ABSTRACT

Release 6.03 of SAS/ETS software is available for PCs and for Sun and HP Unix systems. It includes all the procedures of Version 5 plus several significant enhancements and one entirely new procedure.

This paper reports on the new features in Version 6.03 of SAS/ETS Software and reviews work now in progress on new features for future release.

THE NEW EXPAND PROCEDURE

Conversion of time series to different frequencies and the ability to automatically interpolate missing values in time series were the two features most frequently requested by SAS/ETS users on the SASwear Ballot. The new EXPAND procedure is both a complete tool for collapsing or expanding time series to any desired frequency, and a missing value interpolation procedure.

For example, quarterly estimates can be constructed from annual series, or quarterly values aggregated to annuals. Missing values can be interpolated either without change of series frequency, or in conjunction with expanding or collapsing a series.

Figure 1 Interpolation of Missing Values

PROC EXPAND can convert between any combination of input and output frequencies, and a wide range of interval types are supported. The FROM= option gives the time interval for the input frequency and the TO= option gives the interval for the output frequency. For example, to convert yearly series to monthly you could use the statements shown in Figure 1.

```
proc expand data=a set=b; id date; run;
```

NEW TIME INTERVALS

Interval names are used to specify the frequency of time series. Interval specifications are used on the FROM= and TO= options of PROC EXPAND, and on the INTERVAL= option of several other SAS/ETS procedures.
The syntax for specifying the frequency of time series data has been generalized to incorporate multiple and shifted intervals, and three new interval classes have been added. Eleven interval class names are now supported: YEAR, SEMIYEAR, OTR, and three new interval classes have been added. Eleven interval names can be qualified with a starting subperiod number, thus supporting conversions involving fiscal years, work shifts, and so forth. The starting subperiod index is suffixed to the interval class name. For example, YEAR2 specifies fiscal years beginning in July.

Multiple period intervals can be constructed by suffixing a number to the interval class name. For example, YEAR2 indicates a biennial frequency, while the interval MONTlTH2 is a bimonthly frequency.

In addition, most kinds of interval names can be qualified with a starting subperiod number, thus supporting conversions involving fiscal years, work shifts, and so forth. The starting subperiod index is suffixed to the interval class name after a period. For example, YEAR2 specifies fiscal years beginning in July.

Figure 4 shows some examples of generalized interval specifications which indicate the various possibilities.

**Figure 4** Examples of Time Interval Specification

**CHANGES TO PROC MODEL, SYSNLIN, AND SIMNLIN**

The three nonlinear systems modeling procedures: MODEL, SYSNLIN, and SIMNLIN, have been combined into a new interactive PROC MODEL. The MODEL procedure now estimates parameters when a FIT statement is used, and solves the equation system to produce forecasts and model simulations when a SOLVE statement is used.

PROC SYSNLIN and PROC SIMNLIN can still be used, and existing PROC MODEL programs do not need to be changed. Compatibility has been maintained so that older SAS programs using these procedures will still run. However, in Version 6 of SAS/ETS, PROC SYSNLIN just invokes PROC MODEL with a generated FIT statement, and PROC SIMNLIN just invokes PROC MODEL with a generated SOLVE statement.

FIT and SOLVE statements may be used interactively and any number of them may be used in a PROC MODEL program. You can use different input data sets and create different output data sets with each FIT or SOLVE statement. For example, you could use one data set for input and one for output, or you could use the same data set for both input and output.

A major new MODEL feature in 6.03 is the ability to compute inputs needed to produce target outputs. The new SOLVE statement allows the model to be solved "backwards" to produce goal seeking solutions. Any subset of model variables (endogenous or exogenous) may be listed in the SOLVE statement, and PROC MODEL will compute a solution for those variables conditioned on the input values of the other variables.

In addition to combining the three procedures into one, the new PROC MODEL is easier to use in other ways. PROC MODEL now uses more intelligence to infer variable attributes from context. Thus declaration statements that were required in Version 5 are now often optional.

It is no longer necessary to classify model variables as ENDGENOUS and EXOGENOUS. PROC MODEL now automatically reads variables from the input data set, and copies all the variables in the input data set used in the model to the output data set. Thus it is now not necessary to declare exogenous variables at all, and the OUTVARS statement is normally not needed.

For example, a nonlinear regression model for Y as a power function of X can now be fit with PROC MODEL using the statements shown in Figure 5.

```
proc model data=s; y = x + b * x ** c; fit y; run;
```

**Figure 5** Nonlinear Regression Example

Another major enhancement is that PROC MODEL can now handle general form equation systems as well as normalized form equation systems. This is useful, for example, for supply and demand models.

In a normalized form equation system each equation must be written as an assignment to a different model variable, with one equation for each endogenous variable.

In a general form equation system the equations are written as expressions which must equal zero and are assigned to a variable that labels the equation. With the general form equations it is not necessary to write the equation as a prediction for a specific dependent variable.

General form equations are identified by special EQ prefixed names. For example, points of intersection of a circle of radius r and an exponential function could be solved by PROC MODEL with the statements shown in Figure 6.

```
proc model data=s;
  eq.coe = x ** 2 + y ** 2 = r ** 2;
  eq.exp = exp(x) - y;
  solve x y satisfy one eq / print ;
  run;
```

**Figure 6** General Form Equation System

Several other PROC MODEL features are new in Release 6.03.

In solving a simultaneous equation system, PROC MODEL now makes use of efficient sparse matrix techniques to invert the partial derivatives matrix, which saves memory and computer time for large models.

PROC MODEL now supports several programming and attribute statements of the SAS DATA step that were not supported in earlier versions, and several other differences between the PROC MODEL programming language and the SAS DATA step language have been removed, although some minor differences remain.

All of the DATA step functions are now supported by PROC MODEL, including the probability functions, sample statistics.
functions, and financial functions. The differentiator has been improved to compute analytic derivatives for most functions not previously supported, and numerical derivatives are computed for the few functions that it does not differentiate analytically.

A new option is available to report information on the dependency structure of the model. The LISTDEP option lists, for each variable used in the model, the variables that it depends on and the variables that depend on it.

Figure 7 shows an example which illustrates some of the new PROC MODEL features.

```
/* invoke the MODEL procedure -------------------------------------*/
proc model;
/* define the model equations -------------------------------------*/
eq.demand = d0 + d.p * price + d.i * income
          + d.a * adxpent - quantity;
eq.supply = s0 + s.p * price + s.w * wage - quantity;
/* estimate the parameters from historical data using the
 two stage least squares method ---------------------------------*/
   fit {d=adxpent} supply / datad=s=history2sls;
/* fit demand supply / datad=history2sls;
   instruments income wage rate adxpent;
/*.forecast the fitted model for assumed future values of income
   and wage rate and planned advertising expenditures -----------
   solve price quantity / data assume out-forecast;
/* compute a goal seeking solution for price and advertising
   that satisfies the simultaneous equations system for
   target sales quantity and forecast income and wage rate -->
   solve price adxpent / data equal out-plan;
/* print the forecast ---------------------------------*/
   proc print data=forecast;
/* print the goal seeking solution ---------------------------------*/
   proc print data=plan;
Figure 7 Illustrative PROC MODEL program for Supply/ Demand Model
```

**Enhancements to OTHER SAS/ETS PROCEDURES**

Many other SAS/ETS procedures have been enhanced in Version 6.03.

**Enhancements to PROC ARIMA**

A major new feature is support for ARIMA modeling of series with imbedded missing values. PROC ARIMA, in addition to basic ARIMA models, can also process transfer function models with missing values in the response variable or the predictor variables.

Also new with Version 5.03 of PROC ARIMA is an option on the IDENTIFY statement to write the autocovariance, autocorrelation, partial autocorrelation, and inverse autocorrelation functions to an output SAS data set.

**Enhancements to PROC SYSLIN**

Another major new feature in Release 6.03 SAS/ETS is support for full information maximum likelihood estimation by PROC SYSLIN.

**Enhancements to PROC SIMLIN**

PROC SIMLIN can now produce an output data set containing the reduced form coefficients and the multipliers.

PROC SIMLIN can now apply the BY statement to either the EST= or the DATA= input data set. If the BY variables are found in the EST= data set, the BY statement is applied to the EST= data set. Otherwise the BY statement applies to the DATA= data set.

The SIMLIN Statistics of Fit report now includes columns for Mean Error, Mean % Error, Mean Abs Error, and Mean Abs % Error, in addition to Root Mean Square Error and Root Mean Square % Error.

**Enhancements to PROC FORECAST**

PROC FORECAST now supports the additive version of the Winters method. The ADOWINTERS method is like the WINTERS method except that the seasonal factors are added to the trend instead of multiplied with the trend.

The way that PROC FORECAST initializes the seasonal parameters for the WINTERS method has also been changed. Instead of starting the seasonal parameters at 1.0, the ratio of the average value for each season over the first two years of the series to the overall average for those years is used.

PROC FORECAST now allows gaps in the input observations. For example, if INTERVAL=MONTH and the input observations skip from January to April, PROC FORECAST will assume two observations with all missing values for February and March.

**Enhancements to PROC COMPUTAB**

PROC COMPUTAB can now assign formats to specific cells of the COMPUTAB data table with the new CELL statement. Formats specified in CELL statements override formats specified in ROW and COLUMN statements. The form of the CELL statement is shown in Figure 8.

```
cell rowname, colname ... / format=format;
Figure 8 The PROC COMPUTAB CELL Statement
```

**Enhancements to PROC CITIBASE**

PROC CITIBASE now supports different compounding intervals, including continuous compounding, and it is no longer restricted to monthly payment schedules. PROC CITIBASE now has an option to write the loan summary report information to an output data set.

**Enhancements to PROC MORTGAGE**

PROC MORTGAGE now supports different compounding intervals, including continuous compounding, and it is no longer restricted to monthly payment schedules. PROC MORTGAGE now has an option to write the loan summary report information to an output data set.

**Enhancements to PROC X11**

PROC X11 now supports a TABLES statement to select the tables to be printed. For example, to print X11 tables C15 and D10 you could use the TABLES statement in Figure 9.
Figure 9  The PROC X11 TABLES Statement

PROC X11 can now process data sets with missing values at the beginning or end of the series, and the format of the printing of the tables has been improved.

FUTURE PLANS AND WORK IN PROGRESS

Now that the conversion of SAS/ETS Software from Version 5 to the Multi-Vendor Architecture of Version 6 is complete, the SAS/ETS development staff can move on to new projects. In deciding on new work to undertake, we will be guided by the SASware Ballot results.

New Loan Analysis Procedure

The leading SAS/ETS SASware Ballot item this year was to give PROC MORTGAGE the ability to analyze variable rate mortgages. We have decided to go further and develop a new procedure for general loan analysis and comparison.

A new procedure to analyze adjustable rate, fixed rate, balloon payment, and buydown rate mortgages and other kinds of loans is near completion. The new loan analysis procedure, PROC LOAN, can also compare different loans on any of several economic criteria and report the best alternative.

New Financial and Economic Database Access Procedure

More interfaces to financial and economic databases has been popular with SASware ballot respondents for years, and we have now started a project to provide a comprehensive solution.

Work is now underway on a new procedure to make it easy to extract data from many different kinds of economic and financial data files, just as the current PROC CITIBASE procedure makes it easy to extract data from CITIBASE data files.

Our short term goal for this new procedure is to read data from International Financial Statistics data tapes from the International Monetary Fund, as well as support CITIBASE and COMPSTAT files. Other data sources will be added later.

Support for X11-ARIMA

Work is also underway on supporting the Statistics Canada X11-ARIMA variant of the Census X11 seasonal adjustment method.

Menu Driven Applications

We are also working on some menu driven applications for forecasting, financial analysis, time series analysis, and econometric modeling. These application will be available through SAS/ASSIST in a future release, and will serve as a partial front-end to SAS/ETS facilities.

Other Projects Planned

An number of other projects are under study but not yet started. In addition to new procedures, we will continue to add more enhancements to the existing procedures.