



SAS® Model Manager

Create, manage, deploy, monitor and operationalize analytical models

What does SAS® Model Manager do?

SAS Model Manager streamlines the tedious and often error-prone steps of creating, managing, deploying, monitoring and operationalizing analytical models.

Why is SAS® Model Manager important?

Analytical models are high-value assets that play an important role in making better decisions. SAS Model Manager provides a common framework to support full lifecycle management and governance of models. It streamlines analytical modeling processes to quickly put “best” models into production. The performance monitoring and retraining capabilities help users take quick actions if model performance is degrading, which could ultimately affect business outcomes.

For whom is SAS® Model Manager designed?

- Model validation and compliance analysts who need to perform review and validation of models to ensure they perform correctly and comply with stated specifications.
- IT professionals responsible for preparing data for model deployment and validating score code as it is deployed in operational environments.
- Analytic professionals concerned with the performance degradation of analytical models already in production.
- Business unit heads who want to apply analytical insights to make better decisions on a continuous basis.

For most organizations today, managing the life cycle of analytics is largely a manual process. Moving data and models from creation to production often entails tedious programming or operating system translations as the analytics are pushed across platforms. Mistakes can be made as code is cut, pasted or rewritten by different people. Rarely is there time to go back and add comments describing why a particular algorithm was used or why variables were chosen. Model deployment simply takes too long.

Model decay is another serious challenge. Retaining poorly performing models can result in inaccurate projections, which lead to poor business decisions. Failure to update a model frequently enough can result in loss of revenue and earnings as competitors observe and act on changing trends before you do. SAS Model Manager defends against risks associated with model degradation with capabilities that continually verify the accuracy and usefulness of models.

The lack of a common framework for managing an analytical model throughout its life cycle is also painfully evident as organizations struggle to meet deadlines from external agencies. Compliance reports are frantically prepared, and problems arise when conflicting assumptions surface. Not understanding why the champion model was chosen or how a particular score was calculated make it difficult to meet regulatory requirements, which can result in penalties, fines and loss of reputation.

SAS® Model Manager solves these problems by enabling all stakeholders to collaborate as they manage analytic

modeling workflow in an efficient and cost-effective manner.

Key Benefits

- **Expedites the management and deployment of “best” models into production.** SAS Model Manager provides an efficient and repeatable process for registering, validating, deploying, monitoring and retraining models. Accountability metrics and version control status reports track who changes what, when control is passed from one area to another, etc. Models can be monitored from their creation to deployment into real-time or batch scoring systems until they are retired.
- **Ensures analytical models are up-to-date and accurate.** With its iterative framework, SAS Model Manager ensures analytical models are tested and compared, performance benchmarking reports are generated and as models are deployed, performance metrics are pushed to established reporting channels. Modelers can easily collaborate and reuse models, and automated alerts can be set to detect when the scoring results are changing over time, indicating model decay.
- **Enables auditability and compliance to meet regulatory requirements.** Unique compliance and validation reporting capabilities in SAS Model Manager are highly sought-after by those facing heightened regulatory requirements. A centralized model repository, lifecycle templates and version control provide visibility into analytical processes and ensure that they can be audited to comply with internal governance and external regulations. In



addition, new Basel II risk model validation reports help organizations gain transparency by assessing the soundness of internal credit risk measurement systems, tracking down anomalies and answering regulator inquiries on demand.

- **Streamlines analytical modeling processes to generate consistent and timely results.** SAS Model Manager provides an easy-to-access Web-based client (the SAS Workflow Console) that provides an automated and collaborative model management process. Users can track the progress through each step of the modeling project(s), and can create multiple, customized workflows for different types of models. Different users touching or interpreting a model will get a unified view of its current stage with access to meaningful information that will help them take relevant actions.

Product Overview

SAS Model Manager streamlines the management and deployment of analytic models. It provides a repeatable

framework to register, validate, deploy, monitor and retrain analytic models to ensure usefulness as organizations operationalize analytics for more timely and accurate decisions. SAS Model Manager provides a common environment for stakeholders to collaborate and treat analytic models as high-value assets throughout their life cycles. It offers a patented, secure analytic model repository complemented by a rich metadata structure and project templates.

Extensive tracking, validation and auditing reports are produced as analytical models are used across different departments and deployed against operational applications and databases until the time of model refinement or retirement. Model retraining allows the execution of model refinements from the same deployment environment, streamlining the process for users. A Web-based client, the SAS Workflow Console, allows automation of the model management process, and enables more effective collaboration by letting users track the progress through each step of the modeling process.

Integration with SAS Scoring Accelerator for Aster, SAS Scoring Accelerator for DB2, SAS Scoring Accelerator for Greenplum SAS Scoring Accelerator for Netezza, SAS Scoring Accelerator for Oracle and SAS Scoring Accelerator for Teradata enable the registration and validation of in-database scoring functions within those databases.

Central, secure repository for managing analytical models

The SAS Model Manager repository stores extensive documentation about the model, scoring code and associated metadata by allowing collaborative sharing of models coupled with users' group authentication, version control and auditability. Analytical professionals analyze historical data and register the predictive models into the repository along with the required data structure for the deployment of these models.

Analytical workflow management

A Web interface, SAS Workflow Studio, provides the ability to define and track custom workflows for model lifecycle management. This can include all phases from problem-statement creation through development and deployment of models.

Scoring-logic validation before models are exported to production

Scoring officers using SAS Model Manager have a template to follow and a system to record each test that the scoring engine goes through to ensure the logic embedded within the champion model is sound. A map that details each accuracy checkpoint along with the expected scoring results is captured, recorded and logged in the system. This precise method of checking and double-checking the model-scoring logic reduces the risk exposure of making incorrect decisions after the model is pushed to production. Champion models can be exported



Performance monitoring dashboards allow users to track the performance across multiple projects quickly, and enable teams to focus on projects that need the most immediate attention. The software includes an easy-to-use GUI to define the indicators and ranges.

for on-demand and batch scoring only after they are completely validated.

The SAS Metadata Repository can deploy the scoring engine from SAS Data Integration Server or any other SAS component that produces analytical scoring engines. An automated publishing event is launched to notify assigned individuals (via various channels such as email or Web-generated alerts) when it is their turn to act.

SAS Model Manager also can be integrated with SAS Real-Time Decision Manager for scoring and managing analytical models for customer retention, acquisition or loyalty programs. The SAS Real-Time Decision Manager scoring activity allows the user to choose any of the scoring projects (published by SAS Model Manager). Whenever a decision flow that includes scoring activities is run, those activities execute the referenced score code in real time.

Monitoring and reporting on model performance during test and production life cycles

As the champion model reaches test, stage and production lifecycle milestones, model status and performance information is pushed to subject-matter experts in the organization who manage the test criteria being evaluated at each milestone. SAS Model Manager uses procedural templates to document the validation performance and sign-off process. An audit trail is created as the champion model is phased into production and the predecessor champion model is retired. Performance benchmarks are calculated to display the champion model's scoring performance and to document conformity to required industry reporting standards. Several out-of-the-box reports are provided as well as the flexible user-designed reports that monitor production model performance on an

Key Features

Central, secure repository for managing analytical models

- Project-based storage of models.
 - Set up and maintain separate versions of champion and challenger models within a project:
 - Champion model is automatically set as a default version. One only champion model is produced per project. Select challenger models to the project champion model.
 - Monitor and publish challenger and champion model packages.
 - Monitor performance of champion models for all projects within a portfolio of models and publish the models to the SAS Metadata Repository.
 - Create and manage multiple projects as a portfolio of models.
 - Map prerequisite data sources used for model reporting and score code testing.
 - Accounting and auditability, including event logging, and the ability to attach Microsoft Word documents, Excel spreadsheets, HTML files, etc.
 - Prebuilt templates for automatically registering data mining models: prediction (including SAS Rapid Predictive models), segmentation, classification and scorecards.
- User-defined templates.
- Optional batch model registration support for bulk loading.
- General properties such as model name, type of algorithm, creation date, modification date, etc.
- Model validation reports are provided for Basel II risk models, including probability of default (PD) and loss given default (LGD).
- Provide more control in setting input and output variables to define the project.
- Import multiple Base SAS, SAS/STAT®, SAS/ETS and SAS Enterprise Miner models, including training code, score logic, estimate tables, target and input variables, and output variables.
- Import from a SAS package file (.SPK):
 - SAS/STAT linear models: LOGISTIC, GENMOD, REG, GLMSELECT, GLIMMIX and MIXED.
 - SAS/ETS models: COUNTREG and SEVERITY.
 - SAS High-Performance Statistics models: HPBIN, HPLOGISTICS, HPREG and HPSPLIT.
 - SAS High-Performance Data Mining models: HPBIN, HPREDUCE, HPNEURAL and HP FOREST.
- Import and export PMML model code with inputs and outputs. Create DATA step score code for PMML models for inclusion in scoring tasks, reporting and performance monitoring.
- Register, compare, report, score and monitor models built in R.
- Repository metadata summary report with information such as number of models, number of scoring jobs, model-aging profiles, and frequency counts of how often each target and input variable has been used across the model portfolio.
- Model repository can be queried by attributes used to store models such as type of algorithm, input or target variables, model creator, model ID, etc.
- Secure, reliable model storage and access administration, including backup and restore capabilities, overwrite protection, event logging, and user authentication.

Analytical workflow management

- Create custom processes for each model using SAS Workflow Studio – a Web-based client:
 - SAS Workflow Studio is used to design the model approval process that is imported and managed through the SAS Model Manager Workflow Console.
 - Provide collaboration across teams with automated notifications.
 - Define, manage and track complete analytic life cycles.
 - Enable enterprise access and collaboration with the Web interface.
 - Increase efficiency with process management capabilities.
 - Associate milestones with activities as part of the workflow process definition.
 - Create and view reports within a workflow activity.
 - View the process flow diagram for an active workflow process.
- Perform common model management tasks using the SAS Model Manager Workflow Console:
 - Import, view and attach supporting documentation and publish models.
 - Set a project champion model and flag challenger models.
 - Publish models for scoring purposes.
 - View dashboard reports.

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ongoing basis. SAS Model Manager provides an easy-to-use interface to generate the data needed to create a series of performance-monitoring dashboards. It also can create an HTML dashboard report that can be deployed throughout the organization. Model-monitoring dashboards and reports allow for a time-series statistical overview of all modeling projects. Metrics include many standard compliance and governance-type statistics. The production champion model remains deployed until business conditions dictate its retirement, or until a new model is created and the predictive model life cycle begins a new iteration.

Overall lifecycle management of analytical models

Prebuilt model lifecycle templates are provided for collaborative project management. In addition, the Lifecycle Template editor enables you to create custom templates to meet your business process needs. Testing, scoring and sharing of model lifecycle and performance data over established publishing channels are also supported. Accountability metrics and the validation of analytical steps through model creation, deployment and the retirement stage are available.

SAS® Model Manager System Requirements

To learn more about SAS Model Manager system requirements, download white papers, view screenshots and see other related material, please visit sas.com/modelmanager.

Key Features (continued)

Scoring-logic validation before models are exported to production

- Define test and production score jobs using required inputs and outputs:
 - Map required inputs and outputs, add SAS code, view log and results tables.
- Schedule scoring tasks to run at certain times and dates on available servers.
- Specify where to save the scoring task output and view job history.
- Export models to SAS Metadata Repository.
- Production scoring:
 - Model Scoring Task is available in SAS Data Integration Studio and SAS® Enterprise Guide®.
 - Publish models directly to SAS Real-Time Decision Manager.
- Publish model updates to different scoring channels:
 - Notify subscribers via email or store results to a file system or post to a corporate intranet.
- In-database model deployment:
 - Using integration with SAS Scoring Accelerator, publish and validate scoring functions for native scoring within databases.
 - Publish model scoring files using a vendor-defined function in Teradata, DB2 and Pivotal (previously Greenplum).
 - Publish model scoring files using the SAS Embedded Process in Teradata, Aster Data, IBM Netezza, DB2 and Oracle.

Monitoring and reporting on model performance during test and production life cycles

- Model performance reports:
 - Variable distribution plots, characteristic charts, stability charts, lift charts, Receiver Operating Curve (ROC) charts, Kolmogorov-Smirnov (K-S) charts and Gini charts.
 - For prediction model function that has an interval target.
 - For champion and challenger model comparisons.
 - Full complement of BASEL backtesting reports.
- Model comparison reports:
 - Model profile report, delta report, dynamic lift report, interval target variable report, etc.
 - HTML, RTF, PDF and Microsoft Excel output formats.
 - Aggregated report to combine multiple reports from the Reports folds into a single report.
- Training summary data set report showing frequency and distribution charts.
- Easy-to-use wizard for creating performance-monitoring dashboards:
 - Update all reports or update reports for projects that have new performance data.
- Model retraining allows users to create new challenger models based on SAS Enterprise Miner models currently registered in a project, and new data and variables.
- Perform scoring and performance monitoring on an appliance – Teradata or Pivotal (previously Greenplum) – that has been configured for use with SAS high-performance analytics products.
- Support multiple SAS application servers when scoring or retraining a model, and monitoring performance of champion and challenger models.
- Schedule scoring and performance monitoring jobs to automate predictive modeling tasks.
- Specify multiple data sources and time collection periods when defining monitoring tasks.

Overall lifecycle management of analytical models

- Model lifecycle templates for collaborative project management:
 - Basic, standard, extended and user-defined.
 - Model Lifecycle Template editor for user-defined templates.
 - Task-oriented milestone completion and approval signoff.
- Create folders, projects, and versions using macros.