

# **SAS<sup>®</sup> Workshop: Forecasting**

Course Notes

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**SAS® Workshop: Forecasting Course Notes**

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SGF14FOR\_001

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# Chapter 1   Forecasting

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# 1.1 Introduction

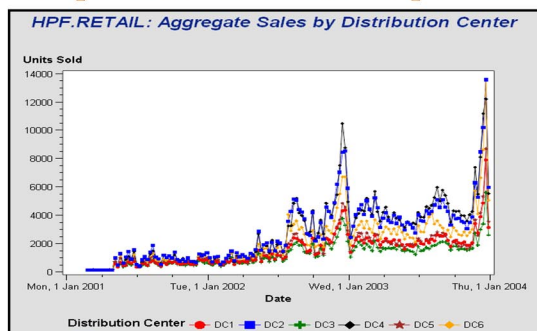
## Introduction to the Large-Scale Forecasting Problem and to SAS Forecast Server

- Define the large-scale forecasting problem.
- Discuss central ideas and key components of the large-scale forecasting process.



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## Motivation: The Large-Scale Forecasting Problem



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## Forecasting a Single Time Series

A skilled analyst can forecast a single time series by

- applying good judgment based on knowledge and experience
- using various proven time-series analysis techniques
- utilizing good software based on sound statistical theory.



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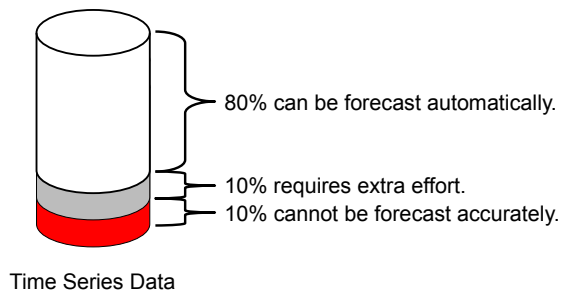
## Large-Scale Forecasting

- Modern businesses require efficient, reliable forecasts for many series. These forecasts usually need to be updated on a regular basis.
- There are not sufficient resources to apply the single series forecasting approach to all series that need to be forecast.
- The series might be hierarchically arranged and require reconciliation of forecasts at different levels.



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## Large-Scale Forecasting Scenario



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## Large-Scale Forecasting Requirements

- Automation
- Speed
- Power



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## SAS High-Performance Forecasting Software

- Automation
  - » Best model from customizable list
  - » Automatic Box-Jenkins model specification
  - » Automatic diagnosis of model features such as trend and seasonality
  - » Rich set of model selection criteria
  - » Ability to use hold-out data for honest assessment
- Speed
  - » Fast algorithms
  - » Efficient implementation



## SAS High-Performance Forecasting Software

- Power
  - » Aggregates time-stamped data
  - » Supports a rich set of models:
    - » Exponential smoothing models (ESM)
    - » Intermittent demand models (IDM)
    - » Box-Jenkins autoregressive integrated moving average (ARIMA) models
    - » Unobserved components models (UCM)
    - » Variants of univariate models that support causal inputs and calendar effects
  - » Produces forecasts
  - » Evaluates forecasts
  - » Aggregates/disaggregates forecasts

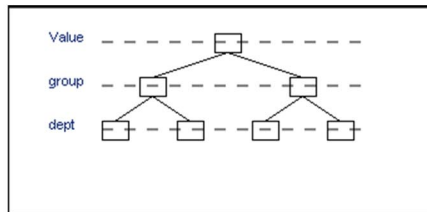


## The Large Scale Forecasting Process: Essential Ideas

- Data Hierarchies
- Automatic Forecasting
- Forecast Accuracy
- Hierarchical Reconciliation



## Data Hierarchies

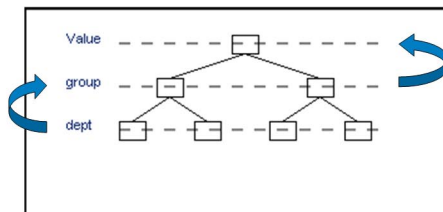


SKU or item-level sales can be grouped based on geographic regions or distribution levels.



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## Data Hierarchies: Aggregation



Data in the middle and upper levels of the hierarchy is constructed from data in the base level of the hierarchy. Above, group-level data is created by adding together department-level series. The top level (for example, total sales) is created by adding up all base-level series.



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## Data Hierarchies ⇒ Automatic Forecasting

- Every series in the hierarchy is forecast separately using a statistical model.
- In SAS Forecast Studio, statistical models reside in a *model selection list*. A model selection list usually contains several statistical models.



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## Automatic Forecasting: One Series at a Time

- Each series is forecast separately.
- All models from the model selection list are fit to each individual series.

Question:

How does the software know which fitted model to use when generating forecasts for a series?

Answer:

It uses the model that best fits the series.



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## Automatic Forecasting: Choosing the Best Model

- MAPE, or mean absolute percent error, is the default fit statistic in SAS Forecast Studio. It measures the average percentage difference between the actual and predicted (forecast) values over the range of the data.
- RMSE, or root mean square error, is another popular fit statistic. It can be thought of as a measure of the average difference between the actual values and the forecast values over the range of the data.



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## Automatic Forecasting: Choosing the Best Model

- Because MAPE and RMSE measure the difference between actual and predicted values (model error), smaller values are better.
- For any series, the best model is the one with the lowest MAPE (or RMSE).
- The automatic forecasting process described selects the best model for each series in the hierarchy. The selected models are then used to generate forecasts for each series in the hierarchy.



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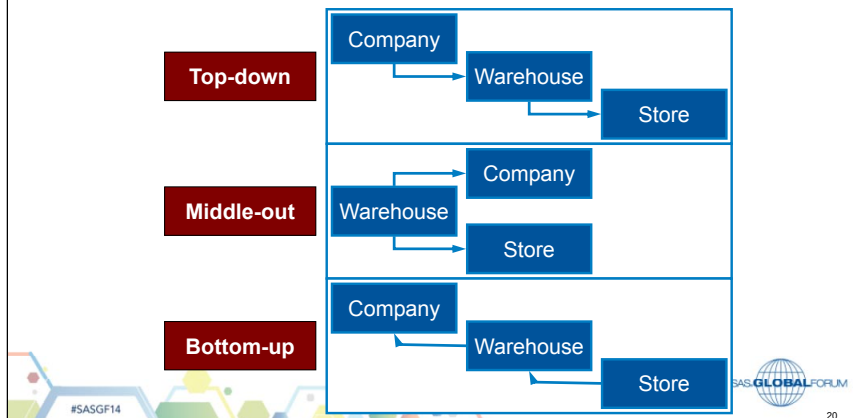
## Automatic Forecasting $\Rightarrow$ Reconciliation

- Because the automatic forecasting process generally uses different models to forecast the individual series up and down the hierarchy, the statistical forecasts usually will not add up or reconcile.
- Reconciliation* is the process of making the statistical forecasts add up for each time interval in the data.



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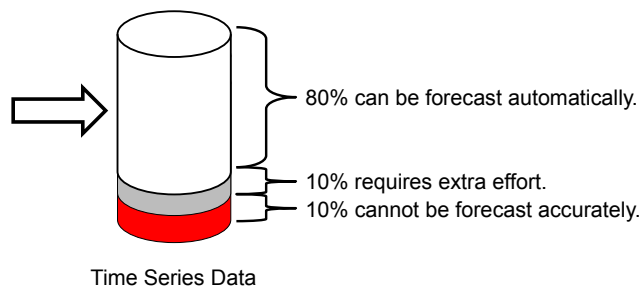
## Forecasting Reconciliation Approaches



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# 1.2 Generating Forecasts Automatically

## Large-Scale Forecasting Scenario



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## The Data

- The data is weekly case sales of wine from a wine distribution company from January 17, 2004, to May 26, 2007.
- The data hierarchy has three levels: Type (base level), Region, and Total Sales.
- There are four aggregate wine types: tblred (Table Red), tblwt (Table White), Value, and Vintage (limited production).
- There are four Regions: Reg1 – Reg4.



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## The Business Problem: Maximize Profit

- It is assumed that profit is maximized when the following conditions are met: wine sales are maximized and inventory costs are minimized.
  - » Wine sales are maximized when there are no lost sales due to wine being out of stock.
  - » Inventory costs are minimized when inventories are kept as small as possible while still satisfying demand.
- Accurate forecasts of wine demand over wine types and distribution regions are essential components in a profit-oriented business strategy.



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## Generating Forecasts

1. Select **Start** ⇒ **SAS** ⇒ **Forecast Studio 13.1**.

SAS Forecast Studio

**SAS**

**SAS® Forecast Studio 13.1**

THE POWER TO KNOW.

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SAS environment: Default SAS Environment

Default SAS Environment

☐ Use Integrated Windows authentication (single sign-on)

User ID: sasdemo

Password: \*\*\*\*\*

☒ Remember password

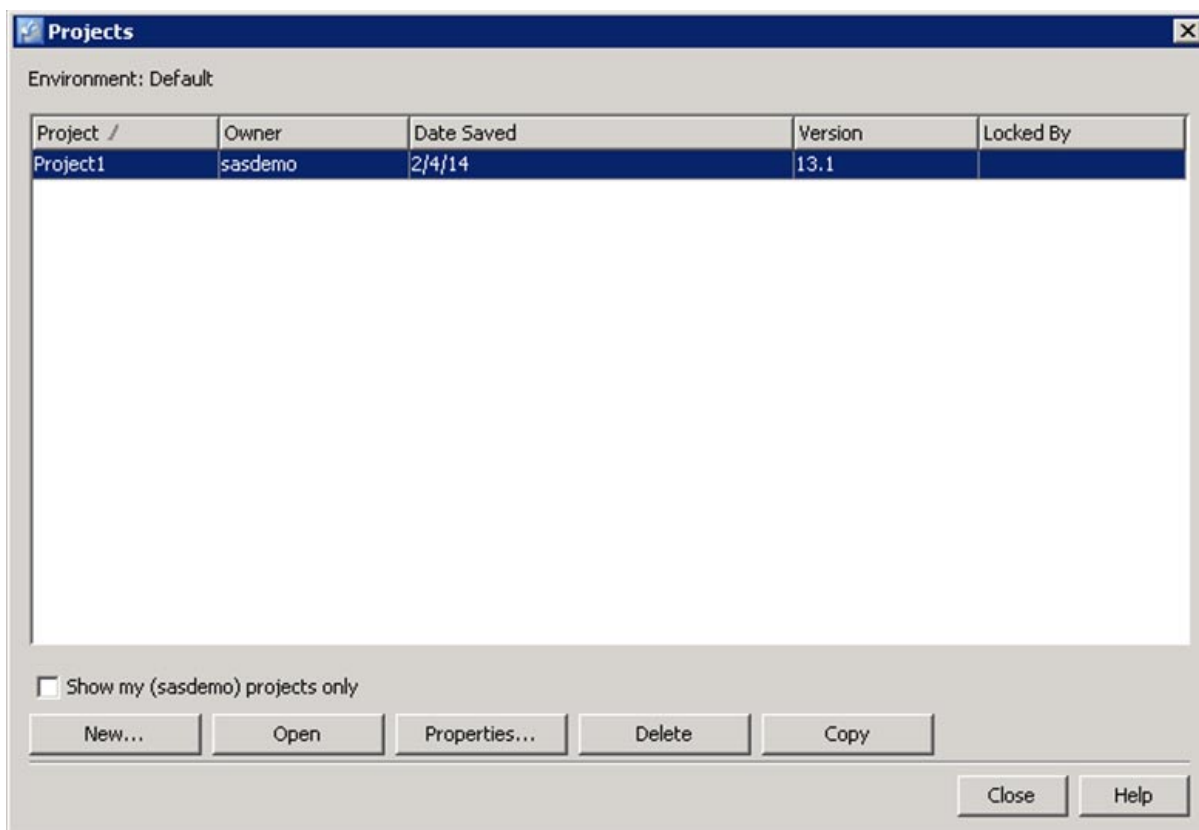
Log On Cancel

2. Select **Log On**.



Your user name, password, and server name is already provided. You only need to log on.

3. Select the **New...** button to create a new project.



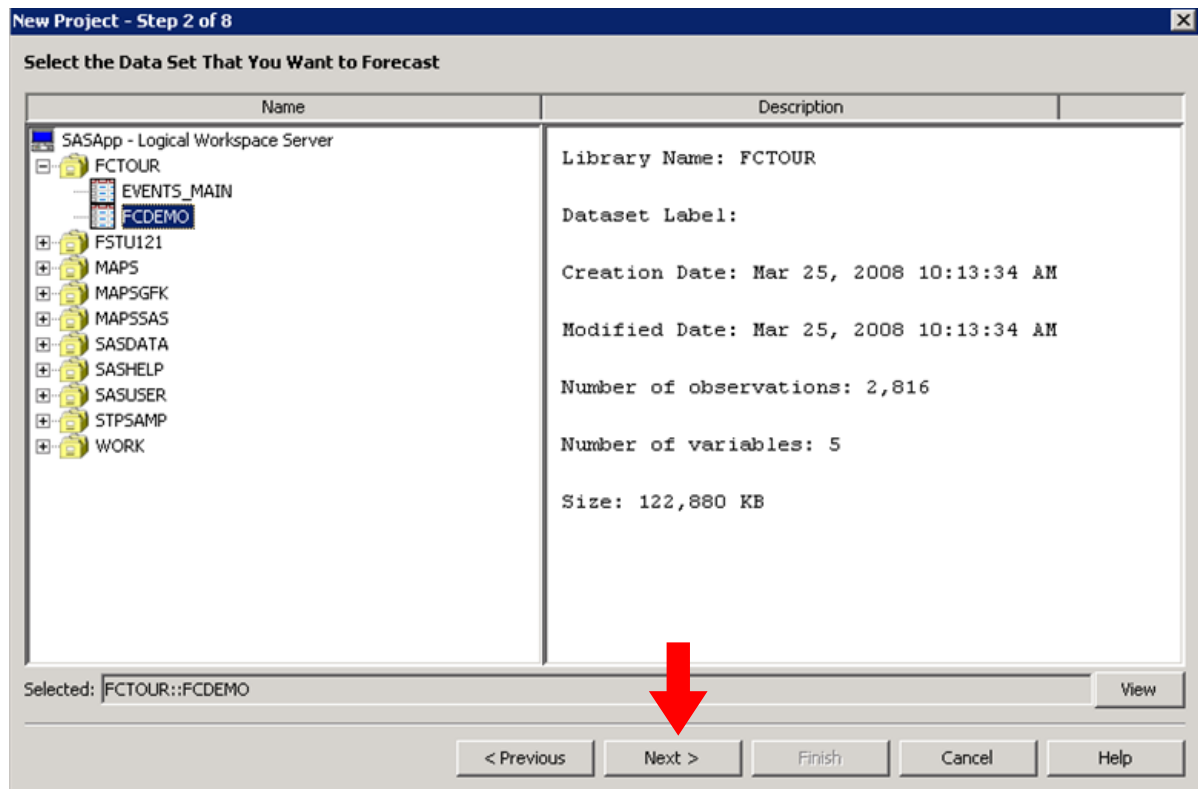
4. In step 1, provide a name and a description for your project. Select **Next >**.

The 'New Project - Step 1 of 8' dialog box is titled 'Name Your Project'. It includes an 'Environment' dropdown set to 'Default', a 'Name' text box containing 'FCTOUR', and a 'Description' text area containing 'Generate forecasts for wine type demand over Region 1-4. Type includes Red, White, Vinage and Value ..'. A note '(200 character limit)' is below the description. A checkbox 'Allow other users to view and edit this project' is checked. A 'Start-up and Shutdown Code...' button is at the bottom left. Navigation buttons at the bottom right include '< Previous', 'Next >', 'Finish', 'Cancel', and 'Help'.



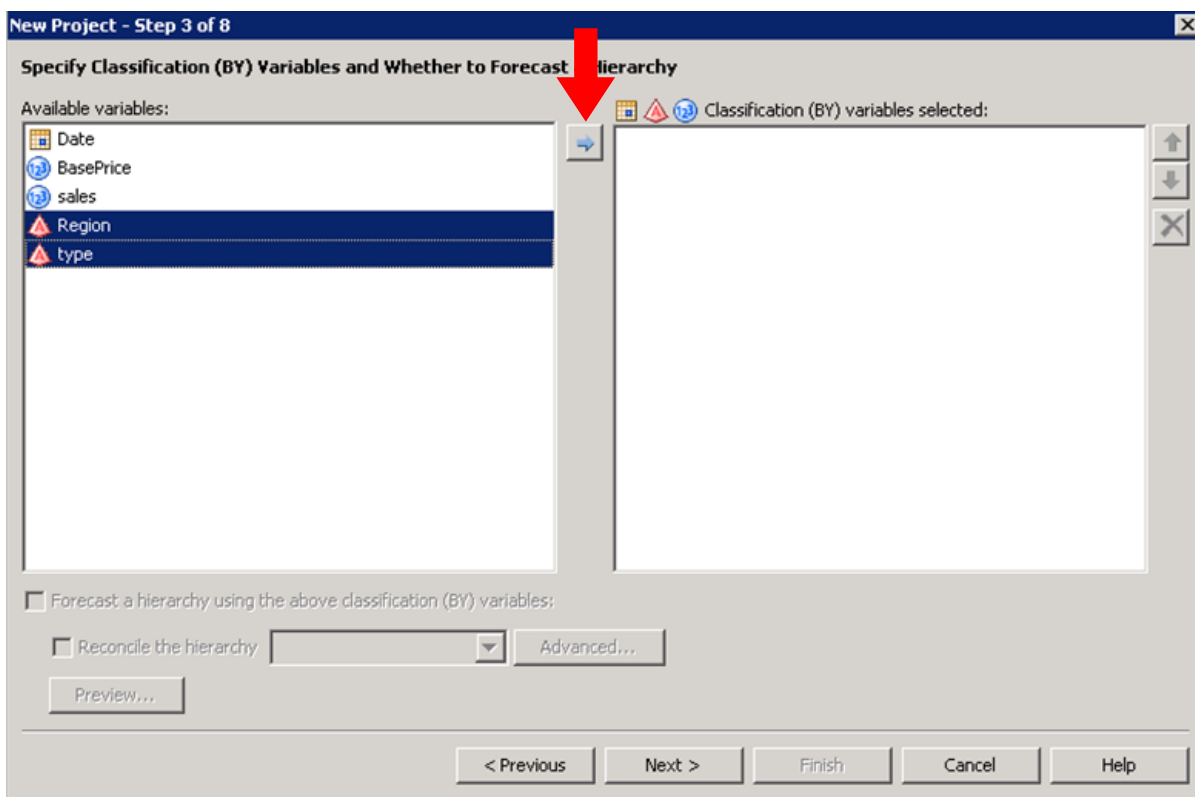
Naming the project something meaningful and providing a reasonably detailed description is considered a best practice.

5. In step 2, expand the **FCTOUR** library and select the **FCDEMO** data set.

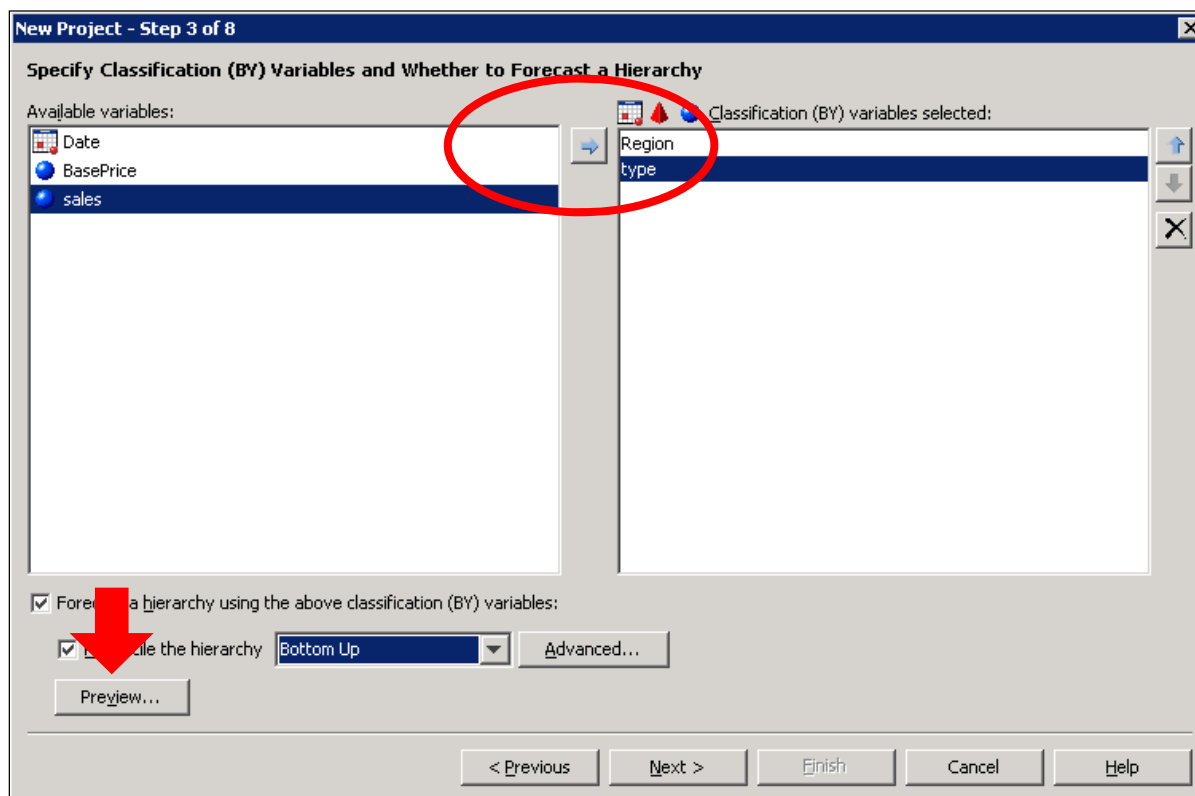


6. Select **Next >** to move to step 3, BY variable specification.

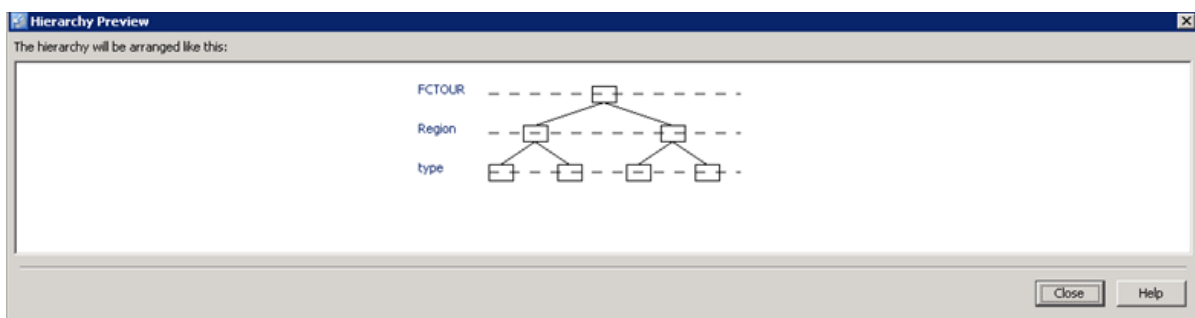




7. Select **Region** and then **type**. Use the arrow as indicated below. **Bottom Up** reconciliation is used to reconcile the generated statistical forecasts.



The Hierarchy Preview window confirms the appropriate data hierarchy structure.



**Region** and **type** are BY variables in the **FCDEMO** data set. BY variables subset the data set by wine type and region. These variables define the data hierarchy.

8. Select **Next >** to move to step 4. The Time ID variable is assigned in step 4.

The 'New Project - Step 4 of 8' window is titled 'Specify The Properties of the Time Dimension of Your Data'. It contains the following fields and controls:

- Time ID variable:** A dropdown menu with 'Date' selected.
- Interval:** A dropdown menu with 'Date' selected.
- Multiplier:** A dropdown menu with 'BasePrice' selected.
- Shift:** A dropdown menu with '1' selected.
- Seasonal cycle length:** A dropdown menu with '1' selected.
- Format:** A text field containing '9,'.

Buttons include 'Weekend...', 'Edit...', '< Previous', 'Next >', 'Finish', 'Cancel', and 'Help'.

The detected time interval is a one-week interval that begins on Saturday.

**New Project - Step 4 of 8**

**Specify the Properties of the Time Dimension of Your Data**

Time ID variable:

Interval:

Multiplier:

Shift:

Seasonal cycle length:

Format: WEEKDATE17. (e.g. Tue, Feb 4, 2014)

< Previous   Next >   Finish   Cancel   Help

9. Select **Next >** to move to step 5. Step 5 assigns dependent and independent variables for the project.

**New Project - Step 5 of 8**

**Assign Roles to Variables in Your Data**

**i** You must specify a dependent variable.

Variable	Role	Aggregation	Accumulation	Usage in System-Generat...
BasePrice	Independent	Average of values	Average of values	Try to use
sales	Dependent	Sum of values	Sum of values	

☒ Set accumulation to the value used for aggregation

< Previous   Next >   Finish   Cancel   Help

**Sales** is the dependent, or forecast, variable for the project.

**BasePrice** is an independent variable. Assigned independent variables are used as candidate variables in the automatic forecasting process.

10. Select **Next >** to move to step 6. Step 6 lists the data preparation options for the project.

**New Project - Step 6 of 8**

**Specify How to Prepare the Data for Each Forecast**

Select how to interpret embedded missing values:

Select which leading/trailing missing values to remove:

Select which leading/trailing zero values to interpret as missing:

☐ Ignore data points earlier than the following date:

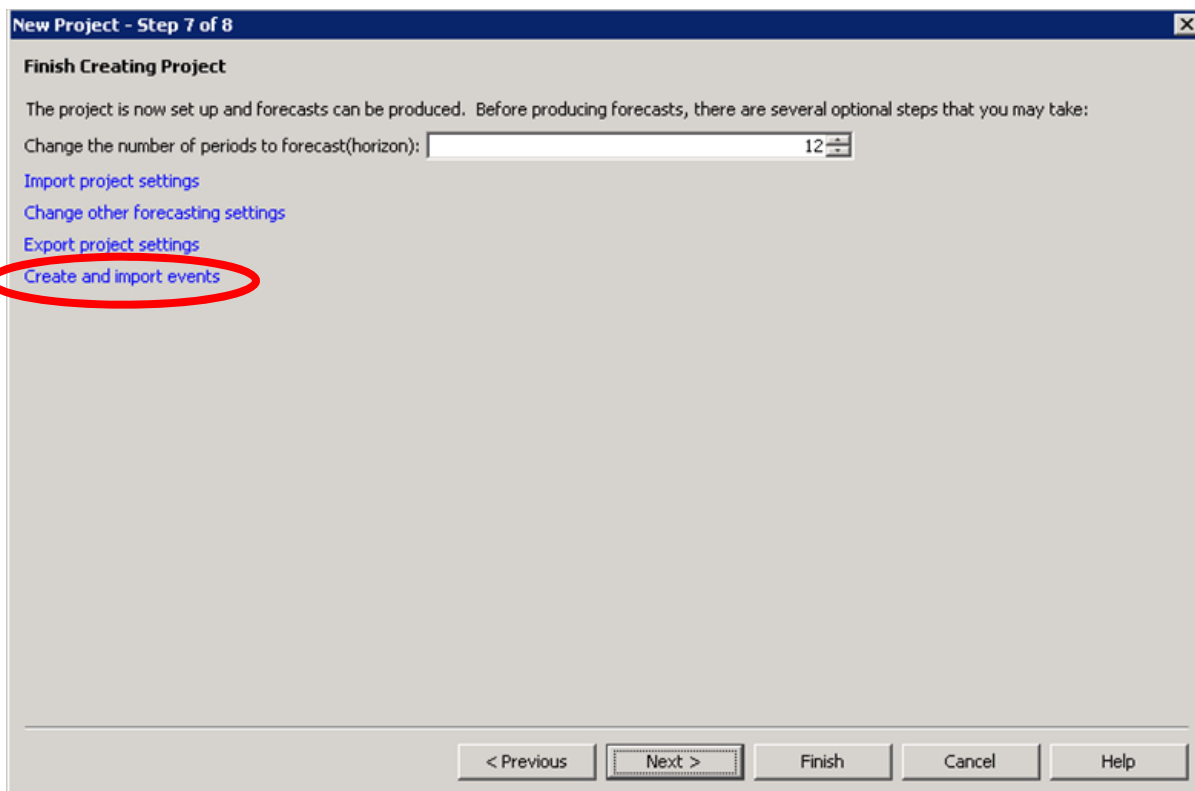
< Previous   **Next >**   Finish   Cancel   Help

Use the default values for these options.

11. Select **Next >** to move to step 7.

Step 7 informs the user that SAS Forecast Studio has enough information to run the project under default settings for model generation, model selection, and forecast generation.

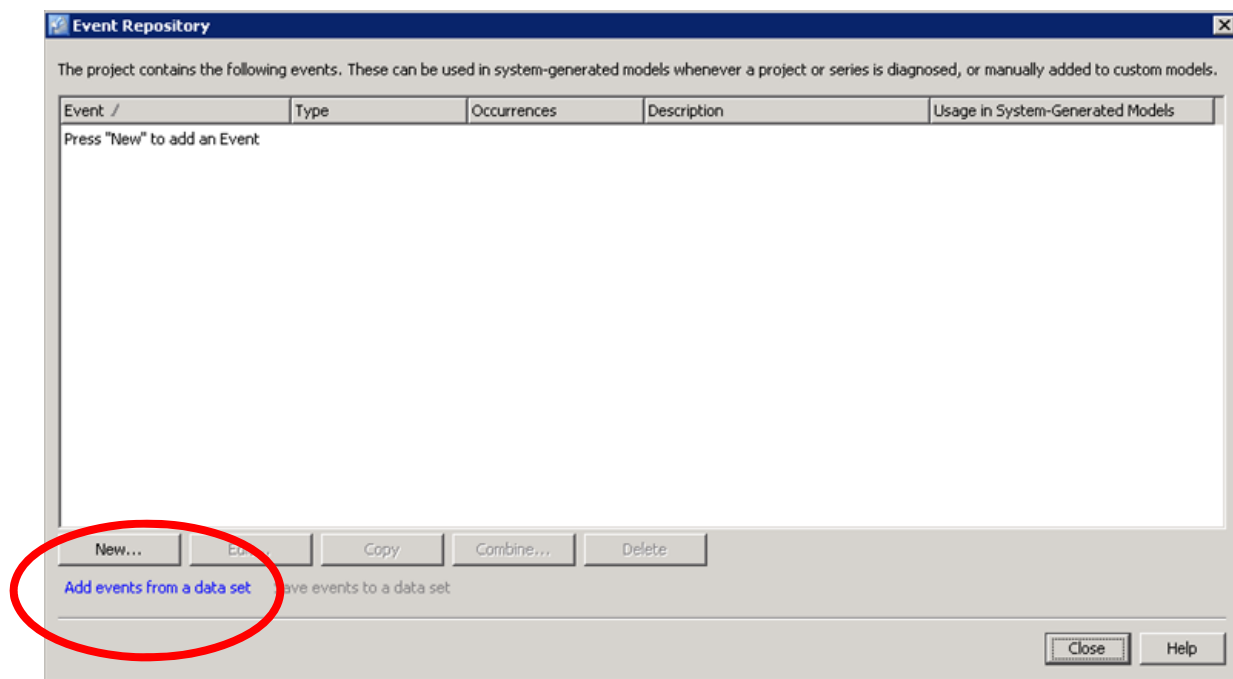
12. Select **Create and import events** to begin the process of bringing these variables into the project.



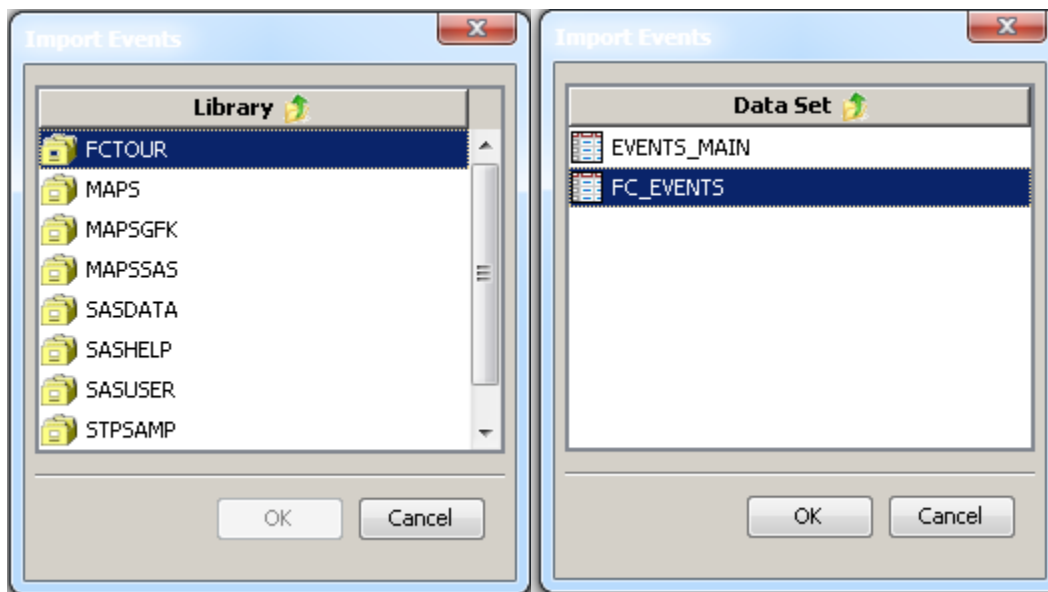
It is hypothesized that recurring calendar events impact wine demand over some regions and wine types. Event variables that characterize these effects were created and stored in a SAS data set.

New event variables can be created in the Event Repository.

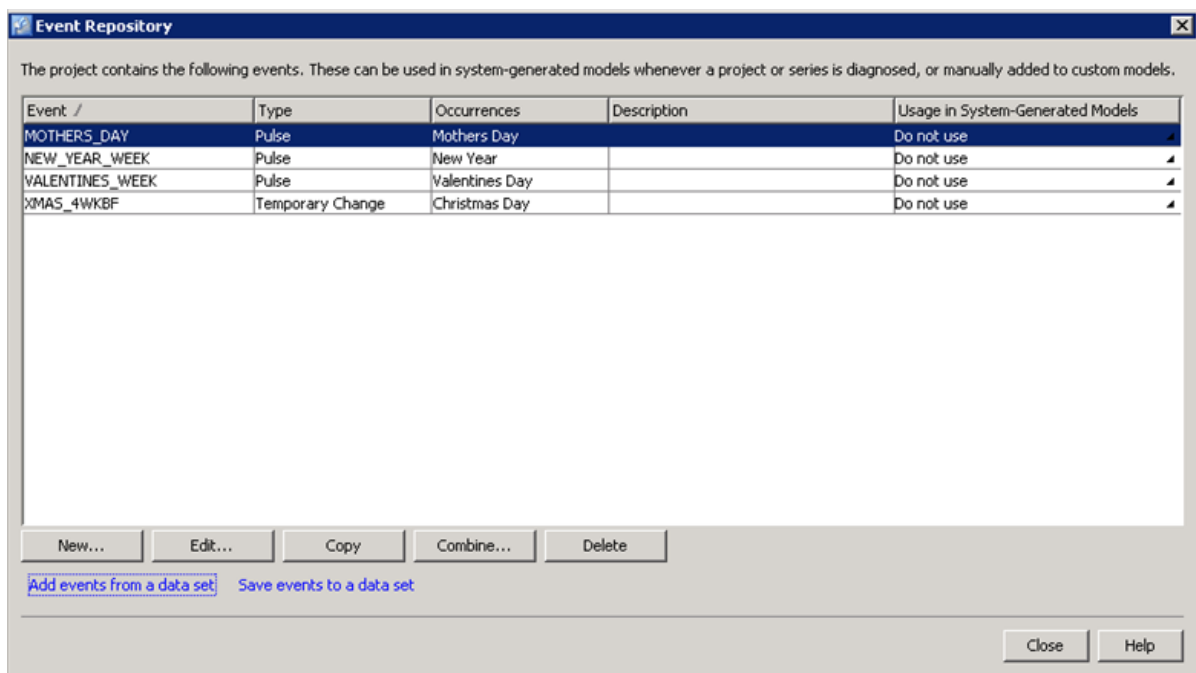
13. To access existing event variables, select **Add events from a data set**. The SAS data set that contains the event variables is in the FCTOUR library.



14. Double-click the **FCTOUR** library to access the **FC\_EVENTS** data set.

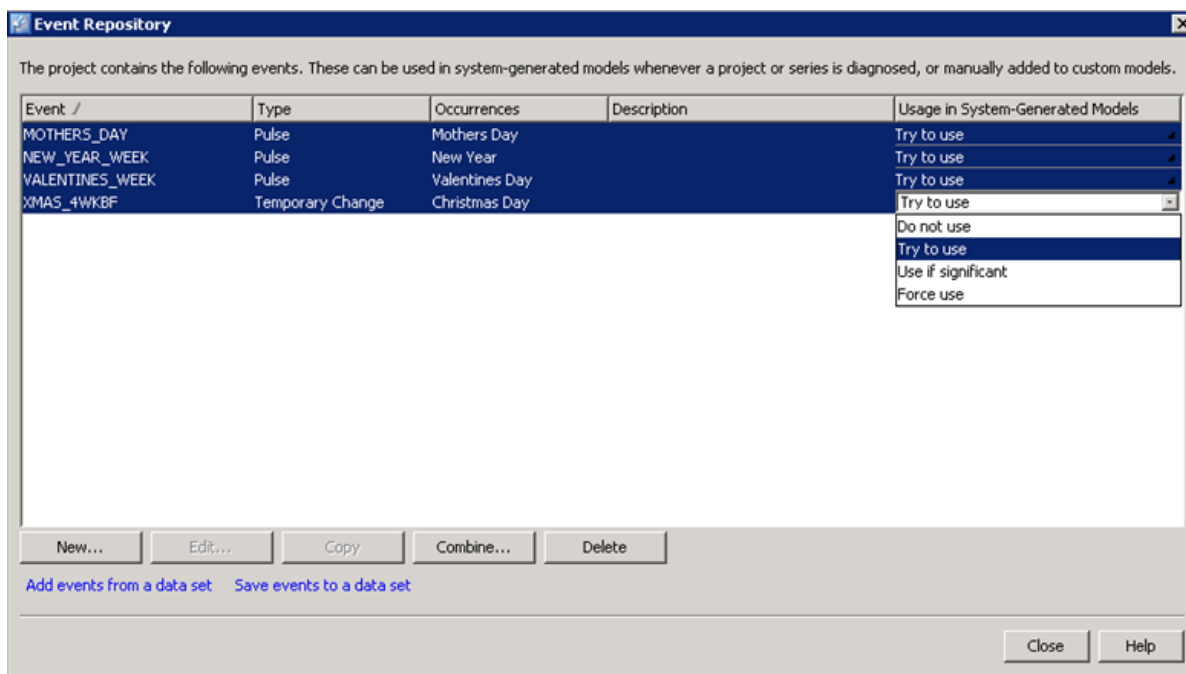


15. Select **OK** to populate the project's Event Repository with the event variables contained in the **FC\_EVENTS** data set.



Notice that the Usage in System-Generated Models status is **Do not use**.

16. The idea is to have the event variables, shown above, considered as candidates in the model-building process. To accomplish this, change their usage status to **Try to use**.



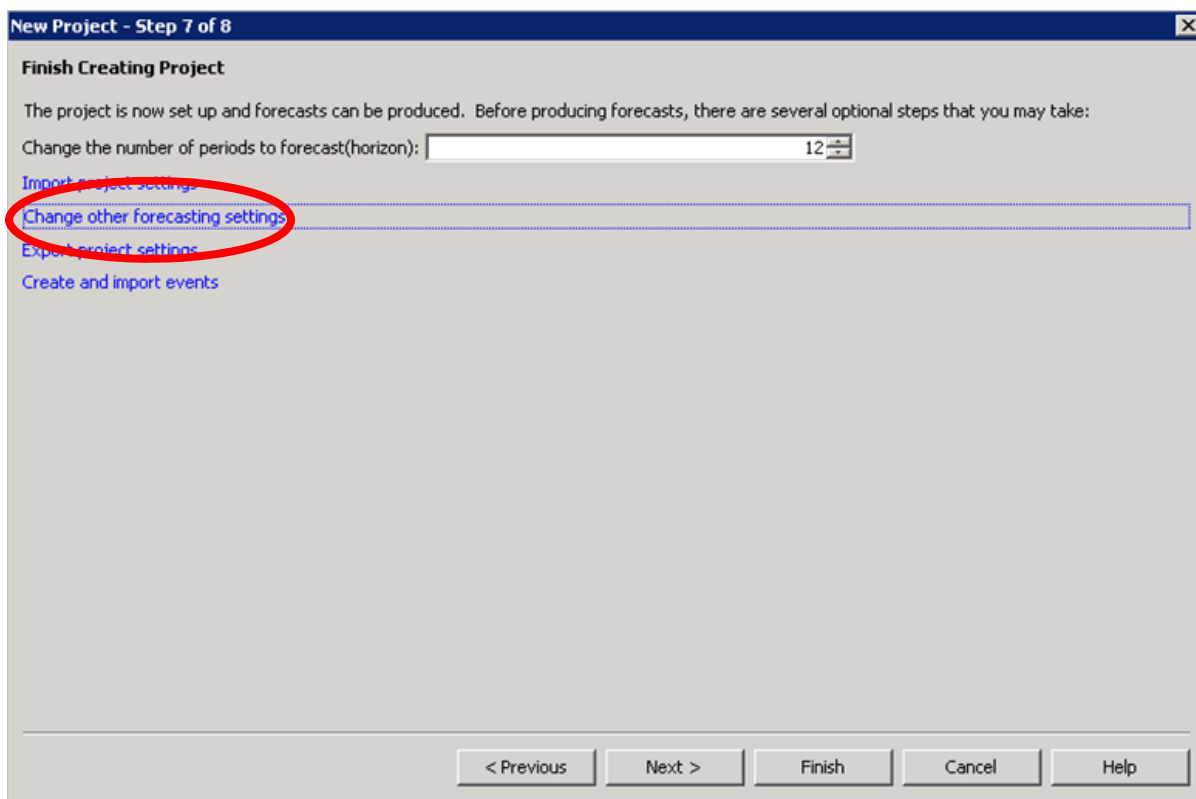
17. Select **Close** to return to step 7.



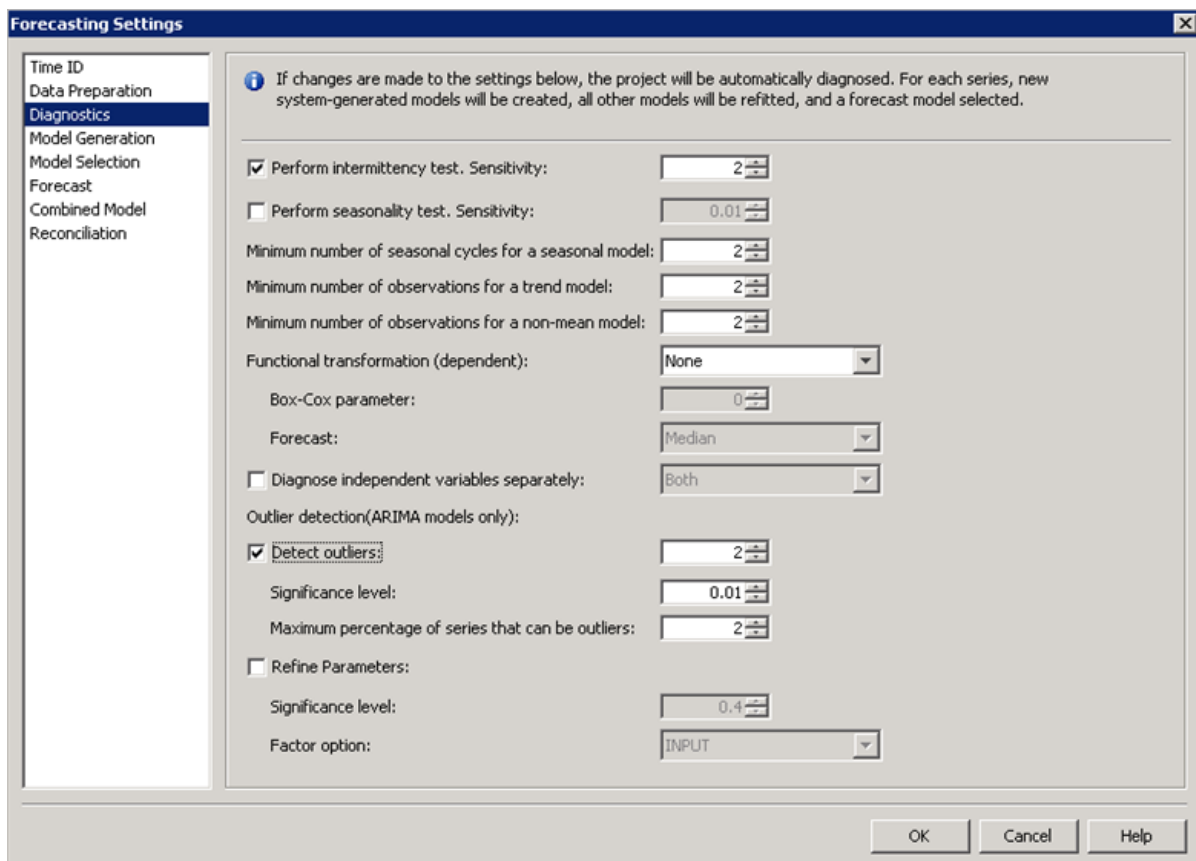
There is a hypothesized effect on wine demand associated with individual weeks containing Mother's Day, January 1, and Valentine's Day for some wine types and regions. This effect is indicated by the Pulse event variable type. The **xmas\_4wkbf** event variable is a Temporary Change type. This event variable captures variation in wine demand that starts four weeks before Christmas week. The effect then decays and goes to zero in the week that contains December 25.

It is also hypothesized that there are irregular event effects in wine demand data. *Outlier detection* can be helpful in identifying time intervals in which this type of variation occurs and for building ad hoc event variables to model it.

18. In the automatic forecasting process, outlier detection is useful for finding unknown events or outliers. Outliers usually have non-regular or non-recurring effects. To activate outlier detection, select **Change other forecasting settings**.



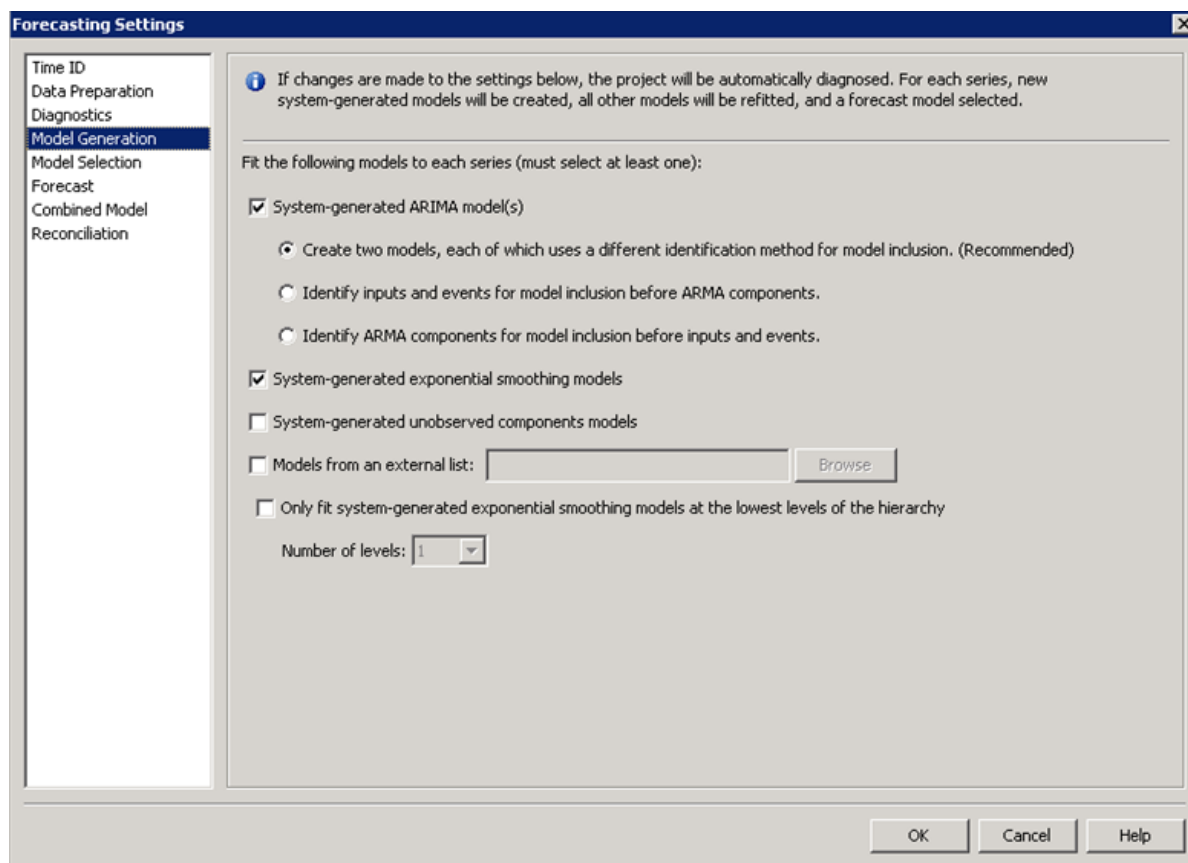
19. Select **Diagnostics**. Select the check box next to **Detect outliers** to activate outlier detection.



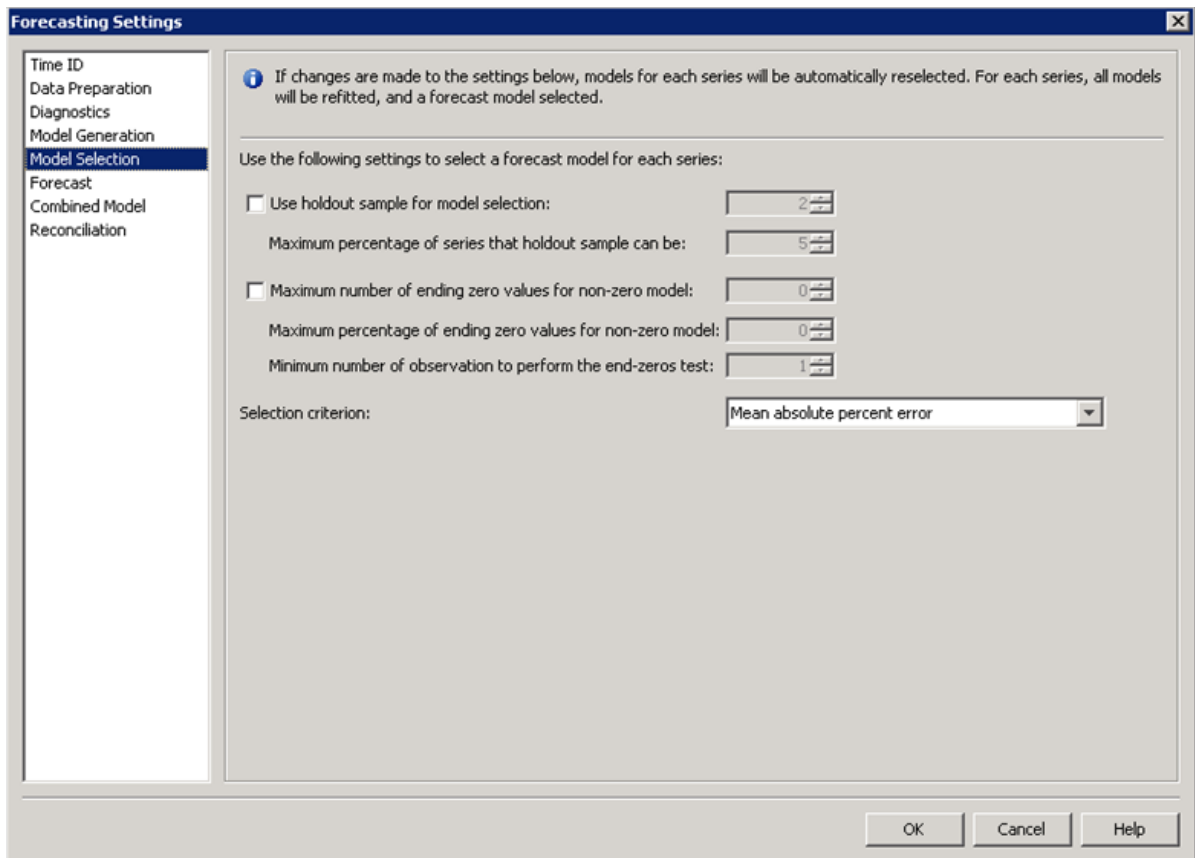


You will briefly look at other subsets of forecasting options before you proceed with the automatic forecasting process.

Selecting **Model Generation** shows the default model generation options. A system-generated ARIMAX and ESM model will be built for each series in the data by default.



Selecting **Model Selection** shows that MAPE is the default model selection criterion for the project.



20. Select **OK** to return to step 7.
21. Select **Next >** to move to step 8.

**New Project - Step 8 of 8**

**Optional Project Actions**

Select action to perform on pressing "Finish":

☒ Produce forecasts and display in SAS Forecast Studio. For each series the following steps will be performed:

- Diagnose: The series will be analyzed for features such as trends, seasonality, and cyclicity, and system-generated models appropriate to the series will be created. If you have specified independent variables or events, these will be taken into account for system-generated ARIMA and UCM models. They will be used in models if they improve performance.
- Select: The system-generated models, along with any other models you have included, will be evaluated against the data and the best-performing model selected as the forecast model.
- Fit: A final set of parameters of the forecast model will be estimated.
- Forecast: The forecast model will be used to produce a forecast.

After forecasts have been produced for each series, the hierarchy will be reconciled.

☐ Save SAS code to produce forecasts later

< Previous    Next >    **Finish**    Cancel    Help

The default project action is to run the project and display the results in SAS Forecast Studio.

## 22. Select **Finish**.



The Forecast Summary window shows the distribution of fit statistics, generated model types, and families, up and down the data hierarchy.

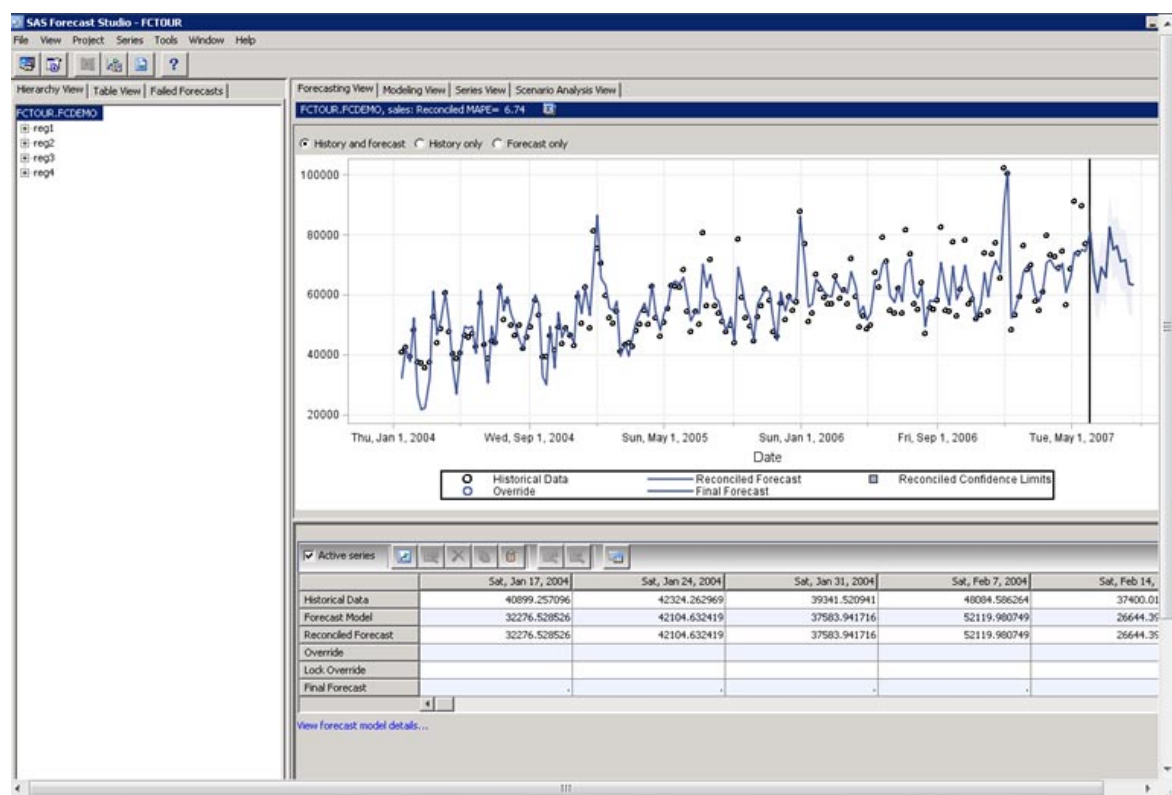
## Four Views in SAS Forecast Server

- The *Forecast* view contains the forecast graph and a table of statistical and reconciled forecasts for each series.
- The *Model* view is useful for exploring the forecast models in the project and for model refinement.
- The *Series* view provides diagnostics to help a skilled analyst identify model components that can improve accuracy over that produced by SAS Forecast Server's automatic modeling capabilities.
- The *Scenario Analysis* view enables users to assess changes in future values of input variables.



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In the Forecasting view, details about the total sales forecast are shown in the plot and table.

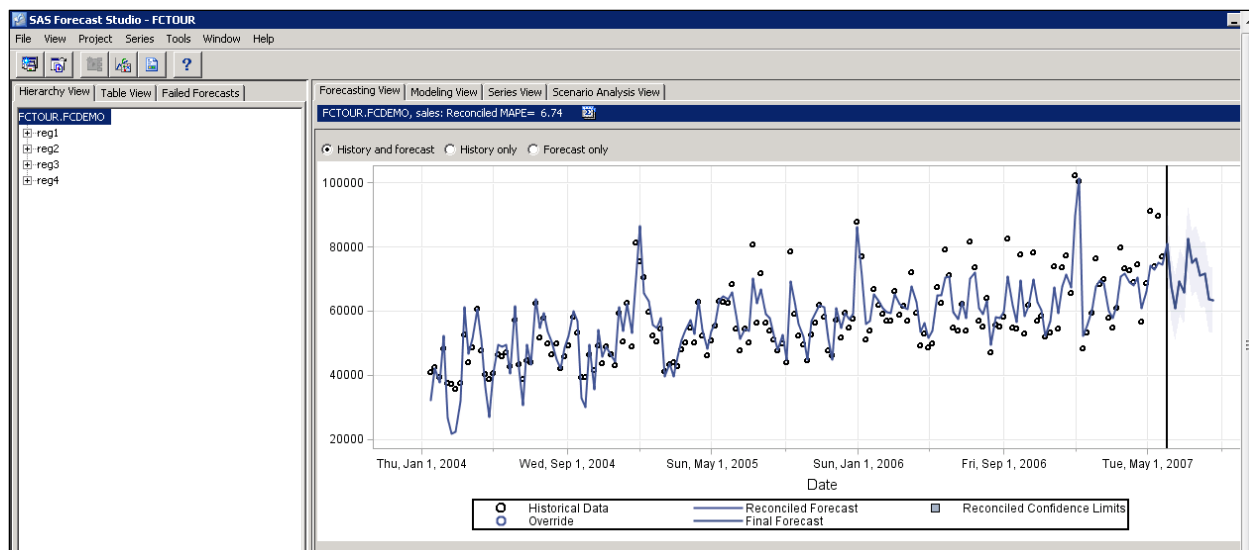


Notice that the aggregated series at the top level of the hierarchy is given the project name. This series represents total wine sales in each time interval across all regions and wine types.

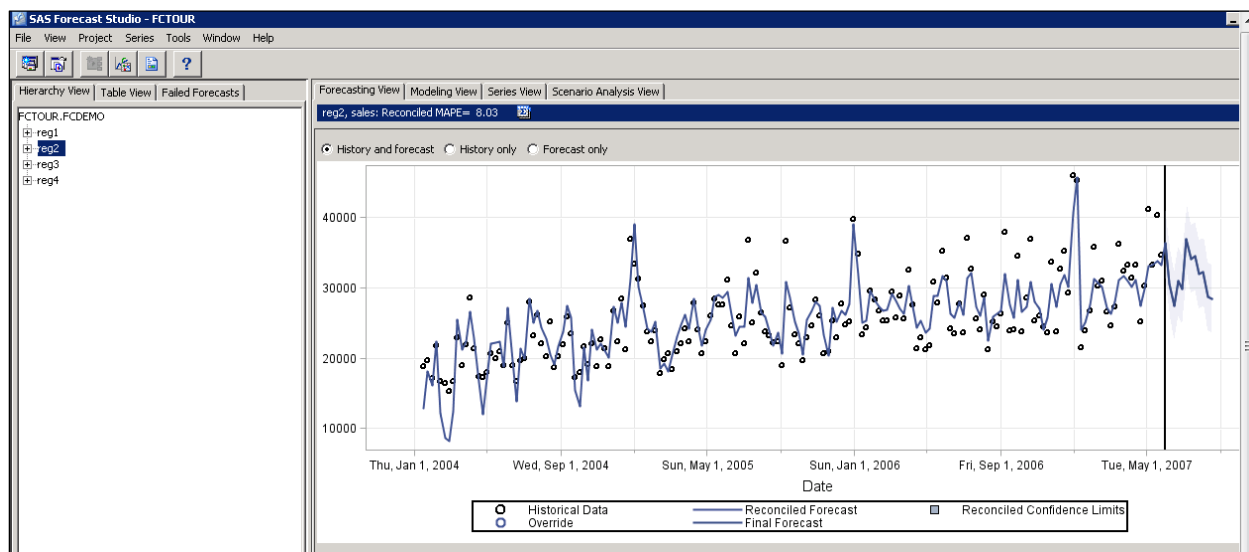


The data in the plot and table corresponds to the highlighted or active series in the view table to the left.

The forecast plot for total sales indicates overall trends in the data.

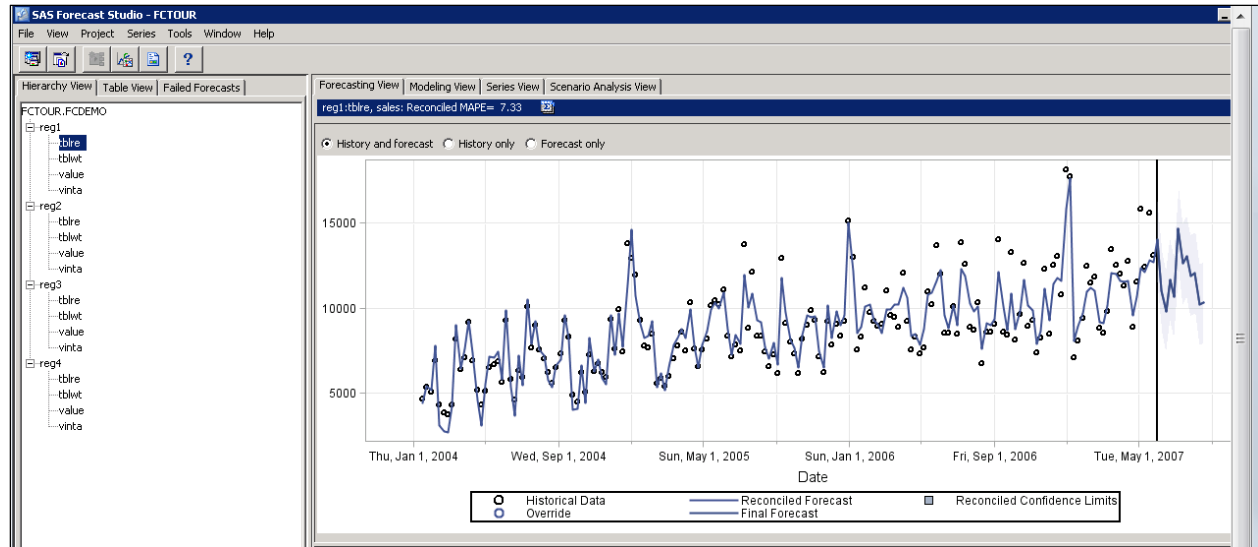


In the Forecasting view – regional sales, forecast results for region 2 sales are shown.



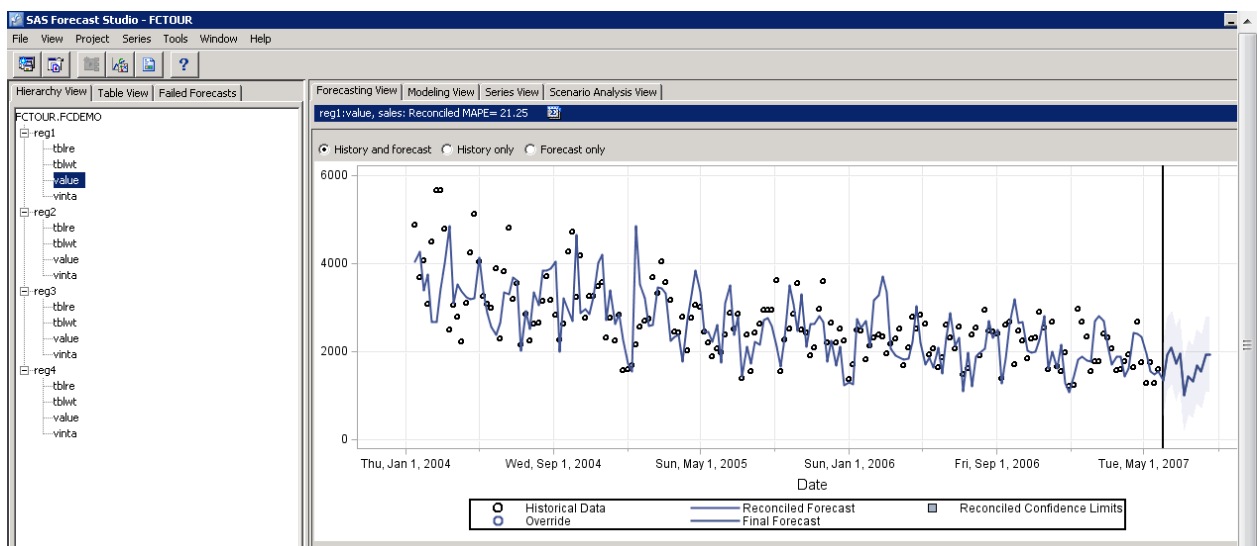
Sales in regions 1 through 4 differ in scale but have similar characteristics.

In the Forecasting view – base-level sales, forecast results for region 1, table red wine are shown.



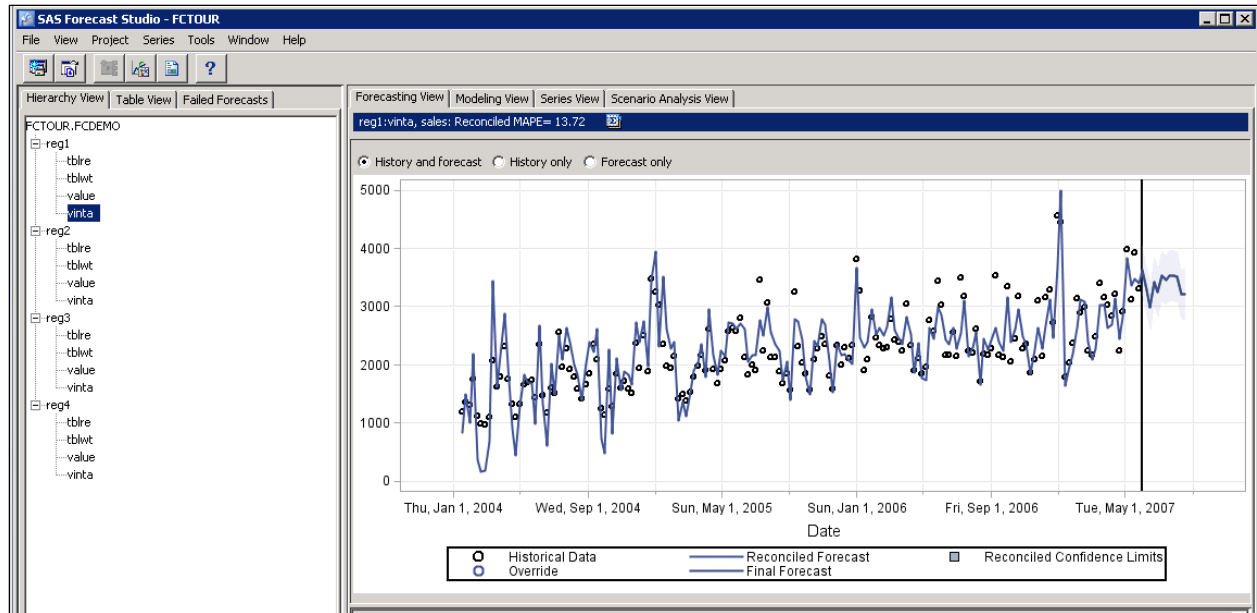
Sales of table red and table white wines are trending up across regions.

In the Forecasting view – base-level sales, forecast results for region 1, value wine are shown.



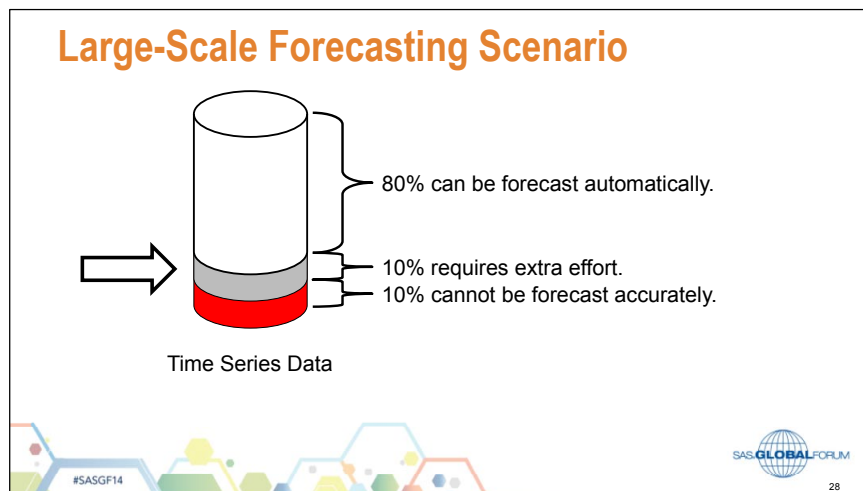
Sales of value wine are trending down across regions.

In the Forecasting view – base-level sales, forecast results for region 1, vintage wine are shown.



Sales of vintage type wines are trending up across regions. Sales for vintage wines have the smallest scale and highest volatility among wine types.

## 1.3 Refining Selected Forecast Models



## Refining Selected Forecast Models

- Vintage-type wine forecasts have been identified as “high-value” because of a high associated profit margin but “problematic” because of high volatility.
- Management wants good baseline forecasts and also to quantify the effects of own price variation and promotional events on the demand for vintage-type wines.



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## Strategy for Refining Vintage Forecast Models

- Find vintage forecast models that have outlier variables. Use these as a basis for building custom event variables.
- Improve baseline forecasts by improving the fit of the generated models, if possible. Pay particular attention to large or systematic residuals near the end of the series.
- Quantify the effects of own price variation and promotional events on sales of vintage wines.



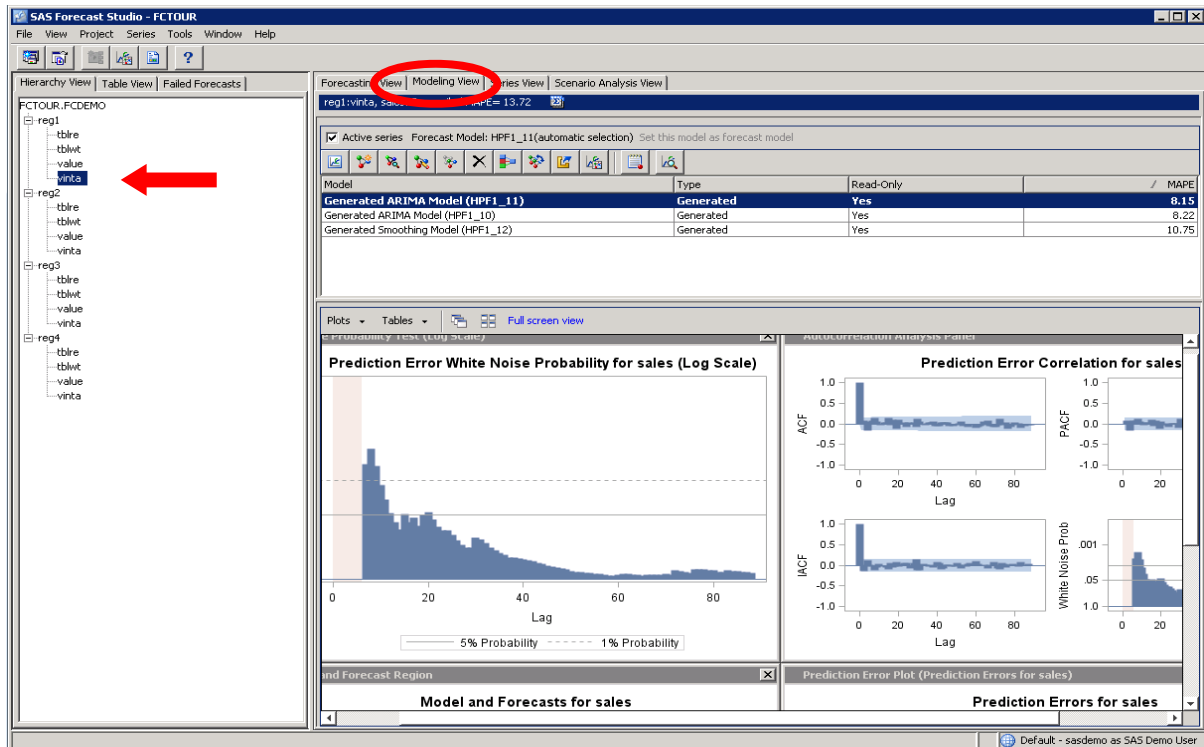
30



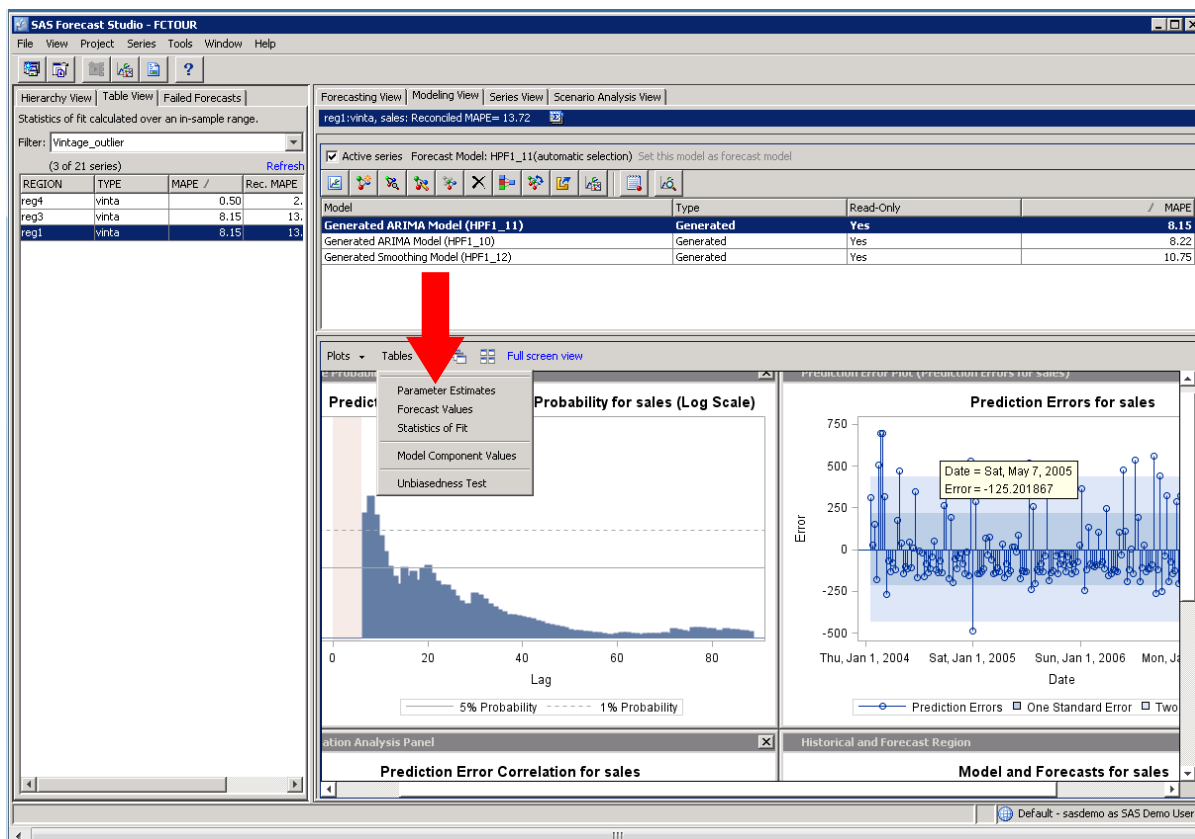
## Refining Forecast Models

1. Switch to the **Modeling View** to view details about the models generating the forecasts. The Modeling View tab is shown in the circle below.





2. Make sure that the region 1 vintage series is selected in the Hierarchy view in the left panel, as shown above by the arrow.
3. Select **Tables** ⇒ **Parameter Estimates** to view the fitted model.



Component	Parameter	Estimate	Standard Error	t Value	Approx Pr >  t
sales	CONSTANT	4077.2	68.39278	59.61	<.0001
sales	AR1_1	0.21320	0.07876	2.71	0.0075
NEW_YEAR_WEEK	SCALE	730.76004	127.65803	5.72	<.0001
BasePrice	SCALE	-25.49404	0.86561	-29.45	<.0001
AO06JAN2007D	SCALE	1146.2	223.51284	5.13	<.0001
LS05MAY2007D	SCALE	582.71837	133.38016	4.37	<.0001

- Apparently, region 1 vintage wine sales are impacted by a New Year's Day effect. The effects of other recurring events, flagged by other candidate event variables, seem negligible for this series.
- The effect of base price is significant and negative as expected.
- Two outlier variables are included:
  - A level shift that begins on May 5, 2007
  - A pulse that occurs on January 6, 2007

## Refining Selected Forecast Models

The marketing director for region 1 furnishes the following details:

- The shift outlier identified for May 5, 2007, actually represents three separate events:
  - a national news magazine story that ran on May 1 about the health benefits of vintage wine
  - a buy-one-get-one-free (BOGOF) promotion on May 5
  - a coupon insert that ran on May 19
- The company offered a selection of green vintage wines in honor of Saint Patrick's Day. The campaign started on March 17, 2007. The campaign is scheduled to run again next Saint Patrick's Day.



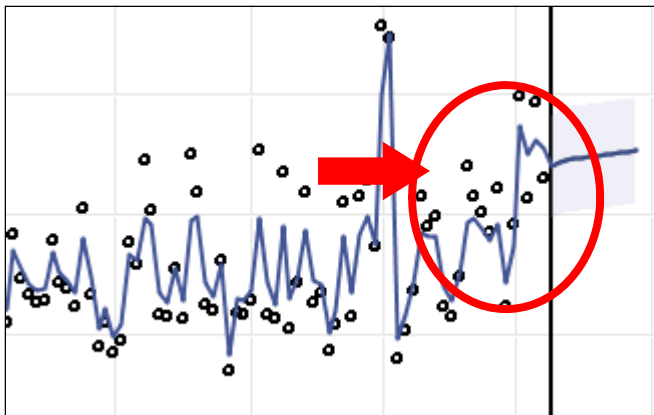
32

## Refining Selected Forecast Models

- Leave the level shift outlier variable in the model to accommodate the effect of the news story.
- Examine late series fit to assess systematic misses and to qualify the Saint Patrick's Day event.
- Create a pulse event variable to capture variation that is associated with the BOGOF promotion.
- Create a pulse event variable to capture variation that is associated with the coupon event.



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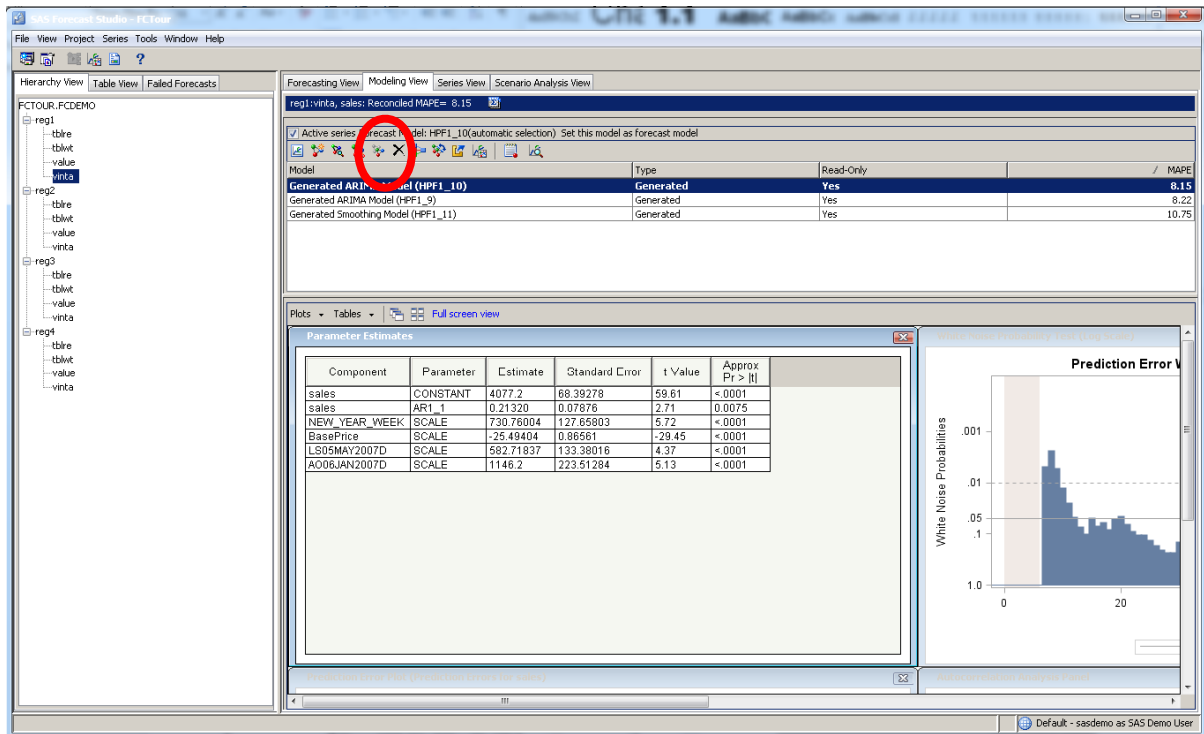


The arrow indicates the observation that is associated with the week that contains March 17, 2007.

A temporary change event variable seems to be a reasonable way to qualify the variation associated with this event.

All other residuals seem reasonably random.

- From the Modeling view, select the **Copy** button to begin augmenting the forecast model for region 1 vintage wine.



The dialog box containing the copy of the forecast model specification is shown.

- Select **Events** in the panel on the left.

**Subset ARIMA Model**

If this model is currently in use, editing it will cause all affected series to be automatically updated and the project to be reconciled. Forecasts may be affected.

⚠ To see if and where the model is currently being used, you may search [here](#).  
Changes to the model could result in invalid scenarios.  
Consequently, you would need to re-create these scenarios.

Name:

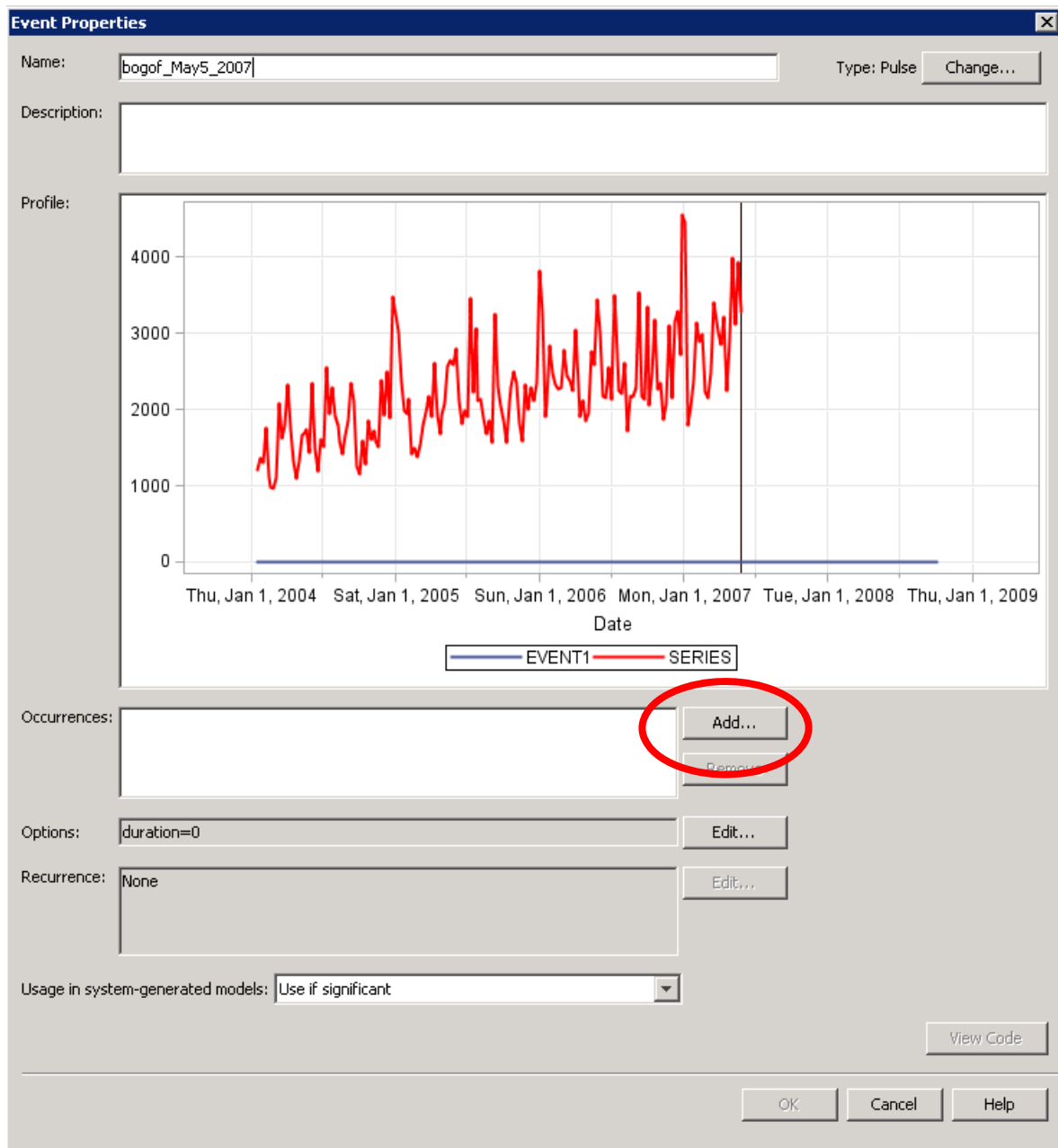
Description:

Details:

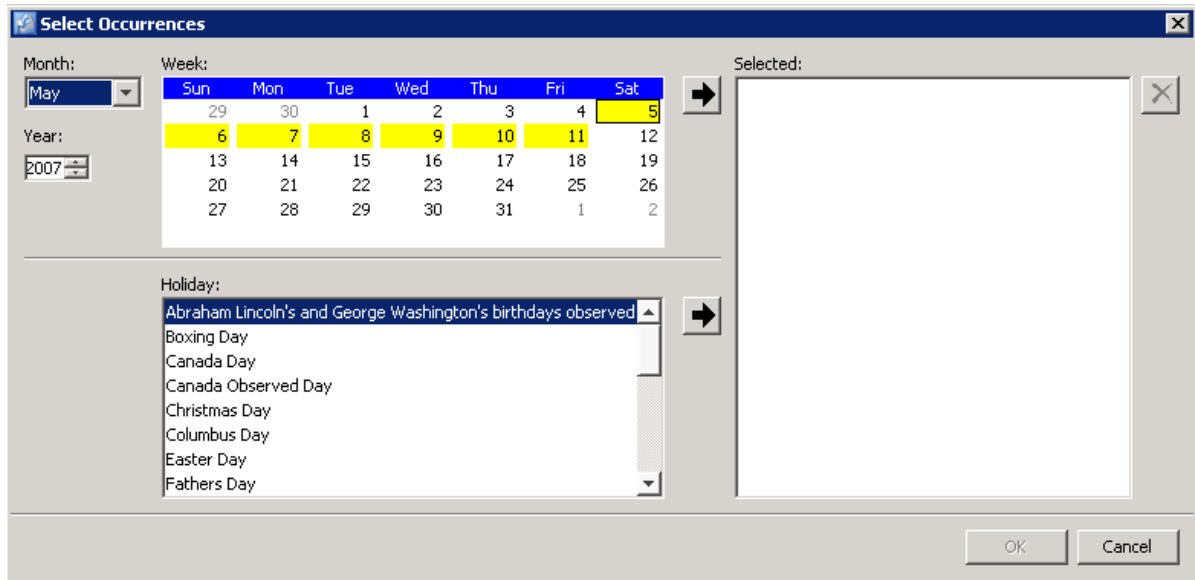
Specification  
Independent Variables  
Predefined Variables  
Outlier Variables  
**Events**  
Estimation

Event /	Transfer Function	Include in Model
MOTHERS_DAY	<a href="#">NONE</a>	<input type="checkbox"/>
NEW_YEAR_WEEK	<a href="#">NONE</a>	<input checked="" type="checkbox"/>
VALENTINES_WEEK	<a href="#">NONE</a>	<input type="checkbox"/>
XMAS_4WKBF	<a href="#">NONE</a>	<input type="checkbox"/>

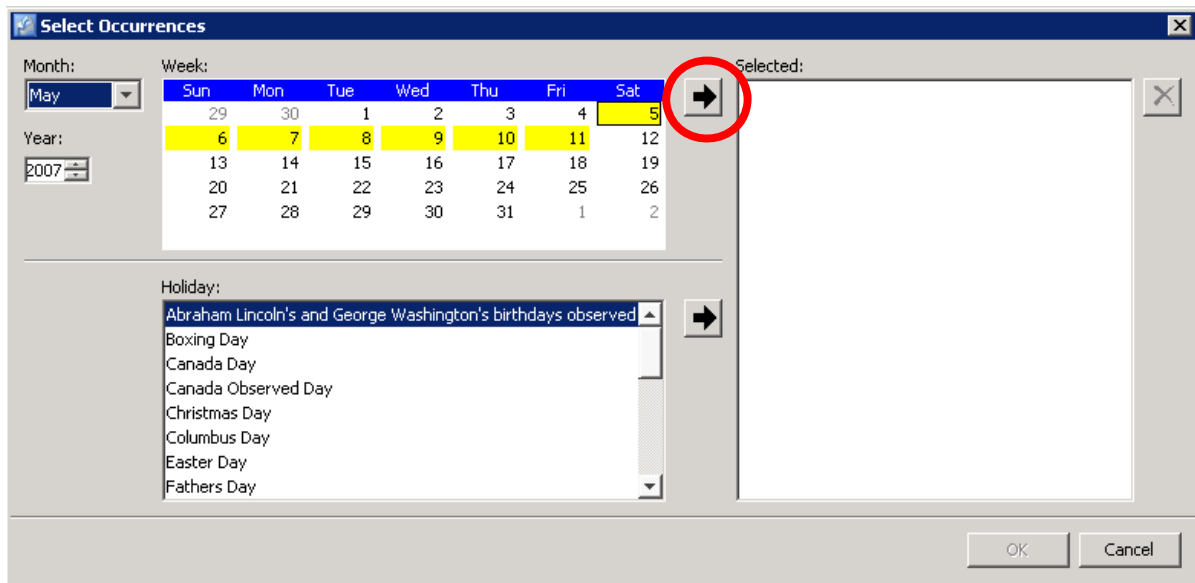
6. Select **New...** to begin creating the indicated event variables.
7. Name the event variable something descriptive such as **bogof\_may5\_2007**.
8. Leave the event variable type as Pulse.
9. Select **Add...** to add the date of occurrence.



10. Set the year to **2007**.
11. Set the month to **May**.
12. Set the week to the week that begins on Saturday the 5th.



Make sure to select the date by clicking the selection arrow.



13. Select **OK**. The defined event variable to flag the May 5, 2007, BOGOF event is shown.

14. Select **OK**.

**Event Properties**

Name:  Type: Pulse

Description:

Profile:

Occurrences:

Options:

Recurrence:

Usage in system-generated models:

The created event populates the project Event Repository.

15. Select **New...** to begin the creation of the coupon event variable.



**Subset ARIMA Model**

If this model is currently in use, editing it will cause all affected series to be automatically updated and the project to be reconciled. Forecasts may be affected.  
 ⚠ To see if and where the model is currently being used, you may search [here](#).  
 Changes to the model could result in invalid scenarios.  
 Consequently, you would need to re-create these scenarios.

Name: HPF1\_11COPY1

Description:

Details: sales = P=( 1 ) + BasePrice ... + BOGOF\_MAY5\_2007

Specification  
 Independent Variables  
 Predefined Variables  
 Outlier Variables  
**Events**  
 Estimation

Event /	Transfer Function	Include in Model
MOTHERS_DAY	<a href="#">NONE</a>	<input type="checkbox"/>
NEW_YEAR_WEEK	<a href="#">NONE</a>	<input checked="" type="checkbox"/>
VALENTINES_WEEK	<a href="#">NONE</a>	<input type="checkbox"/>
XMAS_4WKBF	<a href="#">NONE</a>	<input type="checkbox"/>
BOGOF_MAY5_2007	<a href="#">NONE</a>	<input checked="" type="checkbox"/>

**New...** View

View Code

OK Cancel Help

16. Follow similar steps to create an event variable that flags the variation associated with the coupon promotion that ran on May 19, 2007.

**Select Occurrences**

Month: May

Year: 2007

Week:

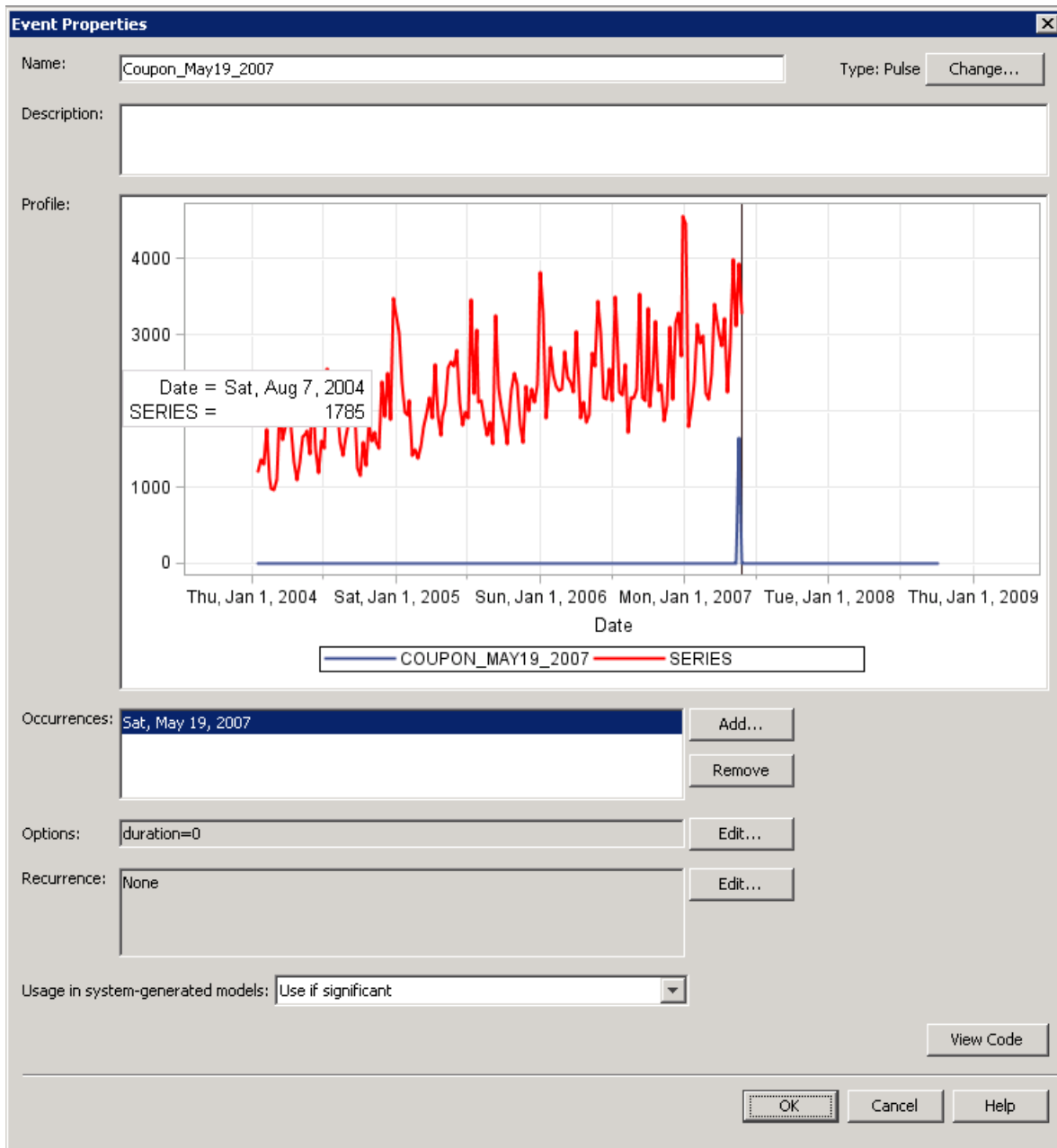
Sun	Mon	Tue	Wed	Thu	Fri	Sat
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2

Holiday:

- Abraham Lincoln's and George Washington's birthdays observed
- Boxing Day
- Canada Day
- Canada Observed Day
- Christmas Day
- Columbus Day
- Easter Day
- Fathers Day

Selected:

OK Cancel



17. Select **New...** to begin the creation of the Saint Patrick's Day event variable.

Recall that variation in the data associated with the Saint Patrick's Day event looks like an abrupt, temporary change that begins on March 17, 2007.

**Subset ARIMA Model**

If this model is currently in use, editing it will cause all affected series to be automatically updated and the project to be reconciled. Forecasts may be affected.  
 ⚠ To see if and where the model is currently being used, you may search [here](#).  
 Changes to the model could result in invalid scenarios.  
 Consequently, you would need to re-create these scenarios.

Name:

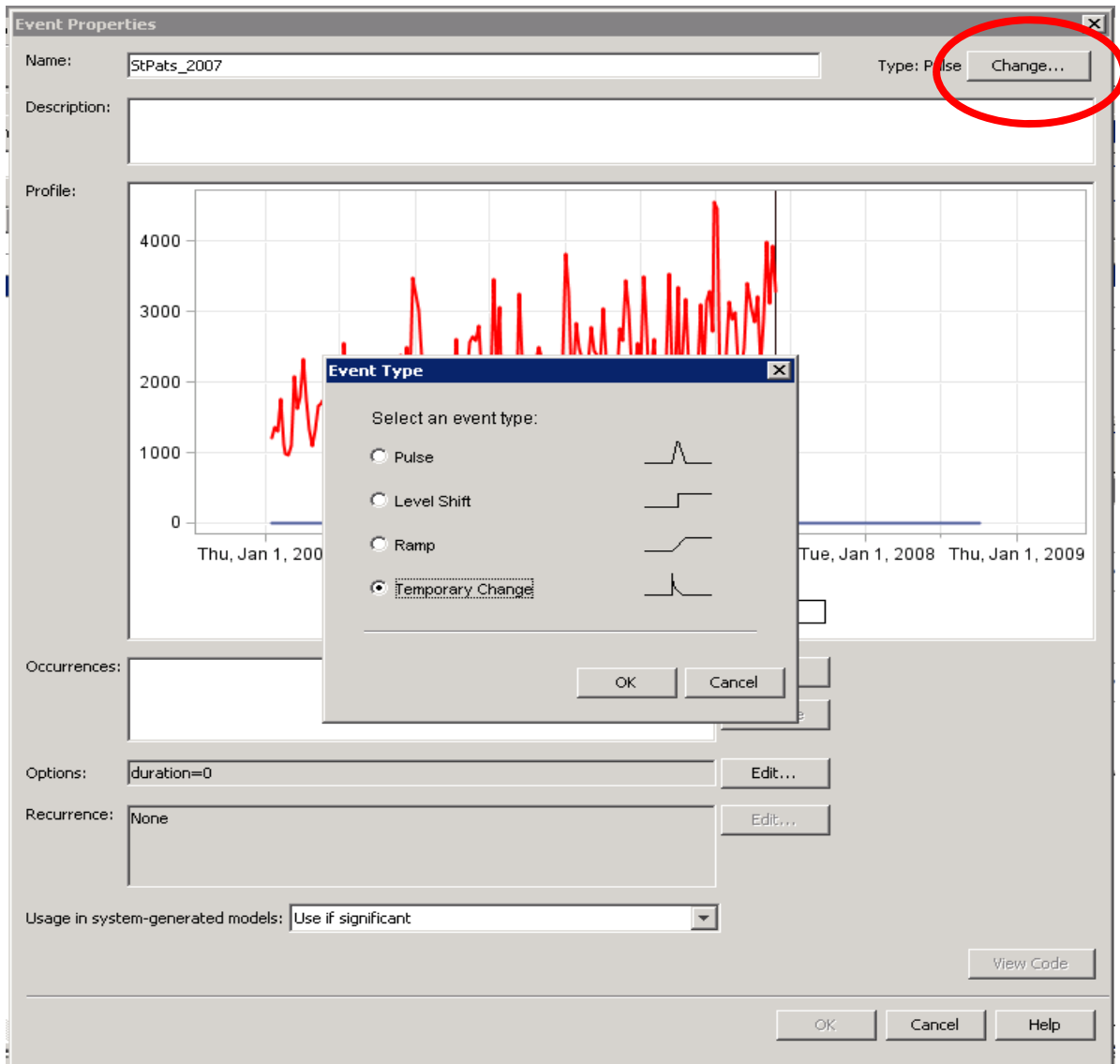
Description:

Details:

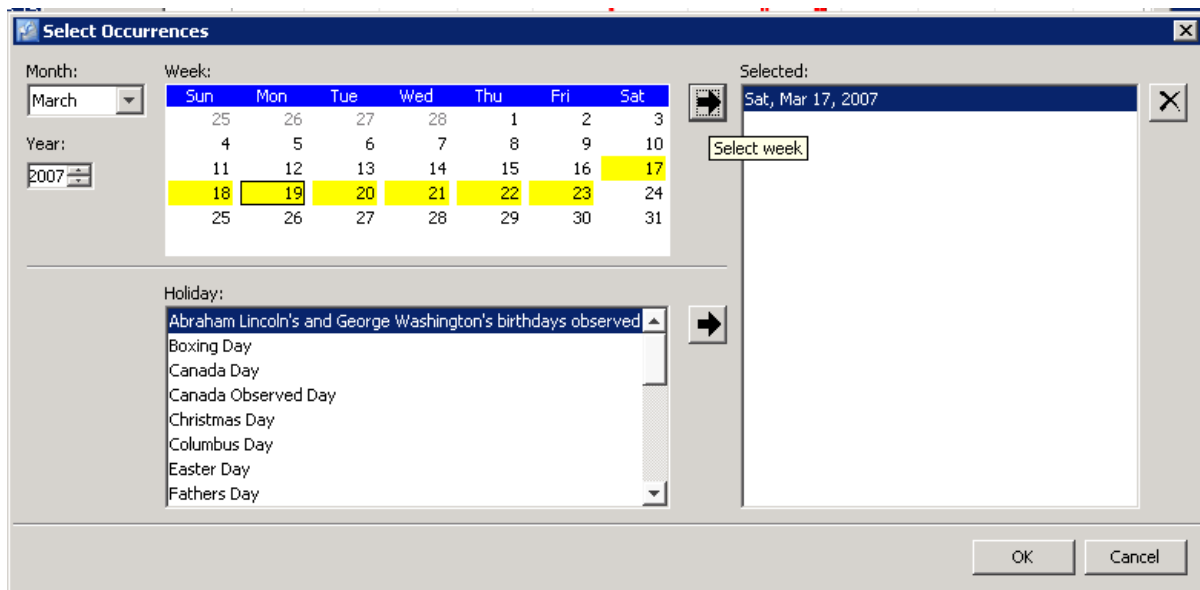
Specification  
 Independent Variables  
 Predefined Variables  
 Outlier Variables  
**Events**  
 Estimation

Event /	Transfer Function	Include in Model
MOTHERS_DAY	<a href="#">NONE</a>	<input type="checkbox"/>
NEW_YEAR_WEEK	<a href="#">NONE</a>	<input checked="" type="checkbox"/>
VALENTINES_WEEK	<a href="#">NONE</a>	<input type="checkbox"/>
XMAS_4WKBF	<a href="#">NONE</a>	<input type="checkbox"/>
BOGOF_MAY5_2007	<a href="#">NONE</a>	<input checked="" type="checkbox"/>
COUPON_MAY19_2007	<a href="#">NONE</a>	<input checked="" type="checkbox"/>

18. Name the event variable something descriptive such as **StPats\_2007**.
19. Select the **Change...** button next to the event variable Type heading.
20. Set the event variable type to **Temporary Change**.

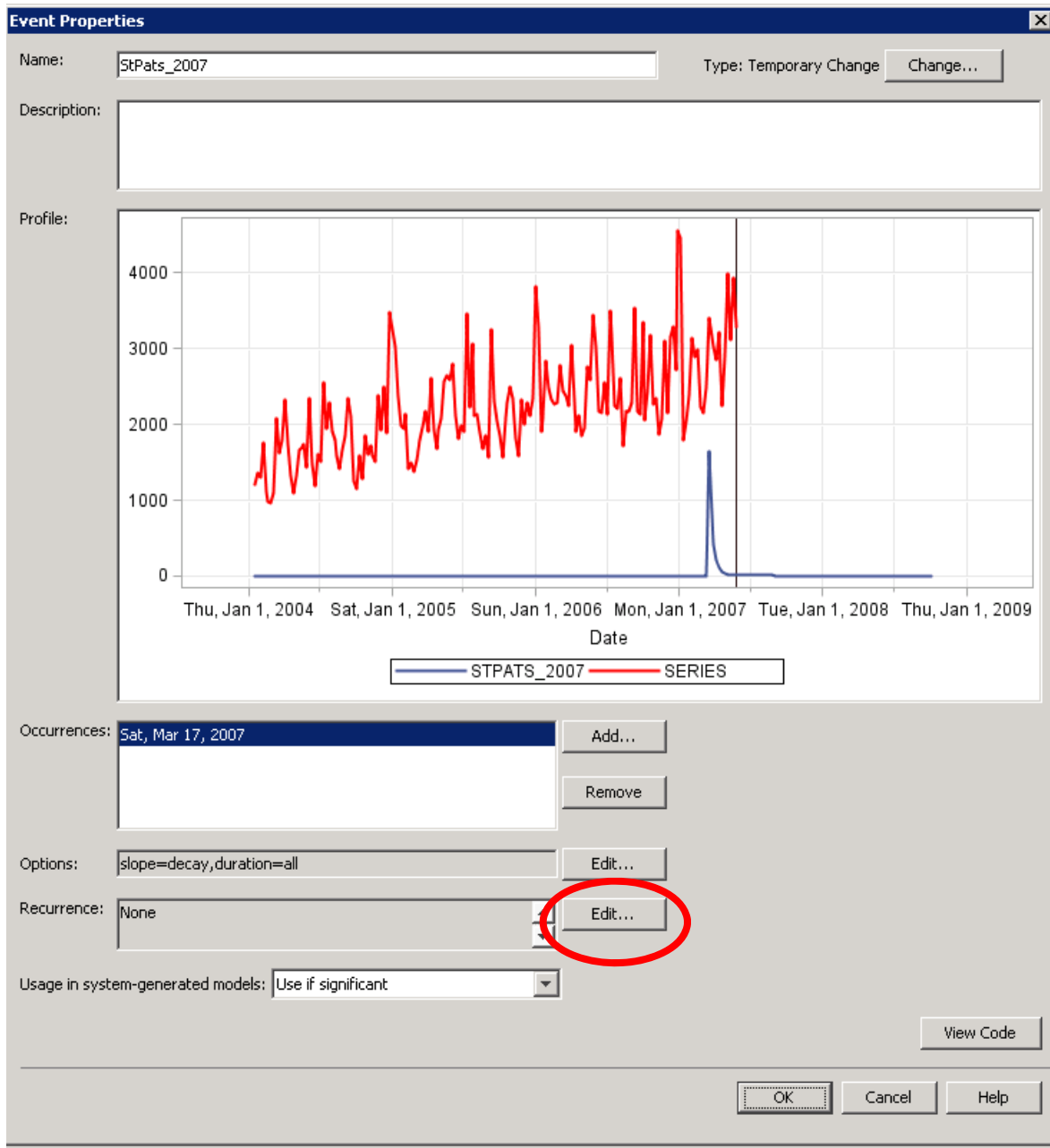


21. Select **OK**.
22. Select the **Add...** button next to Occurrences to set the occurrence date.
23. Select the date **March 17, 2007**.
24. Select **OK**.



Recall that the Saint Patrick's Day promotion is set to occur again next year.

25. Select the **Edit...** button next to Recurrence.



Because Saint Patrick's Day is an annual occurrence, the correct frequency is **Year**.

Because the first instance of this promotion occurred last March, and one more is planned, the appropriate number of occurrences is **2**.

**Event Recurrence**

Select how frequently the event will recur: Year

Specify how long recurrence will last:

☐ Indefinitely before and after the selected occurrence date  
☐ Indefinitely starting with and after the selected occurrence date  
☒ For this many occurrences, starting with the selected occurrence date: 2  
☐ Until this date, starting with the selected occurrence date: Fri, Jan 1, 2016

OK Cancel

26. Select **OK**.

The temporary change, Saint Patrick's Day 2007 event variable, is added to the Event Repository for the project.

**Subset ARIMA Model**

If this model is currently in use, editing it will cause all affected series to be automatically updated and the project to be reconciled. Forecasts may be affected.

⚠ To see if and where the model is currently being used, you may search [here](#).  
Changes to the model could result in invalid scenarios.  
Consequently, you would need to re-create these scenarios.

Name: HPF1\_11COPY1

Description:

Details: sales = P=( 1 ) + BasePrice ... + STPAT5\_2007

Specification  
Independent Variables  
Predefined Variables  
Outlier Variables  
**Events**  
Estimation

Event	Transfer Function	Include in Model
MOTHERS_DAY	NONE	<input type="checkbox"/>
NEW_YEAR_WEEK	NONE	<input checked="" type="checkbox"/>
VALENTINES_WEEK	NONE	<input type="checkbox"/>
XMAS_4WKBF	NONE	<input type="checkbox"/>
BOGOF_MAY5_2007	NONE	<input checked="" type="checkbox"/>
COUPON_MAY19_2007	NONE	<input checked="" type="checkbox"/>
STPAT5_2007	NONE	<input checked="" type="checkbox"/>

New... View

View Code

OK Cancel Help

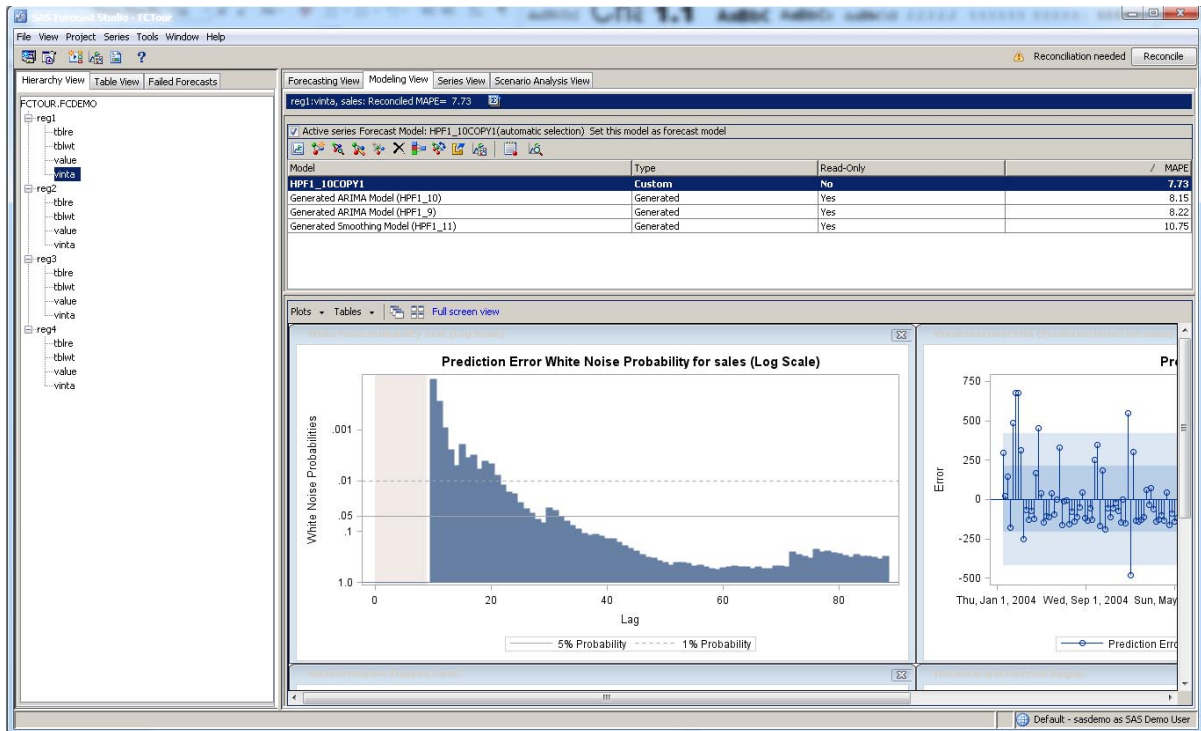


The three new events are automatically set to be included in the model.



27. Select **OK** to run the model.

The fit of the refined forecast model is better,  $\text{MAPE} = 7.73$ , and it is selected as the forecast model for this series.

28. Select **Tables** ⇒ **Parameter Estimates** to view the fitted model.

Parameter Estimates					
Component	Parameter	Estimate	Standard Error	t Value	Approx Pr >  t
sales	CONSTANT	4041.0	67.16164	60.17	<.0001
sales	AR1_1	0.20628	0.07987	2.58	0.0107
BasePrice	SCALE	-25.08514	0.84646	-29.64	<.0001
NEW_YEAR_WEEK	SCALE	748.19576	124.15694	6.03	<.0001
BOGOF_MAY5_2007	SCALE	525.67342	240.78773	2.18	0.0304
COUPON_MAY19_2007	SCALE	503.43121	226.28300	2.22	0.0274
STPATS_2007	SCALE	512.59711	202.57896	2.53	0.0123
LS05MAY2007D	SCALE	337.36531	158.18397	2.13	0.0344
AO06JAN2007D	SCALE	1169.9	217.53366	5.38	<.0001

The effects of the variables characterizing the news story effect, the BOGOF event, and the coupon promotion are positive and significant.

## Interpreting the Refined Model

- The BOGOF promotion generated a temporary increase of 526 cases of vintage wine sales in the week beginning May 5, 2007.
- The coupon promotion generated a temporary increase of 503 cases of vintage wine sales in the week beginning May 19, 2007.
- The media event generated a permanent increase of 337 cases of vintage wine sales beginning in the first week of May 2007.



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## Interpreting the Refined Model

- The estimated parameter on the base price indicates that a \$1.00 increase in the vintage case price leads to a decrease of about 25 cases/week in vintage wine sales over the range of the data.
- The Saint Patrick's Day promotion generated an abrupt, temporary, and positive effect on vintage case sales. The effect in the week ending March 17, 2007, is 513 cases. This effect persisted with decay for approximately five weeks.



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## Extending the Forecasts

- The final step in this demonstration extends lead forecast values over a one-year forecast horizon.



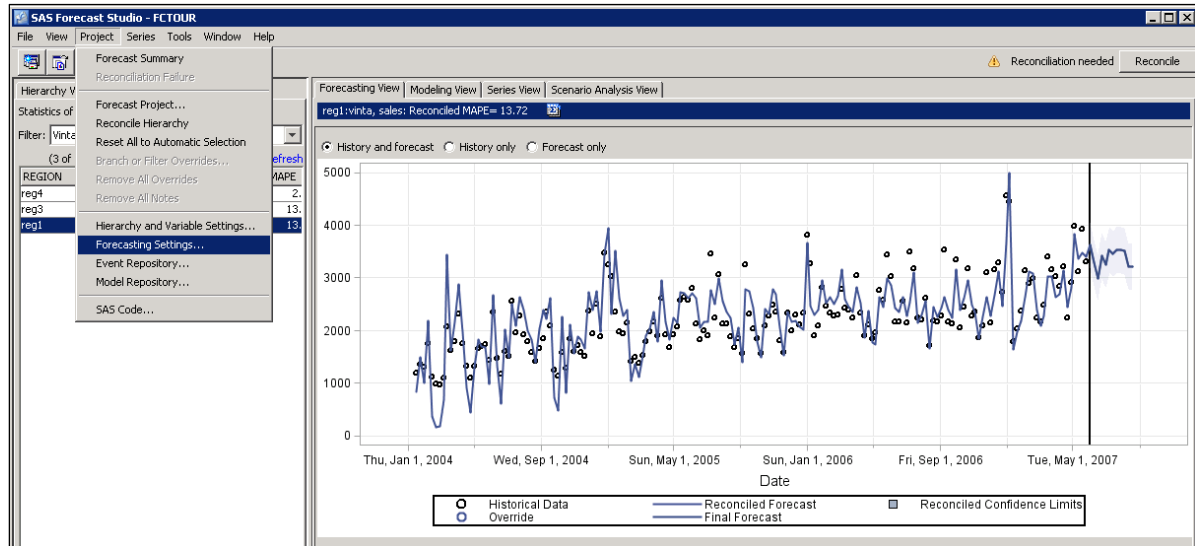
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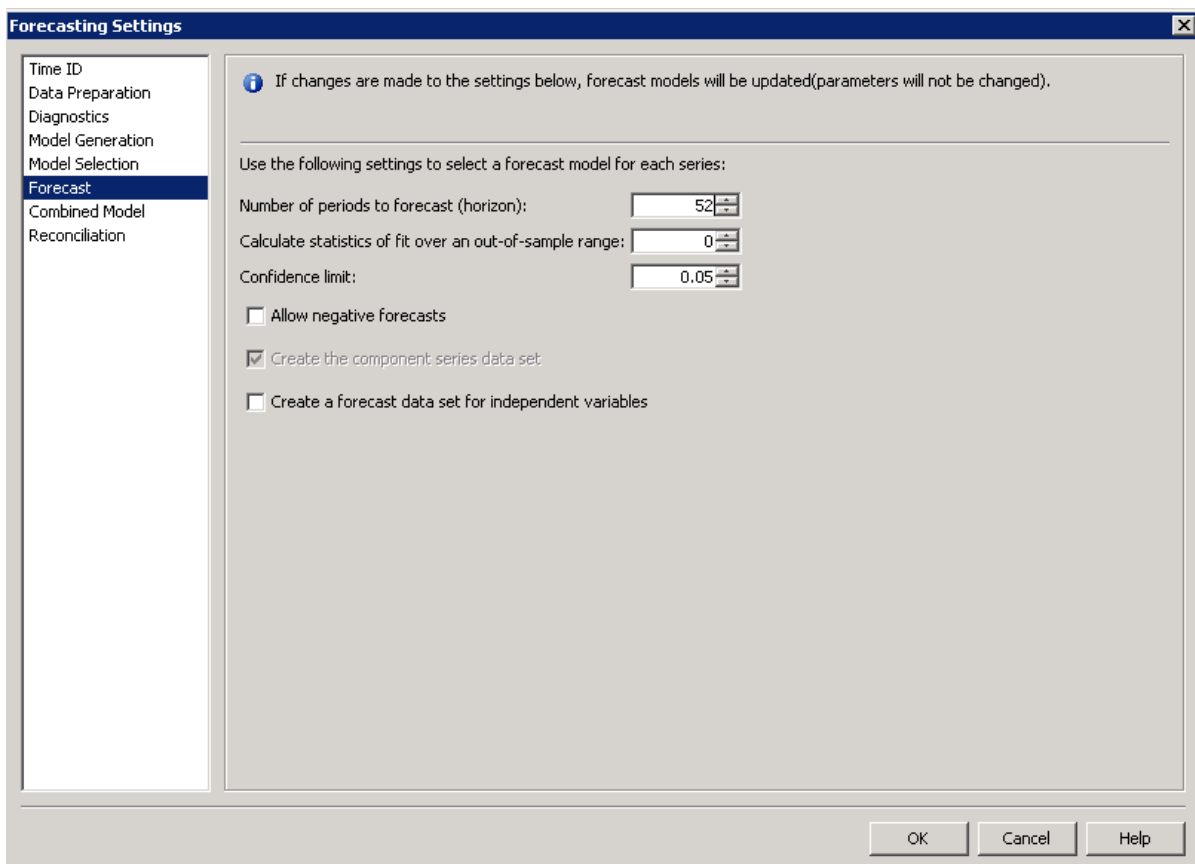
## Extending the Forecasts

The option to set the lead forecast horizon is in the project's forecasting settings.

### 1. Select **Project** ⇒ **Forecasting Settings...**



2. Select the **Forecast** options.
3. Change the horizon to **52** periods.



4. Select **OK**.

The 52-week lead forecast shows lifts associated with New Year's Day and the Saint Patrick's Day promotion.

The lead forecast for sales also reflects a trend forecast for the **BasePrice** input variable.

