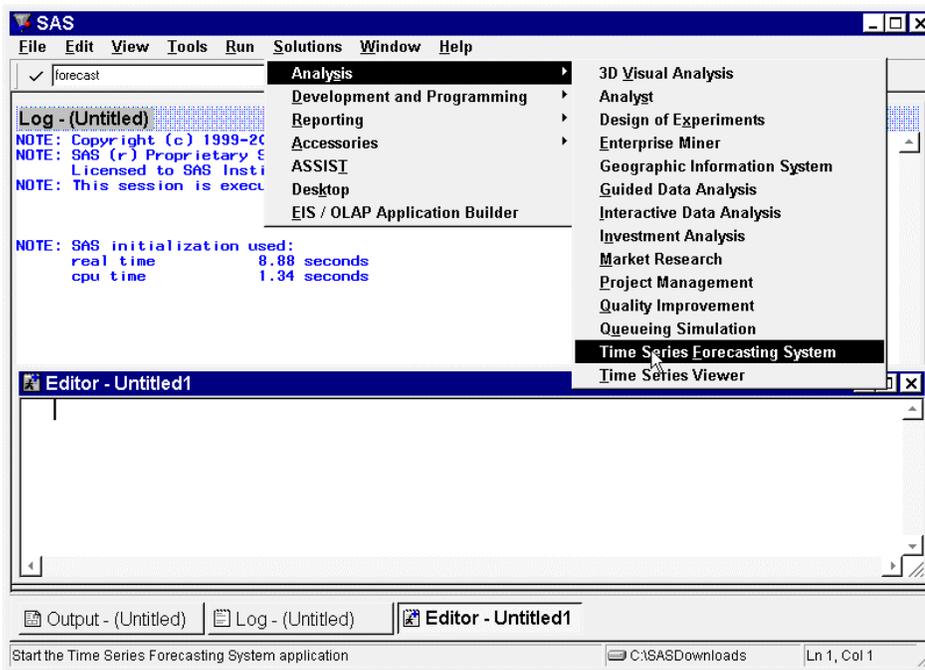


Exhibit 2: Promotional Forecast Demonstration

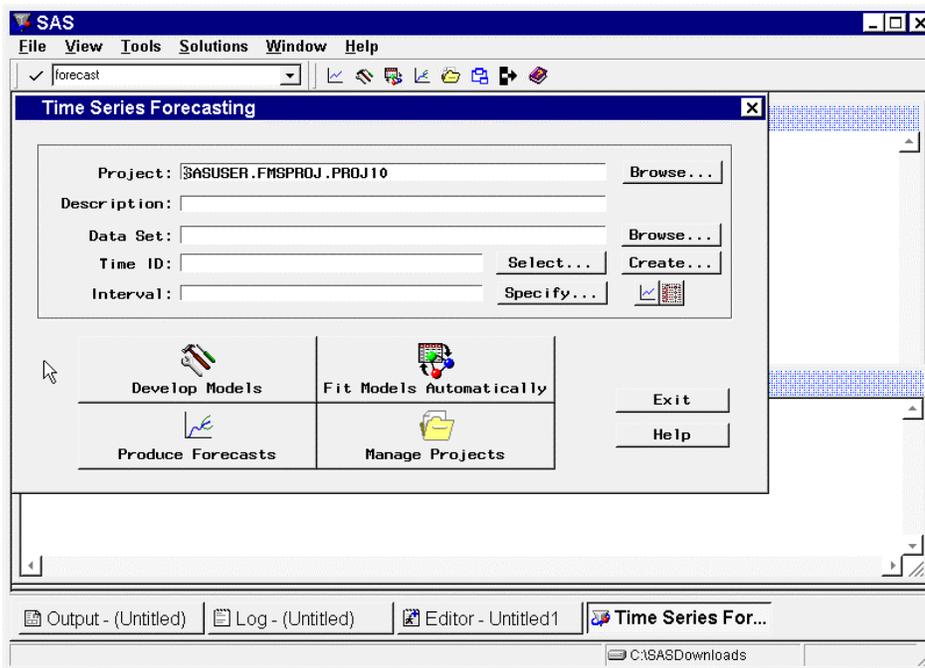
Consider the problem of forecasting for a proposed promotion that will start in December 1997 and continues beyond the forecast horizon. Assume that the promotion deviates the underlying time series process in a step-wise fashion from the proposed starting date until the forecast horizon. Additionally, assume that the adjustment has been scaled and seasonally adjusted. In this demonstration, the adjustment is 106 starting at December 1997. The *time*, *type*, *duration*, and *response* of the adjustment are based on a past (similar) promotion, but the underlying time series model is unknown.

This demonstration also explores some of the interactive analysis and modeling features of the Time Series Forecasting System. If you are not familiar with time series analysis and modeling techniques, Automatic Model fitting will provide you with a pretty good model and forecasts.

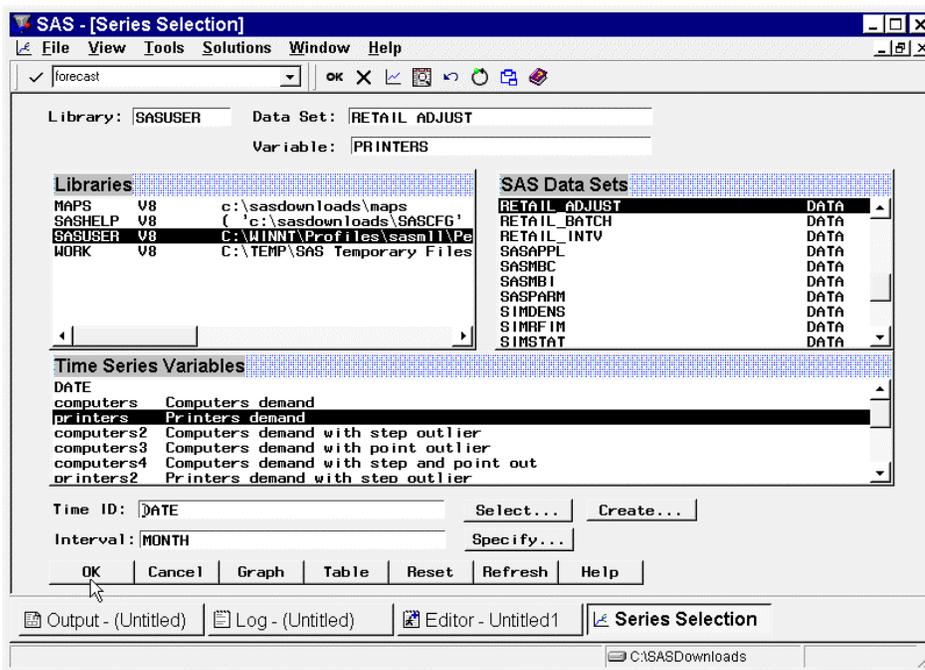
1. Start the SAS System.



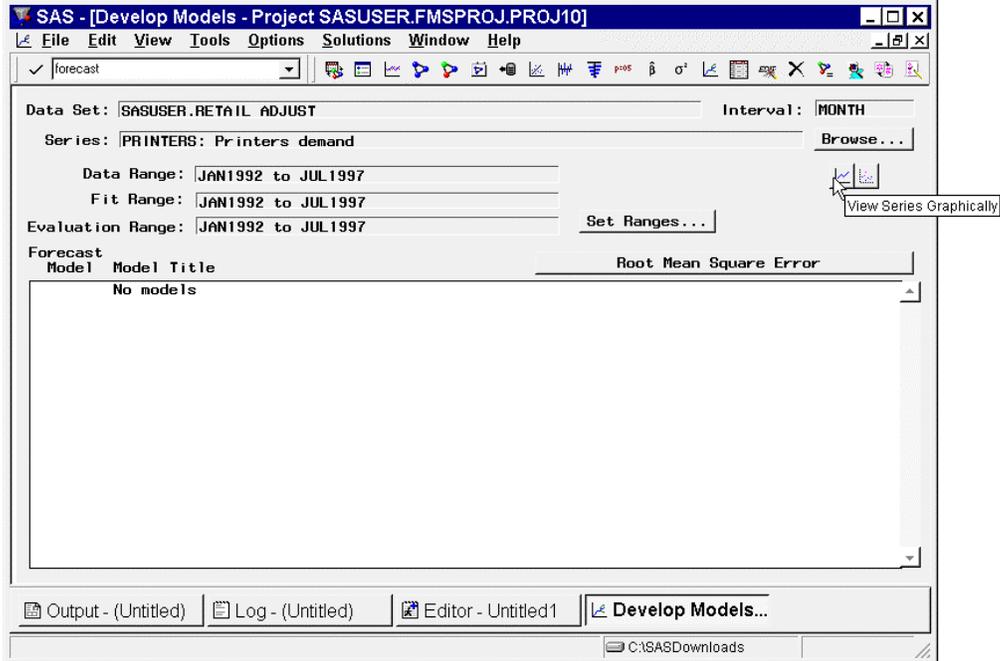
2. Enter "forecast" in the command line or select Solutions -> Analysis -> Time Series Forecasting System from the menu. The **Time Series Forecasting** window will appear.



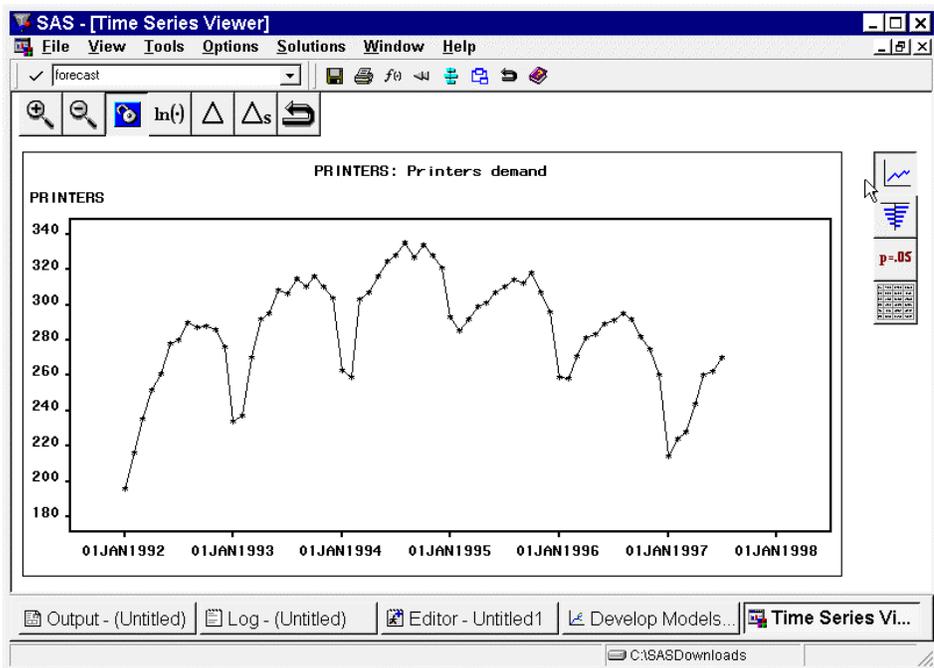
3. In the **Time Series Forecasting** window, click the button **Develop Models**. The **Series Selection** window will appear. The **Series Selection** window is used to select the time series under analysis.



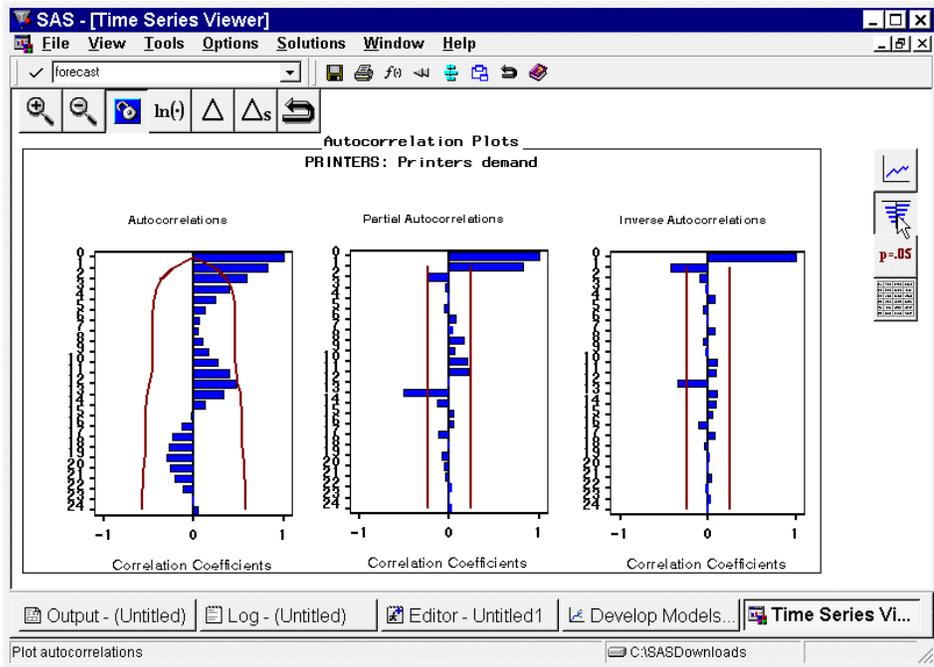
4. From the **Series Selection** window, choose the data set (library and member name), time series variable, time ID variable, and time interval. In this demonstration, SASUSER.RETAIL_ADJUST, PRINTERS, DATE, and MONTH are chosen, respectively. Click the **OK** button. The **Develop Models** window will appear. The **Develop Models** window is used to analyze, model, forecast time series on an individual basis.



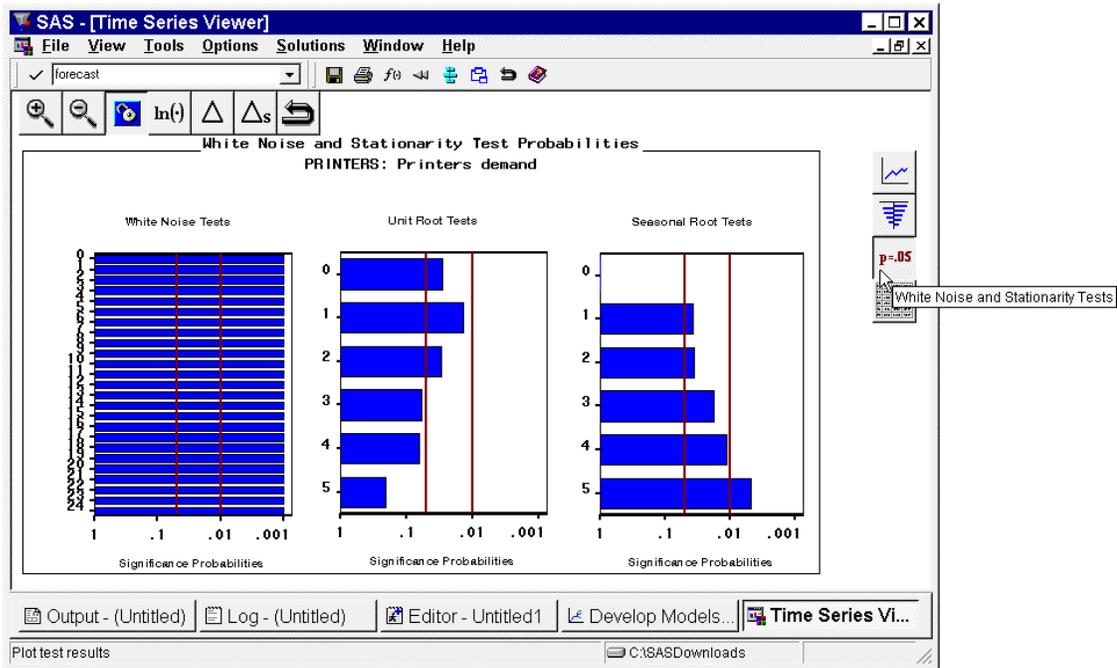
5. In the **Develop Models** window, click the **View Series Graphically** icon. The **Time Series Viewer** will appear. The **Time Series Viewer** is used to analyze the properties of a time series interactively. The next few steps will interactively analyze the series. If you are not familiar with time series analysis techniques, these steps can be skipped. Automatic model fitting will likely help you best.



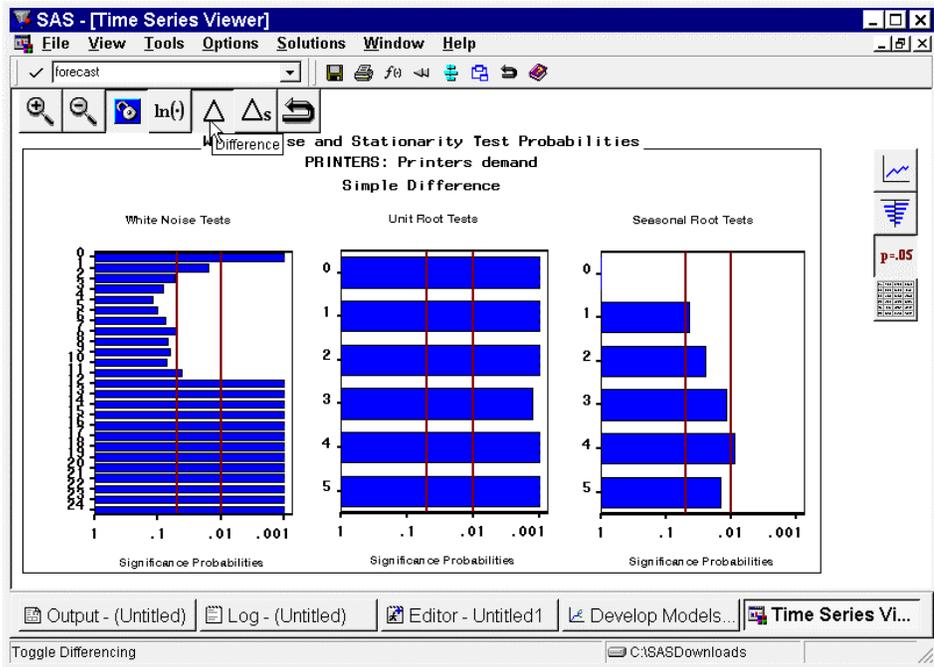
6. Notice that the time series appears seasonal with varying trend (upward then downward). Click on the **Autocorrelations** icon.



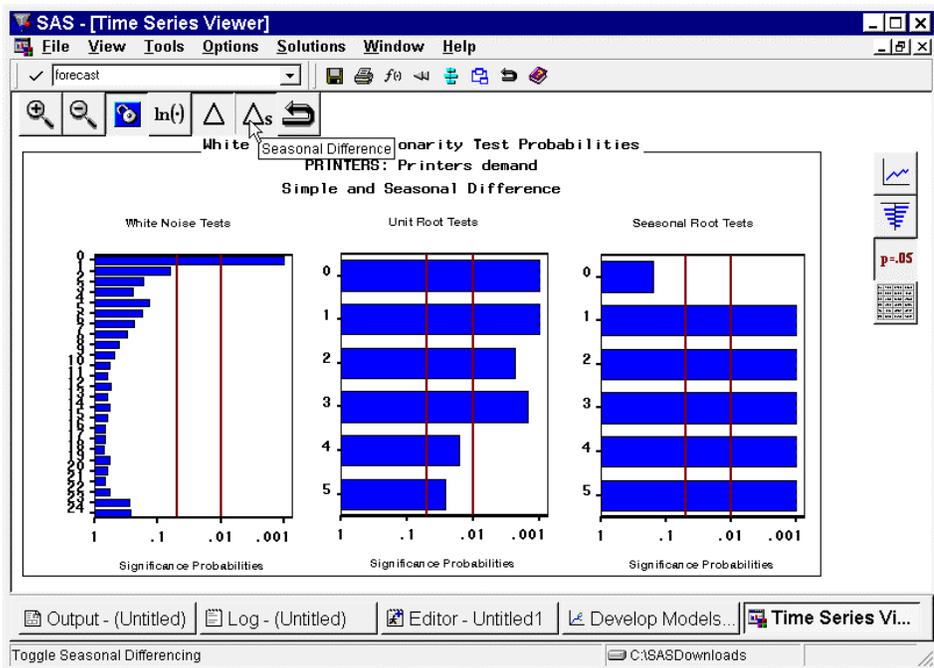
- Notice that the autocorrelation plots shows that the series is non-stationary (trending) and is seasonal. Click on the **Test** icon.



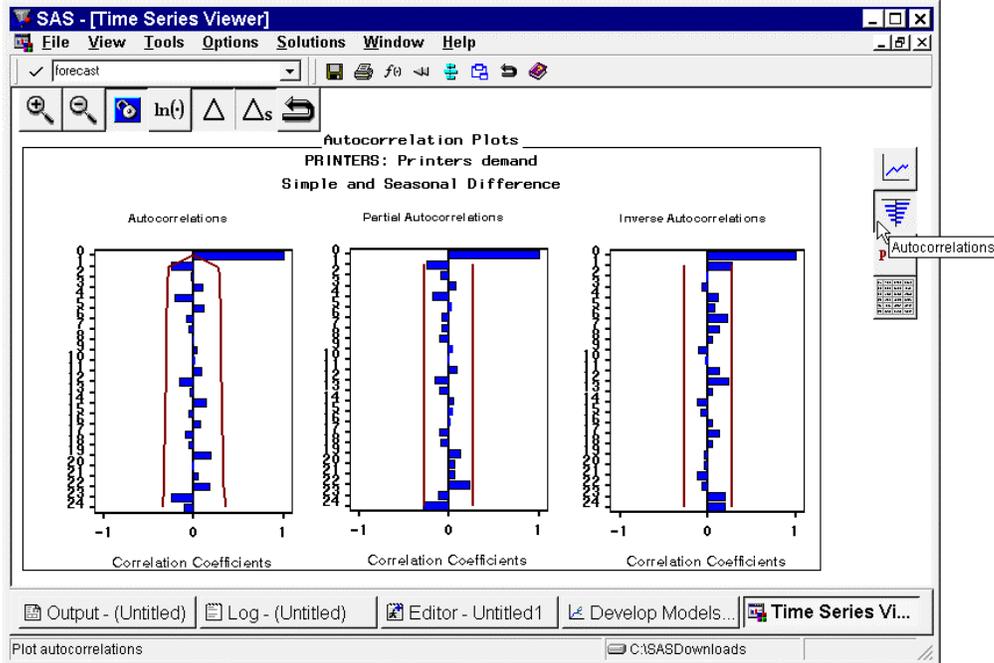
- Notice that the unit root tests suggest that the series is non-stationary (unit roots) and the seasonal unit root tests suggest that the series may contain a seasonal unit root. Notice the white noise tests indicate that the series highly correlated (patterns exist). Click the **Δ** icon to (simple) difference the series.



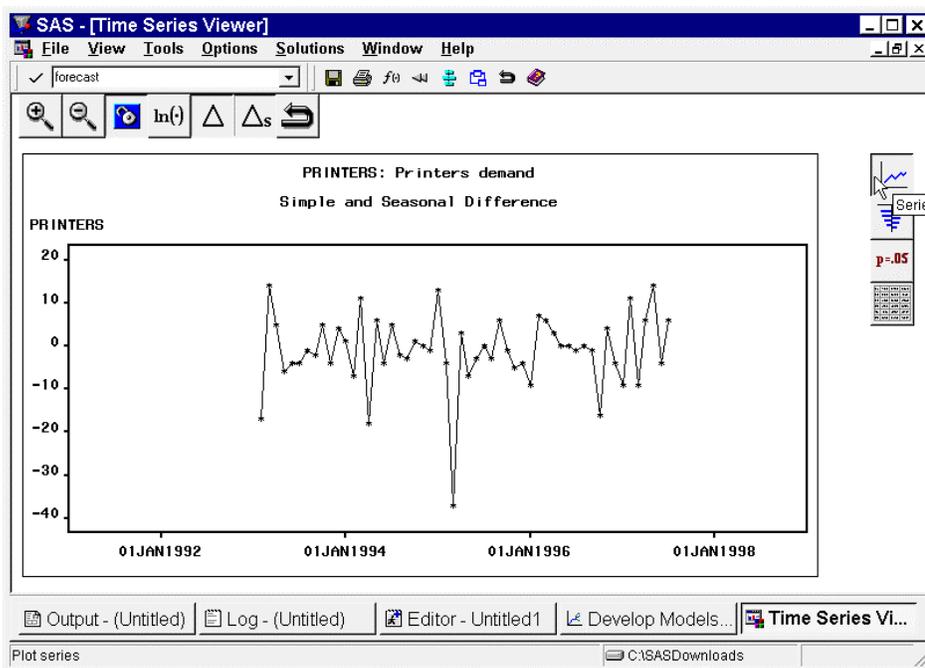
- Notice that the unit root tests suggest that the differenced series is stationary and the white noise tests (high correlation at the twelve lag) and the seasonal unit root tests suggest that the differenced series contains a seasonal unit root. Click the Δ_s icon to seasonally difference the series.



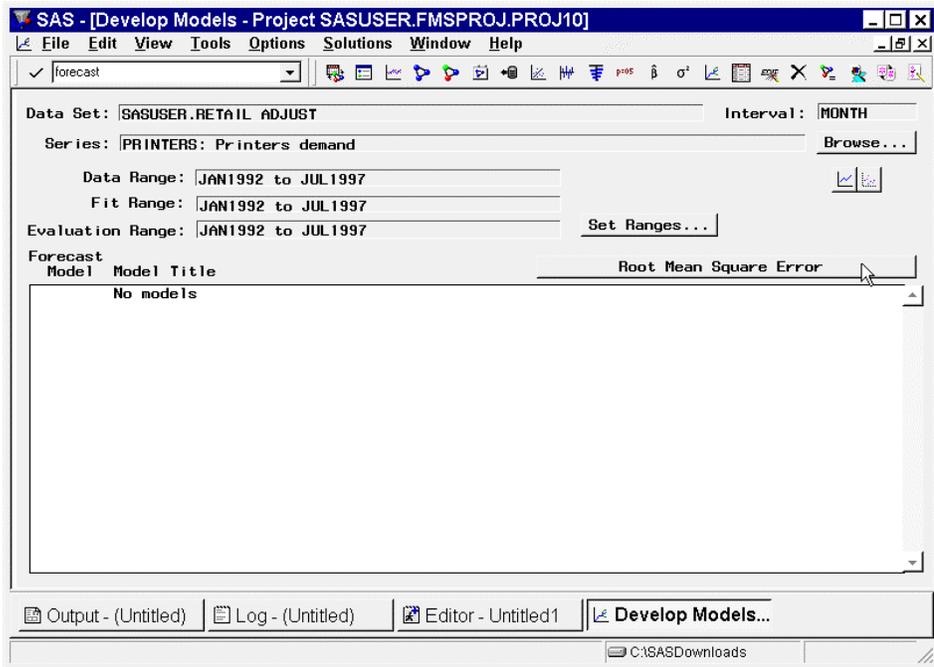
- Notice that the unit root tests and the seasonal unit root tests suggests that the simple and seasonal differenced series is stationary (no trend or seasonality). Also notice that after differencing, the series is close to white noise (little or no patterns). Click on the **Autocorrelations** icon.



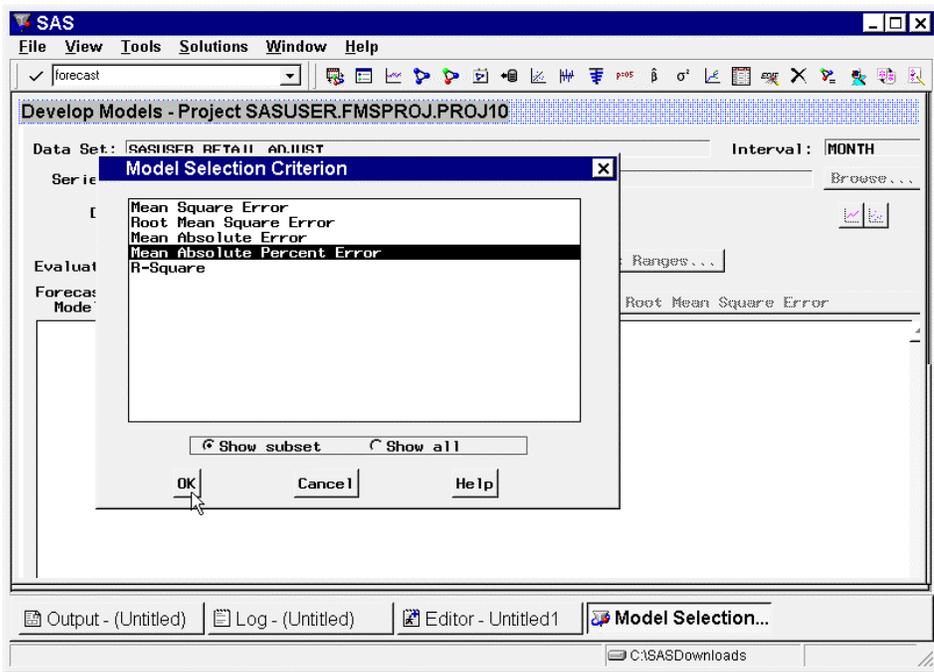
- Notice that the autocorrelation plots indicate that the series is stationary. Also notice that the first lag of Autocorrelations plot is significant. The above analyses suggest that a moving average model with simple and seasonal differencing is likely to be a good candidate model. Click on the **Series** icon.



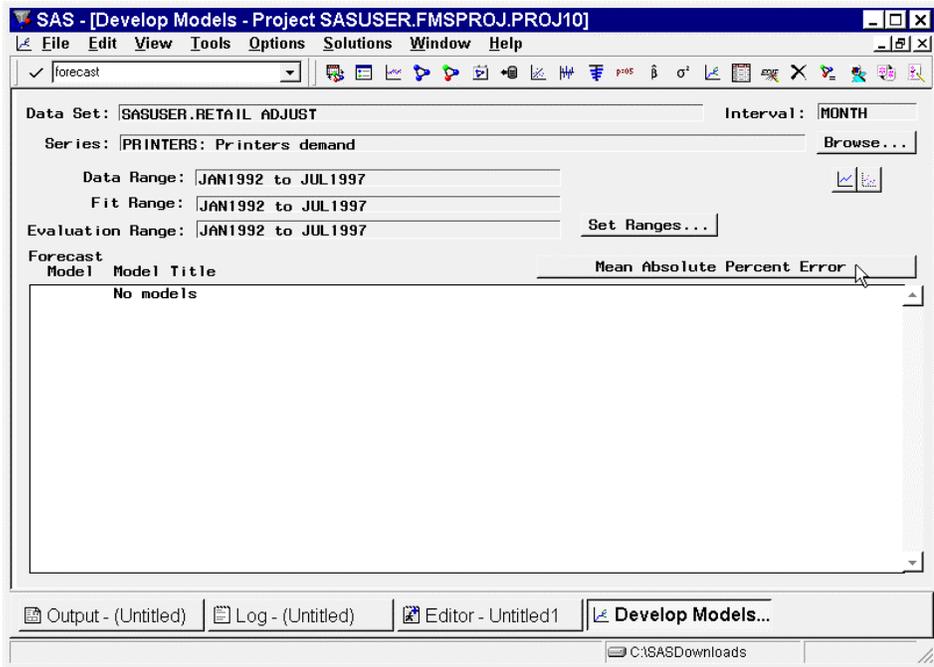
- Notice the simple and seasonally differenced series randomly varies about zero with the exception of a possible outlier at March 1995. Further analysis of the series could be performed using the **Time Series Viewer** but for now, close the **Time Series Viewer**. The **Develop Models** window will appear.



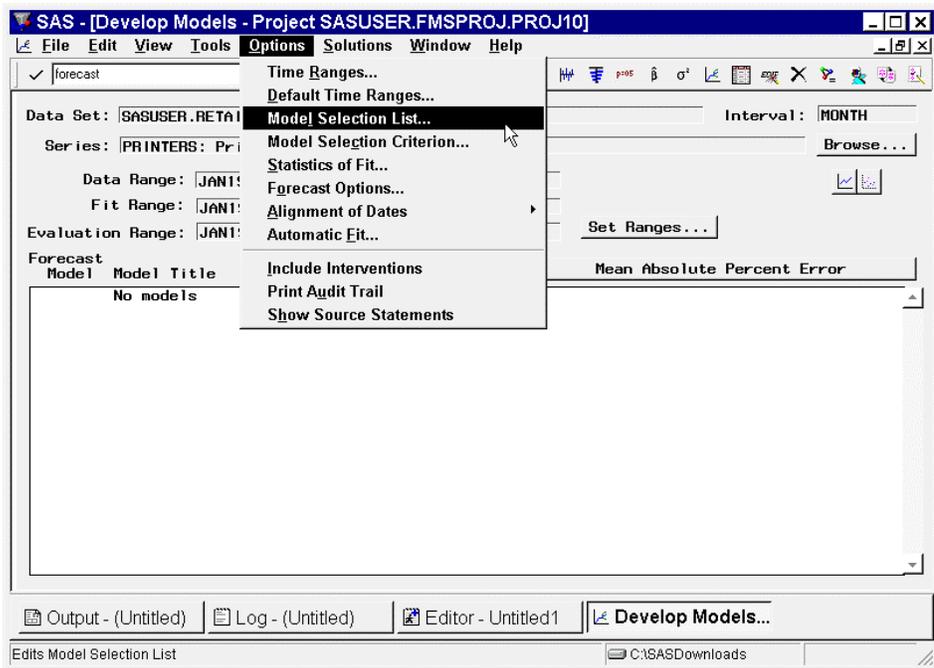
13. In the **Develop Models** window, click the button labeled **Root Mean Square Error**. The **Model Selection Criterion** dialog will appear. The **Model Selection Criterion** dialog specifies how to select the best fitting model when using automatic fitting.



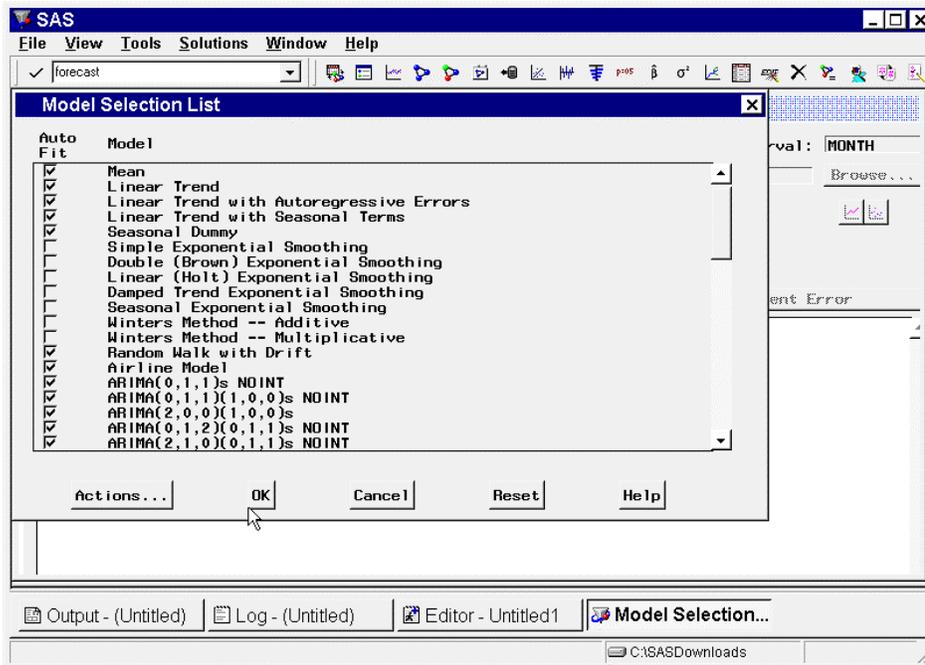
14. Since there are no interventions to model (just adjustments to the forecasts), we are not worried about over parameterizing the underlying time series model. In the **Model Selection Criterion** dialog, select **Mean Absolute Percentage Error (MAPE)** from the list box and click the **OK** button.



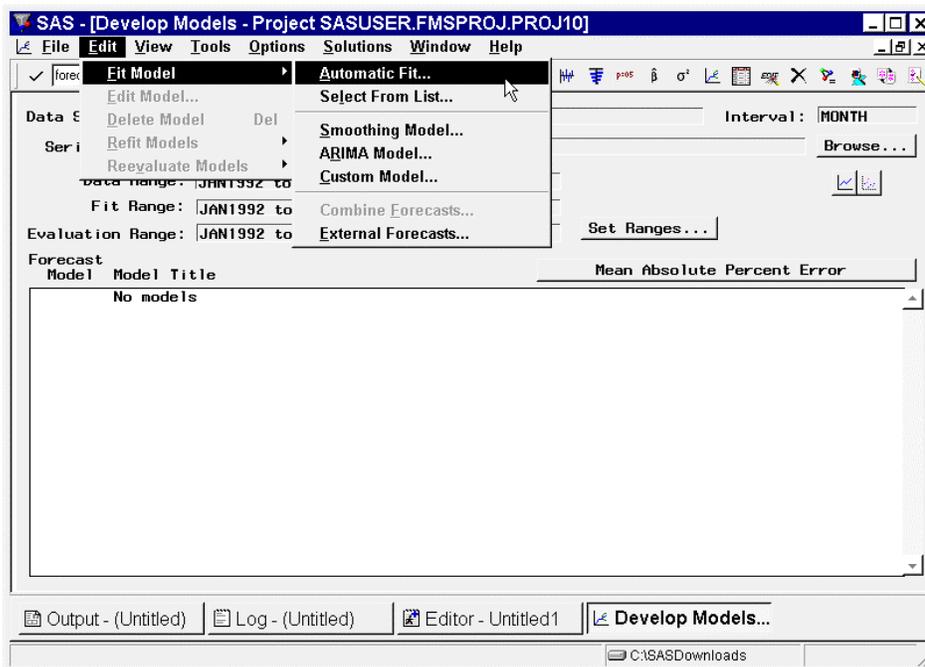
15. Notice that the button previously labeled **Root Mean Square Error** is now **Mean Absolute Percentage Error (MAPE)**. Time series models will now be automatically selected based on a selection criterion that minimizes the mean absolute percentage forecast errors (which is often recommended).



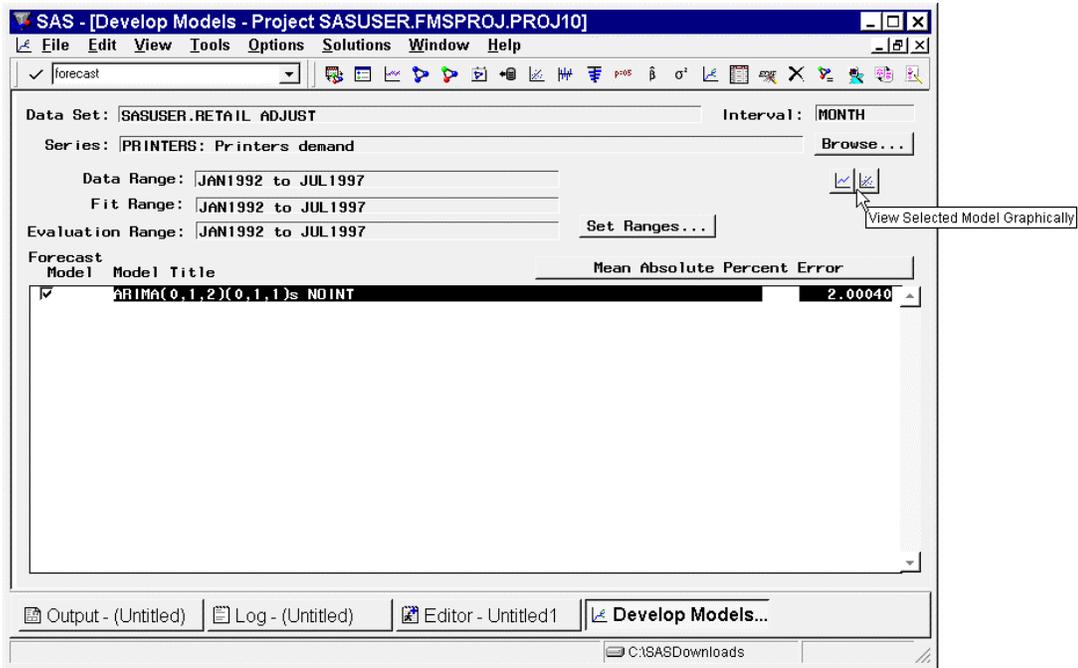
16. From the menu, select Options->Model Selection List. The **Model Selection List** dialog appears. The **Model Selection List** dialog specifies the list of candidate models to be used in automatic model fitting. In this window, you can add, delete, and, disable candidate models as needed.



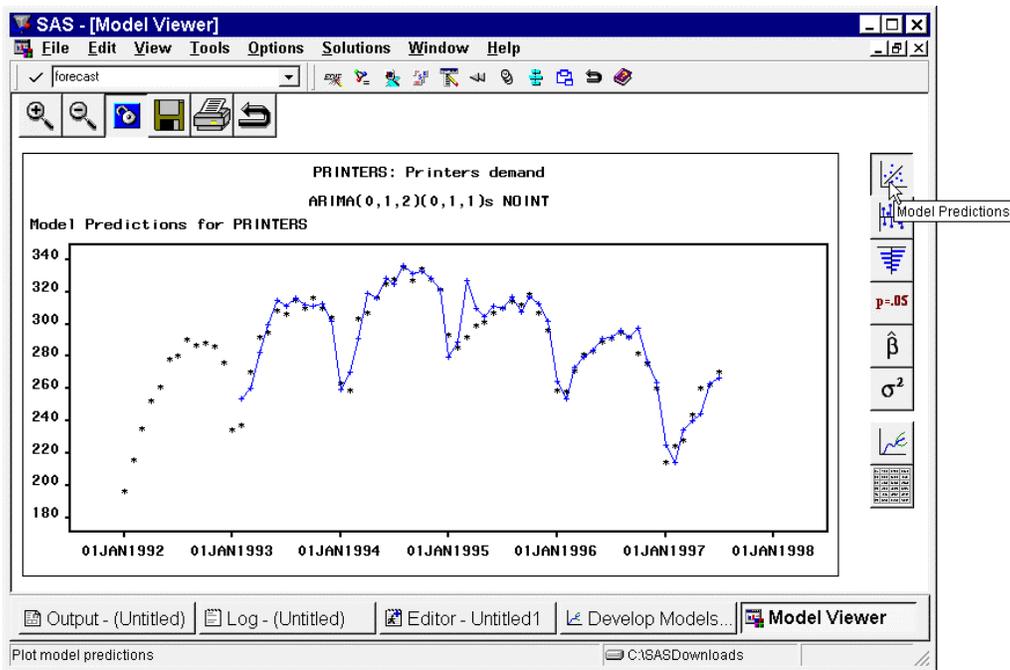
17. In the **Model Selection List** dialog disable (de-select) all of the smoothing models and Winters Method for these models do not support adjustments. The default model selection list contains 14 of these models. Click **OK**. The **Develop Models** window will appear.



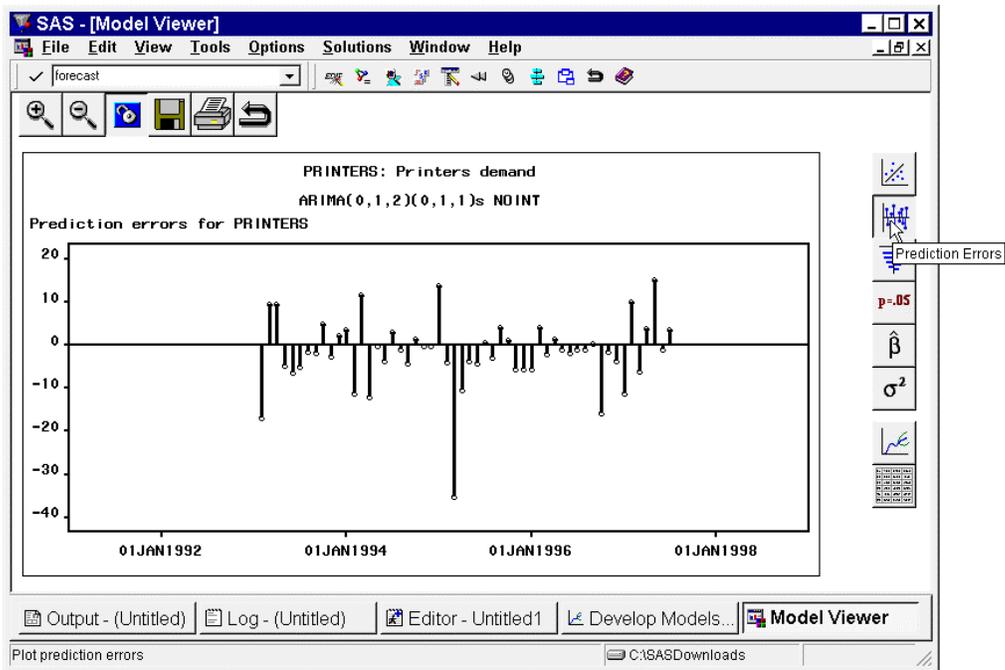
18. From the menu, select Edit->Fit Model->Automatic Fit. The **Automatic Model Selection** dialog will appear stating the number of candidate models to be fit. Click **OK**. The Time Series Forecasting System will fit all models in the Model Selection List (which can be customized), select the best model based on the chosen Model Selection Criterion (in this case MAPE), and keep the best fitting model (depending on the Automatic Model Selection Options).



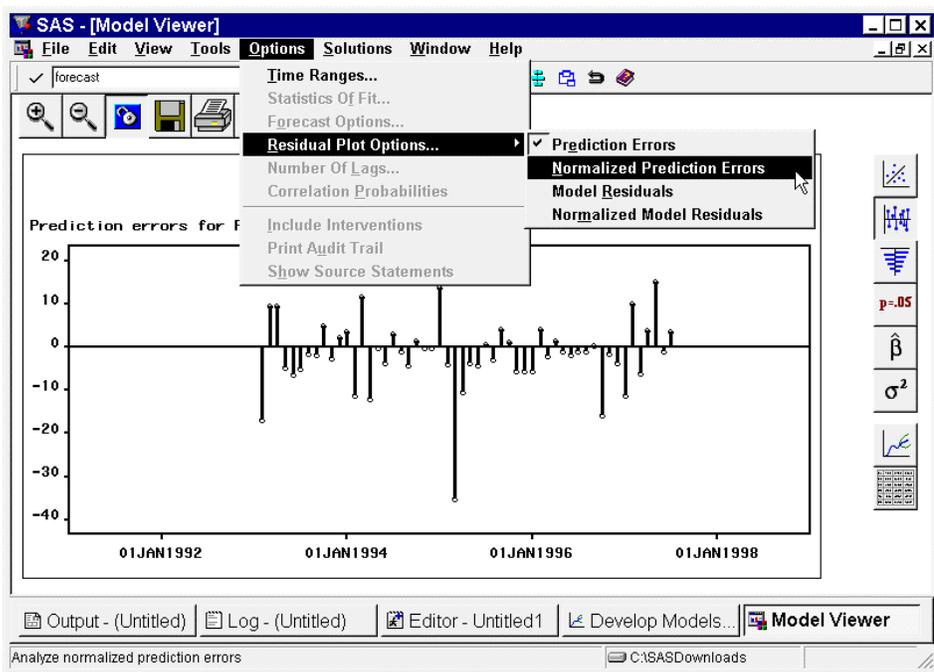
19. Notice that after fitting several models, the model ARIMA(0,1,2)(0,1,1)s NOINT was chosen as the best model. This *model* is a moving average model with simple and seasonal differencing which was suggested from our previous analysis of the time series. Once the automatically selected model has been chosen, click the **View Selected Model Graphically** icon. The **Model Viewer** will appear. The **Model Viewer** is used to analyze the properties of a time series model interactively.



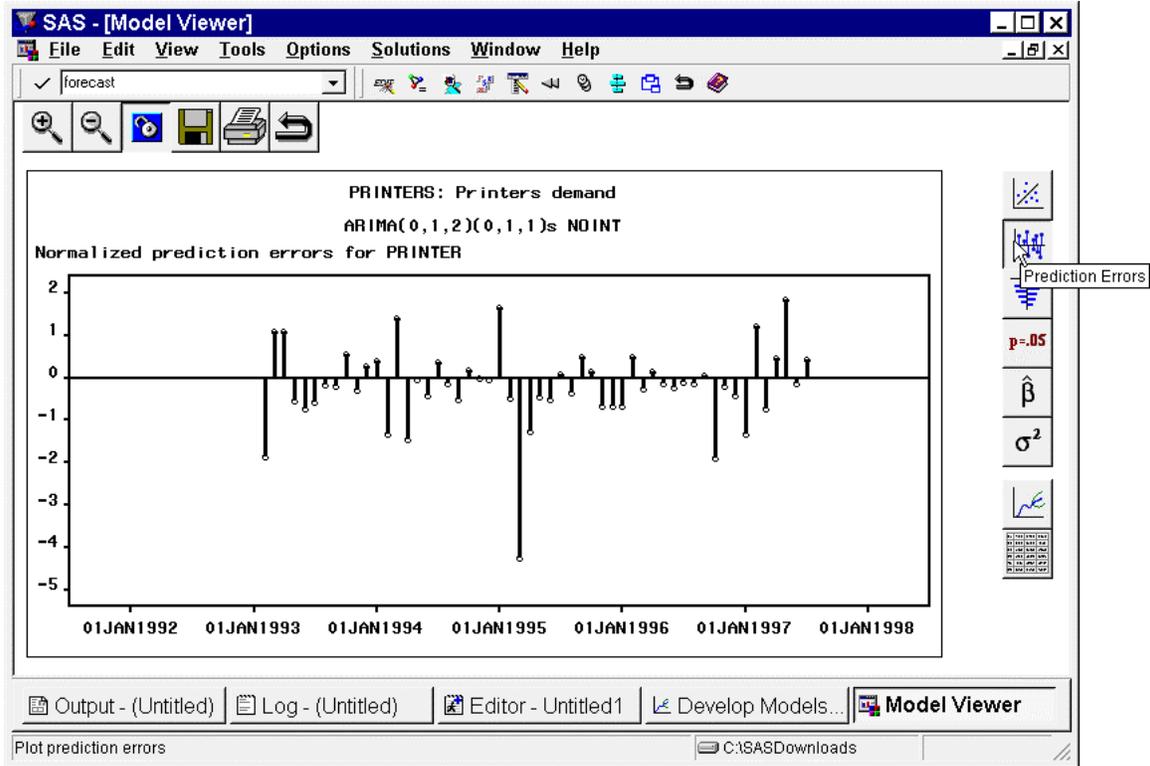
20. When the Model Viewer appears, a plot of the time series and the one-step ahead model predictions is displayed. Notice how closely the model one-step ahead predictions fit the time series. Click on the **Prediction Errors** icon.



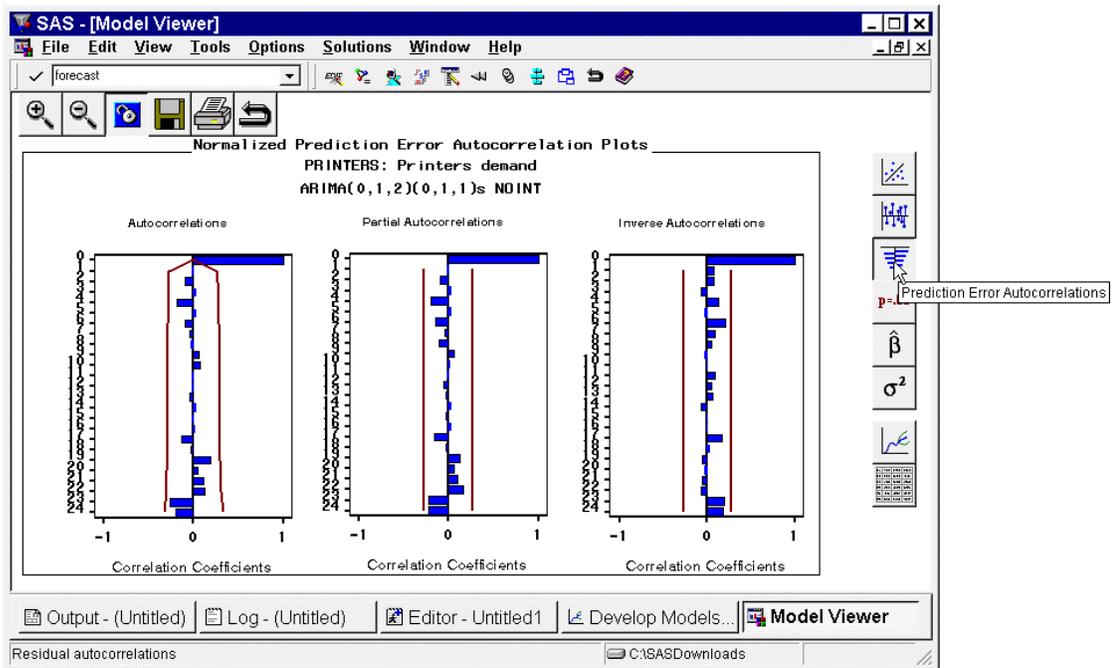
21. A plot of the prediction errors is displayed. Notice that most of the predicted errors are small in magnitude with respect to the time series.



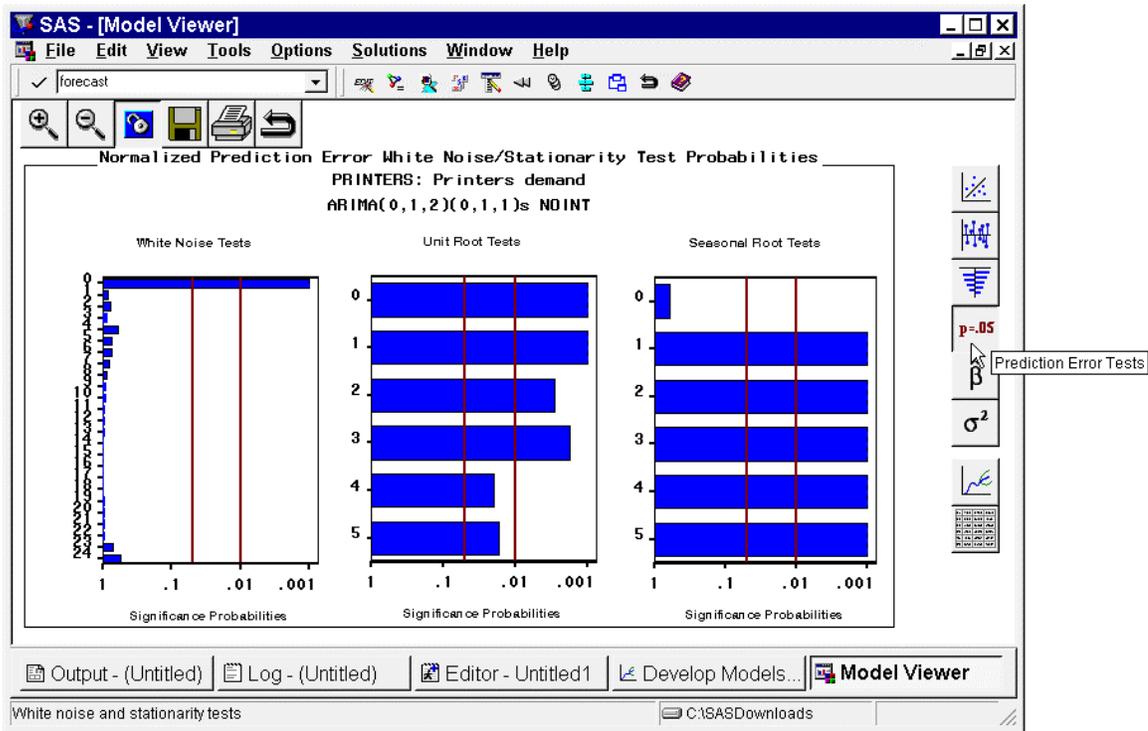
22. From the menu, select Options -> Residual Plot Options -> Normalized Prediction Errors. A plot of the normalized prediction errors is displayed.



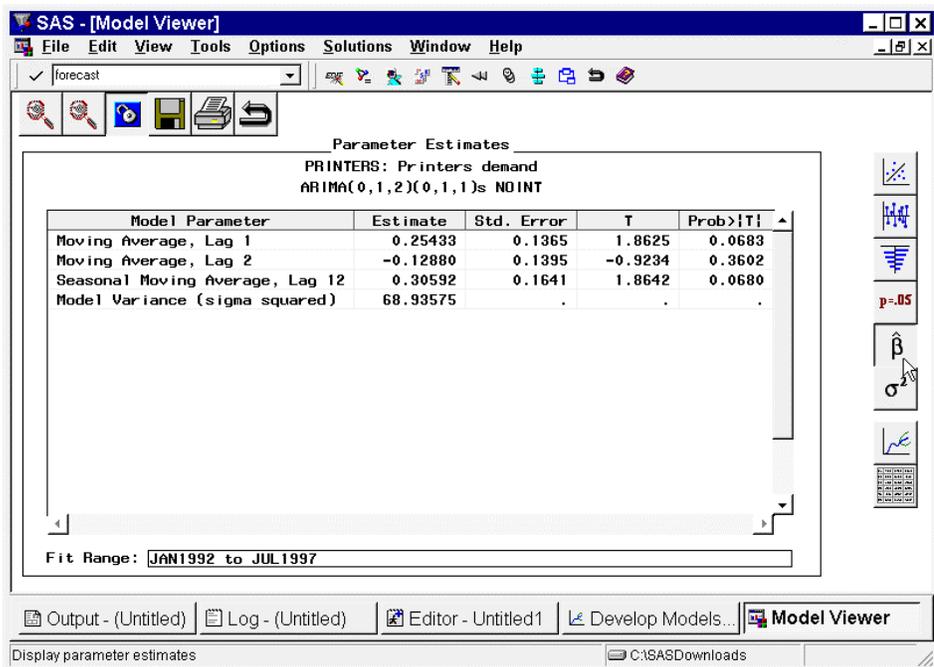
23. Notice that most of the prediction errors are less than two prediction error standard deviations but some are not. This result shows that the model selected by automatic model fitting is pretty good but not perfect. Click on the **Prediction Error Autocorrelation** icon.



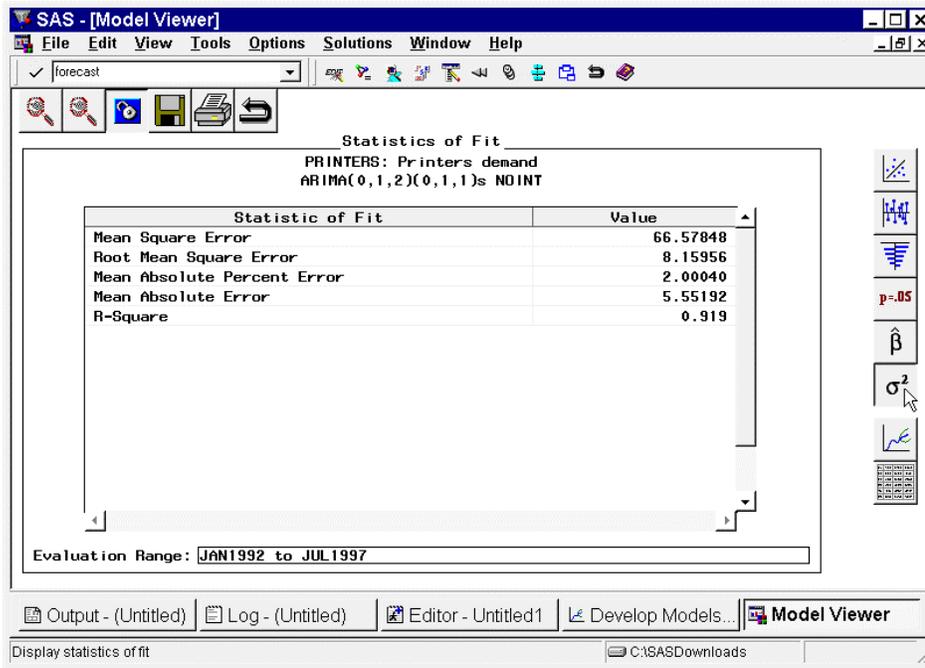
24. Notice that the prediction error autocorrelation, partial autocorrelation, and inverse autocorrelation are insignificant at all time lags. These statistics indicate that the model prediction errors have no significant patterns that have not been modeled. Click on the **Prediction Error Tests** icon.



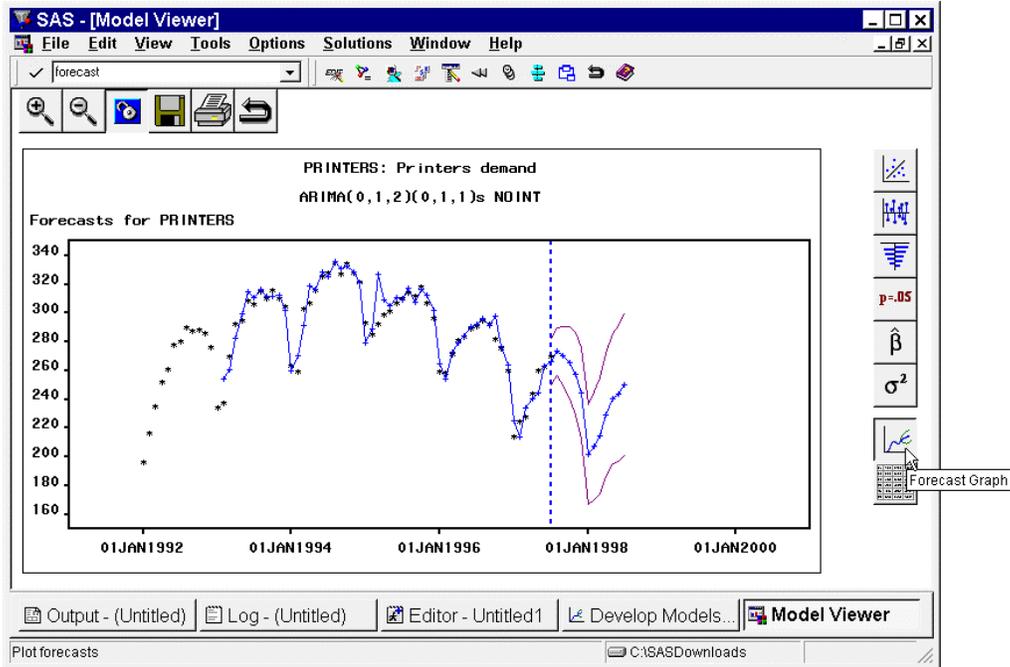
25. Notice that the White Noise Test graphic is nearly completely white, indicating that the model prediction errors represent white noise or that no significant patterns in the model prediction errors exists. Notice also that both unit root and seasonal unit root tests indicate stationarity of the prediction errors. Click on the **Parameter Estimates** icon.



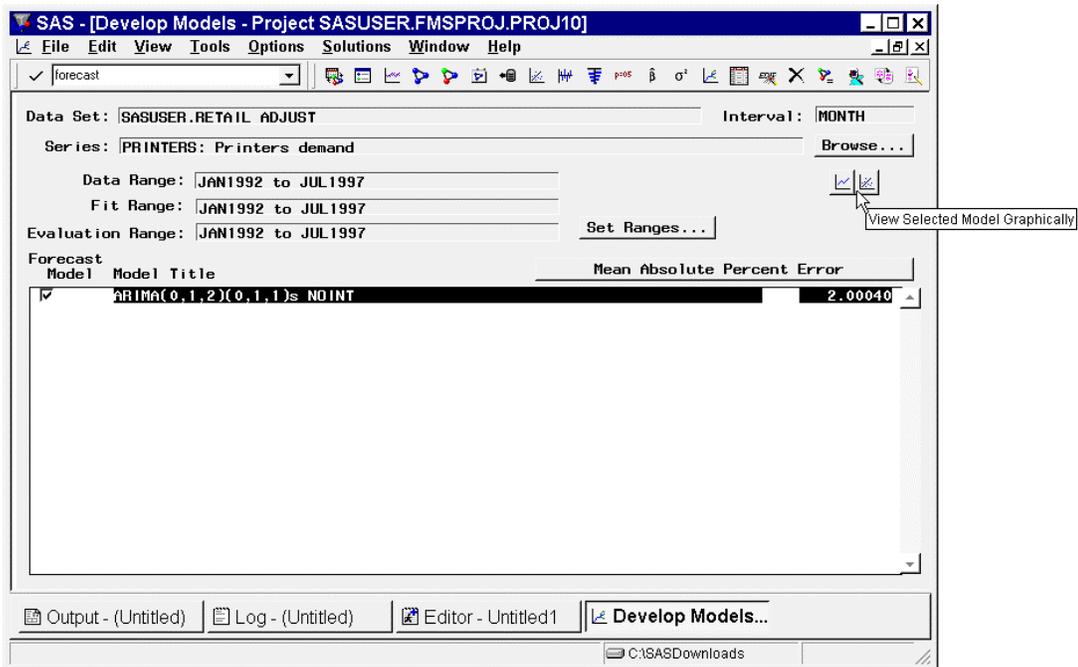
26. Notice that all parameter estimates are significant with respect to a 0.05 significance level with the exception of the second simple moving average parameter. Later we will remove this insignificant parameter when we customize the model for the adjustment needed to model the proposed promotion. Click on the **Statistics of Fit** icon.



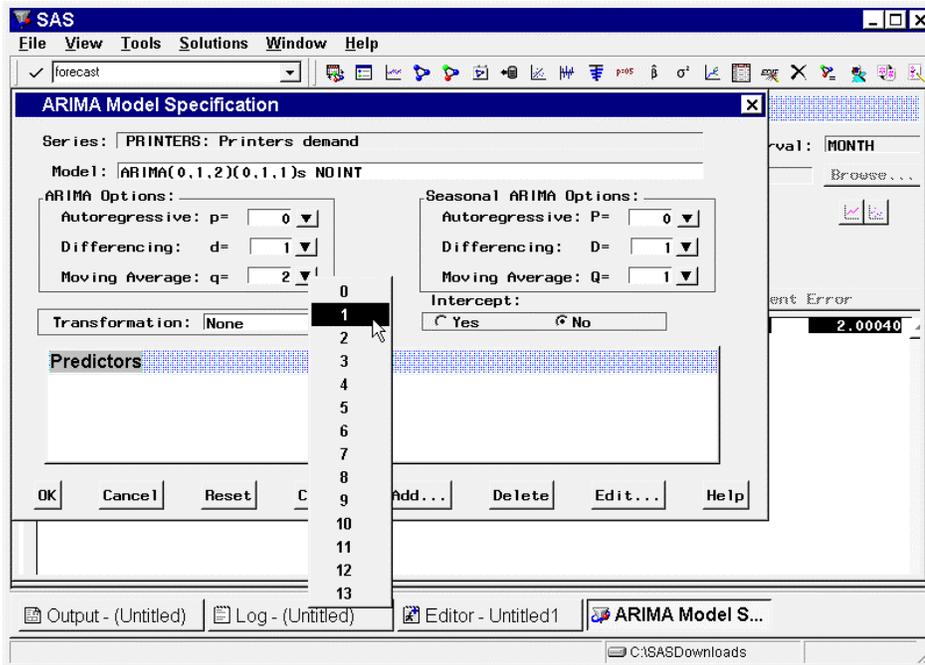
27. This Statistic of Fit table lists various goodness of fit statistics. More can be viewed by selecting Options -> Statistics of Fit from the menu. Based on the Prediction Errors, Prediction Error Autocorrelations, Prediction Error Tests, and the Parameter Estimates, the model selected by automatic fitting is pretty good, although it may be improved upon with further analysis. Click the **Forecast Graph** icon.



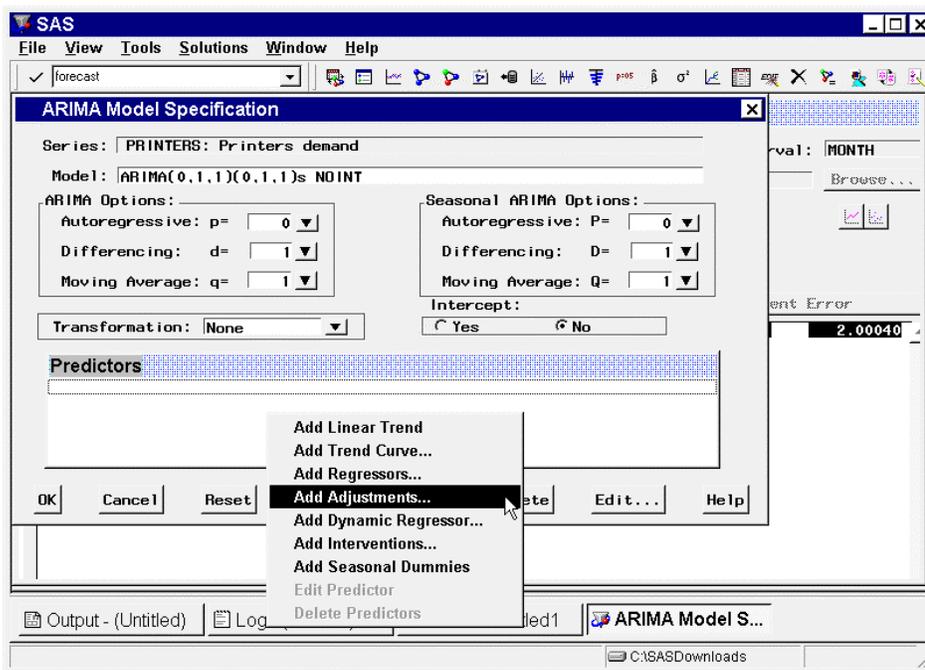
28. Notice how the predictions and confidence limits are plotted. When we adjust the forecast for the proposed promotion, these plots will change. Close the **Model Viewer** by selecting the Close Icon. The **Develop Models** window will appear.



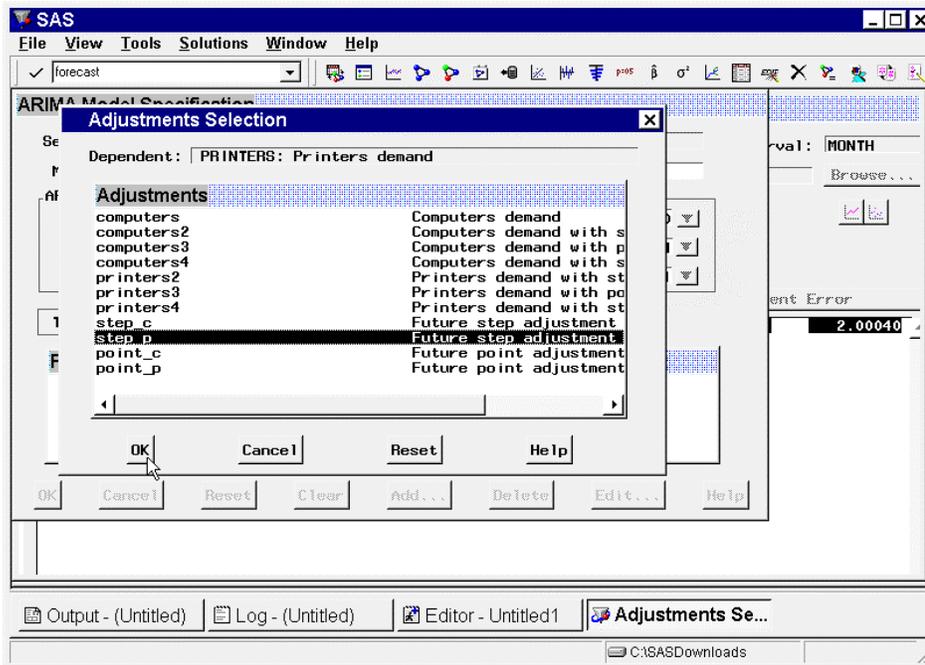
29. From the menu, select Edit->Edit Model. The **ARIMA Model Specification** window will appear.



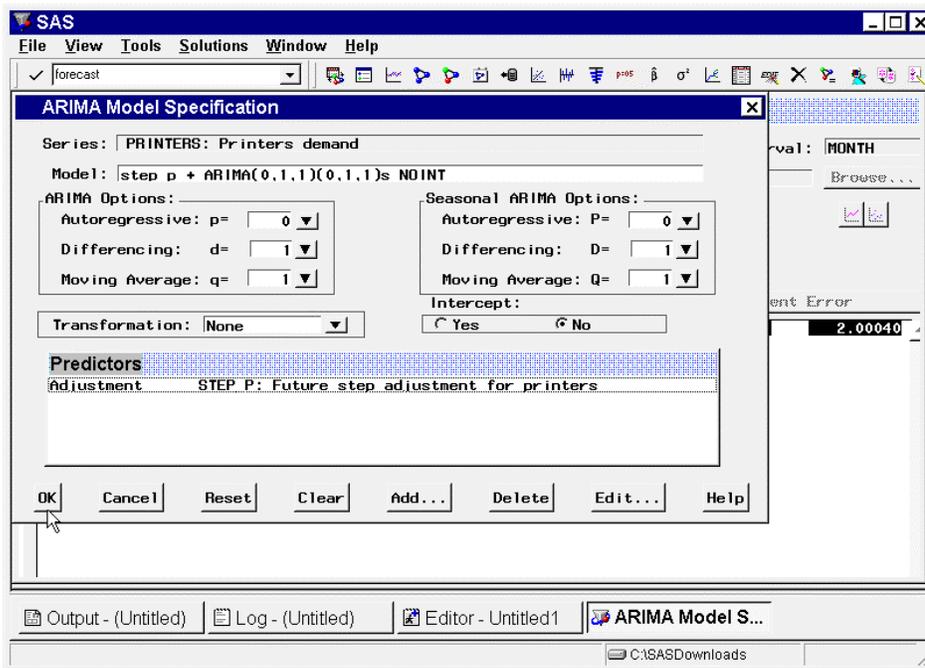
30. In the **ARIMA Model Specification** window, click the **Moving Average** combo box and select **1**. This step will remove the parameter judged insignificant in the previous model.



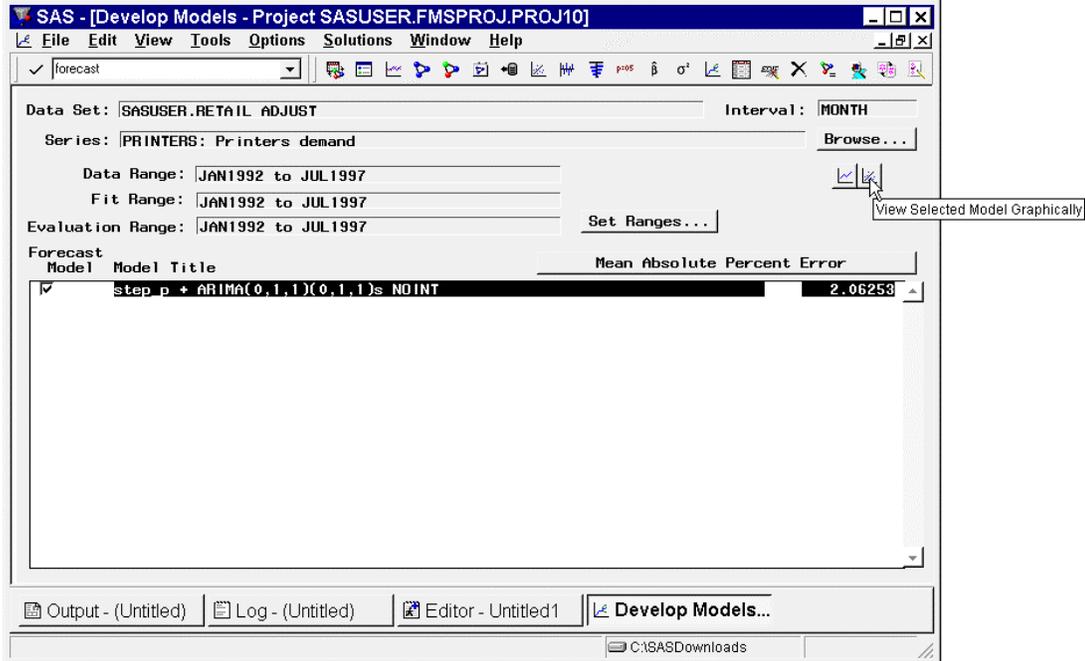
31. In the **ARIMA Model Specification** window, click the **Add** button and select **Adjustments**. The **Adjustments Selection** window will appear.



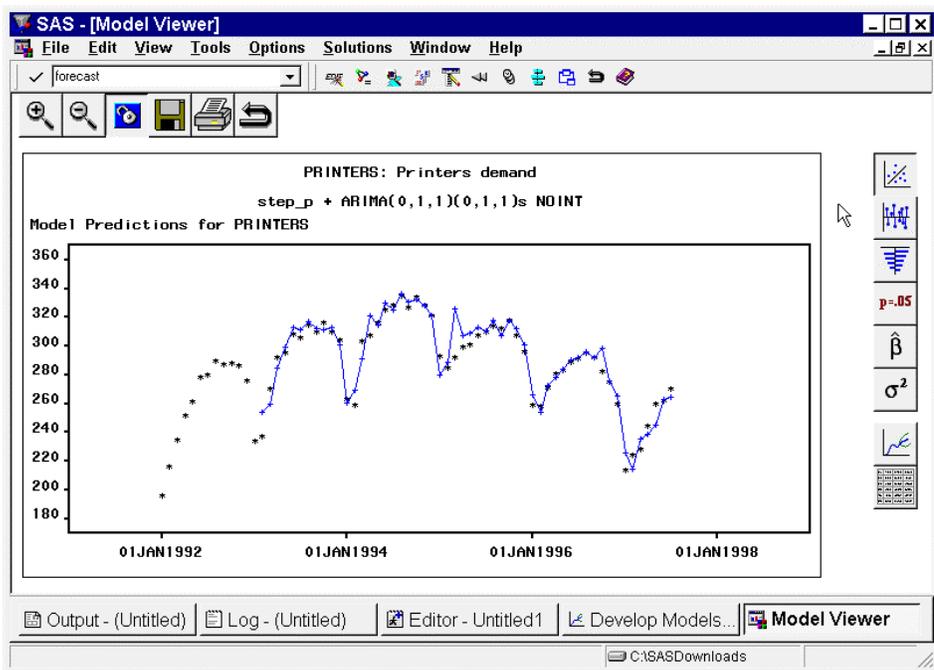
32. In the **Adjustment Selection** dialog, select the variable **STEP_P** and click **OK**. The **ARIMA Model Specification** window will appear.



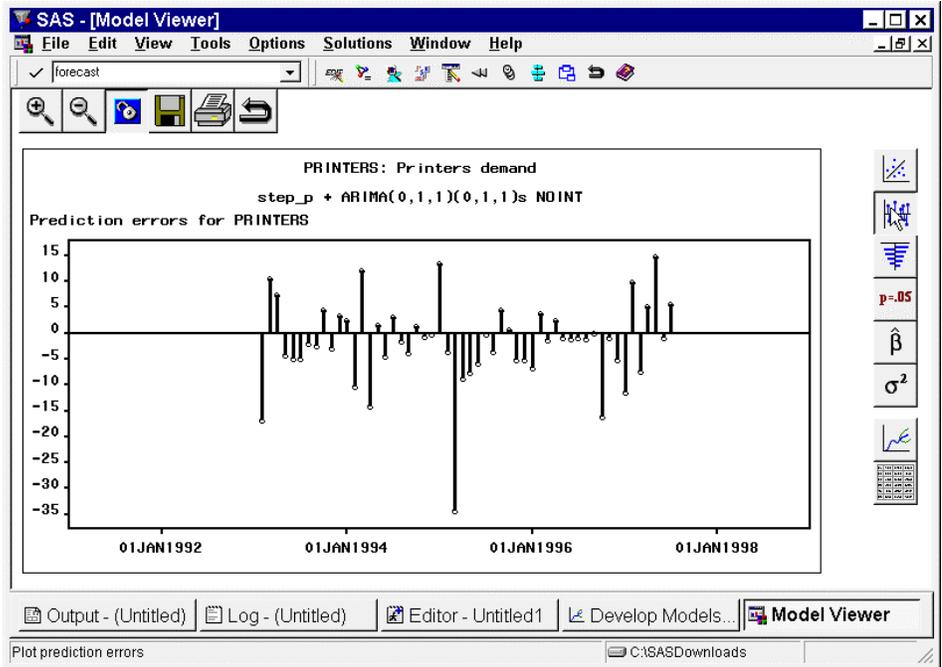
33. In the **ARIMA Model Specification** window, click **OK**. The model will be re-fitted and forecast will then be adjusted and the **Develop Models** window will appear.



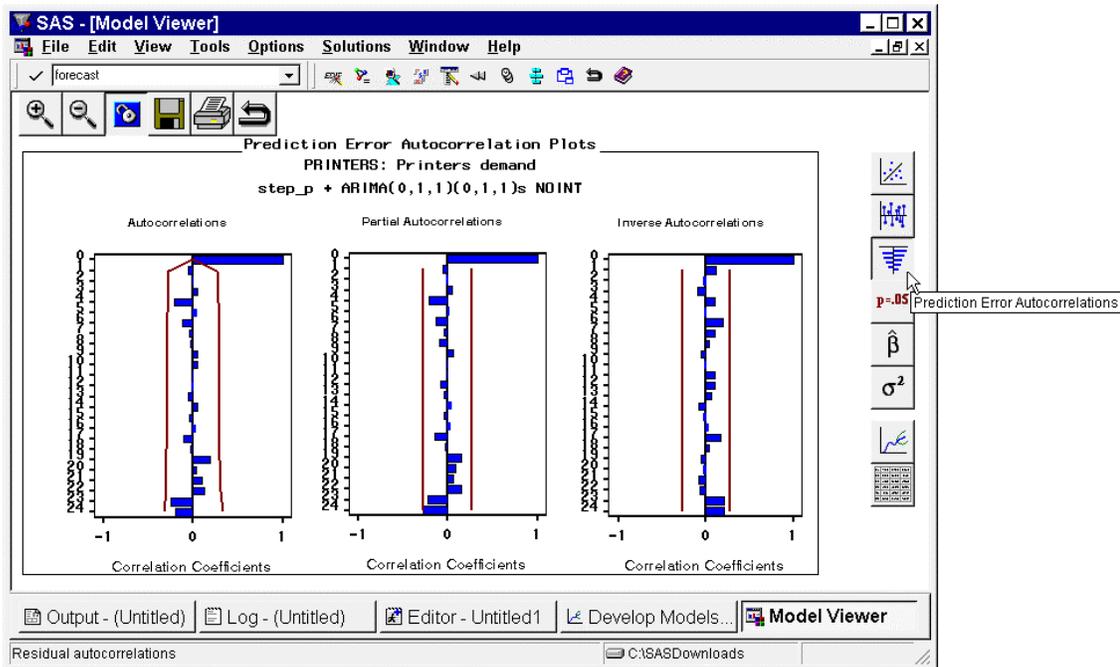
34. Once the model has been re-fit, click the **View Selected Model Graphically** icon. The **Model Viewer** will appear. The Model Viewer is used to interactively analyze the properties of a time series model.



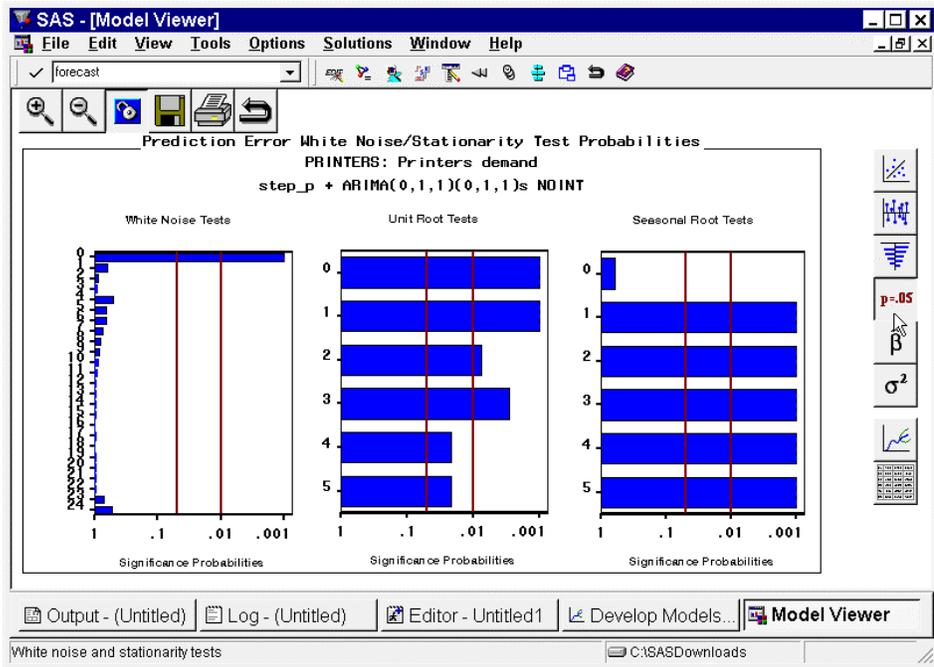
35. Notice that the model one-step ahead predictions are unchanged, because adjustments to the forecast do not affect the fitted model. Click on the **Prediction Errors** icon.



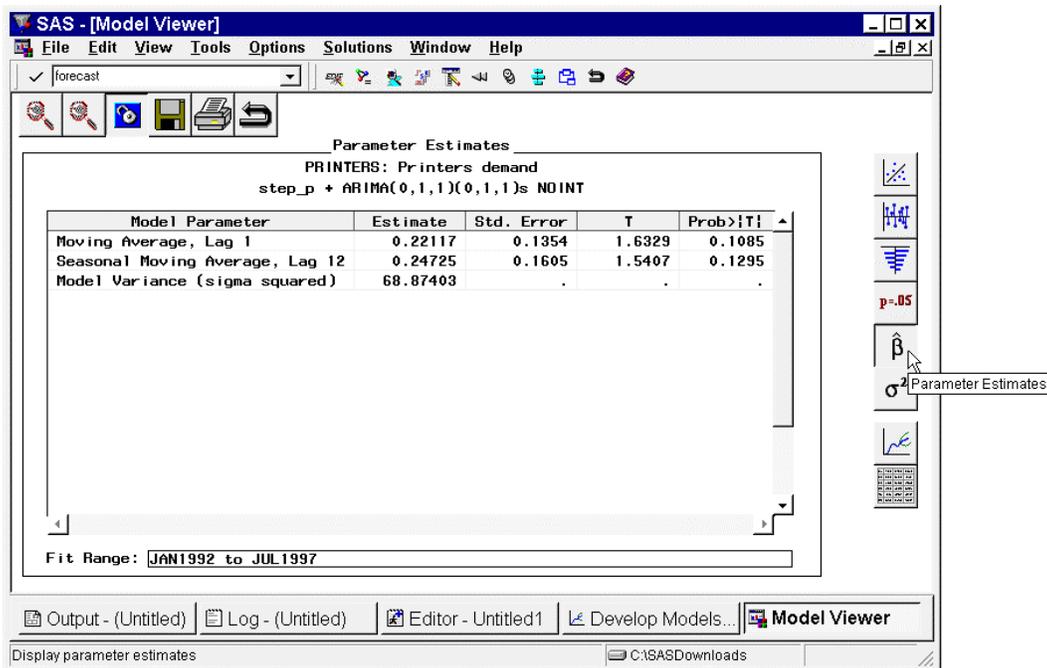
36. A plot of the prediction errors is displayed. Notice that most of the predicted errors are small in magnitude with respect to the time series. You may want to explore the normalized prediction errors as previously demonstrated. Click on the **Prediction Error Autocorrelation** icon.



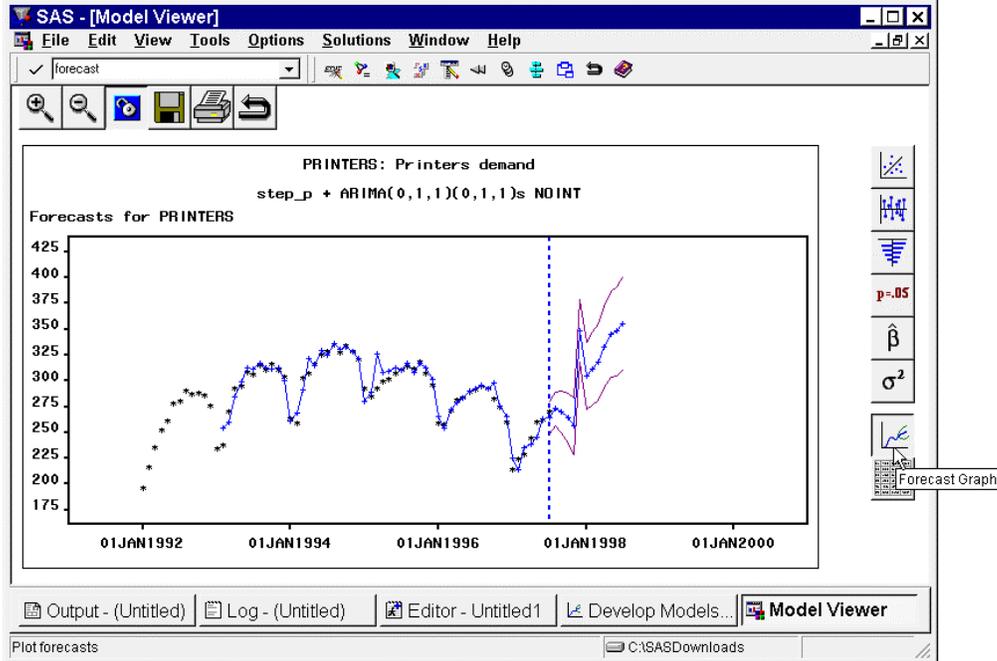
37. Notice that the prediction error autocorrelation, partial autocorrelation, and inverse autocorrelation are insignificant at all time lags. These statistics indicate that the model prediction errors have no significant patterns that have not been modeled. Click on the **Prediction Error Tests** icon.



38. Notice that the White Noise Test graphic is nearly completely white, indicating that the model prediction errors represent white noise or that no significant patterns in the model prediction errors exists. Notice also that both unit root and seasonal unit root tests indicate stationarity of the prediction errors. Click on the **Parameter Estimates** icon.



39. Notice that all parameter estimates are insignificant with respect to a 0.05 significance level but they're more significant than the previous model. The insignificance of the parameters may be due to the fact that after simple and seasonal differencing, the series is essentially white noise. More model fitting and checking can be performed but we will proceed. Click on the **Forecast Graph** icon.



40. Notice that the forecasts and confidence limits have now changed starting at December 1997 based on the adjustment based on the proposed promotion. It is worthy to compare this graph with the previous model without the adjustments to the forecasts.

The ARIMA (0,1,2)(0,1,1)s model was selected from the candidate models based on a selection criterion (MAPE); however, further analysis suggested that an ARIMA (0,1,1)(0,1,1)s model was more desirable. The forecasts were generated using this model. The forecasts were then adjusted by the proposed deviation (106 units).

This simple demonstration showed how to use the SAS/ETS ® Time Series Forecasting System for promotional forecasting using adjustments.