SAS/ETS® Forecasting Application

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Introduction

The SAS/ETS® Forecasting application helps you select the best forecasting method and model for your data, using different forecasting methods such as exponential smoothing, ARIMA (Box-Jenkins) models, Winter's smoothing and time-trend regression models. Both interactive forecasting (where the user selects the best model) and completely automated forecasting are available.

The Forecasting application creates a default project that stores all your session options, models, and forecasts. You can easily define other projects. The application displays a list of previously specified models for each series so you can easily scroll between them.

In specifying a new model, you can use the default model, modify the current one, copy a model from the list, or let one be selected automatically. The Forecasting application is also capable of storing and deleting both models and forecasts to or from data sets you specify.

The forecasting tools you can choose from include: ARIMA models with or without seasonal differencing and/or seasonal autoregressive (AR) and moving average (MA) factors; exponential smoothing (single, double, or triple); Winter's exponential smoothing (with linear or no trend); linear and quadratic time trend; log transform; and adjustment for seasonality (X11).

Various display and graphics output are available at each step of the forecasting task. You have control over the output at each step and can reset the related options as desired. The period of fit and forecast and the confidence intervals can be adjusted as well.

Data exploration features include view of original series; plot of the original, log transformed, and/or differenced series; descriptive statistics; and plots of autocorrelation, inverse autocorrelation, and partial autocorrelation functions of the original, log transformed, and/or differenced series.

Graphical and displayed diagnostics available for forecasting models are model parameters; statistics of fit; view of forecasted values with confidence limits; plot of forecasts; plot of residuals; and descriptive statistics of the forecasts.

Any two models for the same series can be compared by the statistics of fit; a side-by-side view of predicted values, differences, and percent differences; the overlaid plot of forecasts and residuals; and a plot of difference between the forecasts.

This paper walks you through an example to familiarize you with some of the features of the SAS/ETS Forecasting application.

Example: Forecasting Average Quarterly Gas Bill

Assume you have a data set containing the average quarterly gas bill (GAS) from the first quarter of 1981 through the fourth quarter of 1990 and you want to forecast this series for 1991.

When you invoke the SAS/ETS Forecasting application, select Input data set: from the main menu, which displays a selection list of data sets. When you select the GAS data set you are returned to the main menu. If you have a SAS date variable in your input data set, the application automatically selects the id variable (DATE), the periodicity of the data (quarter), and defaults the period of fit to the span of the input data, and the period of forecast to the upcoming year.

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If you select Interactive mode from the Main Menu, you will be taken to the Interactive Forecasting Menu. The Interactive Forecasting Menu enables you to explore your data and define, estimate, evaluate, and compare different forecasting models for different series in the input data set. If you had previously fitted a model to the time series you are about to forecast (BILL), the model name, label, and the creation date would have been displayed as your current model. You first want to explore your data to help you in selecting the forecasting model. Select View series and specify the options in the View Series Options menu.

The plots of the original series and the differenced series,
the plots of the autocorrelation functions,

the plots of the inverse autocorrelation functions,

and the plots of the partial autocorrelation functions will be displayed.
When you return to the Interactive Forecasting Menu, select New model and you will be taken to the Model Specification menu. You define your first model (ARIMADIF) as ARIMA (1,0,1) with seasonal differencing. If you do not enter a model label, one describing the model specifications is created for you.

You return to the Interactive Forecasting Menu, and the model you have just specified is displayed as your current model (model name, label, and creation date). After specifying multiple models, you can switch between them by selecting one from a list (Model list), or using the arrows ← (previous model) and → (next model). You can similarly switch between the time series variables in your input data set by selecting Series list or the respective arrows.

To see current model (ARIMADIF) parameters, you select View model and choose the corresponding option on the View Model Options menu.
To see the plot of forecasts and the residuals for the model, you select View forecast and select the corresponding options on the View Forecast Options menu.
The following plots will be displayed:

![Plot 1](image1.png)

![Plot 2](image2.png)

You specify the next model (ARIMASMA) as an ARIMA(1,1,1) with a seasonal MA parameter in the New Model Specification menu.

![Model Specification](image3.png)
The View Series, View Model, and View Forecast options menus are displayed only the first time you select the respective button. If you want to change the options you specified, select Set options, which displays the Setup Options menu. From this menu, you can also change graphic output (templated vs. individual), the default model specification, period of fit and forecast, and the confidence limits your model uses. You want to see the statistics of fit as well as the model parameters for your second model (ARIMASMA), so you revise the options as follows:

Return to the Interactive Forecasting Menu, select View model and the model parameters and statistics for the ARIMA(1,1,1) model with a seasonal MA parameter are displayed.
Select View forecast to see the plot of forecasts and the residuals for the current model.

If you select Store model, the current model and the respective forecasts are stored to the data sets you specify.

If you select Delete model, the current model is deleted from the project, as well as your data sets (if you had previously stored it). The previous model (if any) becomes the current model.

If you select Compare models, the Model Comparison Menu is displayed with the last two models you specified for the current series. To change the models involved in the comparison, you can select First model and Second model for a selection list of the models you have already specified, or you can use Next and Previous.
Select Compare and the Model Comparison Options menu is displayed. In this case, you select all the comparison output options.
Following your request, the side-by-side view of the forecasts using the two models as well as the differences and the percent differences between the forecasts are displayed.

You can view the model comparison graphical output in the templated form, or as individual graphs as follows:

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