



## SAS/ETS® Software

Integrated econometric and time series techniques for modeling, forecasting and simulating business processes

### What does SAS/ETS® software do?

SAS/ETS offers a broad array of econometric, time series and forecasting techniques enabling you to model, forecast and simulate business processes for improved strategic and tactical planning.

### Why is SAS/ETS® important?

SAS/ETS equips you to address difficult, real-life questions by providing techniques to model complex business scenarios and analyze the dynamic impact that specific events might have on the business over time. It can help you understand the impact that factors such as economic and market conditions, customer demographics, pricing decisions and marketing activity have on your business, providing a scientific basis for better decision making. The forecasting process can help organizations be more proactive and shape their own destinies toward a profitable future.

### For whom is SAS/ETS® designed?

SAS/ETS software is designed for econometricians, forecasters and high-end data analysts responsible for supplying information to business planning processes and decisions. SAS/ETS is desirable for anyone needing breadth and flexibility to address their modeling, forecasting and simulation needs. Users include analysts responsible for supporting a planning process, or the manager of that process.

Measuring the impact of economic and marketplace factors, and getting a view of the future, are key elements for successful planning. You must be able to model and simulate any business process, and the factors that affect those processes – no matter how complex.

SAS/ETS software provides a wide range of integrated capabilities for econometrics and systems modeling, time series analysis, forecasting and financial analysis with direct access to commercial financial databases. Factors that affect your business – such as the economy, market conditions, customer demographics and marketing activities – can be identified, quantified and included in your forecasting and planning processes to improve results.

### Key Benefits

- Analyze the impact of promotions and events.** The time series and econometric capabilities of SAS/ETS software provide users with several mechanisms for determining promotional lift. The depth and flexibility of the SAS modeling environment can accommodate any business scenario. Determining the effectiveness of promotions and events enables you to better allocate marketing dollars in the future.
  - Model customer choices.** SAS/ETS software enables you to maximize marketing efforts by understanding which product features are important to a particular audience. Modeling customer choices based on the attributes of customers and their choices helps improve business strategy by predicting customers' decisions. Understanding these choices and the factors that influence them enables
- you to adjust marketing strategies or fee structures to modify choices or target the right population.
- Measure and predict marketing investment activities.** SAS/ETS software can help you understand which key business drivers are having the most effect on consumer demand. You can model customer demand based on marketing mix activities that measure the impact of pricing, advertising, in-store merchandising, store distribution, sales promotions and competitive activities. Using simulation and optimization tools, you can maximize investments to drive profitable volume growth.
  - Provide the information needed to make better staffing decisions.** SAS/ETS can provide forecasts of demand for services so that organizations can maximize staff resources. It can automatically account for seasonal fluctuations and trends, and can select the best method for generating the demand forecasts. Efficient staff allocations mean customers' needs can be met with no wasted resources.
  - Model risk factors and predict economic outcomes.** Copula methods in SAS/ETS software let you model multivariate dimensions of risk factors. These methods are valuable in risk management applications where many correlated risk factors must be modeled but where the risk factors are non-normally distributed. SAS/ETS can fit probability distributions for the severity (magnitude) of random events, such as the distribution of insurance claims after a disaster, disease outbreaks or the ordering of products with intermittent demand.



## Product Overview

SAS/ETS software offers a broad array of econometric, time series and forecasting techniques enabling you to model, forecast and simulate business processes for improved strategic and tactical planning. It provides techniques for modeling complex business scenarios and analyzing the dynamic effect that specific events might have on an organization over time.

### Explore time-stamped data for insight

By providing graphical and analytical exploration capabilities for time-recorded data, SAS/ETS software helps you uncover and quantify previously undetected trends. Time-stamped data can be decomposed into separate subcomponents – trend, seasonal and “unexplained” components – so you can understand and diagnose what is happening over time and what is expected to happen in the future. Time series decomposition can be performed using classical decomposition, unobserved components models, or the X11-ARIMA and X12-ARIMA methods developed

and popularized by the US Census Bureau and Statistics Canada.

### Forecasting methods

SAS/ETS provides analysts with the broadest array of methods to suit any forecasting problem. The forecasting capabilities in SAS/ETS can be accessed either through SAS procedures or from the interactive Time Series Forecasting System user interface. SAS/ETS contains popular forecasting methods such as regression, unobserved components models, trend extrapolation, exponential smoothing, Winters’ method, ARIMA (Box-Jenkins), and dynamic or transfer function models. For forecasting multiple time series jointly, SAS provides VARMAX and general state space models.

### Singular spectrum analysis

Singular spectrum analysis (SSA) is a technique for decomposing a time series into additive components and categorizing these components based on the magnitudes of their contributions. SSA uses a single parameter, the window length, to quantify patterns in a

time series without relying on preconceived notions about the structure of the time series. Both similarity analysis and singular spectrum analysis are exploratory tools for large numbers of time series with unknown structure.

### Similarity analysis for sets of time series

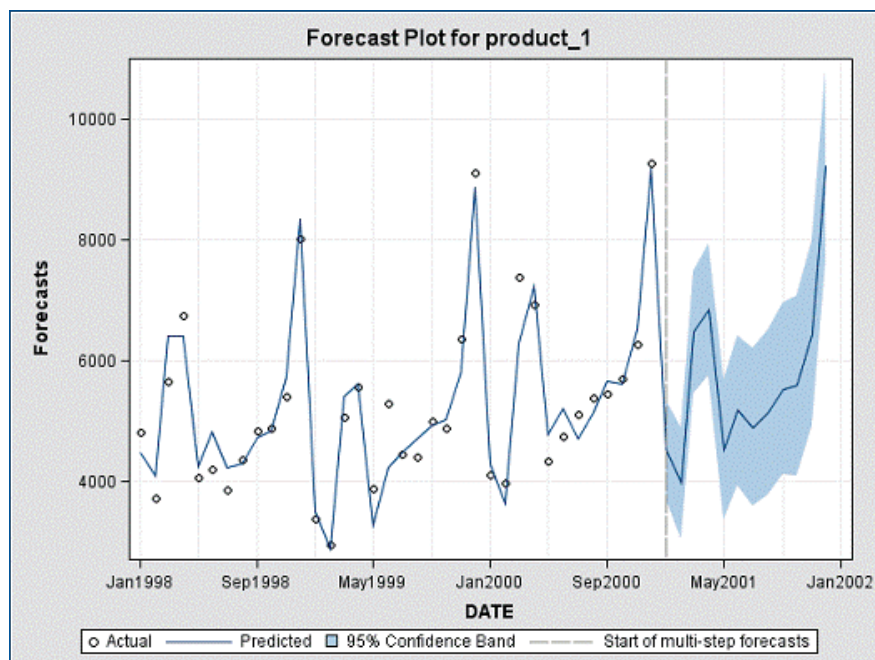
SAS/ETS computes similarity measures for time-stamped transactional data (transactions) with respect to time by accumulating the data into a time series format, and it computes similarity measures for sequentially ordered numeric data (sequences) by respecting the ordering of the data. In addition, it provides similarity measures that “slide” the target sequence with respect to the input sequence. The “slides” can be by observation index (sliding-sequence similarity measures) or by seasonal index (seasonal-sliding-sequence similarity measures). Similarity analysis results are useful for large-scale time series analysis, analogous time series forecasting, new product forecasting or time series (temporal) data mining.

### Modeling severity of events

A new procedure fits models for statistical distributions of the severity (magnitude) of events, such as insurance loss payments or intermittent demand for products. A set of predefined models for commonly used distributions (Burr, exponential, gamma, inverse Gaussian, lognormal, Pareto, generalized Pareto and Weibull) is included, and can be extended to fit any continuous parametric distributions.

### The Time Series Forecasting System

The Time Series Forecasting System is a point-and-click interface that provides interactive exploration and forecasting. It enables novice forecasters to quickly master the forecasting process, and provides a robust set of tools for more experienced analysts. The Time Series Forecasting System can generate forecasts automatically by



**Forecasting:** SAS/ETS can automatically select the most appropriate method for generating forecasts.

selecting the most appropriate forecasting model from an extensive list of candidate models. Advanced forecasters can create their own models in a model development workspace, and these models can then be added to the automatic model selection list. The Time Series Forecasting System allows outside data to be included in the forecasting process. Forecasts from others in your organization also can be fed into the system for statistical evaluation or combined with statistically generated forecasts, enabling a collaborative forecasting process.

### **Econometric analysis**

Econometric analysis is the application of statistical techniques to “economic” problems. SAS/ETS includes many econometric analysis capabilities, ranging from linear and nonlinear modeling of simultaneous equations to discrete choice models. SAS/ETS provides techniques for analysis of small data sets, limited and discrete dependent variables, and sample selection bias – all common problems in the real world.

### **Simulation for strategic forecasting and planning**

For strategic planning, SAS/ETS provides a variety of means for modeling business processes within what-if and Monte Carlo simulation analyses. Complex systems and processes can be simulated and a variety of scenarios can be tested, giving you a safe means for evaluating and fine-tuning proposed policies before actually putting them into practice.

### **State space modeling**

SAS/ETS provides a state space modeling language (experimental) that makes it easy to define very complex models. It can fit state space models for irregularly spaced data, even with replicate measurements for time points, and for longitudinal data where different subjects are measured repeatedly but

## **Key Features**

### **Full range of forecasting, time series and exploratory methods**

- Trend extrapolation; exponential smoothing; Winters' method (additive and multiplicative); ARIMA (Box-Jenkins).
- Structural time series models or unobserved components models.
- Dynamic regression or transfer function models.
- Joint forecasting of multiple time series using vector time series analysis and general state space models.
- Automatic outlier and event detection.
- Time series decomposition and seasonal adjustment.
- Spectral and cross-spectral analysis for finding periodicities or cyclical patterns in your data.
- Singular spectrum analysis.
- Similarity analysis for sets of time series.
- Estimate model parameters and simulate random data from fitted copula distributions.

### **Time Series Forecasting System**

- Point-and-click interface for exploring and forecasting time series data.
- Automatic selection of the most appropriate forecasting model for each time series.
- Mathematically optimized model parameters.
- Interactive model development facility for more experienced forecasters.
- Graphical display of time series diagnostics tests.
- Inclusion of regression variables and unusual events in the forecasting model.
- Diagnostic checks on fitted models.
- Option to statistically combine multiple forecasts.

### **Econometric analysis**

- Regression with correction for autocorrelated errors.
- Fitting, analyzing and simulation for simultaneous systems of both linear and nonlinear regression models.
- Multinomial discrete choice analysis.
- What-if, Monte Carlo simulation.
- Time series cross-sectional analysis.
- Qualitative and limited dependent variable models.

### **State space modeling**

- Linear state space modeling and forecasting of time series and longitudinal data.

### **Time series data management and preparation**

- Conversion of time series from one sampling frequency to another.
- Interpolation of missing values.
- Aggregation of time-stamped transactional data into time series.
- More than 100 time series transformation operations.
- Custom time intervals (functionality provided in Base SAS).

### **Financial analysis**

- Interactive analysis system for time-value-of-money analysis.

### **Provides tools to access many commercial and government databases**

- Commercial database vendors: FAME, DRI, Standard & Poor's (COMPUSTAT), Haver Analytics DLX and CRSP.
- US government data: Bureau of Economic Analysis, Bureau of Labor Statistics.
- International agency data: International Monetary Fund (IMF), Organization for Economic Cooperation and Development (OECD).
- SAS/ACCESS® interfaces and SAS Data Surveyors (licensed separately) provide seamless read, write and update access to other data sources, including relational and nonrelational databases, PC file formats, data warehouse appliances and enterprise applications.

at different times. Models for panel data can also be specified easily.

### Data management and preparation

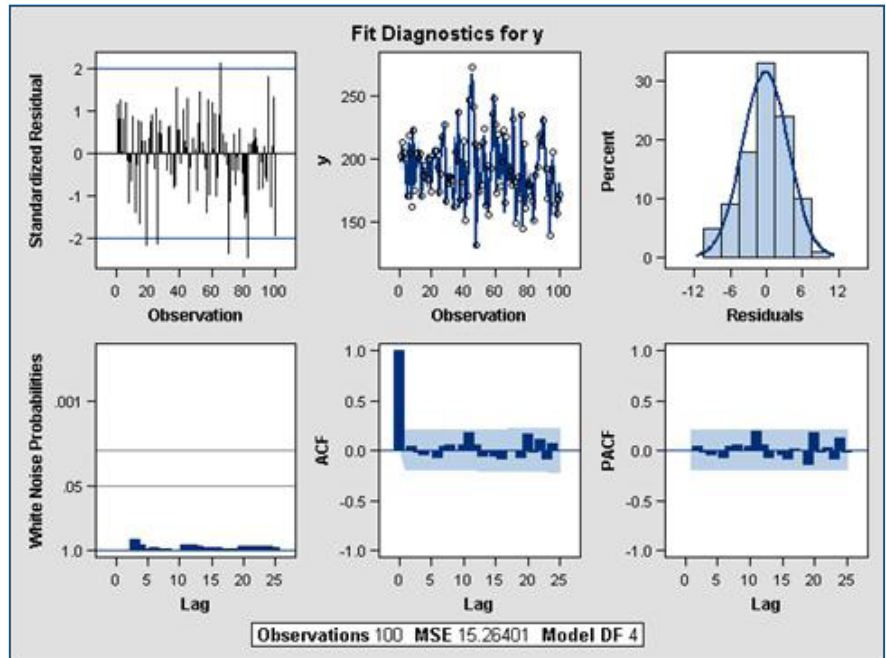
SAS/ETS software provides special data management capabilities for time-recorded data. Data coming from transactional systems, which is typically recorded without regard to a particular time frequency, can be aggregated to form a time series of equally spaced observations (one for each time period) for subsequent analysis. Any time series frequency can be calculated from the same transactional data. Data can also be converted from one time frequency to another. Automatic outlier and intervention (or event) detection are provided in many procedures, and several options are available for specifying how missing values are to be interpreted or replaced.

### Specialized data access to commercial and government databases

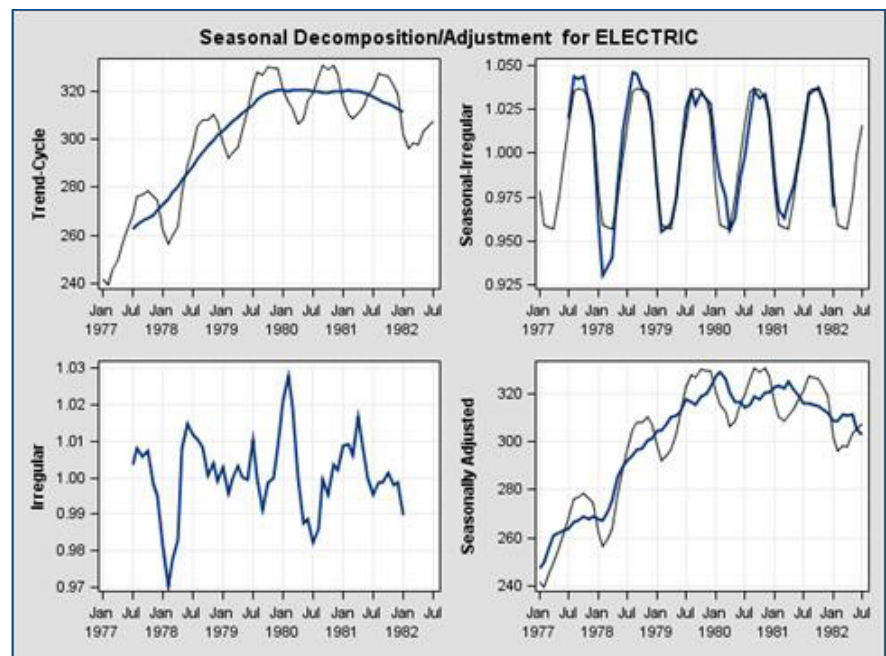
It's easy to access commercially available economic and financial time series data with SAS/ETS software. Data can be extracted directly from files supplied by government and commercial data vendors and then converted to SAS data sets. Time series data can be extracted from commercial data vendors, US government data, international agencies and organizations such as the Center for Research in Security Prices.

#### SAS/ETS® Software System Requirements

To learn more about SAS/ETS system requirements, download white papers, view screenshots and see other related material, please visit [www.sas.com/ets](http://www.sas.com/ets).



*Diagnostics: Here is an example of default diagnostic plots for the autoregression procedure (PROC AUTOREG).*



*Trend analysis: SAS/ETS provides seasonal decomposition and adjustment for time-series data.*