/
   /* Distribution: GAMMA                                               */
   /*********************************************************************/

   _XBETA_ = 0;
   _XBETA_ = _XBETA_ + 1.364239160569600E-02 * MileageDriven ;
   _XBETA_ = _XBETA_ - 4.739639073904200E-03 * IS ;
   /* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 7.307690978471100E-01 * HomeOwner_YES ;
   /* NOTE: Gender_Female is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 1.496025385874300E+00 * Gender_Male ;
   _XBETA_ = _XBETA_ + 9.916621000665000E-01 * CarType_SPORT ;
   _XBETA_ = _XBETA_ + 4.644249491258800E-01 * CarType_TRUCK ;
   /* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ - 1.151946594479500E-02 * AgeDriver ;

   MyPred_AmountLoss_GAMMA = 6.506745978302000E+03 * EXP(_XBETA_);
```

```
/********************************************************************/
/* Distribution: GPD                                                */
/********************************************************************/

_XBETA_ = 0;
_XBETA_ = _XBETA_ + 1.364260675458400E-02 * MileageDriven ;
_XBETA_ = _XBETA_ - 4.739190610741700E-03 * IS ;
/* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ + 7.307694223592400E-01 * HomeOwner_YES ;
/* NOTE: Gender_Female is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ + 1.496025653107000E+00 * Gender_Male ;
_XBETA_ = _XBETA_ + 9.916644144925200E-01 * CarType_SPORT ;
_XBETA_ = _XBETA_ + 4.644265557308700E-01 * CarType_TRUCK ;
/* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ - 1.151818427565500E-02 * AgeDriver ;

MyPred_AmountLoss_GPD = 6.504569551883800E+03 * EXP(_XBETA_);

/********************************************************************/
/* Distribution: IGAUSS                                             */
/********************************************************************/

_XBETA_ = 0;
_XBETA_ = _XBETA_ + 1.375427253970500E-02 * MileageDriven ;
_XBETA_ = _XBETA_ - 4.808982977719000E-03 * IS ;
/* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ + 7.279886646359200E-01 * HomeOwner_YES ;
/* NOTE: Gender_Female is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ + 1.499838197531700E+00 * Gender_Male ;
_XBETA_ = _XBETA_ + 9.940256355577800E-01 * CarType_SPORT ;
_XBETA_ = _XBETA_ + 4.644584176107000E-01 * CarType_TRUCK ;
/* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ - 1.161363856490700E-02 * AgeDriver ;

MyPred_AmountLoss_IGAUSS = 6.790140708730100E+03 * EXP(_XBETA_);

/********************************************************************/
/* Distribution: LOGN                                               */
/********************************************************************/

_XBETA_ = 0;
_XBETA_ = _XBETA_ + 1.379535910756300E-02 * MileageDriven ;
_XBETA_ = _XBETA_ - 4.808040604328300E-03 * IS ;
/* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ + 7.286190149538200E-01 * HomeOwner_YES ;
/* NOTE: Gender_Female is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ + 1.499292691976100E+00 * Gender_Male ;
_XBETA_ = _XBETA_ + 9.935622786295200E-01 * CarType_SPORT ;
_XBETA_ = _XBETA_ + 4.647870916071300E-01 * CarType_TRUCK ;
/* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
_XBETA_ = _XBETA_ - 1.152580789026700E-02 * AgeDriver ;

MyPred_AmountLoss_LOGN = 6.759869565247100E+03 * EXP(_XBETA_);
```

```
   /*********************************************************************/
   /* Distribution: PARETO                                              */
   /*********************************************************************/

   _XBETA_ = 0;
   _XBETA_ = _XBETA_ + 1.365643731959700E-02 * MileageDriven ;
   _XBETA_ = _XBETA_ - 4.710463064928600E-03 * IS ;
   /* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 7.307900535342100E-01 * HomeOwner_YES ;
   /* NOTE: Gender_Female is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 1.496043364894300E+00 * Gender_Male ;
   _XBETA_ = _XBETA_ + 9.918130012553400E-01 * CarType_SPORT ;
   _XBETA_ = _XBETA_ + 4.645298660617500E-01 * CarType_TRUCK ;
   /* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ - 1.143601522019100E-02 * AgeDriver ;

   MyPred_AmountLoss_PARETO = 6.367949946138600E+03 * EXP(_XBETA_);

   /*********************************************************************/
   /* Distribution: STWEEDIE                                            */
   /*********************************************************************/

   _XBETA_ = 0;
   _XBETA_ = _XBETA_ + 1.346890420267100E-02 * MileageDriven ;
   _XBETA_ = _XBETA_ - 4.675720482528600E-03 * IS ;
   /* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 7.318380293889600E-01 * HomeOwner_YES ;
   /* NOTE: Gender_Female is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 1.493775242549600E+00 * Gender_Male ;
   _XBETA_ = _XBETA_ + 9.908288084345400E-01 * CarType_SPORT ;
   _XBETA_ = _XBETA_ + 4.641286573822800E-01 * CarType_TRUCK ;
   /* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ - 1.156384352057300E-02 * AgeDriver ;

   MyPred_AmountLoss_STWEEDIE = 6.293220261934300E+03 * EXP(_XBETA_);

   /*********************************************************************/
   /* Distribution: WEIBULL                                             */
   /*********************************************************************/

 _XBETA_ = 0;
   _XBETA_ = _XBETA_ + 1.282907588332400E-02 * MileageDriven ;
   _XBETA_ = _XBETA_ - 4.480114005729500E-03 * IS ;
   /* NOTE: HomeOwner_NO is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 7.297672767727700E-01 * HomeOwner_YES ;
   /* NOTE: Gender_Female is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ + 1.488831397013200E+00 * Gender_Male ;
   _XBETA_ = _XBETA_ + 9.931730126153400E-01 * CarType_SPORT ;
   _XBETA_ = _XBETA_ + 4.546576968650700E-01 * CarType_TRUCK ;
   /* NOTE: CarType_SEDAN is skipped because it is a redundant regressor. */
   _XBETA_ = _XBETA_ - 1.211172101144000E-02 * AgeDriver ;

   MyPred_AmountLoss_WEIBULL = 5.778646806752700E+03 * EXP(_XBETA_);

END;
```

```
ELSE DO;

   /**********************************************************************/
   /* Set _WARN_ value                                                   */
   /**********************************************************************/

   SUBSTR(_WARN_,1,1) = 'M';
END;

LABEL MyPred_AmountLoss_BURR = "Predicted mean for the Burr Distribution" ;

LABEL MyPred_AmountLoss_EXP = "Predicted mean for the Exponential Distribution" ;

LABEL MyPred_AmountLoss_GAMMA = "Predicted mean for the Gamma Distribution" ;

LABEL MyPred_AmountLoss_GPD = "Predicted mean for the Generalized Pareto
Distribution" ;

LABEL MyPred_AmountLoss_IGAUSS = "Predicted mean for the Inverse Gaussian
Distribution" ;

LABEL MyPred_AmountLoss_LOGN = "Predicted mean for the Lognormal Distribution" ;

LABEL MyPred_AmountLoss_PARETO = "Predicted mean for the Pareto Distribution" ;

LABEL MyPred_AmountLoss_STWEEDIE = "Predicted mean for the Tweedie Distribution
with Scale Parameter" ;

LABEL MyPred_AmountLoss_WEIBULL = "Predicted mean for the Weibull Distribution" ;

DROP _nInputMiss _XBETA_;

/**********************************************************************/
/* End scoring code for SEVERITY                                      */
/**********************************************************************/
```

The following tables are a sampling of the output tables that are created by the example. For each distribution type, PROC SEVERITY creates these tables: Distribution

Information, Convergence Status, Optimization Summary, Fit Statistics, and Parameterization Estimation. The output displays the tables for the stweedie distribution.

## SCALEMODEL and all applicable distributions

### The SEVERITY Procedure

| Input Data Set | |
|---|---|
| **Name** | SEVERITY.PHF |

| Model Selection | | | |
|---|---|---|---|
| **Distribution** | **Converged** | **-2 Log Likelihood** | **Selected** |
| **stweedie** | Yes | 8396 | No |
| **Burr** | Yes | 8390 | Yes |
| **Exp** | Yes | 9857 | No |
| **Gamma** | Yes | 8392 | No |
| **Igauss** | Yes | 8399 | No |
| **Logn** | Yes | 8397 | No |
| **Pareto** | Maybe | 9858 | No |
| **Gpd** | Yes | 9857 | No |
| **Weibull** | Yes | 8459 | No |

## SCALEMODEL and all applicable distributions

### The SEVERITY Procedure
### stweedie Distribution

| Distribution Information | |
|---|---|
| Name | stweedie |
| Description | Tweedie Distribution with Scale Parameter |
| Distribution Parameters | 3 |
| Regression Parameters | 7 |

| Convergence Status |
|---|
| Convergence criterion (GCONV=1E-8) satisfied. |

| Optimization Summary | |
|---|---|
| Optimization Technique | Trust Region |
| Iterations | 9 |
| Function Calls | 37 |
| Log Likelihood | -4197.9 |

| Fit Statistics | |
|---|---|
| -2 Log Likelihood | 8396 |
| AIC | 8416 |
| AICC | 8416 |
| BIC | 8460 |
| Kolmogorov-Smirnov | 8.33978 |
| Anderson-Darling | 6448 |
| Cramer-von Mises | 26.70330 |

| Parameter Estimates | | | | |
|---|---|---|---|---|
| **Parameter** | **Estimate** | **Standard Error** | **t Value** | **Approx Pr > \|t\|** |
| Theta | 9.18984 | 18.75328 | 0.49 | 0.6243 |
| Lambda | 24.39485 | . | . | . |
| P | 1.03440 | 0.06739 | 15.35 | <.0001 |
| AgeDriver | -0.01156 | 0.00203 | -5.71 | <.0001 |
| CarType_TRUCK | 0.46413 | 0.02295 | 20.23 | <.0001 |
| CarType_SPORT | 0.99083 | 0.01879 | 52.74 | <.0001 |
| Gender_Male | 1.49378 | 0.01658 | 90.10 | <.0001 |
| HomeOwner_YES | 0.73184 | 0.01911 | 38.30 | <.0001 |
| IS | -0.00468 | 0.0003363 | -13.90 | <.0001 |
| MileageDriven | 0.01347 | 0.00239 | 5.62 | <.0001 |

## SCALEMODEL and all applicable distributions

### The CONTENTS Procedure

| | | | |
|---|---|---|---|
| Data Set Name | SEVERITY.PHF_WPREDICTION | Observations | 625 |
| Member Type | DATA | Variables | 24 |
| Engine | V9 | Indexes | 0 |
| Created | 06/30/2015 23:33:10 | Observation Length | 192 |
| Last Modified | 06/30/2015 23:33:10 | Deleted Observations | 0 |
| Protection | | Compressed | NO |
| Data Set Type | | Sorted | NO |
| Label | | | |
| Data Representation | WINDOWS_64 | | |
| Encoding | utf-8 Unicode (UTF-8) | | |

| Engine/Host Dependent Information | |
|---|---|
| Data Set Page Size | 65536 |
| Number of Data Set Pages | 2 |
| First Data Page | 1 |
| Max Obs per Page | 340 |
| Obs in First Data Page | 318 |
| Number of Data Set Repairs | 0 |
| ExtendObsCounter | YES |
| Filename | C:\sasdemo\Severity\Test\phf_wprediction.sas7bdat |
| Release Created | 9.0401M3 |
| Host Created | X64_S08R2 |

| Alphabetic List of Variables and Attributes | | | | | |
|---|---|---|---|---|---|
| # | Variable | Type | Len | Format | Label |
| 1 | AgeDriver | Num | 8 | | Age of Driver |
| 2 | AmountLoss | Num | 8 | DOLLAR. | Amount of Loss in Dollars |
| 3 | CarType_SEDAN | Num | 8 | | Indicator of Car Type is Sedan |
| 4 | CarType_SPORT | Num | 8 | | Indicator of Car Type is Sport |
| 5 | CarType_TRUCK | Num | 8 | | Indicator of Car Type is Truck |
| 6 | EExp | Num | 8 | | Earned Exposure in Units of One Year |
| 7 | ExpYr | Num | 8 | | Exposure Year |
| 8 | Gender_Female | Num | 8 | | Indicator of Gender is Female |
| 9 | Gender_Male | Num | 8 | | Indicator of Gender is Male |
| 10 | HomeOwner_NO | Num | 8 | | Indicator of Home Ownership is No |
| 11 | HomeOwner_YES | Num | 8 | | Indicator of Home Ownership is Yes |
| 12 | IS | Num | 8 | | Insurance Score of Driver |
| 13 | MileageDriven | Num | 8 | | Mileage Driven in Units of 1,000 Miles |
| 16 | MyPred_AmountLoss_BURR | Num | 8 | | Predicted mean for the Burr Distribution |
| 17 | MyPred_AmountLoss_EXP | Num | 8 | | Predicted mean for the Exponential Distribution |
| 18 | MyPred_AmountLoss_GAMMA | Num | 8 | | Predicted mean for the Gamma Distribution |
| 19 | MyPred_AmountLoss_GPD | Num | 8 | | Predicted mean for the Generalized Pareto Distribution |
| 20 | MyPred_AmountLoss_IGAUSS | Num | 8 | | Predicted mean for the Inverse Gaussian Distribution |
| 21 | MyPred_AmountLoss_LOGN | Num | 8 | | Predicted mean for the Lognormal Distribution |
| 22 | MyPred_AmountLoss_PARETO | Num | 8 | | Predicted mean for the Pareto Distribution |
| 23 | MyPred_AmountLoss_STWEEDIE | Num | 8 | | Predicted mean for the Tweedie Distribution with Scale Parameter |
| 24 | MyPred_AmountLoss_WEIBULL | Num | 8 | | Predicted mean for the Weibull Distribution |
| 14 | PolicyId | Num | 8 | | Policy Identifier |
| 15 | _WARN_ | Char | 4 | | Warnings |

# Appendix 6
# Model Templates

## What Is a Model Template?

Models that you import into SAS Model Manager are associated with a specific model template. A model template has properties and component files that define a type of model. SAS Model Manager processes four types of models: analytical, classification, prediction, and segmentation. You can create your own model template if your model requires files other than those named in the SAS Model Manager templates.

A model template is an XML file that has three sections. The **General** section names and describes the model template. The **Properties** section provides properties to name the model algorithm, the modeler, and a model label. The **Files** section contains the component files that can be used in the template for that model function type. You associate your component file with the appropriate model template component file. Your component file filenames do not need to be the same name as the filenames in the model template.

Model templates provide you with a way to define metadata about your own model. Most users do not need to write model templates because SAS Model Manager delivers a list of model templates that handle SAS Enterprise Miner models as well as analytical, prediction, classification, and segmentation models. However, you can write your own model templates if the model templates that are provided do not satisfy your requirements. For more information, see "Creating and Managing Templates" on page 60.

## Model Types

SAS Model Manager provides model templates for analytical, classification, prediction, and segmentation models.

| Model Type | Description |
|---|---|
| Analytical | The **Analytical** model template is the most generic template that is designed for models whose model function does not fall in the prediction, classification, and segmentation category. |

| Model Type | Description |
| --- | --- |
| Classification | You use the **Classification** model template if your model is a prediction model that has a categorical, ordinal, or binary target, or if your model is a LOGISTIC procedure regression model. Examples of classification models are models that might classify a loan applicant as Approved or Not Approved, or models that might assess a potential customer's risk of default as Low, Medium, or High. |
| Prediction | The **Prediction** model template is used for predictive models. Predictive models declare in advance the outcome of an interval target. A model that assigns a numeric credit score to an applicant is an example of a prediction model. |
| Segmentation | The **Segmentation** model template is used for segmentation or cluster models that are written in SAS code. Segmentation models are unsupervised models that have no target variable. A segmentation or cluster model is designed to identify and form segments, or clusters, of individuals or observations that share some affinity for an attribute of interest. The output from a segmentation model is a set of cluster IDs. R models cannot have segmentation model function. |

## *Model Template Component Files*

Here is a list of the component files that are associated with the model templates:

| Filename | Analytical | Classification | Prediction | Segmentation |
| --- | --- | --- | --- | --- |
| IGN_STATS.csv on page 342 | — | ✔ | — | — |
| EMPublishScore.sas on page 342 | — | ✔ | — | — |
| Scorecard_GainsTable.csv on page 342 | — | ✔ | — | — |
| score.sas on page 342 | ✔ | ✔ | ✔ | ✔ |
| modelinput.sas7bdat on page 342 | ✔ | ✔ | ✔ | ✔ |
| modeloutput.sas7bdat on page 342 | ✔ | ✔ | ✔ | ✔ |
| target.sas7bdat on page 343 | — | ✔ | ✔ | — |
| inputvar.xml on page 343 | ✔ | ✔ | ✔ | ✔ |
| outputvar.xml on page 344 | ✔ | ✔ | ✔ | ✔ |

| Filename | Analytical | Classification | Prediction | Segmentation |
|---|---|---|---|---|
| targetvar.xml on page 344 | — | ✔ | ✔ | — |
| smmpostcode.sas on page 345 | ✔ | ✔ | ✔ | ✔ |
| trainingvariables.csv on page 345 | — | ✔ | — | — |
| training.sas on page 345 | ✔ | ✔ | ✔ | ✔ |
| training.log on page 345 | ✔ | ✔ | ✔ | ✔ |
| training.lst on page 345 | ✔ | ✔ | ✔ | ✔ |
| outest.sas7bdat on page 346 | ✔ | ✔ | ✔ | — |
| outmodel.sas7bdat on page 346 | ✔ | ✔ | ✔ | — |
| output.spk on page 346 | ✔ | ✔ | ✔ | ✔ |
| miningResult.spk on page 346 | ✔ | ✔ | ✔ | — |
| layout.xml on page 346 | — | ✔ | ✔ | — |
| format.sas7bcat on page 346 | ✔ | ✔ | ✔ | ✔ |
| dataprep.sas on page 346 | ✔ | ✔ | ✔ | ✔ |
| batch.sas on page 346 | ✔ | ✔ | ✔ | ✔ |
| pmml.xml on page 346 | ✔ | ✔ | ✔ | — |
| training.r on page 346 | ✔ | ✔ | ✔ | — |
| outmodel.rda on page 346 | ✔ | ✔ | ✔ | — |
| score.r on page 346 | ✔ | ✔ | ✔ | — |
| fitstats.xml on page 346 | — | ✔ | ✔ | — |
| HPDMForest_VARIMPORT.csv on page 346 | — | ✔ | ✔ | — |

| Filename | Analytical | Classification | Prediction | Segmentation |
|---|---|---|---|---|
| HPDMForest_ITERATION.csv on page 346 | — | ✔ | ✔ | — |
| outmdlfile.bin on page 346 | — | ✔ | ✔ | — |

**IGN_STATS.csv**
The value of IGN_STAT.csv is the name of a file whose values are separated by commas, and whose values are bin definitions for input variables. This is a component file that is generated by SAS Enterprise Miner for a scorecard model and is not needed for SAS code models.

**EMPublishScore.sas**
The value of EMPublishScore.sas is the name of a SAS code file that is used to change input variables into bins and is a component of a SAS Enterprise Miner scorecard model. This file is needed to define a performance task. This file is not needed for SAS code models.

**Scorecard_GainsTable.csv**
This file includes the bin score definitions and is not used in reporting by SAS Model Manager. The file's content can be viewed by users.

**score.sas**
The value of score.sas is the name of a filename for the SAS score code for the model.

For R models, this file transforms a scoring data set to an R data frame.

The score.sas file is DATA step score code and is used as input by the SAS Scoring Accelerator when publishing a model to a database. When you are using the scoring function publish method, some SAS language elements and syntax are not supported when you create or modify your score code. Only the SAS language elements and syntax that are required to run critical data transformations and model scoring functions are available. If you use a statement or function that is not supported, an error occurs and your model is not published to the database. For more information, see "Considerations When Creating or Modifying DATA Step Score Code" in *SAS In-Database Products: User's Guide*.

**modelinput.sas7bdat**
The value of modelinput.sas7bdat is the name of a sample data set that is used to create an inputvar.xml file for the model if one does not exist. When no inputvar.xml file exists for the model, SAS Model Manager creates the inputvar.xml file using the variable name and attributes in the modelinput.sas7bdat file. Observation values are not used. Therefore, the sample data set can have no observations or it can have any number of observations. If an inputvar.xml is specified in the model template, modelinput.sas7bdat is ignored.

When you import a SAS code model, the data set that you used to test your score code can be used as the value for the modelinput.sas7bdat file.

*Note:* If the same variables appear in your modelinput.sas7bdat file and your modeloutput.sas7bdat file, when you import the model, SAS Model Manager removes the duplicate variables in the outputvar.xml file.

**modeloutput.sas7bdat**
The value of modeloutput.sas7bdat is the name of a sample data set that is used to create an outputvar.xml file for the model if one does not exist. When no outputvar.xml file exists for the model, SAS Model Manager creates the

outputvar.xml file using the variable name and attributes in the modeloutput.sas7bdat file. Observation values are not used. Therefore, the sample data set can have no observations or it can have any number of observations. If an outputvar.xml is specified in the model template, modeloutput.sas7bdat is ignored.

You can create a modeloutput.sas7bdat file by running the score.sas file against the modelinput.sas7bdat file.

**target.sas7bdat**

The value of target.sas7bdat is the name of a sample data set that is used to create a targetvar.xml file for the model if one does not exist. When no targetvar.xml file exists for the model, SAS Model Manager creates the targetvar.xml file using the variable name and attributes in the target.sas7bdat file. Data set values are not used. Therefore, the sample data set can have no observations or it can have any number of observations. If a targetvar.xml file is specified in the model template, target.sas7bdat is ignored.

You can create a target.sas7bdat file by creating a data set that keeps only the target variables that are taken from the training data set, as in this example:

```
data mydir.target;
    set mydir.myModelTraining (obs-1);
    keep P_BAD;
run;
```

**inputvar.xml**

The value of inputvar.xml is the name of an XML file that defines the model input variables. When your model template includes a file for modelinput.sas7bdat, SAS Model Manager creates the model inputvar.xml file. Otherwise, you must create the XML file.

The following XML file is a sample inputvar.xml file that has one variable, CLAGE. You can use this model to create an inputvar.xml file that contains a VARIABLE element for each model input variable.

```
<?xml version="1.0" encoding="utf-8"?>
<TABLE>
   <VARIABLE>
         <NAME>CLAGE</NAME>
         <TYPE>N</TYPE>
         <LENGTH>8</LENGTH>
         <LABEL Missing=""/>
         <FORMAT Missing=""/>
         <LEVEL>INTERVAL</LEVEL>
         <ROLE>INPUT</ROLE>
        </VARIABLE>
   </TABLE>
```

NAME
: specifies the variable name.

TYPE
: specifies the variable type. Valid values are N for numeric variables and C for character variables.

LENGTH
: specifies the length of the variable.

LABEL Missing=""
: specifies the character to use for missing values. The default character is a blank space.

FORMAT Missing=""
specifies a SAS format to format the variable.

LEVEL
specifies either NOMINAL, ORDINAL, INTERVAL, or BINARY.

ROLE
specifies INPUT for input variables.

**outputvar.xml**

The value of outputvar.xml is the name of an XML file that defines the model output variables. When your model template includes a file for modeloutput.sas7bdat, SAS Model Manager creates the model outputvar.xml file. Otherwise, you must create the XML file.

The following XML file is a sample outputvar.xml file that has one variable, I_BAD. You can use this model to create an outputvar.xml file that contains a VARIABLE element for each model output variable.

```
<?xml version="1.0" encoding="utf-8"?>
<TABLE>
   <VARIABLE>
         <NAME>I_BAD</NAME>
         <TYPE>C</TYPE>
         <LENGTH>12</LENGTH>
         <LABEL>Into: BAD</LABEL>
         <FORMAT Missing=""/>
         <LEVEL>NOMINAL</LEVEL>
         <ROLE>CLASSIFICATION</ROLE>
   </VARIABLE>
 </TABLE>
```

NAME
specifies the variable name.

TYPE
specifies the variable type. Valid values are N for numeric variables and C for character variables.

LENGTH
specifies the length of the variable.

LABEL Missing=""
specifies a label for the output variable.

FORMAT Missing=""
specifies a SAS format to format the variable.

LEVEL
specifies either NOMINAL, ORDINAL, INTERVAL, or BINARY.

ROLE
specifies the type of model output. Valid values are CLASSIFICATION, PREDICT, SEGMENT, and ASSESS.

**targetvar.xml**

The value of targetvar.xml is the name of an XML file that defines the model target variables. When your model template includes a file for target.sas7bdat, SAS Model Manager creates the targetvar.xml file. Otherwise, you must create the XML file.

The following XML file is a sample targetvar.xml file that has one variable, I_BAD. You can use this model to create an outputvar.xml file that contains a VARIABLE element for each model output variable.

```
<?xml version="1.0" encoding="utf-8"?>
<TABLE>
   <VARIABLE>
         <NAME>BAD</NAME>
         <TYPE>N</TYPE>
         <LENGTH>8</LENGTH>
         <LABEL>Missing=””/>
         <FORMAT Missing=""/>
         <LEVEL>BINARY</LEVEL>
         <ROLE>TARGET</ROLE>
  </VARIABLE>
 </TABLE>
```

NAME
specifies the variable name.

TYPE
specifies the variable type. Valid values are N for numeric variables and C for character variables.

LENGTH
specifies the length of the variable.

LABEL Missing=""
specifies a label for the target variable.

FORMAT Missing=""
specifies a SAS format to format the variable.

LEVEL
specifies either NOMINAL, ORDINAL, INTERVAL, or BINARY.

ROLE
specifies TARGET as the value.

**smmpostcode.sas**
SAS Model Manager creates this file to document the mapping that the user specified between the model variables and the project variables.

**trainingvariables.csv**
This optional file contains a list of the training variables.

**training.sas**
This file is the optional SAS code that was used to train the model that you are importing. If at some time, SAS Model Manager reporting utilities detect a shift in the distribution of model input data values or a drift in the model's predictive capabilities, the training.sas code can be used to retrain the model on the newer data. If it is not available at import time, the training.sas code can be added at a later point using the Add Local Files feature.

**training.log**
This file is the optional log file that was produced when the model that you are importing was trained. The information in the optional SAS training log can be helpful if the model must be retrained in the future.

**training.lst**
This file is the optional text output that is produced when the training.sas code is run. The information in the optional SAS training.lst table can be helpful if the model must be retrained in the future.

**outest.sas7bdat**
This data set contains output estimate parameters that are produced by a few SAS procedures, including the LOGISTIC procedure.

**outmodel.sas7bdat**
This data set contains output data that is produced by a few SAS procedures, including the LOGISTIC procedure and the ARBORETUM procedure. It contains complete information for later scoring by the same SAS procedure using the SCORE statement.

**output.spk**
This file is the SAS package file that contains the SPK collection of model component files.

**miningresult.spk**
This is a SAS package file that stores detailed information about SAS Enterprise Miner nodes in the flow from which the model is created and the detailed information for SAS/STAT item store models.

**layout.xml**
This optional file contains information about the SAS Enterprise Miner diagram topology.

**format.sas7bcat**
This file is the optional SAS formats catalog file that contains the user-defined formats for their training data. If the model that you are importing does not use a user-defined format, then you do not need to import a format.sas7bcat catalog file.

**dataprep.sas**
This file contains optional SAS code that is intended to be executed before each run of score code.

**batch.sas**
This file is created by SAS Enterprise Miner and is used for model retraining by SAS Model Manager.

**pmml.xml**
This file contains score code in PMML format.

**training.r**
This is an optional R script file that is used to retrain R models in SAS Model Manager.

**outmodel.rda**
SAS Model Manager requires this file to save the output parameter estimate for R models.

**score.r**
This file is an R script that is used to predict new data.

**fitstats.xml**
This file is created by SAS Enterprise Miner and contains the basic Fit Statistics for the model.

**HPDMForest_VARIMPORT.csv**
This CSV file contains the variable importance data for a PROC HPFOREST model.

**HPDMForest_ITERATION.csv**
This CSV file contains statistics across each iteration of a PROC HPFOREST model.

**OUTMDLFILE.bin**
This is a binary file that contains the PROC HPFOREST model information to be used for scoring.

For information about preparing R model component files, see Appendix 10, “R Model Support,” on page 395.

## *Model Template Properties*

### *Template Properties*

Here is a list of the general properties that define the model template.

<table>
<tr><th>Property Name</th><th>Description</th></tr>
<tr><td>Name</td><td>Identifies the name of the template. This property is required. The characters @ \ / * % # & $ ( ) ! ? < > ^ + ~ ` = { } [ ] | ; : ‘ " cannot be used in the name.</td></tr>
<tr><td>Description</td><td>Specifies user-defined information about the template.</td></tr>
<tr><td>Type</td><td>Specifies the type of the model. SAS Model Manager supports the following model types:<br>Analytical Model<br>specifies the type of model that is associated with the Analytical model function.<br>Classification Model<br>specifies the type of model that is associated with the Classification model function.<br>Prediction Model<br>specifies the type of model that is associated with the Prediction model function.<br>Clustering Model<br>specifies the type of model that is associated with the Segmentation model function.</td></tr>
<tr><td>Tool</td><td>Specifies a text value that describes which tool is used to produce this type of model.</td></tr>
<tr><td>Validate</td><td>Indicates that SAS Model Manager verifies that all of the required files are present when users try to import a model. If validation fails, the model will not be successfully imported.</td></tr>
<tr><td>Display name</td><td>Specifies a text value that is displayed as the name of the model template.</td></tr>
<tr><td>Score code type</td><td>Specifies whether the imported model score code runs by using a DATA Step fragment, SAS Program code, PMML, Analytic store, or DS2.</td></tr>
</table>

### *File List Properties*

Here is a list of the File List properties that specify the files that are contained in a model.

| Property Name | Definition |
|---|---|
| **Name** | Identifies the name of the file. This property is required. |
| **Description** | Specifies user-defined information about the file. |
| **Required** | When it is selected, indicates that the file is a required component file of the model that must be imported before using the model. |
| **Report** | When it is selected, indicates that the file is to be included in a SAS package file when a model is published to a channel. |
| **Type** | Specifies a file whose type is text or binary. |
| **Fileref** | Specifies an eight-character (or fewer) SAS file reference to refer to this file in score.sas code. The fileref is assigned by SAS Model Manager when a SAS job is submitted. |

*Note:* All user-defined models must have three files.

- score.sas is the model's score code.
- modelinput.sas7bdat is a SAS data set whose variables are used by the model score code. The contents of the data set is not used by SAS Model Manager.
- modeloutput.sas7bdat is a resulting data set when a user runs score.sas against modelinput.sas7bdat. The data set provides output variables that the model creates after a scoring test is executed. The contents of the data set is not used by SAS Model Manager.

### System and User Properties

Here is a list of the system-defined and user-defined properties for a model template. Users can set these properties when they import a model.

| Property Name | Description |
|---|---|
| **Name** | Identifies the name of the property. This is a required field. |
| **Description** | Specifies user-defined information about the property. |
| **Type** | Specifies a property whose type is String or Date. |
| **Edit** | Indicates that the property can be modified when importing a model or after the model is imported. |
| **Required** | Indicates that the property is required. |
| **Initial value** | Specifies a text string for the initial value for the property. |
| **Display name** | Specifies a text value that is displayed as the name of the property. |

### *Specific Properties*

Here is a list of specific properties for a model that identify the fundamental model data structures and some of the critical model life cycle dates. Where applicable, project-based or version-based data structures automatically populate properties for model-based data structures.

| Property Name | Description |
|---|---|
| **Default scoring input table** | Specifies a default SAS data set that is used as the input data table for all of scoring tests within the project. The model's **Default scoring input table** property inherits the property value from the associated version or project, if one is specified. |
| **Default scoring output table** | Specifies a default SAS data set that defines the variables to keep in the scoring results table and the scoring test output table. The model's **Default scoring output table** property inherits the property value from the associated version or project, if one is specified. |
| **Default performance table** | Specifies the default performance table for all model performance monitoring tasks within a project.<br>A model's **Default performance table** property inherits the property value from the associated version or project, if one is specified. If you do not specify a performance table, some of the monitoring reports might not be enabled. |
| **Default train table** | The train table is optional and is used only as information. However, when a value is specified for a model's **Default train table** property. |
| **Expiration date** | Specifies a date property by which the selected model is obsolete or needs to be updated or replaced. This property is for informational purposes and is not associated with any computational action. This property is optional. |
| **Model label** | Specifies a text string that is used as a label for the selected model in model assessment charts. If no value is provided for the **Model Label** property, the text string that is specified for the **Model Name** property is used. The **Model Label** property can be useful if the Model Name property that is specified is too long for use in plots. This property is optional. |
| **Subject** | Specifies a text string that is used to provide an additional description for a model, such as a promotional or campaign code. This property is for informational purposes and is not associated with any computational action. This property is optional. |
| **Algorithm** | Specifies the computational algorithm that is used for the selected model. This property cannot be modified. |

| Property Name | Description |
|---|---|
| **Function** | Specifies the function class that was chosen when the associated project was created. The **Function** property specifies the type of output that models in the predictive model project generate. |
| **Modeler** | Specifies the Modeler ID or, when Modeler ID is missing, specifies the user ID of the individual who created the model that is stored in the SPK file for SAS Enterprise Miner models. Otherwise, the modeler can be specified during model import for local files. |
| **Tool** | Specifies whether the imported model came from SAS Enterprise Miner or from other modeling tools. |
| **Tool version** | Specifies the version number of the tool that is specified in the **Tool** property. |
| **Score code type** | Specifies whether the imported model score code is a DATA step fragment, ready-to-run SAS code, or a PMML file. Valid values are **DATA step**, **SAS Program**, **PMML**, **Analytic store**, and **DS2**.<br>*Note:* If the model is created using PMML 4.2 or later, the **Score Code Type** is **DATA step** and not **PMML**. For more information, see "PROC PSCORE and PMML Support" on page 393.<br>*Note:* SAS Model Manager cannot publish models to a database whose **Score Code Type** model property is set to **SAS Program**, **PMML**, **Analytic store**, and **DS2**. |
| **Template** | Specifies the model template that was used to import the model and to create pointers to its component files and metadata. |
| **Copied from** | Specifies where the original model is if this model is copied from another model repository. |
| **Target variable** | Specifies the name of the target variable for a classification or prediction model. This property can be ignored for segmentation, cluster, and other models that do not use target variables. For example, if a model predicts when GENDER=M, then the target variable is **GENDER**. |
| **Target event value** | Specifies a value for the target event that the model attempts to predict. This property is used only when a value is specified for the **Target Variable** property. For example, if a model predicts when GENDER=M, then the target event value is **M**. |

# *Appendix 7* Project Tables



## Descriptions of Project Tables

### *Project Control Tables*

A project control table is a data set that contains the projects, models, and segments that are used to create the structure of the projects within a portfolio. The project control table must at least contain a project variable with the name of project_name. If you want to monitor the performance of the champion models within a portfolio, then the project control table must also contain a segment ID variable. The segment ID variable must also be in the performance tables that are used to monitor performance. If you want to include the models for each project when creating a portfolio, then the control table must also contain the model variable.

## Project Input Tables

A project input table is an optional SAS data set that contains the champion model input variables and their attributes. It is a prototype table that can be used to define the project input variables and the variable attributes such as data type and length. A project can have numerous candidate models that use different predictor variables as input. Because the project input table must contain all champion model input variables, the variables in the project input table are a super set of all input variables that any candidate model in the project might use.

A project input table can have one or more observations. Data that is in a project input table is not used by SAS Model Manager.

If you use a prototype table to define the project input variables, either create the table and register the table to the SAS Metadata Repository in the Data category view or by using SAS Management Console. Tables that are registered using the SAS Management Console must be made available to SAS Model Manager using the Data category view.

The project input variables must be available to SAS Model Manager either by specifying a project input table or by defining individual variables before you set a champion model. You can view input variables for a project on the **Input** tab of the project's **Variables** page, or in the Data category view.

*Note:* An alternative to using prototype tables to define the project input and output variables is to copy the variables from the champion or challenger model, or to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 55.

### See Also

- "Defining Project Input and Output Variables" on page 55
- "Creating Project Input and Output Tables" on page 355

## Project Output Tables

A project output table is an optional SAS data set or database table that defines project output variables and variable attributes such as data type and length. It is a prototype table that contains a subset of the output variables that any model in the project might create.

A project output table can have one or more observations. Data that is in a project output table is not used by SAS Model Manager.

If you use a prototype table to define the project output variables, either create the table and register the table to the SAS Metadata Repository in the Data category view or by using SAS Management Console. Tables that are registered using the SAS Management Console must be made available to SAS Model Manager using the Data category view. For more information, seeChapter 3, "Managing Data Tables," on page 31.

The project output variables must be available to SAS Model Manager either by specifying a project output table or by defining individual variables before you set a champion model. You can view output variables for a project on the **Output** tab of the project's **Variables** page or in the Data category view.

*Note:* An alternative to using prototype tables to define the project input and output variables is to copy the variables from the champion or challenger model, or to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 55.

### See Also


- "Defining Project Input and Output Variables" on page 55
- "Creating Project Input and Output Tables" on page 355


## Scoring Input Tables

A scoring input table is a SAS data set that contains the input data that is used in a scoring test.

Before you can create a scoring test, you must create a scoring input table and register it in the SAS Metadata Repository in the Data category view or by using SAS Management Console. Tables that are registered using the SAS Management Console must be made available to SAS Model Manager using the Data category view. In SAS Model Manager, you can view scoring input tables in the Data category view.

### See Also

"Creating Scoring Input and Output Tables" on page 357

## Scoring Output Tables

A scoring output table is used by a scoring test to define the variables for the scoring results table.

Depending on the mode in which a scoring test is run, the scoring output table can be a prototype table or a physical data table. A scoring test can run in test mode, which is the default mode, or it can run in production mode. In both test mode and production mode, a scoring test output table is used by the scoring test to define the structure of the scoring results table. When the scoring test runs, it creates a scoring results table. In test mode, the scoring results table is stored in the SAS Model Manager model repository or on a local or network drive. You can view the scoring results table on the **Results** tab of the **Scoring** page for a project. The scoring output table in the SAS Metadata Repository or on a local or network drive is not updated in test mode. In production mode, the contents of the scoring output table in the SAS Metadata Repository or the local or network drive are replaced by the contents of the scoring results table. The scoring results table is not stored in the SAS Model Manager model repository or on a local or network drive.

Before you can create a scoring test, the scoring output table must be added and accessible from the Data category view. To add the scoring output table to SAS Model Manager, perform one the following actions:

- Add the table manually by creating the table. Then, register the table in the SAS Metadata Repository in the Data category view or by using SAS Management Console.
- Use the Create a Scoring Output Table feature that is available from the toolbar on the project's **Models** page. When you use the Create a Scoring Output Table window, SAS Model Manager creates the table in the library that is specified in the **Library**

box. The table is registered in the SAS Metadata Repository and is available in the Data category view.

You can view scoring output tables in the Data category view.

### See Also

"Creating Scoring Input and Output Tables" on page 357

## Train Tables

A train table is used to build predictive models. Whether your predictive models are created using SAS Enterprise Miner or you created SAS code models, you used a train table to build your predictive model. SAS Model Manager uses this same train table. The train table must be registered in the SAS Metadata Repository and accessible to SAS Model Manager in the Data category view.

You specify a train table as a version-level property. When you define the train table at the version level, the table can be used to build all predictive models that are defined on the **Models** page for a project.

In SAS Model Manager, train tables are used for information purposes only with one exception. SAS Model Manager uses train tables to validate scoring results immediately after you publish a scoring function or model scoring files, and if the **Validate scoring results** box is selected when you publish scoring functions or model scoring files to a database.

*Note:* A train table cannot contain an input variable name that starts with an underscore.

For information about registering a train table using the Data category view, see Chapter 3, "Managing Data Tables," on page 31.

## Test Tables

A test table is used to create the Dynamic Lift report and the Interval Target Variable report that can be used to identify the champion model. Test tables are typically a subset of a train table, and they are identical in table structure to the corresponding train table. Update test tables by creating a new subset of the corresponding train table.

To view test tables in SAS Model Manager, the tables must be registered in the SAS Metadata Repository. In SAS Model Manager, you can view test tables in the Data category view.

After a test table is added to SAS Model Manager, you can specify the table in the **Default test table** field in the project properties.

For information about registering test tables using the Data category view, see Chapter 3, "Managing Data Tables," on page 31.

### See Also

"Creating a Test Table" on page 358

## Performance Tables

A performance table is a SAS data set that is used as the input table for each SAS Model Manager performance definition. A performance definition is used to monitor a champion model's performance by comparing the observed target variable values with the predicted target variable values. A performance table is a sampling of operational data that is taken at a single point in time. Each time you run a performance definition, you use a new performance table to take a new sampling of the operational data. For example, a champion model is deployed to a production environment for the first time in March 2013. You might want to take a new sampling of the operational data in June 2013, September 2013, and January 2014. These new tables are performance tables in the context of SAS Model Manager.

To view a performance table in SAS Model Manager, you must register the tables in the SAS Metadata Repository using the Data category view or by using SAS Management Console. You can view performance tables in the Data category view. After a performance table is registered, you can specify the table in the **Default performance table** field in the project properties. The default performance table value at the project level is the default value for the **Performance data source** field in the Edit Performance Definition wizard.

*Note:* If you run SAS Model Manager report macros outside of SAS Model Manager to monitor a champion model's performance, the macros cannot access the performance tables in SAS Model Manager to create model performance monitoring reports.

#### See Also

"Creating a Performance Table" on page 358

### See Also

"Remove a Table" on page 38

## Creating Project Input and Output Tables

### Create a Project Input Table

You can create a project input table either from the train table that you used to develop your model, or you can define the project variables in a DATA step. The project input table must include the input variables that are used by the champion model. Therefore, if you have several candidate models for your project, make sure that all candidate model input variables are included in the project input table. If you create the project input table from the train table, be sure to exclude the target variable from the project input table.

Here is one method that you can use to create the project input table from the train table. Use the SET statement to specify the train table and the DROP or KEEP statements to specify the variables from the train table that you want in the project input table. You can drop the target variable or keep all variables except the target variable.

This DATA step creates the project input table from the train table and drops the target variable Bad:

```
data hmeqtabl.invars;
   set hmeqtabl.training (obs=1);
   drop bad;
run;
```

This DATA step creates the project input table from the train table and keeps all variables except for the target variable Bad:

```
data hmeqtabl.invars;
   set hmeqtabl.training (obs=1);
```

```
   keep mortdue reason delinq debinc yoj value ninq job clno derog clag loan;
run;
```

You can also create the project input table using the LENGTH statement to specify the variables and their type and length. You could also specify the LABEL, FORMAT, or INFORMAT statements, or the ATTRIB statement to specify additional variable attributes. The following DATA step uses the LENGTH statement to specify the project input variables in the table:

```
data hmeqtabl.invars;
   length mortdue 8 reason $7 delinq 8
          debinc 8 yoj 8 value 8
          ninq 8 job $7 clno 8 derog 8
          clag 8 loan 8;
run;
```

If you find that you need to modify the project input variables after you have created a project input table, you can use the project's **Variables** page to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 55.

### See Also

- *SAS 9.4 Statements: Reference*
- *SAS 9.4 Language Reference: Concepts*

## Create a Project Output Table

You can create a project output table either from the train table that you used to develop your model, or you can define the project variables in a DATA step. The project output table includes only output variables that are created or modified by the champion model. Therefore, if you have several candidate models for your project, you must make sure that all project output variables are mapped to the champion model output variables.

To create the project output table using the training table, use the SET statement to specify the training table, and use the KEEP statement to specify the variables from the training table that you want in the project output table. The following DATA step creates the project output table Hmeqtabl.Outvars:

```
data hmeqtabl.outvars;
   set hmeqtabl.training (obs=1);
   %include "c:\temp\score.sas";
   keep score;
run;
```

The following DATA step creates the same project output table using the LENGTH statement to specify the output variable and its type and variable length:

```
data hmeqtabl.outvars;
   length score 8;
run;
```

If you find that you need to modify the project output variables after you have created a project output table, you can use the project's **Variables** page to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 55.

# Creating Scoring Input and Output Tables

## About Scoring Input and Output Tables

The scoring input table is a data table whose input is used by the scoring test to score a single model. The scoring input table must contain the variables and input data for the variables that the model requires. Typically, a scoring table is identical to its corresponding train table except that the target variables in the train table are not included in the scoring table.

A scoring output table contains the data that is produced when you execute a scoring test. You can provide a scoring output table or you can create a scoring output table definition in SAS Model Manager. When a scoring test is executed, SAS Model Manager uses the scoring output table definition to create the scoring output table. The name of the scoring output table definition is used as the name of the scoring output table.

You can create a scoring output table definition by using the Create a Scoring Output Table function on the **Models** page. In the Create a Scoring Output Table window, you select variables from a scoring input table as well as variables from the model's output. The variables in the **Input Variables** table are variables from the scoring input table if one is specified for the **Default scoring input table** property for a project or model property. Otherwise, the **Input Variables** table is empty. The **Output Variables** that appear in the window are model output variables. You use the variables from both tables to create the scoring output table.

SAS Model Manager saves the table definition as metadata in the SAS Metadata Repository. The location of the metadata is defined by the SAS library that you specify when you create the output table definition. After SAS Model Manager creates the table definition, the table can be selected as the output table for subsequent scoring tests.

A SAS Model Manager scoring test can run in test mode, which is the default mode, or it can run in production mode. When the test runs, it populates a scoring output table. In test mode, the scoring output table is stored in the SAS Model Manager model repository. You view the table under the scoring test on the project's **Scoring** page. In production mode, if the scoring output table is a table that you provided, that table is updated. If you created a scoring test output definition, the scoring output table is located in the designated SAS library that you specified when you created the table definition in the Create a Scoring Output Table window. The production scoring output table is not stored in the SAS Model Manager repository.

## Create a Scoring Input Table

This DATA step creates a scoring test input table from customer data, keeping 500 rows from the train table:

```
data hmeqtabl.scorein;
   set hmeqtabl.customer (obs=500);
   keep mortdue reason delinq debinc yoj value ninq job clno derog clage loan;
run;
```

### Create a Scoring Output Table

You can create a scoring output table using the Create a Scoring Output Table window that you open from the project's **Models** page. The Create a Scoring Output Table window enables you to select the variables that you want to include in your scoring output table. If the library that you select in the Create a Scoring Output Table window is a folder in the SAS Metadata Repository, SAS Model Manager registers the table in the repository. You can view the table in the Data category view of SAS Model Manager. For information, see "Create Scoring Output Tables" on page 116.

You can also create a scoring output table using a DATA step to keep or drop variables from the train table.

The input variables that you might want to keep in the output data set are key variables for the table. Key variables contain unique information that distinguishes one row from another. An example would be a customer ID number.

This DATA step keeps the input variable CLNO, the client number, which is the key variable, and the output variable SCORE:

```
data hmeqtabl.scoreout;
   length clno 8 score 8;
run;
```

## Creating a Test Table

The test table is used during model validation by the Dynamic Lift report. You can create a test table by taking a sampling of rows from the original train table, updated train table, or any model validation table that is set aside at model training time. This DATA step randomly selects approximately 25% of the train table to create the test table:

```
data hmeqtabl.test;
  set hmeqtabl.train;
  if ranuni(1234) < 0.25;
run;
```

### See Also

"Create a Dynamic Lift Report" on page 130

## Creating a Performance Table

### About Performance Tables

Here are the requirements for a performance table:

- the input variables that you want reported in a Characteristic report
- if you have score code:
  - all input variables that are used by the champion model or challenger models
  - all output variables that are used by the champion model or challenger models

- if you have no score code:
  - the actual value of the dependent variable and the predicted score variable
  - all output variables that you want reported in a Stability Report

You create a performance table by taking a sampling of data from an operational data mart. Make sure that your sampling of data includes the target or response variables. The data that you sample must be prepared by using your extract, transform, and load business processes. When this step is complete, you can then use that data to create your performance table.

As part of the planning phase, you can determine how often you want to sample operational data to monitor the champion model performance. Ensure that the operational data that you sample and prepare represents the period that you want to monitor. For example, to monitor a model that determines whether a home equity loan could be bad, you might want to monitor the model every six months. To do this, you would have two performance tables a year. The first table might represent the data from January through June, and the second table might represent the data from July through December.

Here is another example. You might want to monitor the performance of a champion model that predicts the delinquency of credit card holders. In this case, you might want to monitor the champion model more frequently, possibly monthly. You would need to prepare a performance table for each month in order to monitor this champion model.

In addition to planning how often you sample the operational data, you can also plan how much data to sample and how to sample the data. Examples in this section show you two methods of sampling data and naming the performance tables. You can examine the sampling methods to determine which might be best for your organization.

### *Naming a Performance Table for Use with the Edit Performance Definition Wizard*

The Edit Performance Definition wizard is a graphical interface to assist you in creating a performance definition to monitor the champion model performance. When you run the Edit Performance Definition wizard, you specify a performance table that has been registered to the SAS Metadata Repository. When you create a performance table, you can collect and name the performance table using a method that is most suitable for your business process.

#### *See Also*

"Overview of Performance Monitoring" on page 165

### *Create a Performance Table*

You can use the following DATA steps as examples to create your performance tables.

This DATA step creates a performance table using 5,000 sequential observations from the operational data:

```
data hmeqtabl.perform;
   set hmeqop.JulDec (firstobs=12001 obs=17000);
run;
```

This DATA step creates a performance table from operational data for the past six months of the year. The IF statement creates a random sampling of approximately 10% of the operational data:

```
data hmeqtabl.perform;
  set hmeqop.JulDec;
  if ranuni(1234) < 0.1;
run;
```

# Using Tables from a Local or Network Drive

## *About Using Tables from a Local or Network Drive*

If you have migrated or upgraded from a previous release of SAS Model Manager, the start-up code that enabled you to use tables from the local SAS Workspace Server or network drive is still available. In SAS Model Manager 14.1 you can no longer use the Edit Start-up Code feature to define a libref to use tables on a local or network drive. In SAS Model Manager 14.1 tables must be registered in the SAS Metadata Repository and accessible in the Data category view. If the libref was defined before you migrated or upgraded you can use the local or network tables to complete these SAS Model Manager tasks:

- Create a project
- Create projects from a control table
- Specify project input and output variables
- Create a scoring test
- Create a model retrain definition
- Create reports
- Create a performance definition

The migrated start-up code that was migrated can be viewed using the Edit Start-up Code window. You can access this window from the **Actions** menu on the toolbar in the Projects and Portfolios category views.

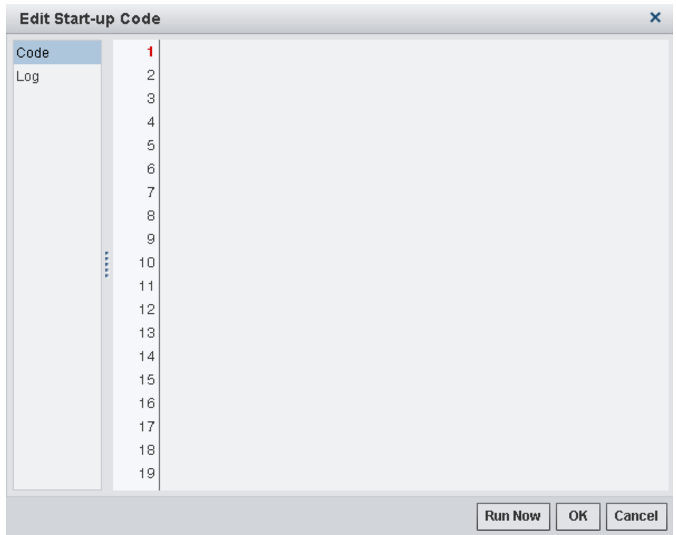

Here is an example LIBNAME statement:

```
libname SalesLib 's:\sales\2013\october';
```

## *Edit Start-Up Code*

To edit the start-up code:

1. Select **Actions** ⇨ **Edit Start-up Code**. The Edit Start-up Code window appears.




2. Enter the SAS code.
3. Click **Run Now**.
4. Click the **Log** tab to see the SAS log.
5. Click **OK**. The SAS code is saved in the Edit Start-up Code window.

   *Note:* If you save the code without running it by clicking **OK**, the code automatically runs the next time the middle-tier server starts.

## *Delete a Libref*

You delete a libref using the Edit Start-up Code window.

1. Select **Actions** ⇨ **Edit Start-up Code**
2. Type **`libname`** *libref* **`clear`**.
3. Click **Run Now**.

*Appendix 8*

# Create Performance Reports Using Batch Programs

# Overview of SAS Programs to Monitor Model Performance

A SAS program that creates performance monitoring reports consists of three conceptual sections:

- The first section defines the report specifications that identify the project, the types of reports that you want to create, alert and warning conditions, and the date and time to run the batch jobs.
- The second section extracts the champion model from a publishing channel. Any batch job that creates performance monitoring reports must extract models from a publishing channel. The champion model must have been published to the channel from the project folder.
- The third section defines the operating environment and the performance data set. This section calls a SAS macro that creates the reports.

*Note:* SAS programs for performance monitoring reports can be run only for champion models. Performance monitoring reports for challenger models can be run only by creating a performance definition using SAS Model Manager.

You define the report specifications by writing four DATA steps:

- mm_jobs.project defines the project specifications.
- mm_jobs.emailaddr defines the email address where you send job, alert, and warning notifications.
- mm_jobs.reportdef defines which type of reports you want to create, and the alert and warning conditions for those reports.
- mm_jobs.jobtime defines the date and time to run the batch jobs.

After the report specification data sets have been created, you extract the champion model from the publishing channel to the SAS Model Manager server using the %MM_GetModels() macro. You set macro variables to define the operating environment, specify the performance data set, and run the %MM_RunReports() macro to create the reports.

You view the reports by selecting the project's **Performance** page in SAS Model Manager. The reports are saved at the version level.

SAS Model Manager provides the following performance monitoring macros:

- %MM_GetModels() extracts models from a publishing channel.
- %MM_UpdateCharacteristicTable creates a Characteristic report.
- %MM_UpdateStabilityTable creates a Stability report.
- %MM_UpdateAssessmentTable creates model monitoring reports.
- %MM_RunReports() sets the operating environment and runs the macros to create the reports.

*Note:* The macros are in the sashelp.modelmgr catalog. The location of this catalog for Windows is **`\`*`sasintalldir`*`\SASFoundation\9.4\mmcommon\sashelp`**. The default value for ***`sasinstalldir`*** in Windows is **`C:\Program Files\SASHome`**. The location of this file for UNIX is ***`/sasinstalldir/`***

**SASFoundation/9.4/sashelp**. The default value for ***sasinstalldir*** in UNIX is **/usr/local/SASHome**.

SAS provides example SAS programs in the sashelp.modelmgr catalog that you can modify for your environment.

# Prerequisites for Running Batch Performance Reports

## *Overview of Prerequisites for Running Batch Performance Reports*

Batch performance reporting requires you to complete several tasks before you can modify the example programs. After the following tasks have been completed, you are ready to modify the example programs:

- Determine the channel that is used to publish the project champion model.
- Ensure that the champion model has been published from the project folder to a channel.
- Create a folder structure on the SAS Model Manager server.

  *Note:* The folder on the SAS Model Manager server that is used in creating batch performance reports must be accessible to the batch performance program.
- Store performance data sets on the SAS Model Manager server.
- If you are using SAS example programs, copy the example programs to the SAS Model Manager server.
- Determine a SAS Model Manager user ID and password to authorize the batch processing.

## *Publish the Champion Model from the Project Folder*

In order to run performance reports in batch, you must publish the champion model from the project folder. The SAS Model Manager performance macros use project metadata when running performance reports.

Whenever you have a new champion model, you must publish the new champion model again.

## *Create a Folder Structure*

Create a folder structure on your SAS Model Manager server to contain the report monitoring files. First, create a root folder to contain performance reporting files for one or more SAS Model Manager projects. You might further organize your file structure by project. The examples in the following table use a classification of HMEQ for the files that are used to create home equity performance monitoring reports. Create folders to contain the following types of files:

| Folder Contents | Description | Example |
|---|---|---|
| job local path | Specifies the folder that contains the reporting specification data sets that are used by the %MM_RunReports() macro. | c:\mmReports\HMEQ \reportJobs |
| report output | Specifies the folder that contains data sets and auxiliary files that are created during the creation of the performance reports when the %MM_RunReports() macro is run in test mode. | c:\mmReports\HMEQ \testReportOutput |
| performance data | Specifies the folder that contains the performance data sets for each time period.<br>Performance data sets can be stored in a DBMS as well. If your performance data set is in a DBMS, then this folder is not necessary. | c:\mmReports\HMEQ\scoreIn |
| channel | Specifies the folder on the SAS Model Manager server to save the SPK file that is created during the processing of the %MM_GetModels() macro. The SPK file contains the model.<br>When you publish a model to a channel, the published model package file (SPK) is placed in this folder.<br>*Note:* The channel that you publish a model to must use archive persistence because the %MM_GetModels() macro requires a directory path. The directory path must be the same path that was used for the channel's persistence.<br>A channel can be shared by multiple model projects.<br>If you do not use the SAS channel that was predefined during the installation of SAS Model Manager, see the Help for the Publishing Framework in SAS Management Console. | c:\mmReports\HMEQ \channel2 |

| Folder Contents | Description | Example |
|---|---|---|
| model | Specifies the folder to where the SPK model is extracted to by the %MM_GetModels() macro. The macro creates a \scorecode folder that contains the model score code and saves the data set current.sas7bdat, logs.sas7bdat, and processingspk.sas7bdat in the model folder. The current.sas7bdat data set contains project and model information that is used to create the performance monitoring reports. | c:\mmReports\HMEQ\model<br>c:\mmReports\HMEQ\model \scorecode |

To ensure that your report data is not lost, regularly back up these report folders.

### See Also

"Report Output in Test and Production Modes" on page 368

## Obtain Performance Data

The performance data set is a snapshot of a data set that includes scoring input variables and one or more target variables. After the snapshot is available, store the data set in a performance data folder on the SAS Model Manager server.

### See Also

"Creating a Performance Table" on page 358

## Determine the Publish Channel

You can determine the channel that was used to publish the model by using one of these methods:

- Open a model and select **History** ⇨ **Log** on the **Model Properties** page. Look for a publish model entry. In this example, the channel name is **MMChannel**: `Jul 5, 2015 9:47:18 PM[sasdemo] "Reg 1" was published to "MMChannel(sas-oma://rdcesx16083.race.sas.com:8561/reposid=A5BXGH17/ITChannel;id=A5BXGH17.BI000001)" successfully.`
- In SAS Management Console, click the **Plug-ins** tab and expand the following nodes under **SAS Management Console** to find the publishing channels that are used by SAS Model Manager: **Environment Management** ⇨ **Publishing Framework** ⇨ **Foundation** ⇨ **Channels** ⇨ **Model Manager Channels**. Right-click the channel and select **Properties**. The channel path is located on the **Persistent Store** tab.

  *Note:* If the **Plug-ins** tab does not appear in your view of SAS Management Console, contact your SAS administrator.

*Note:* A publish channel can be shared by multiple projects.

### Copy Example Batch Programs

SAS provides several example programs that you can use to create a batch program that monitors the performance of the champion model. You can find the example programs in the sashelp.modelmgr catalog. The catalog includes these example programs:

reportExample1
: contains example SAS code to extract a project or model from the channel using the %MM_GetModels() macro.

reportExample2
: contains DATA steps to create performance data that can be used to test the batch programs that create performance monitoring reports.

reportExample3
: contains example DATA steps to create the SAS data sets that contain report specifications, such as the project UUID and path, various input variables, the location of the performance data source, alert and warning conditions, and email addresses for report notifications.

reportExample4
: contains an example program that are used to define the operating environment using macro variables. This program also contains the DATA steps that are used to create the reports.

You can copy these example programs to the job local path folder and you can modify them for your operating environment.

### Determine SAS Model Manager User ID and Password

Performance monitoring reports must specify a validSAS Model Manager user ID and password. The user ID must be in one of the following groups:

- Model Manager Users
- Model Manager Advanced Users
- Model Manager Administrator Users

#### See Also

"Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide*

## Report Output in Test and Production Modes

### Report Output in Test Mode

When you run the %MM_RunReports() macro, you can either run the report in Test mode or Production mode, by using the _MM_ReportMode macro variable.

To run in Test mode, ensure that you make the following assignments:

- In the DATA step mm_jobs.project, set the variable testDestination=*reportOutputPath*, where *reportOutputPath* is the report output folder on the SAS Model Manager server or network. This is the location that you defined when you completed the prerequisites for running batch performance jobs.

- In the %MM_RunReports() macro, set the macro variable _MM_ReportMode=TEST.

Test report output is then written to the SAS Model Manager server or network location. You can test your %MM_RunReports() macro any number of times without corrupting the integrity of your model repository. You can delete the contents of the report output folder and resubmit your macro as necessary.

To view the report output:

1. Sign in to SAS Model Manager.
2. Open the project. For example, open the **`HMEQ`** project in the **`Tutorial3`** folder.
3. Select the **Versions** page and click ✚. Click **OK**.

   *Note:* A best practice is to create a new version and add the files to it. If you do not create a new version, ensure that you delete the performance data sets from the **Results** tab of the **Performance** page when you no longer need these files.
4. Double-click the new version to select it as the displayed version.
5. Select the **Results** tab on the **Performance** page.
6. Click ✚ to add the performance data set from the report output folder that is defined in **`testDestination=`*`reportOutputPath`***. For more information, see "Manage Performance Data Sets" on page 187.
7. Click to update the performance results. You should then be able to select the different charts and view the performance data.

## Report Output in Production Mode

When you run the %MM_RunReports() macro in Production mode, ensure that you complete the following code changes:

- In the DATA step mm_jobs.project, remove the assignment of the variable testDestination=*reportOutputPath*.
- In the %MM_RunReports() macro, set the macro variable _MM_ReportMode=Production.

Production report output is written to the champion version of a project.

To view the report output:

1. Sign in to SAS Model Manager.
2. Open the project. For example, open the **`HMEQ`** project in the **`Tutorial3`** folder.
3. Select the **Versions** page and double-click the champion version to select it as the displayed version.
4. Select the **Results** tab on the **Performance** page.
5. Click to update the performance results. You can now select the different charts and view the performance data.

## See Also

"Prerequisites for Running Batch Performance Reports" on page 365

# Define the Report Specifications

## *Overview of Code to Define Report Specifications*

Before you can create a monitoring report for a project, you must create several data sets that define the report specifications:

| | |
|---|---|
| mm_jobs.project | defines the project information, such as the project UUID, project variables, and the model repository URL for the project. It is recommended that you create only one observation in this data set. |
| mm_jobs.emailaddr | defines the email addresses for the recipients of job status and the notification flags for alert and warning notifications. |
| mm_jobs.reportdef | defines the types of reports to create and the warning and alert conditions that are associated with those reports. |
| mm_jobs.jobtime | defines the date and time to run the reports and a label that describes the time performance data set period. |

The code that you write to create the report specifications might need to be run only after it is created and only whenever it is modified. These data sets might not need to be created every time you want to create reports.

## *Required Libref*

To create the report specifications, you need to define the following libref:

mm_jobs
: defines the local path to the folder that contains the report job files.

  Example: **`libname mm_jobs "c:\mmReports\HMEQ";`**

## *Project Specifications*

### *DATA Step mm_jobs.project*

This DATA step defines the project specifications.

```
/*********************************************/
/* DATA step mm_jobs.project                 */
/*                                           */
/* Create a data set to initialize the       */
/* performance monitoring batch program      */
/* project specifications                    */
/*********************************************/

DATA mm_jobs.project;
   length testDestination %150
      projectuuid $36
      projectpath $2000
      projectAlias $50
```

```
      precode $32000
      isActive $1
      notes $500;

   isActive='Y';

/*********************************************/
/* Specify the destination for the report     */
/* output when the report is run in TEST mode */
/*********************************************/

testDestination='reportOutputPath';

/**********************************************/
/* Specify the project UUID                    */
/**********************************************/

projectuuid='projectuuid';

/***********************************************/
/* Map project specification variables to       */
/* macro variables                              */
/***********************************************/

precode='
   %let _MM_EventProbVar=eventProbabilityVariable;
   %let _MM_TargetVar=targetVariable;
   %let _TargetLevel=targetLevel;
   %let _MM_TargetEvent=targeEventValue;
   %let _MM_ScoreFlag=scoreFlagValue;
   %let _MM_ReportDatasrc=scoreIn.dataSetName;
   %let _MM_KeepVars=variablesToKeep;
   %let _MM_DropVars=variableToDrop;';

/************************************************/
/* Specify the URL to the project in the model   */
/* repository and a description of the project   */
/************************************************/

projectPath='projectURL';
projectAlias='alternateProjectName';

run;
```

### *Variable Descriptions for mm_jobs.project*

The following variables are used in the mm_jobs.project DATA step:

isActive='Y | N'

specifies whether to enable the project definitions. Valid values are Y (yes) and N (no). You specify N to indicate that project files do not need to be removed from the SAS Model Manager server in order to deactivate a project entry. Enclose the value of isActive in quotation marks.

Interaction: Always set isActive='Y' when the data set mm_jobs.project has only one observation.

testDestination='*reportOutputPath*';
: specifies the local path that contains the output files that are created when the %MM_RunReports() macro report mode macro variable _MM_ReportMode is set to TEST. Enclose the value of testDestination in quotation marks.

  Example: `testDestination='c:\mmReports\HMEQ\testOutput';`

  See: "Report Output in Test and Production Modes" on page 368

projectuuid
: specifies the universally unique identifier for a SAS Model Manager modeling project. To obtain the project UUID, in the SAS Model Manager, open a project and select **System** on the **Properties** page. You can copy the UUID from the UUID property. projectuuid is used to redirect reporting job output data sets to the appropriate project folders in the model repository when the %MM_RunReports() macro is run in Production mode.

  *Note:* If you copy the UUID from SAS Model Manager, you might need to remove leading text and spaces that are copied with the UUID.

precode='*macroVariableDefinitions*'
: specifies the macro variables that are used by the %MM_RunReports() macro. Enclose the value of the precode variable in quotation marks.

  %let _MM_EventProbVar=*outputEventProbabilityVariable*;
  : specifies the name of the output event probability variable. To obtain the name, open a project and select **Specific** on the **Properties** page. Use one of the values for the **Output event probability variable** property list box.

  %let _MM_TargetVar=*targetVariable*;
  : specifies the target variable name. To obtain the name, open a project and select **Specific** on the **Properties** page. The target event variable is found in the property **Training target variable**. If a target variable is not specified, see your performance data set or the model for the name of the target variable.

  %let _TargetLevel=*targetLevel*;
  : specifies the class target level of binary, nominal, ordinal, or interval. To obtain the name, open a project and select **Specific** on the **Properties** page. Use one of the values from the **Class target level** property list box.

  %let _MM_TargetEvent=*targetEventValue*;
  : specifies the target event value. To obtain the name, open a project and select **Specific** on the **Properties** page. The value is found in the property **Target event value**. If a target event value is not specified, see your performance data set or the model to determine the value.

    Requirement: The value of _MM_TargetEvent must be an unformatted, raw value even if the original target variable has a SAS format applied to it.

  %let _MM_ScoreFlag=*scoreFlagValue*;
  : specifies whether the macro should run the score code in the performance monitoring job. Valid values are `1` (yes) and `0` (no). If a value for the score flag macro variable is not specified, the default value is set to `1` and the score code is run. Using this macro variable has the same effect as using the **Run model score code** option in the Edit Performance Definition window when you are running the performance monitoring reports for a project.

  %let _MM_ReportDatasrc=scoreIn.*dataSetName*;
  : specifies the libref and the data set name for the performance data set that is being analyzed.

If you process multiple data sets at one time, you can specify a generic data set name in this macro definition. The generic data set name is used to process all performance data sets. Before you run the %MM_RunReports() macro, you should create a DATA step with the name scoreIn.*genericDataSetName*, where the only statement in the DATA step is the SET statement that specifies the performance data set to process.

%let _MM_KeepVars=*variablesToKeep*;
specifies one or more output variables, separated by a space, that are kept in the performance data source to create the Stability report data set.

%let _MM_DropVars=*variablesToDrop*;
specifies one or more input variables, separated by a space, that are dropped from the performance data source to create the Characteristic report data set.

projectPath='*projectURL*'
specifies the project URL. To obtain the project URL, open a project and select **System** on the **Properties** page. You can copy the URL from the **URL** property. The project URL is used for information purposes only; it is not used to access project resources. *projectURL* is dynamically retrieved when the %MM_RunReports() macro runs. Enclose the value of projectPath in quotation marks.

projectAlias='*alternateProjectName*'
specifies an alternate project name. The alternate project name can be used to help identify the project when the projectPath is long. If you do not have an alternate project name, you can leave this variable blank. Enclose the value of projectAlias in quotation marks.

notes='userNotes'
specifies any notes that the user might want to add to the project specifications. Enclose the value of notes in quotation marks.

## Email Recipient Specifications

### DATA Step mm_jobs.emailaddr

This DATA step defines the email recipient specifications:

```
/****************************************************/
/* DATA mm_jobs.emailaddr                           */
/*                                                  */
/* Create a data set that specifies the email      */
/* addresses of the users who will receive job      */
/* status notification as well as warnings and      */
/* alerts.                                          */
/****************************************************/

DATA mm_jobs.emailaddr;
   length address $50 sendAlertWarning sendJobStatus $1;
   address='emailAddress';
      sendAlertWarning='Y';
      sendJobStatus='N';
      output;
   address='emailAddress';
      sendAlertWarning='Y';
      sendJobStatus='Y';
      output;
run;
```

### Variable Descriptions for mm_jobs.emailaddr

The following variables are used in the mm_jobs.emailaddr DATA step:

address='*emailAddress*'
: specifies the email address of the user to receive job, alert, and warning notices. Enclose the value of address in quotation marks.

sendAlertWarning='Y | N'
: specifies whether alert warning notifications are sent to the email address specified in address. Valid values are Y (yes) and N (no). Enclose the value of sendAlertWarning in quotation marks.

sendJobStatus='Y | N'
: specifies whether the job status report is sent to the email address specified in address. Valid values are Y (yes) and N (no). Enclose Y or N in quotation marks.

## Report Specifications

### DATA Step mm_jobs.reportdef

This DATA step defines the type of reports to create, provides the macro syntax for the report type, and defines alert and warning specifications. You can specify one, two, or three report types in the DATA step. The %MM_RunReports() macro runs the reports that are defined in the mm_jobs.reportdef data set. For each type of report, assign the reportName, the macro, and alert and warning conditions.

```
/**************************************************/
/* DATA set mm_jobs.reportdef                     */
/*                                                */
/* Create a data set that defines the report      */
/* metadata and alarm thresholds for the          */
/* Characteristic, Stability, and Model Assessment */
/* reporting jobs.                                */
/**************************************************/

DATA mm_jobs.reportdef;
   length reportName $20
   macro $1000
   alertCondition $200
   warningCondition $200
   isActive $1
   notes $500;

   isActive='Y';

  /************************/
  /* Characteristic Report */
  /************************/

   reportName='Characteristic';
   macro='
     %MM_UpdateCharacteristicTable(
        datasrc=&_MM_ReportDatasrc,
        dropVars=&_MM_DropVars;)';
```

```
      alertCondition='alertConditions';
      warningCondition='warningConditions';
      output;

     /*******************/
     /* Stability Report */
     /*******************/

      reportName='Stability';
      macro='
        %MM_UpdateStabilityTable(
           datasrc=&_MM_ReportDatasrc,
           keepVars=&_MM_KeepVars;)';

      alertCondition='alertConditions';
      warningCondition='warningConditions';
      output;

     /**************************/
     /* Model Assessment Report */
     /**************************/

      reportName='Model Assessment';
      macro='
        %MM_UpdateAssessmentTable(
           datasrc=&_MM_ReportDatasrc);';

      alertCondition='alertConditions';
      warningCondition='warningConditions';
      output;
   run;
```

### *Variable Descriptions for mm_job.reportdef*

The following variable definitions are used in the mm_jobs.reportdef DATA step:

isActive
: specifies whether to enable the report definitions. Valid values are Y (yes) and N (no). Specifying N means that a report definition file does not need to be removed from the SAS Model Manager server to deactivate a report definition entry.

  Interaction: Always set isActive='Y' when the data set mm_jobs.project has only one observation.

reportName='*reportName*'
: specifies the name of the report. Valid report types are as follows:

  - Characteristic
  - Stability
  - Model Assessment

  Enclose *reportName* in quotation marks. This argument is required.

macro='*macroDefinition*';
: specifies the report macro that is executed when the %MM_RunReports() macro is executed. This argument is required.

alertConditions='*alertConditions*';
specifies an alert condition for the type of report. Enclose *alertConditions* in quotation marks. Here are example alert conditions for each type of report:

| Report Type | Example Alert Condition |
|---|---|
| Characteristic | alertCondition='p1>5 or p25>0'; |
| Stability | alertCondition='outputDeviation > 0.03'; |
| Model Assessment | alertCondition='lift5Decay>0.15 and lift10Decay>0.12) or giniDecay>0.1 or ksDecay>0.1';<br>alertCondition=’msedecay > 20’; |

See also: see “Performance Index Warnings and Alerts” on page 173.

warningConditions='*warningConditions*';
specifies a warning condition for the type of report. Enclose *warningConditions* in quotation marks.

| Report Type | Example Warning Condition |
|---|---|
| Characteristic | warningCondition='p1>2'; |
| Stability | alertCondition='outputDeviation > 0.01'; |
| Model Assessment | warningCondition='lift5Decay>0.05';<br>warningCondition==’msedecay >10’; |

See also: see “Performance Index Warnings and Alerts” on page 173.

notes='*userNotes*';
specifies a note to add to the report definition data set. Enclose *userNotes* in quotation marks.

## %MM_UpdateCharacteristicTable() Macro

Here is the syntax for the %MM_UpdateCharacteristicTable() macro:

**%MM_UpdateCharacteristicTable**(datasrc=&_MM_ReportDatasrc, <dropvars=&_MM_DropVars>);

datasrc=&_MM_ReportDatasrc
specifies the macro variable that defines the performance data set that is used to create the Characteristic report.

dropvars=&_MM_DropVars
specifies the macro variable that defines the input variables to drop from the performance data set. Consider dropping variables from the performance data set whose values do not need to be monitored.

## %MM_UpdateStabilityTable() Macro

Here is the syntax for the %MM_UpdateStabilityTable() macro:

**%MM_UpdateStabilityTable**(datasrc=&_MM_ReportDatasrc,
<keepvars=&_MM_KeepVars>);

datasrc=&_MM_ReportDatasrc
: specifies the macro variable that defines the performance data set that is used to create the Stability report.

keepvars=&_MM_KeepVars
: specifies the macro variable that defines the output variables to keep in the performance data set. Consider keeping only the variables in the performance data set whose values are to be monitored.

### *%MM_UpdateAssessmentTable() Macro*

Here is the syntax for the %MM_UpdateAssessmentTable() macro:

**%MM_UpdateAssessmentTable**(datasrc=&_MM_ReportDatasrc);

datasrc=&_MM_ReportDatasrc
: specifies the macro variable that defines the performance data set that is used to create the Model Assessment reports.

## *Job Scheduling Specifications*

### *DATA Step mm_jobs.jobtime*

This DATA step defines the dates and times that the data sets that underlie the performance monitoring reports are to be created or updated.

```
/*************************************************/
/* DATA step mm_jobs.jobtime                     */
/*                                               */
/* Define the report schedule by specifying the  */
/* dates and times for each incremental reporting */
/* interval. You can schedule as many jobs as you */
/* would like. The following jobs are scheduled to*/
/* run one second before midnight on the dates   */
/* listed below.                                 */
/*************************************************/

DATA mm_jobs.jobtime;
  length scheduledTime $18 time $10;
  scheduledTime='dateTime';time='timePeriodLabel';output;
run;
```

### *Variable Descriptions for mm_jobs.jobtime*

Here are the variables that are used in the DATA step mm_jobs.jobtime:

scheduledTime='*dateTime*'
: specifies the date and time to run the report. The value of scheduledTime must be in the form *ddmmmyyyy:hh:mm:ss* where *dd* is a two-digit year, *mmm* is the first three letters of the month, *yyyy* is a four-digit year, *hh* is a two-digit hour, *mm* is a two-digit minute, and *ss* is a two-digit second. Enclose *dateTime* in quotation marks.

: The values of scheduledTime are used by the %MM_RunReports() macro, rather than by your job scheduler. Each time that the %MM_RunReports() macro runs, it checks the values of the scheduleTime variable. If the scheduled time has passed, the report runs. If it has not passed, the performance data sets are not created.

Example: **scheduledTime='03Jun2012:23:59:00';**

time='t*timePeriodLabel*'
: specifies a label that represents the time period for which the performance data was collected. Enclose *timePerodLabel* in quotation marks. Use short and clear labels to create charts that can be easily read.

  Example: **time='2012Q4';**

### *Example Code to Create the Report Specifications*

This example creates a single SAS program to create the report specification data sets. After you copy the example code from the sashelp.modelmgr library, you providing values for the required variables and macros. The variable and macro names are highlighted in the example code to identify the values that you would modify to create the report specifications.

```
/* Source file name: sashelp.modelmgr.reportExample3.source */

LIBNAME mm_jobs 'c:\mm.test\report.auto';

/********************************************/
/* DATA step mm_jobs.project                */
/*                                          */
/* Create a data set to initialize the      */
/* performance monitoring report batch      */
/* job project specification metadata and   */
/* report precode metadata.                 */
/********************************************/

DATA mm_jobs.project;
  length testDestination $50
    projectuuid $36
    projectpath $200
    projectAlias $50
    precode $32000
    isActive $1
    notes $500;

  isActive='Y';

/**********************************************/
/* Specify the destination path for the report */
/* and the universal unique ID for the project */
/**********************************************/

testDestination=
    'c:\mm.test\report.test.output\project_123';
  projectuuid=
    '8817ea06-0a28-0c10-0034-68f4ba396538';

/***********************************************/
/* The precode section uses macro variables to  */
/* map individual model metadata components     */
/* to their respective variables, target event  */
/* values, and data used to create the report.  */
```

```
/**********************************************/

precode='
    %let _MM_EventProbVar=p_bad1;
    %let _MM_TargetVar=bad;
    %let _TargetLevel=BINARY;
    %let _MM_TargetEvent=1;
    %let _MM_ReportDatasrc=scoreIn.hmeq0;
    %let _MM_KeepVars=p_bad1;
    %let _MM_DropVars=bad job;
  ';

/**********************************************/
/* Specify the path to the project and provide  */
/* an Alias name for the project reports.       */
/**********************************************/

  projectPath=
    'http://myserver:7980/SASContentServer/repository/default/ModelManager/
MMRoot/demo/Creditcardpromotion';
  projectAlias=
    'credit risk for younger customers';
run;

/***********************************************/
/* DATA set mm_jobs.emailaddr                   */
/*                                              */
/* Create a data set that specifies the email  */
/* recipient notification list, and whether to  */
/* send the alert, warning, and job status      */
/* notifications.                               */
/***********************************************/

DATA mm_jobs.emailaddr;
  length address $50 sendAlertWarning sendJobStatus $1;
  address='recipient1@mail.com';
    sendAlertWarning='Y';
    sendJobStatus='N';
    output;
  address='recipient2@mail.com';
    sendAlertWarning='Y';
    sendJobStatus='Y';
    output;
run;

/*************************************************/
/* DATA set mm_jobs.reportdef                     */
/*                                                */
/* Create a data set that defines the report      */
/* metadata and alarm thresholds for the          */
/* Characteristic, Stability, and Model Assessment */
/* reporting jobs.                                */
/*************************************************/

DATA mm_jobs.reportdef;
  length reportName $20
```

```
    macro $1000
    alertCondition $200
    warningCondition $200
    isActive $1
    notes $500;

  isActive='Y';

  /************************/
  /* Characteristic Report */
  /************************/

  reportName='Characteristic';
  macro='
    %MM_UpdateCharacteristicTable(
      datasrc=&_MM_ReportDatasrc,
      dropVars=&_MM_DropVars;)';

  alertCondition='p1>5 or p25>0';
  warningCondition='p1>2';
  output;

  /*******************/
  /* Stability Report */
  /*******************/

  reportName='Stability';
  macro='
    %MM_UpdateStabilityTable(
      datasrc=&_MM_ReportDatasrc,
      keepVars=&_MM_KeepVars;)';

  alertCondition='outputDeviation > 0.03';
  warningCondition='outputDeviation > 0.01';
  output;

  /**************************/
  /* Model Assessment Report */
  /**************************/

  reportName='Model Assessment';
  macro='
    %MM_UpdateAssessmentTable(
    datasrc=&_MM_ReportDatasrc);';

  alertCondition='
    (lift5Decay>0.15 and lift10Decay>0.12)
     or giniDecay>0.1
     or ksDecay>0.1';
  warningCondition='lift5Decay>0.05';
  output;
run;

/**************************************************/
/* DATA step mm_jobs.jobtime                      */
/*                                                */
```

```
/* Define the report schedule by specifying the   */
/* dates and times for each incremental reporting */
/* interval. The jobs below are scheduled to run  */
/* one second before midnight on the dates listed */
/* below.                                         */
/*                                                */
/* For each scheduledTime variable you need a     */
/* separate DATA step to execute whose SET        */
/* statement names the appropriate performance    */
/* data source.                                   */
/**************************************************/

DATA mm_jobs.jobtime;
  length scheduledTime $18 Time $10;
  scheduledTime='01OCT2012:23:59:59';time='2012Q3';output;
  scheduledTime='01JAN2013:23:59:59';time='2012Q4';output;
  scheduledTime='01APR2013:23:59:59';time='2013Q1';output;
  scheduledTime='01JUL2013:23:59:59';time='2013Q2';output;
  scheduledTime='01OCT2013:23:59:59';time='2013Q3';output;

run;
```

### See Also


- "Extracting the Champion Model from a Channel" on page 381
- "SAS Code to Run Performance Reports" on page 384


## Extracting the Champion Model from a Channel

### Using the %MM_GetModels() Macro

Before you run the %MM_RunReports() macro, you must extract the model from the publishing channel to the SAS Model Manager server. The model must have been published to the channel from the project folder. The %MM_GetModels() macro extracts models and auxiliary files from a SAS Publishing Framework SPK file to the SAS Model Manager server. All models that were published to the specified channel are included in the SPK file for a given modeling project. If a model has been published multiple times over the channel, the latest model is used in the extraction. The macro then extracts the files from the SPK file to their respective folders on the SAS Model Manager server. The auxiliary files are extracted to the model folder and the model score code is extracted to a folder named **\scorecode**, which the macro creates as a subfolder of the model folder.

*Note:* You can run the %MM_GetModels() macro when no new model has been published to the channel for a modeling project.

The auxiliary files include three SAS data sets:

- current.sas7bdat contains project and model metadata
- logs.sas7bdat contains the SAS logs that were created during the model extraction process
- processingspk.sas7bdat contains information that is necessary to process the SPK file

The models in the **\scorecode** folder are named using the project UUID as the model folder name. The %MM_RunReports() macro uses the mm_jobs.project data set to determine the project UUID. The project UUID is then used as the name of the model on the SAS Model Manager server for scoring when the performance monitoring reports are created.

The current data set contains project and model information and is used by the %MM_RunReports() macro. To ensure that the %MM_RunReports() macro is using the most current project and model metadata, always run the %MM_GetModels() macro before you run the %MM_RunReports() macro. For a list of the information that is contained in the current data set, see "The current.sas7bdat Data Set" on page 383.

## Accessing Model Management Report Macros

The %MM_RunReports() macro, the %MM_GetModel() macro, and all other Model Management macros are available in the catalog sashelp.modelmgr.reportmacros.source. Use the following FILENAME statement to make these macros available to your program:

```
filename repmacro catalog 'sashelp.modelmgr.reportmacros.source';
%inc repmacro;
```

## %MM_GetModels() Macro Syntax

Here is the syntax for the %MM_GetMacros() macro:

**%MM_GetModels**(channel=*channelPath*localPath=*localModelPath*);

channel=*channelPath*
: specifies the path of the channel to extract the models from. To obtain the channel path, see "Determine the Publish Channel" on page 367. Do not enclose the value of channel in quotation marks.

*Note:* The %MM_GetModels() macro supports only publishing channels that have a persistent store type of **Archive**.

localPath=*localModelPath*
: specifies a folder on the SAS Model Manager server to where the model and auxiliary files are extracted from the SPK file. Do not enclose *localModelPath* in quotation marks.

## Example Program to Extract a Model from a Channel

The following SAS code uses the %MM_GetModel macro to extract a champion model from a channel.

```
/* Source file name: sashelp.modelmgr.reportExample1.source */

FILENAME mmmac
  catalog 'sashelp.modelmgr.reportmacros.source';
%inc mmmac;

%MM_GetModels(
  channel=\\network1\MMChampion\channel1,
  localPath=c:\mm.test\model.extraction);
```

### *The current.sas7bdat Data Set*

When models are extracted from a publishing channel, the current.sas7bdat data set contains the following information for each model:

| Variable Name for the Project or Model Information | Description |
|---|---|
| algorithm | The algorithm that was used to create the model |
| fileName | Not used |
| isChampionModel | True or False to indicate whether the model is the champion model |
| keyWords | Keywords |
| miningFunction | The type of mining function, such as classification, prediction, segmentation |
| model | Not used |
| modeler | The name of the person who created the model |
| modelName | The name of the model |
| modelProductionTimestamp | The time at which the model was declared as a production model |
| modelTool | The name of the tool that was used to train the model |
| modelUUID | The UUID for the model |
| nodeDescription | Not used |
| projectPath | The project URL |
| project UUID | The UUID for the project |
| repository | The repository URL |
| scoreCodeType | DATA step or SAS program |
| subject | The subject name |
| targetName | The Training target variable name |
| userAttr | User-defined attributes, such as "MODELER='sasguest' MODELPROJECTVARMAP='predictedProbability eq P_BAD1; predictedClass eq I_BAD;' " |
| versionName | The name of the version that contains the model |

| Variable Name for the Project or Model Information | Description |
|---|---|
| whenPublished | The date and time at which the project or model was published to the channel |
| whoPublished | The user who published the model |

### See Also


- "Define the Report Specifications" on page 370
- "SAS Code to Run Performance Reports" on page 384


## SAS Code to Run Performance Reports

### Overview of the SAS Code to Run the Performance Reports

After you have created the data sets that define the report specifications and have extracted the model from the publishing channel, you then run the %MM_RunReports() macro to create the reports for one or more time periods. Using the data sets that were created to define the report specifications, the %MM_RunReports() macro uses the report specifications to create the reports. The report specifications include the type of report to create, such as characteristic, stability, or model assessment. Other report specifications include the target variable, the libref, and the data set name that is used as the performance data source, variables to keep and drop from reports, email addresses to send report notifications, and performance index warnings and alerts.

To run the %MM_RunReports() macro, your code must accomplish the following tasks:

- access the reporting macros
- define the librefs and the macro variables that are required by the %MM_RunReports() macro
- specify the performance data set to process. To do this, execute a DATA step before each %MM_RunReports() macro

To ensure that you have the latest model, extract the model from the channel each time you create the performance reports. For this reason, you could combine into one SAS program the extraction process and the code to run the reports.

If you run a set of batch jobs every night, you could include this batch job with that set of batch jobs. The reports would be created only after the scheduled date and time that is specified in the mm_jobs.jobtime data set.

The following sections describe each of these components of your SAS program. The last section is an example of a program that is used to test the %MM_RunReports() macro.

If you are running macros in a SAS session that requires a connection to the SAS Metadata Server, you must specify the metadata connection system options before you run the macros. If these options are not specified, you will be prompted for the information. If you are running the macros in batch mode, you must include the metadata connection system options. Otherwise, you will receive a failure message. For more information, see "Setting Metadata Connection System Options" on page 289.

### Accessing Model Management Report Macros

The %MM_RunReports() macro, the %MM_GetModel() macro, and all other Model Management macros are available in the catalog sashelp.modelmgr.reportmacros.source. Use the following FILENAME statement to make these macros available to your program:

```
filename repmacro catalog 'sashelp.modelmgr.reportmacros.source';
%inc repmacro;
```

### Required Librefs

The following librefs are required in your report monitoring program:

mm_jobs
: defines the local path to the folder that contains the report job files.

  Example: **libname mm_jobs "c:\mmReports\HMEQ";**

mm_meta
: defines the local path to the folder that stores the data sets that are created from running the %MM_GetModels() macro. The value of this libref must have the same value as the localPath argument for the %MM_GetModels() macro.

  Example: **libname mm_meta "c:\mmReports\HMEQ\model";**

*scoreIn*
: specifies a user-defined libref that points to the local path that contains the performance data sources.

  Interaction: You can use this libref when you set the value of Model Management macro variables, such as _MM_ReportDatasrc, in the precode variable of the mm_jobs.project data set. Here is an example: %let _MM_ReportDatasrc=scoreIn.foo.

  Example: **libname scoreIn "c:\mmReports \project1\perfdatasets";**

### Macro Variables to Define Report Local Folders and Data Sets

Define the following macro variables in your report monitoring program. Then define the location of the job and model on the SAS Model Manager server:

_MM_JobLocalPath
: specifies the path on the SAS Model Manager server that contains the root folder for the reporting files of a given modeling project.

  Example: **%let _MM_JobLocalPath=c:\mmReports\HMEQ1;**

_MM_ModelLocalPath
: specifies the path on the SAS Model Manager server that contains the model after it has been extracted from the SAS Metadata Repository.

  Example: **%let _MM_ModelLocalPath=c:\mmReports\HMEQ\model;**

mapTable
specifies a libref and data set in the form *libref.dataSet* that contains the mapping of the project output variables to the model output variables. When the model is extracted from the channel, the data set current.sas7bdat is extracted to the folder that contains the model. Use this data set as the value of mapTable.

Example: **`mapTable=mm_meta.current`**. The data set name **`current`** is arbitrary. It is recommended that you use the name **`current`**.

For a description of the macro variables, see "Macro Variables" on page 277.

## Macro Variables That Are Used by the %MM_RunReports() Macro

### Required Macro Variables

The following macro variables are required to run the %MM_RunReports() macro:

_MM_User
specifies a valid user.

_MM_Password
specifies the password for the user who is identified in the _MM_User macro variable.

See: "Encoding SAS Model Manager User Passwords" on page 386

For a description of the macro variables, see "Macro Variables" on page 277.

### Optional Macro Variable

The example programs use the following global macro variable, which you might find useful in your report monitoring program:

_MM_ReportMode
specifies the mode to run the %MM_RunReports() macro. Valid values are TEST and PRODUCTION. The default value is PRODUCTION. You might want to use a value of TEST while you are testing your program. When the value is TEST, the report output files are written to the SAS Model Manager server. When the value is PRODUCTION, the report output files are written to the appropriate project folders in the model repository.

Interaction: If _MM_ReportMode is set to TEST, you must supply a value for the testDestination variable in the mm_jobs.project data set.

Example: **`%let _MM_ReportMode=TEST;`**

For a description of the macro variables, see "Macro Variables" on page 277.

### Encoding SAS Model Manager User Passwords

Each time that your run a SAS program to be processed by SAS Model Manager, you specify a user ID and assign the user's password to the global macro variable _MM_Password. In order to not store passwords in clear text, you can use the PWENCODE procedure to encode a password and store it in a file, in a network-accessible directory. Then, in your SAS program, you create a fileref to the network file that contains the encoded password and you use a DATA step to assign the encoded password to the _MM_Password global macro variable.

In a separate SAS program, encode your password:

```
filename pwfile "my-network-path\pwfile";
```

```
proc pwencode in="12345" out=pwfile;
run;
```

In your SAS program, use a DATA step to access the encoded password file:

```
filename pwfile "my-network-path\pwfile";
%let _MM_User=mmuser1;
data _null_;
   infile pwfile obs=1 length=l;
   input @;
   input @1 line $varying1024. l;
   call symput('_MM_Password',substr(line,1,l));
run;
```

## The DATA Step to Access the Performance Data Set

You use a DATA step to access the performance data set before you run the %MM_RunReports() macro:

```
DATA libref.dataStepName;
   set libref.performanceDataSetName;
run;
```

Here is an example of a DATA step to access the performance data set:

```
DATA scoreIn.hmeq;
   set scoreIn.hmeq_perf_q1;
run;
```

## The %MM_RunReports() Macro

### Description of the %MM_RunReports() Macro

You use the %MM_RunReports() macro to create or update the data sets that underlie the performance monitoring reports. Before each %MM_RunReports() macro that you specify in your program, you might want to update the performance data set by including a DATA step that accesses the performance data set input file.

The %MM_RunReports() macro uses the data sets that are stored in the library that is specified by the mm_jobs libref. These data sets define the report specifications and are the data sets that are created in the report specification program. For more information about the report specification program, see "Define the Report Specifications" on page 370.

### Syntax

Use the following syntax for the %MM_RunReports() macro:

**%MM_RunReports**(

<dataSource=*libname.dataset*>, localPath=&_MM_JobLocalPath, mapTable=&mapTable,

user=&_MM_User, password=&_MM_Password, <currentTime=&currentTime>);

### Syntax Description

dataSource=*libname.dataset*

specifies the name of the performance data set. The default value is **scoreIn.hmeq0**. The default value is used if you do not specify this argument when calling this macro.

Example: **dataSource=mmlib.hmeq_perf_Q2**

localPath=&_MM_ModelLocalPath

specifies the path on the SAS Model Manager server to the location where the %MM_GetModels() macro stores the files extracted from the channel. The %MM_RunReports() macro retrieves the score code from the score code folder, which is a subfolder of &_MM_ModelLocalPath.

Example: **localPath=&_MM_ModelLocalPath**

mapTable=&mapTable

specifies the name of the data set that contains metadata about the extracted model. mapTable is the data set named current.sas7bdat that is created when the model is extracted using the %MM_GetModels() macro. No modification of this argument is necessary.

Example: **mapTable=&mapTable**

user=&_MM_User

specifies a valid user. Use the macro variable that defines the valid user.

Example: **user=&_MM_User**

password=&_MM_Password

specifies the password for _MM_User. Use the _MM_Password global macro variable that defines the password for the user. The value of _MM_Password is a text string.

Example: password=&_MM_Password

See: "Encoding SAS Model Manager User Passwords" on page 386

currentTime=*currentTime*

specifies a time to use for the current time. Use this argument for testing the %MM_RunReports() macro. You do not need to specify an argument for currentTime when you run the macro in a production environment, where the system timestamp is used as a value for currentTime.

The value of currentTime must be in the form *ddmmmyyyy:hh:mm:ss* where *dd* is a two-digit year, *mmm* is the first three letters of the month, *yyyy* is a four-digit year, *hh* is a two-digit hour, *mm* is a two-digit minute, and *ss* is a two-digit second.

Example: currentTime=03Jul2013:12:15:30

### Example %MM_RunReports() Macro

The following code is an example of using the %MM_RunReports() macro:

```
%MM_RunReports(
   dataSource=scoreIn.hmeq0,
   localPath=&_MM_ModelLocalPath,
   mapTable=&mapTable,
   user=&_MM_User,
   password=&_MM_Password);
```

### *Example Code to Run the Reports*

The following example program defines the librefs and macro variables to test the %MM_RunReports() macro's ability to assess home equity performance data for multiple time periods. Before this section of code can be run, the report specifications must be defined in SAS data sets and the model must be extracted from the publishing channel. For more information, see "Define the Report Specifications" on page 370 and "Extracting the Champion Model from a Channel" on page 381.

The example program sets the current time to a time that would trigger the creation of data sets or the updating of data sets that underlie the model monitoring reports. When you run your batch program in a production environment, you do not need a variable to set the current time. When no value is set for the current time, the %MM_RunReports() macro uses the system timestamp as the value of the current time variable.

The highlighted values are user-supplied values.

```
/* Source file name: sashelp.modelmgr.reportExample4.source */

FILENAME repmacro catalog 'sashelp.modelmgr.reportmacros.source';
%inc repmacro;

/* Fileref to the encoded password                */

FILENAME pwfile "my-network-path\pwfile";

/***************************************************/
/* Specify the report execution metadata and      */
/* configure the _MM_ macro variables to run the  */
/* report job in TEST mode.                       */
/***************************************************/

%let _MM_ReportMode=TEST;
%let _MM_User=mmuser1;
data _null_;
   infile pwfile obs=1 length=l;
   input @;
   input @1 line $varying1024. l;
   call symput('_MM_Password',substr(line,1,l));
run;
;

%let _MM_PathMayChange=Y;

%let _MM_JobLocalPath=c:\mm.test\report.auto;
%let _MM_ModelLocalPath=c:\mm.test\model.extraction;

LIBNAME mm_jobs "&_MM_JobLocalPath";
LIBNAME mm_meta "&_MM_ModelLocalPath";
LIBNAME scoreIn 'c:\mm.test\score.in';

%let mapTable=mm_meta.current;

/****************************************************/
/* DATA step scoreIn.hmeq0                         */
/*                                                 */
```

```
/* First, run the Q4 report.It is necessary to */
/* artificially declare a "currentTime" argument   */
/* of 01Jan2013 in order to trigger the report     */
/* execution scheduled for the Q4 interval.    */
/*****************************************************/

%let currentTime=01Jan2013:12:30:15;
%MM_RunReports(
  localpath=&_MM_JobLocalPath,
  currentTime=&currentTime,
  mapTable=&mapTable,
  user=&_MM_User,
  password=&_MM_Password);

/*****************************************************/
/* Now, run the Q1 report. It is necessary to  */
/* artificially declare a "currentTime" argument   */
/* of 03Apr2012 in order to trigger the report     */
/* execution scheduled for the Q1 interval.    */
/*****************************************************/

%let currentTime=03Apr2012:12:30:15;
%MM_RunReports(
  dataSource=scoreIn.hmeq_perf_q1,  localpath=&_MM_JobLocalPath,
  currentTime=&currentTime,
  mapTable=&mapTable,
  user=&_MM_User,
  password=&_MM_Password);

/*****************************************************/
/* Now, run the Q2 report. It is necessary to  */
/* artificially declare a "currentTime" argument   */
/* of 03Jul2012 in order to trigger the report     */
/* execution scheduled for the Q2 interval.    */
/*****************************************************/
%let currentTime=03Jul2012:12:30:15;
%MM_RunReports(
  dataSource=scoreIn.hmeq_perf_q2,  localpath=&_MM_JobLocalPath,
  currentTime=&currentTime,
  mapTable=&mapTable,
  user=&_MM_User,
  password=&_MM_Password);

/*****************************************************/
/* Now, run the Q3 report. It is necessary to  */
/* artificially declare a "currentTime" argument   */
/* of 03Oct2012 in order to trigger the report     */
/* execution scheduled for the Q3 interval.    */
/*****************************************************/
%let currentTime=03Oct2012:12:30:15;
%MM_RunReports(
  dataSource=scoreIn.hmeq_perf_q3,  localpath=&_MM_JobLocalPath,
  currentTime=&currentTime,
  mapTable=&mapTable,
  user=&_MM_User,
  password=&_MM_Password);
```

```
/*************************************************/
/* Now, run the Q4 report. It is necessary to  */
/* artificially declare a "currentTime" argument   */
/* of 03Jan2013 in order to trigger the report     */
/* execution scheduled for the 2012Q4 interval.    */
/*************************************************/
  %let currentTime=03Jan2013:12:30:15;
%MM_RunReports(
  dataSource=scoreIn.hmeq_perf_q4,  localpath=&_MM_JobLocalPath,
  currentTime=&currentTime,
  mapTable=&mapTable,
  user=&_MM_User,
  password=&_MM_Password);
```

### See Also


- "Define the Report Specifications" on page 370
- "Extracting the Champion Model from a Channel" on page 381

# *Appendix 9*
# PROC PSCORE and PMML Support

## *Overview*

PMML is an XML markup language that was developed to exchange predictive and statistical models between modeling systems and scoring platforms. Users can import the majority of standard-compliant PMML models and score them within a SAS environment via the SAS PSCORE procedure.

## *PROC PSCORE Functionality*

The SAS PSCORE procedure generates SAS DATA step score code that is functionally equivalent to the PMML model. The generated score code can be executed on all platforms that are supported by SAS to score the data sets. You can submit the score code in SAS Enterprise Miner via the Program Editor, SAS Enterprise Miner Project code, or within a SAS Enterprise Miner Process Flow Diagram, via the SAS Code node. However, the SAS Enterprise Miner UI environment is not necessary to run the score code.

## *Supported Versions*

SAS PROC PSCORE currently supports the use of PMML 4.2 or later. Earlier versions of PMML are not supported for use with PROC PSCORE.

## *Supported PMML Models*

SAS PROC PSCORE supports the following types of PMML models:

- Regression
- Trees
- Neural Networks
- Clustering models
- Scorecard
- Vector Machine
- Naïve Bayes
- Baseline models

The following models are supported on an experimental basis:

- Time Series

- General Regression

### Requirements for PROC PSCORE

In order to use PROC PSCORE, you must have SAS 9 or later, a well formed PMML modeling file, and Write access to the output directory for the DATA step score file. A SAS Enterprise Miner license is not necessary to run PROC PSCORE.

### PROC PSCORE Usage

```
PROC PSCORE PMML FILE = "<full-pathname-of-PMML-file>"
     DS FILE = "<full-pathname-of-output-DS-file>"
```

### PROC PSCORE Example

/*Run the PSCORE procedure on a generated PMML file*/

```
PROC PSCORE PMML FILE = "C:\temp\heart_pmml1.xml"
     DS FILE = "C:\temp\ds_heart_score.sas";
  run;
```

# *Appendix 10*
# R Model Support



## Overview of Using R Models with SAS Model Manager

R is a freely available language and environment for statistical computing and graphics. Using the open architecture of SAS Model Manager, you can register and import R models. SAS Model Manager requires a model template file and model component files that are created specifically for R models.

The following SAS components are required to use R models in SAS Model Manager:

- Ensure that the installed R language version is 2.13.0 or later.
- SAS/IML. You must license SAS/IML because the IML procedure is required to export SAS data sets to R and to submit R code.
- the RLANG system option. You must set this system option.

SAS Model Manager supplies three R model templates that you can use, or you can create your own template as well. The R model templates that are provided by SAS Model Manager support the analytic, classification, and prediction model functions. The segmentation model function is not supported for R models.

After the model component files are registered, you can perform all SAS Model Manager functions except for exporting an R model to the SAS Metadata Repository.

To use R models in SAS Model Manager, do the following tasks:

1. Ensure that the RLANG system option is set. To have the RLANG system option set when SAS starts, have your site administrator add the RLANG system option to the SAS configuration file.
2. Build an R model. For more information, see “Build an R Model” on page 396.

   SAS/IML must be installed before you build an R model.

3. Ensure that you have a model template file. For more information, see "Prepare an R Model Template File" on page 397.
4. Ensure that you have the required model component files. For more information, see "Prepare R Model Component Files" on page 398.
5. Import the R model. For more information, see "Import Models from Local Files" on page 72.

# Preparing R Model Files to Use with SAS/IML

## *Build an R Model*

Use the following SAS code to create an R model and save it in the outmodel.rda model component file:

```
/* Define the libref to the SAS input data set.   */

libname libref "path-to-input-data-set";

/* Use PROC IML to export the SAS input data set to the R input data set. */

proc iml;
    run ExportDatasetToR("input-data-set" , "R-matrix-input");

/* Submit the model-fitting R code.   */

submit /R;
        attach(R-matrix-input)

        # -----------------------------------------------
        # FIT THE MODEL
        # -----------------------------------------------
        model-name<- model-fitting-function

        # -----------------------------------------------
        # SAVE THE PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
        # -----------------------------------------------
        save(model-name, file="path/outmodel.rda")
    endsubmit;
run;
quit;
```

Supply the following values:

***path-to-input-data-set***
is the path to the library where the input data set is stored.

***input-data-set***
is the name of the input data set.

***R-matrix-input***
is the R input data.

***model-name***
is the name of the model.

***model-fitting-function***
is the R formula that is used to fit the model.

***path***
is the path to where outmodel.rda is to be stored.

Here is an example of creating an R model using the HMEQ train data set as the SAS input data set:

```
libname mmsamp "!sasroot\mmcommon\sample";
proc iml;
    run ExportDatasetToR("mmsamp.hmeq_train" , "mm_inds");
    submit /R;
        attach(mm_inds)

        # -----------------------------------------------
        # FIT THE LOGISTIC MODEL
        # -----------------------------------------------
        logiten<- glm(BAD ~ VALUE + factor(REASON) + factor(JOB) + DEROG +
                   CLAGE + NINQ + CLNO , family=binomial)

        # -----------------------------------------------
        # SAVE THE PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
        # -----------------------------------------------
        save(logiten, file="c:/RtoMMfiles/outmodel.rda")
    endsubmit;
run;
quit;
```

### Prepare an R Model Template File

SAS Model Manager provides three R model templates that you can use as a model template for your R model:

- RClassification
- RPrediction
- RAnalyticalmodel

To view these model templates:

1. From the Projects category view, Click and select **Manage Templates**. The Manage Templates appears.
2. Select an R model template and click .
3. Review the model template to make sure that it contains all of the model component files and properties for your model. If it does, you can use this template to import your R model. To customize the model template, you can copy the XML content from one of the supplied template files and make modifications using a text editor. You can then create a new model template using the modified XML content and the model template to the SAS Content Server.

   To create a custom R model template, see "Model Template Component Files" on page 340 and "User-Defined Model Templates" on page 87.

## Prepare R Model Component Files

### R Model Component Files for Executing R Models Using SAS/IML

To submit R models from SAS Model Manager using SAS/IML, you need several model component files:

- modelinput.sas7bdat
- modeloutput.sas7bdat
- target.sas7bdat
- inputvar.xml
- outputvar.xml
- targetvar.xml
- outmodel.rda
- score.r
- score.sas
- training.r (not required if you do not retrain your R model)
- training.sas (not required if you do not retrain your R model)

You create the modelinput.sas7bdat, modeloutput.sas7bdat, target.sas7bdat, inputvar.xml, outputvar.xml, and targetvar.xml files as you would for importing a SAS code file. For more information, see "Model Template Component Files" on page 340.

The remaining files, outmodel.rda, score.r, score.sas training.r, and training.sas require additional file preparation.

### Create outmodel.rda

The outmodel.rda file contains the output parameter estimate. This file is used by SAS Model Manager to register and score the model. You create outmodel.rda when you build an R model. See "Build an R Model" on page 396. The outmodel.rda file uses the R function save() to save the scoring results.

Here is the syntax of an outmodel.rda file:

```
save(model-name, file="path/outmodel.rda")
```

Supply the following values:

***model-name***
is the name of the R model.

***path***
is the system path to the location where outmodel.rda is stored.

Here is an example outmodel.rda file:

```
save(logiten, file="c:/temp/outmodel.rda")
```

### Create score.r

The score.r script is an R script that is used to score data. You can use the following R script to create score.r:

```
attach(R-matrix-input)
```

```
# -----------------------------------------------
# LOAD THE OUTPUT PARAMETER ESTIMATE FROM FILE OUTMODEL.RDA
# -----------------------------------------------
load('&_mm_scorefilesfolder/outmodel.rda')

# -----------------------------------------------
# SCORE THE MODEL
# -----------------------------------------------
score<- predict(model-name, type="response", newdata=R-matrix-input)

# -----------------------------------------------
# MERGING PREDICTED VALUE WITH MODEL INPUT VARIABLES
# -----------------------------------------------
mm_outds <- cbind(R-matrix-input, score)
```

Supply the following values:

***R-matrix-input***
is the name of the input R matrix file that you specified in the ExportDatasetToR function in the IML procedure. See "Build an R Model" on page 396.

***score***
is the output variable. The value for *score* must match the output variable that is defined in modeloutput.sas7bdat and outputvar.xml.

***model-name***
is the name of the R model. The value of *model-name* must match the R save function *model-name* argument that is specified in the outmodel.rda file.

Here is an example score.r file:

```
attach(mm_inds)

# -----------------------------------------------
# LOAD THE OUTPUT PARAMETER ESTIMATE FROM FILE OUTMODEL.RDA
# -----------------------------------------------
load('&_mm_scorefilesfolder/outmodel.rda')

# -----------------------------------------------
# PREDICT
# -----------------------------------------------
score<- predict(logiten, type="response", newdata=mm_inds)

# -----------------------------------------------
# MERGE THE PREDICTED VALUE WITH MODEL INPUT VARIABLES
# -----------------------------------------------
mm_outds <- cbind(mm_inds, score)
```

### Create score.sas

The score.sas program defines the score test information in a data set and calls the %mmbatch macro. When you submit the %mmbatch macro, the task mm_r_model_train_main completes the following tasks:

- transforms a scoring data set to an R data frame
- generates and submits R code for scoring
- transforms the scored output to a SAS data set for reporting in SAS Model Manager

Here is the score.sas program:

```
filename tmp catalog "sashelp.modelmgr.mm_include.source";
%include tmp;
filename tmp;

data work.mm_score_task_information;
   length role $ 8;
   length name $ 80;
   length value $ 200;

   role = "input";
   name = "importedData";
   value = "&_mm_inputds";
   output;

   role = "input";
   name = "modelID";
   value = "&_mm_modelID";
   output;

   role = "output";
   name = "exportedData";
   value = "&_mm_outputds";
   output;

   role = "input";
   name = "dataRole";
   value = "output-variable-name";
   output;

   role = "input";
   name = "p_Target";
   value = "output-variable-name";
   output;
run;

/* mm_r_model_score_main is a SAS Model Manager process flow that is used to run */
/* R model scripts using PROC IML.                                               */

%mmbatch(task=mm_r_model_score_main, taskprops= mm_score_task_information);
```

Supply the following value:

***output-variable-name***
is the output variable that is defined in modeloutput.sas7bdat or modeloutput.xml.

To print verbose SAS logs, add the following lines before the RUN statement in the previous DATA step:

```
role = "input";
   name = "_mm_trace";
   value = "ON";
   output;
```

## *Create training.r*

The training.r script is an R script that is used to build a train model. Use the following script for the training.r file. In the R save function, the path in the file= argument must be &_MM_TrainResultFolder.

You can use the following script to create training.r:

```
attach(R-matrix-input)

# ----------------------------------------------
# FIT THE LOGISTIC MODEL
# ----------------------------------------------
model-name<- model-fitting-function

# ----------------------------------------------
# SAVE THE OUTPUT PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
# ----------------------------------------------
save(model-name, file="&_MM_TrainResultFolder/outmodel.rda")
```

Supply the following values:

***R-matrix-input***
is the name of the R matrix that is specified in the ExportMatrixToR function that is used to build a model using the IML procedure.

***model-name***
is the name of the R model.

***model-fitting-function***
is an R model fitting function, such as lm() or glm().

Here is an example training.r R script to build the HMEQ R train model:

```
attach(mm_inds)

# ----------------------------------------------
# FIT THE LOGISTIC MODEL
# ----------------------------------------------
logiten<- glm(BAD ~ VALUE + factor(REASON) + factor(JOB) + DEROG + CLAGE +
              NINQ + CLNO , family=binomial)

# ----------------------------------------------
# SAVE THE OUTPUT PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
# ----------------------------------------------
save(logiten, file="&_MM_TrainResultFolder/outmodel.rda")
```

### *Create training.sas*

If you do not need to retrain your R model in SAS Model Manager, you do not need this file.

The training.sas program defines the train task information in a data set and calls the %mmbatch macro. When you submit the %mmbatch macro, the task mm_r_model_train_main completes the following tasks:

- transforms a training data set to an R data frame
- generates and submits R code for training
- registers the training output parameter estimate file in SAS Model Manager

Here is the training.sas file:

```
filename tmp catalog "sashelp.modelmgr.mm_include.source";
%include tmp;
filename tmp;

data work.mm_train_task_information;
```

```
      length role $ 8;
      length name $ 80;
      length value $ 200;

      role = "input";
      name = "trainData";
      value = "&_mm_inputds";
      output;

      role = "input";
      name = "modelID";
      value = "&_mm_modelID";
      output;
   run;

   /* mm_r_model_train_main is a SAS Model Manager process flow that is used to run */
   /* R model scripts using PROC IML.                                               */

   %mmbatch(task=mm_r_model_train_main, taskprops= mm_train_task_information);
```

To print verbose SAS logs, add the following lines before the RUN statement in the previous DATA step:

```
role = "input";
   name = "_mm_trace";
   value = "ON";
   output;
```

# Appendix 11
# Statistical Measures Used in Basel III Reports

## *Overview of Statistical Measures Used for Basel III Reports*

SAS Model Manager Basel III reports use several statistical measures to validate the stability, performance, and calibration for the two key types of Basel III risk models: the Probability of Default (PD) model and the Loss Given Default (LGD) model.

The statistical measures for model validation are grouped into three categories:

| Category | Description |
|---|---|
| Model Stability | Tracks the change in distribution of the modeling data and scoring data. |
| Model Performance | • Measures the ability of a model to discriminate between customers with accounts that have defaulted, and customers with accounts that have not defaulted. The score difference between non-default and default accounts helps determine the required cutoff score. The cutoff score helps predict whether a credit exposure is a default account.<br>• Measures the relationship between the actual default probability and the predicted default probability. This helps you understand the performance of a model over a time period. |
| Model Calibration | Checks the accuracy of the PD and LGD models by comparing the correct quantification of the risk components with the available standards. |

The sections that follow describe the measures, statistics, and tests that are used to create the PD and LGD reports.

## *Model Stability Measure*

The following table describes the model stability measure that is used to create the PD report and the LGD reports.

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| System Stability Index (SSI) | SSI monitors the score distribution over a time period. | Yes | Yes |

## Model Performance Measures and Statistics

The following table describes the model performance measures that are used to create the PD and LGD reports.

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| Accuracy | Accuracy is the proportion of the total number of predictions that were correct. | Yes | No |
| Accuracy Ratio (AR) | AR is the summary index of Cumulative Accuracy Profile (CAP) and is also known as Gini coefficient. It shows the performance of the model that is being evaluated by depicting the percentage of defaulted accounts that are captured by the model across different scores. | Yes | Yes |
| Area Under Curve (AUC) | AUC can be interpreted as the average ability of the rating model to accurately classify non-default accounts and default accounts. It represents the discrimination between the two populations. A higher area denotes higher discrimination. When AUC is 0.5, it means that non-default accounts and default accounts are randomly classified, and when AUC is 1, it means that the scoring model accurately classifies non-default accounts and default accounts. Thus, the AUC ranges between 0.5 and 1. | Yes | No |
| Bayesian Error Rate (BER) | BER is the proportion of the whole sample that is misclassified when the rating system is in optimal use. For a perfect rating model, the BER has a value of zero. A model's BER depends on the probability of default. The lower the BER, and the lower the classification error, the better the model. | Yes | No |
| D Statistic | The D Statistic is the mean difference of scores between default accounts and non-default accounts, weighted by the relative distribution of those scores. | Yes | No |
| Error Rate | The Error Rate is the proportion of the total number of incorrect predictions. | Yes | No |

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| Information Statistic (I) | The Information Statistic value is a weighted sum of the difference between conditional default and conditional non-default rates. The higher the value, the more likely a model can predict a default account. | Yes | No |
| Kendall’s Tau-b | Kendall's tau-b is a nonparametric measure of association based on the number of concordances and discordances in paired observations. Kendall's tau values range between -1 and +1, with a positive correlation indicating that the ranks of both variables increase together. A negative association indicates that as the rank of one variable increases, the rank of the other variable decreases. | Yes | No |
| Kullback-Leibler Statistic (KL) | KL is a non-symmetric measure of the difference between the distributions of default accounts and non-default accounts. This score has similar properties to the information value. | Yes | No |
| Kolmogorov-Smirnov Statistic (KS) | KS is the maximum distance between two population distributions. This statistic helps discriminate default accounts from non-default accounts. It is also used to determine the best cutoff in application scoring. The best cutoff maximizes KS, which becomes the best differentiator between the two populations. The KS value can range between 0 and 1, where 1 implies that the model is perfectly accurate in predicting default accounts or separating the two populations. A higher KS denotes a better model. | Yes | No |
| 1–PH Statistic (1–PH) | 1-PH is the percentage of cumulative non-default accounts for the cumulative 50% of the default accounts. | Yes | No |
| Mean Square Error (MSE), Mean Absolute Deviation (MAD), and Mean Absolute Percent Error (MAPE) | MSE, MAD, and MAPE are generated for LGD reports. These statistics measure the differences between the actual LGD and predicted LGD. | No | Yes |

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| Pietra Index | The Pietra Index is a summary index of Receiver Operating Characteristic (ROC) statistics because the Pietra Index is defined as the maximum area of a triangle that can be inscribed between the ROC curve and the diagonal of the unit square.<br><br>The Pietra Index can take values between 0 and 0.353. As a rating model's performance improves, the value is closer to 0.353. This expression is interpreted as the maximum difference between the cumulative frequency distributions of default accounts and non-default accounts. | Yes | No |
| Precision | Precision is the proportion of the actual default accounts among the predicted default accounts. | Yes | No |
| Sensitivity | Sensitivity is the ability to correctly classify default accounts that have actually defaulted. | Yes | No |
| Somers' D (p-value) | Somers' D is a nonparametric measure of association that is based on the number of concordances and discordances in paired observations. It is an asymmetric modification of Kendall's tau. Somers' D differs from Kendall's tau in that it uses a correction only for pairs that are tied on the independent variable. Values range between -1 and +1. A positive association indicates that the ranks for both variables increase together. A negative association indicates that as the rank of one variable increases, the rank of the other variable decreases. | Yes | No |
| Specificity | Specificity is the ability to correctly classify non-default accounts that have not defaulted. | Yes | No |
| Validation Score | The Validation Score is the average scaled value of seven distance measures, anchored to a scale of 1 to 13, lowest to highest. The seven measures are the mean difference (D), the percentage of cumulative non-default accounts for the cumulative 50% of the default accounts (1-PH), the maximum deviation (KS), the Gini coefficient (G), the Information Statistic (I), the Area Under the Curve (AUC), or Receiver Operating Characteristic (ROC) statistic, and the Kullback-Leibler statistic (KL). | Yes | No |

## *Model Calibration Measures and Tests*

The following table describes the model calibration measures and tests that are used to create the PD and LGD reports:

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| Binomial Test | The Binomial Test evaluates whether the PD of a pool is correctly estimated. It does not take into account correlated defaults, and it generally yields an overestimate of the significance of deviations in the realized default rate from the forecast rate. The Modified Binomial Test now addresses the overestimate. This test takes into account the correlated defaults[1]. The default correlation coefficient in SAS Model Manager is 0.04. By using past banking evaluations, you can use these rho values[2]:<br>rho=0.04 Qualifying revolving retail<br>rho=0.15 Residential mortgage<br>rho=0.16 Other retail<br>rho=0.24 Corporations, sovereign, and banks<br>If the number of default accounts per pool exceeds either the low limit (binomial test at 0.95 confidence) or high limit (binomial test at 0.99 confidence), the test suggests that the model is poorly calibrated.<br>To change the default rho value, contact your application administrator. The value is a report option in SAS Management Console. | Yes | No |
| Brier Skill Score (BSS) | BSS measures the accuracy of probability assessments at the account level. It measures the average squared deviation between predicted probabilities for a set of events and their outcomes. Therefore, a lower score represents a higher accuracy. | Yes | No |

1 Rauhmeier, Robert, and Englemann, Bernd. "PD Validation - Experience from Banking Practice." Available at http://d.yimg.com/kq/groups/12093474/1121755262/name/The+Basel+III+Risk+Parameters.pdf

2 Rauhmeier, Robert, and Englemann, Bernd. "PD Validation - Experience from Banking Practice." Available at http://d.yimg.com/kq/groups/12093474/1121755262/name/The+Basel+III+Risk+Parameters.pdf

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| Confidence Interval | The Confidence Interval indicates the confidence interval band of the PD or LGD for a pool. The Probability of Default report compares the actual and estimated PD rates with the CI limit of the estimate. If the estimated PD lies in the CI limits of the actual PD model, the PD performs better in estimating actual outcomes.<br>For the Loss Given Default (LGD) report, confidence intervals are based on the pool-level average of the estimated LGD, plus or minus the pool-level standard deviation, and multiplied by the 1-(alpha/2) quantile of the standard normal distribution. | Yes | Yes |
| Correlation Analysis | The model validation report for LGD provides a correlation analysis of the estimated LGD with the actual LGD. This correlation analysis is an important measure for a model's usefulness. The Pearson correlation coefficients are provided at the pool and overall levels for each time period are examined. | No | Yes |
| Hosmer-Lemeshow Test (p-value) | The Hosmer-Lemeshow test is a statistical test for goodness-of-fit for classification models. The test assesses whether the observed event rates match the expected event rates in pools. Models for which expected and observed event rates in pools are similar are well calibrated. The p-value of this test is a measure of the accuracy of the estimated default probabilities. The closer the p-value is to zero, the poorer the calibration of the model. | Yes | No |
| Mean Absolute Deviation (MAD) | MAD is the distance between the account level estimated and the actual loss LGD, averaged at the pool level. | No | Yes |
| Mean Absolute Percent Error (MAPE) | MAPE is the absolute value of the account-level difference between the estimated and actual LGD, divided by the estimated LGD, and averaged at the pool level. | No | Yes |
| Mean Squared Error (MSE) | MSE is the squared distance between the account level estimated and actual LGD, averaged at the pool level. | No | Yes |

| Measure | Description | PD Report | LGD Report |
|---|---|---|---|
| Normal Test | The Normal Test compares the normalized difference of predicted and actual default rates per pool with two limits estimated over multiple observation periods. This test measures the pool stability over time. If a majority of the pools lie in the rejection region, to the right of the limits, then the pooling strategy should be revisited. | Yes | No |
| Observed versus Estimated Index | The observed versus estimated index is a measure of closeness of the observed and estimated default rates. It measures the model's ability to predict default rates. The closer the index is to zero, the better the model performs in predicting default rates. | Yes | No |
| Traffic Lights Test | The Traffic Lights Test evaluates whether the PD of a pool is underestimated, but unlike the binomial test, it does not assume that cross-pool performance is statistically independent. If the number of default accounts per pool exceeds either the low limit (Traffic Lights Test at 0.95 confidence) or high limit (Traffic Lights Test at 0.99 confidence), the test suggests the model is poorly calibrated. | Yes | No |

# Recommended Reading

Here is the recommended reading list for this title:

- *SAS Model Manager: Administrator's Guide*
- *SAS In-Database Products: User's Guide*
- *SAS Factory Miner: User's Guide*

For a complete list of SAS publications, go to sas.com/store/books. If you have questions about which titles you need, please contact a SAS Representative:

SAS Books
SAS Campus Drive
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Phone: 1-800-727-0025
Fax: 1-919-677-4444
Email: sasbook@sas.com
Web address: sas.com/store/books

# Glossary

**analytical model**
a statistical model that is designed to perform a specific task or to predict the probability of a specific event.

**attribute**
*See* variable attribute.

**backtesting**
a procedure for monitoring the quality of behavioral and application scoring models. Backtesting validates the accuracy of the model's predictions.

**baseline**
the initial performance prediction against which the output data from later tasks is compared.

**bin**
a grouping of predictor variable values that is used for frequency analysis.

**candidate model**
a predictive model that evaluates a model's predictive power as compared with the champion model's predictive power.

**challenger model**
a model that is compared and assessed against a champion model for the purpose of replacing the champion model in a production scoring environment.

**champion model**
the best predictive model that is chosen from a pool of candidate models in a data mining environment.

**characteristic report**
a report that detects and quantifies shifts in the distribution of input variables over time in data that is used to create predictive models.

**classification model**
a predictive model that has a categorical, ordinal, or binary target.

**clustering model**
a model in which data sets are divided into mutually exclusive groups in such a way that the observations for each group are as close as possible to one another, and different groups are as far as possible from one another.

**component file**
a file that defines a predictive model. Component files can be SAS programs or data sets, XML files, log files, SPK files, or CSV files.

**data model training**
the process of building a predictive model from data.

**data object**
an object that holds the business data that is required to execute workflow tasks.

**data set**
*See* SAS data set.

**data source (source)**
a table, view, or file from which you will extract information. Sources can be in any format that SAS can access, on any supported hardware platform. The metadata for a source is typically an input to a job.

**DATA step**
in a SAS program, a group of statements that begins with a DATA statement and that ends with either a RUN statement, another DATA statement, a PROC statement, or the end of the job. The DATA step enables you to read raw data or other SAS data sets and to create SAS data sets.

**DATA step fragment**
a block of SAS code that does not begin with a DATA statement. In SAS Model Manager, all SAS Enterprise Miner models use DATA step fragments in their score code.

**delta report**
a report that compares the input and output variable attributes for each of the variables that are used to score two candidate models.

**dynamic lift report**
a graphical report that plots the sequential lift performance of one or more models over time, against test data.

**file reference**
*See* fileref.

**fileref (file reference)**
a name that is temporarily assigned to an external file or to an aggregate storage location such as a directory or a folder. The fileref identifies the file or the storage location to SAS. *See also* libref.

**format**
*See* SAS format.

**Gini coefficient**
a benchmark statistic that is a measure of the inequality of distribution, and that can be used to summarize the predictive accuracy of a model.

**holdout data**
a portion of the historical data that is set aside during model development. Holdout data can be used as test data to benchmark the fit and accuracy of the emerging predictive model.

**identity**
*See* metadata identity.

**index**
*See* SAS index.

**informat**
*See* SAS informat.

**inner join**
a join between two tables that returns all of the rows in one table that have one or more matching rows in the other table.

**input variable**
a variable that is used in a data mining process to predict the value of one or more target variables.

**Kolmogorov-Smirnov chart**
a chart that shows the measurement of the maximum vertical separation, or deviation between the cumulative distributions of events and non-events.

**library reference**
*See* libref.

**libref (library reference)**
a SAS name that is associated with the location of a SAS library. For example, in the name MYLIB.MYFILE, MYLIB is the libref, and MYFILE is a file in the SAS library.

**life cycle phase**
a collection of milestones that complete a major step in the process of selecting and monitoring a champion model. Typical life cycle phases include development, test, production, and retire.

**logistic regression**
a form of regression analysis in which the target variable (response variable) represents a binary-level, categorical, or ordinal-level response.

**macro variable (symbolic variable)**
a variable that is part of the SAS macro programming language. The value of a macro variable is a string that remains constant until you change it.

**metadata**
descriptive data about data that is stored and managed in a database, in order to facilitate access to captured and archived data for further use.

**metadata identity (identity)**
a metadata object that represents an individual user or a group of users in a SAS metadata environment. Each individual and group that accesses secured resources on a SAS Metadata Server should have a unique metadata identity within that server.

**milestone**

a collection of tasks that complete a significant event. The significant event can occur either in the process of selecting a champion model, or in the process of monitoring a champion model that is in a production environment.

**model assessment**

the process of determining how well a model predicts an outcome.

**model function**

the type of statistical model, such as classification, prediction, or segmentation.

**model input variable report**

reports the frequencies that input variables are used in the models for an organizational folder, a project, or a version.

**model profile report**

reports the profile data that is associated with the model input variables, output variables, and target variables.

**model scoring (scoring)**

the process of applying a model to new data in order to compute outputs.

**model target variable report**

a report that indicates the frequency in which target variables are used in the models that exist in the selected folder.

**monitoring report**

a report that consists of assessment charts, a ROC chart, a Gini Trend chart, a KS (Kolmogorov-Smirnov) chart, and a KS trend chart that can be used to compare the model performance curves of several candidate models.

**neural network**

any of a class of models that usually consist of a large number of neurons, interconnected in complex ways and organized into layers. Examples are flexible nonlinear regression models, discriminant models, data reduction models, and nonlinear dynamic systems.

**observation**

a row in a SAS data set. All of the data values in an observation are associated with a single entity such as a customer or a state. Each observation contains either one data value or a missing-value indicator for each variable.

**package**

*See* SAS package.

**participant**

a user, group, or role that is assigned to a task. These users, groups, and roles are defined in SAS metadata and are mapped to standard roles for the workflow.

**performance table**

a table that contains response data that is collected over a period of time. Performance tables are used to monitor the performance of a champion model that is in production.

**PFD**

*See* process flow diagram.

**PMML**
*See* Predictive Modeling Markup Language.

**policy**
a workflow element that associates event-driven logic with a task or subflow. Policies are usually triggered automatically by an event such as a status change or a timer event.

**prediction model**
a model that predicts the outcome of an interval target.

**Predictive Modeling Markup Language (PMML)**
an XML based standard for representing data mining results for scoring purposes. It enables the sharing and deployment of data mining results between applications and across data management systems.

**process flow diagram (PFD)**
a graphical sequence of interconnected symbols that represent an ordered set of steps or tasks that, when combined, form a workflow designed to yield an analytical result.

**production models aging report**
reports the number and the aging distribution of champion models.

**profile data**
information that consists of the model name, type, length, label, format, level, and role.

**project**
a collection of models, SAS programs, data tables, scoring tests, performance data, and reporting documents.

**project tree**
a hierarchical structure made up of folders and nodes that are related to a single folder or node one level above it and to zero, one, or more folders or nodes one level below it.

**property**
any of the characteristics of a component that collectively determine the component's appearance and behavior. Examples of types of properties are attributes and methods.

**publication channel (SAS publication channel)**
an information repository that has been established using the SAS Publishing Framework and that can be used to publish information to users and applications. *See also* publish.

**publish**
to deliver electronic information to one or more destinations. These destinations can include message queues, publication channels, and so on.

**Publishing Framework**
a component of SAS Integration Technologies that enables both users and applications to publish SAS files (including data sets, catalogs, and database views), and other digital content to a variety of destinations. The Publishing Framework also provides tools that enable both users and applications to receive and process published information.

**receiver operating characteristic (ROC)**
the name given to a chart used in signal detection theory to plot the sensitivity, or true positive rate, against the false positive rate (1 − specificity, or 1 − true negative rate) of binary data values. An ROC chart is used to assess a model's predictive performance.

**ROC**
*See* receiver operating characteristic.

**SAS code model**
a SAS program or a DATA step fragment that computes output values from input values. An example of a SAS code model is the LOGISTIC procedure.

**SAS Content Server**
a server that stores digital content (such as documents, reports, and images) that is created and used by SAS client applications. To interact with the server, clients use WebDAV-based protocols for access, versioning, collaboration, security, and searching.

**SAS data set (data set)**
a file whose contents are in one of the native SAS file formats. There are two types of SAS data sets: SAS data files and SAS data views.

**SAS format (format)**
a type of SAS language element that is used to write or display data values according to the data type: numeric, character, date, time, or timestamp.

**SAS index (index)**
a component of a SAS data set that enables SAS to access observations in the SAS data set quickly and efficiently. The purpose of SAS indexes is to optimize WHERE-clause processing and to facilitate BY-group processing.

**SAS informat (informat)**
a type of SAS language element that is used to read data values according to the data's type: numeric, character, date, time, or timestamp.

**SAS Metadata Repository**
a container for metadata that is managed by the SAS Metadata Server. *See also* SAS Metadata Server.

**SAS Metadata Server**
a multi-user server that enables users to read metadata from or write metadata to one or more SAS Metadata Repositories.

**SAS Model Manager repository**
a location in the SAS Content Server where SAS Model Manager data is stored, organized, and maintained.

**SAS package (package)**
a container for data that has been generated or collected for delivery to consumers by the SAS Publishing Framework. Packages can contain SAS files, binary files, HTML files, URLs, text files, viewer files, and metadata.

**SAS publication channel**
*See* publication channel.

**SAS variable (variable)**
a column in a SAS data set or in a SAS data view. The data values for each variable describe a single characteristic for all observations (rows). *See also* macro variable.

**scoring**
*See* model scoring.

**scoring function**
a user-defined function that is created by the SAS Scoring Accelerator from a scoring model and that is deployed inside the database.

**scoring input table**
a table that contains the variables and data that are used as input in a scoring test.

**scoring output table**
a table that contains the output variables and data that result from performing a scoring test. Before executing a scoring test, the scoring output table defines the variables to keep as the scoring results.

**scoring test**
a workflow that executes a model's score code.

**segmentation model**
a model that identifies and forms segments, or clusters, of individual observations that are associated with an attribute of interest.

**source**
*See* data source.

**stability report**
a graphical report that detects and quantifies shifts in the distribution of output variables over time in data that is produced by a model.

**subscriber**
a recipient of information that is published to a SAS publication channel.

**swimlane**
a workflow diagram element that enables you to group tasks that are assigned to the same participant.

**symbolic variable**
*See* macro variable.

**target event value**
for binary models, the value of a target variable that a model attempts to predict. In SAS Model Manager, the target event value is a property of a model.

**target variable**
a variable whose values are known in one or more data sets that are available (in training data, for example) but whose values are unknown in one or more future data sets (in a score data set, for example). Data mining models use data from known variables to predict the values of target variables.

**task**
*See* workflow task.

**task status**
the outcome of a task in a workflow. The status of a task (for example, Started, Canceled, Approved) is typically used to trigger the next task.

**test table**
a SAS data set that is used as input to a model that tests the accuracy of a model's output.

**training data**
data that contains input values and target values that are used to train and build predictive models.

**universally unique identifier (UUID)**
a number that is used to uniquely identify information in distributed systems without significant central coordination. There are 32 hexadecimal characters in a UUID, and these are divided into five groups with hyphens between them as follows: 8-4-4-4-12. Altogether the 16-byte (128-bit) canonical UUID has 36 characters (32 alphanumeric characters and 4 hyphens). For example: 123e4567-e89b-12d3-a456-426655440000

**user-defined report**
a customized report. The customized report is a SAS program and its auxiliary files and is stored on the workspace server that is used by SAS Model manager. User-defined reports are accessible from the New Reports wizard.

**UUID**
*See* universally unique identifier.

**variable**
*See* SAS variable.

**variable attribute (attribute)**
any of the following characteristics that are associated with a particular variable: name, label, format, informat, data type, and length.

**WebDAV server**
an HTTP server that supports the collaborative authoring of documents that are located on the server. The server supports the locking of documents, so that multiple authors cannot make changes to a document at the same time. It also associates metadata with documents in order to facilitate searching. The SAS business intelligence applications use this type of server primarily as a report repository. Common WebDAV servers include the Apache HTTP Server (with its WebDAV modules enabled), Xythos Software's WebFile Server, and Microsoft Corporation's Internet Information Server (IIS).

**workflow**
a series of tasks, together with the participants and the logic that is required to execute the tasks. A workflow includes policies, status values, and data objects.

**workflow definition**
a workflow template that has been uploaded to the server and activated. Workflow definitions are used by the SAS Workflow Engine to create new workflow instances.

**workflow instance**
a workflow that is running in the SAS Workflow Engine. After a workflow template is uploaded to the server and activated, client applications can use the template to

create and run a new copy of the workflow definition. Each new copy is a workflow instance.

**workflow task (task)**
a workflow element that associates executable logic with an event such as a status change or timer event.

**workflow template**
a model of a workflow that has been saved to an XML file.

# Index