



What does SAS® High-Performance Forecasting do?

SAS High-Performance Forecasting automatically generates large volumes of reliable forecasts to support planning and decision making at all levels of business, including the most operational level.

Why is SAS® High-Performance Forecasting important?

Built for speed, operational efficiency and accuracy, SAS High-Performance Forecasting brings unsurpassed scalability, automation and analytical sophistication to the forecasting process. It can generate extremely large numbers of forecasts in the turnaround time necessary to run your business. SAS High-Performance Forecasting automatically selects the business drivers, holidays and events that affect your forecasting process. Its automated sophistication enables you to produce better forecasts in less time, with less effort.

For whom is SAS® High-Performance Forecasting designed?

SAS High-Performance Forecasting is designed for organizations needing automated support for producing large numbers of forecasts with limited resources and time.

SAS® High-Performance Forecasting

Produce extremely large numbers of high-quality forecasts quickly and automatically to improve planning and decision making

Forecasting provides the foundation for planning processes across organizations, including demand and inventory planning, budgeting, sales quotas, marketing campaigns and procurement activities. Each day important decisions are based on predictions of the future. Better forecasting can lead to better decision making.

Good forecasting helps keep successful organizations on track and enables effective operations. However, producing large numbers of frequent, up-to-date forecasts can be a tremendous challenge, especially when huge amounts of data are involved.

Frequently, the number of forecasts needed is so great that human interaction is impractical. When your organization needs to produce forecasts for thousands, even millions, of items, how can you ensure that you are using the most appropriate statistical models and that the forecasts produced are reliable?

The combined scalability and modeling sophistication of SAS High-Performance Forecasting produces huge volumes of dependable forecasts. Built on more than 35 years of analytics software development, SAS High-Performance Forecasting automatically selects the time series models, business drivers and events that best explain your historical data, optimizes all model parameters and generates high-quality forecasts. You get a clearer view of the future so each day you can operate your business with more confidence.

Key Benefits

- **Produces trustworthy forecasts that reflect the realities of your business.** Automatic selection of business drivers, holidays and events aids in the forecasting process, producing trustworthy forecasts that reflect the realities of your business environment.
- **Lets you focus on what's most important.** By providing automatic, reliable forecasts on a large scale, SAS High-Performance Forecasting makes complex forecasting processes manageable. Forecasters can focus their attention on the most critical forecasts rather than manually building models for each individual item.
- **Reduces bias and forecasting error.** Statistically sophisticated forecasts are produced automatically. This reduces the potential bias and politics of a judgment-driven forecasting process.
- **Improves inventory management.** SAS forecasting provides insights into future demands for your products, enabling you to better match supply with demand, avoiding excess inventory and the associated expenses. Forecasts can be calculated for every product at each location, ensuring you are getting the right inventory to the right place at the right time. Forecasts are generated in a scalable batch process so they can be easily integrated into a production forecasting environment.
- **Improves forecasts for items that rarely sell.** The software includes intermittent demand models designed to forecast slow-moving goods so you can match inventory with the next spike in demand.



Product Overview

SAS High-Performance Forecasting is the fastest and most analytically advanced large-scale forecasting package on the market. It performs automatic forecasting in a batch environment to produce extremely large numbers of forecasts with unprecedented speed. SAS High-Performance Forecasting tests for the presence of both seasonality and intermittency in your data and is equipped with models to automatically handle either phenomenon. It automatically detects outliers and level shifts and determines which business drivers, events and holidays will affect your forecasts.

These features enable you to produce forecasts that reflect the true complexity of your business environment. With SAS High-Performance Forecasting, you can successfully plan for future fluctuations, discover previously unnoticed trends and understand how

events affect your forecasts, giving you the power to run your business more effectively.

The unsurpassed sophistication of SAS High-Performance Forecasting means the system can address even the most complex forecasting challenges and can conform to your unique needs, resulting in forecasts you can trust.

Data preparation

Data preparation is important for producing good forecasts. Data collected in transactional format is not initially suitable for forecasting because it is not recorded in equally spaced time intervals. SAS High-Performance Forecasting converts transactional data to time series data by accumulating the data into any time interval desired. This means the same set of transactional data can be quickly transformed into different time series to address different planning problems. Data already in time

series format can be aggregated into different time intervals.

Automatic forecasting

SAS High-Performance Forecasting automatically selects the most appropriate model for each item being forecast based on user-defined criteria. Holdout samples can be specified so that models are selected not only by how well they fit past data, but also how well they are likely to predict the future. Users can choose the desired level of automation.

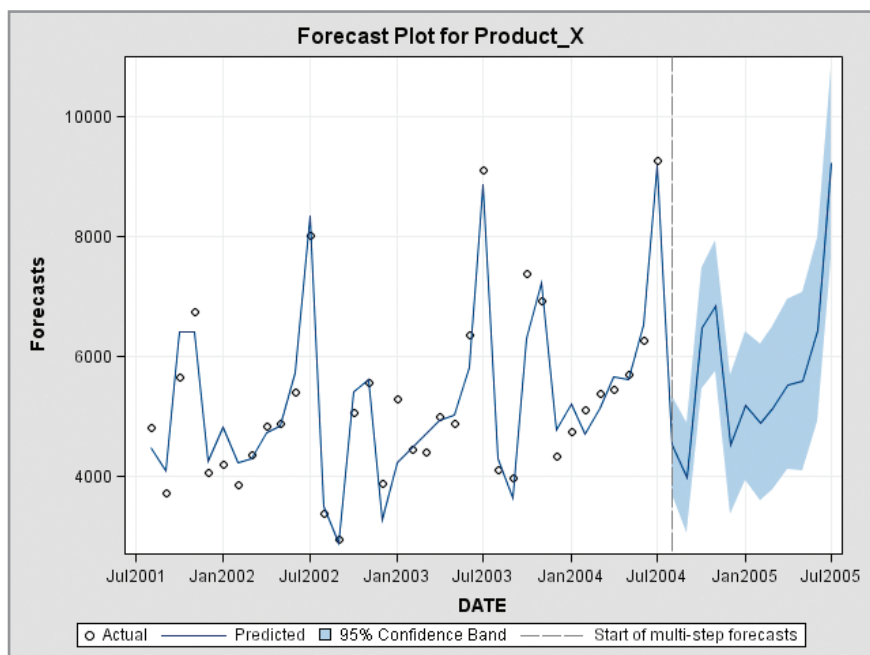
If the best forecasting model for each item is unknown or the models are outdated, a maximum level of automation can be chosen in which all three forecasting steps (model selection, parameter estimation and forecast generation) are performed. If suitable models have been determined, users may keep the current models and re-estimate the model parameters to generate forecasts. For maximum processing speed, users may keep previously selected models and parameters and simply generate their forecasts.

Automatic regressor/event selection

Regressors and events that improve the forecasting model are automatically selected from regressors supplied in the modeling process. In addition, SAS High-Performance Forecasting automatically determines how they are to be specified in the model. Variable transformations, lags and transfer function definitions are computed automatically, making SAS High-Performance Forecasting the most advanced large-scale forecasting software available.

Unlimited model selection lists and extensible model repository

In addition to the models supplied with the software, SAS High-Performance Forecasting provides users with great flexibility to define their own models in order to meet unique forecasting chal-



SAS High-Performance Forecasting can automatically account for seasonal fluctuations and other business drivers, selecting the most appropriate method for generating forecasts.

lenges. Once stored in the model repository, user-defined models become part of the automatic model selection process or are applied to specific series as desired.

Automatic model selection list generation

If users do not wish to use a pre-existing model selection list, SAS High-Performance Forecasting will diagnose the data and automatically generate a tailored model list for each item being forecast. The system is highly advanced and can automatically determine the order of ARIMAX models, whether regressors are needed and their specification in the model, and which components are needed in unobserved components models.

Optimized model parameters

Manual setting of model parameters is a time-consuming process in which results depend on the skills and statistical savvy of the model builder. Without automation this is not feasible in a large-scale setting, as it would require too many model builders and too much time. The usual compromise is to apply the same models and parameters to large groups of items. However, in SAS High-Performance Forecasting, mathematically optimized model parameters are automatically provided for each item. This saves time and ensures that model parameters are the most appropriate for each item being forecast.

Automatic outlier detection

The history of each item being forecast is examined, and outliers and shifts in data are automatically identified. If appropriate, subsequent forecasts adjust for the outliers and shifts, preventing spurious results due to abnormalities in the data. This automatic detection enables forecasters to spend less time fixing data problems and more time focusing on more strategic forecasts.

Predefined and customizable events

Common events and holidays are predefined for inclusion in forecasting models, making model development and deployment quick and easy. Using predefined events reduces data entry errors and frees up data storage space. In addition to predefined events and holidays, users can create customized event definitions, specifying event duration, shape and recurrence options. Event definitions and calendars also can be imported from external sources such as Microsoft Outlook.

Automatic indicator variable creation

Indicator or “dummy” variables can be created upon request for any user-defined or predefined event or holiday. By default, indicator variables are created in memory at the time of analysis. The ability to output the indicator variables to a data set makes them readily available for analysis in other areas of SAS or third-party systems.

Intermittent demand models

Special models are included for forecasting the intermittent demand pattern of slow-moving goods. Commonly used exponential smoothing models are insufficient and tend to drive the forecast to zero. Intermittent demand models produce a recommended stocking level designed to align inventory with the next spike in demand.

Unobserved components models

Unobserved components models are a cross between regression models and time series models. They provide more intuitive explanatory power than ARIMA models. Also, unobserved components such as trend and seasonality can be isolated and forecast independently.

Hierarchical forecasting

Forecasts can be produced based on any grouping or category represented in the historical data, such as by region, department, product family, etc., allowing the forecasting process to flexibly map to the organizational hierarchy. Forecasts produced at different hierarchical levels can be reconciled.

Temporal reconciliation

This new feature allows models built at different frequencies (e.g., hourly, daily, weekly, yearly, etc.) to be reconciled. This is a particularly important capability for forecasting electricity demand, call center staffing and other areas with demand cycles that vary by time interval. For example, electricity demand has seasonal patterns within a day, by day of the week and by week across the year. Models can be built at each time level and then reconciled to take advantage of the unique seasonal patterns at each level in time.

Integration

SAS High-Performance Forecasting is an integrated member of a larger suite of analytical and business intelligence offerings, providing you with a complete forecasting solution that encompasses data management, analysis, visualization and reporting.

Key Features

Data preparation

- Aggregates transactional data into time series format.
- Identifies and accounts for missing values.
- Accumulates time-stamped data into any time interval (hours, weeks, months, etc.) for time series forecasting.

Sophisticated modeling techniques

- Automatic outlier detection.
- Trend analysis.
- Optimized model parameters.
- BY-group processing for flexible forecasting hierarchies.
- Seasonality and intermittent series tests.
- Handles zero-padded data (leading or trailing zeros recorded in the data).
- Extensible model repository.
- Predefined as well as customizable holiday and calendar event definitions.
- Automatic indicator variable creation.
- Reconciliation of hierarchical forecasts.
- Temporal reconciliation allows forecasts generated for different time intervals (e.g., hourly, daily, weekly, yearly, etc.) to be reconciled to take advantage of unique seasonalities.

Automatic model selection

- Seasonal and nonseasonal exponential smoothing models.
- ARIMAX models.
- Intermittent demand models.
- Unobserved components models.
- User-defined models.
- Automatic variable transformations (log, square root, logistic, Box-Cox).
- Model selection based on performance in a holdout sample region (optional).
- Several goodness-of-fit statistics and overall performance metrics.
- Automatic regressor and event selection and model specification. Determines whether lagged and/or dynamic relationships are present.
- Automatic generation of model selection lists.
- Choice of automation level for all three forecasting steps: model selection, model parameter estimation and forecast generation.

Customized output and reports

- Output produced in several popular formats: HTML, PDF, Microsoft Word, etc.
- SAS Output Delivery System (ODS) graphics.
- Several output data sets available, including forecasts, goodness-of-fit statistics, model parameters, seasonal and trend statistics, and more.

Superior scalability

- Run time is linear with the number of forecasts.
- No limit on the amount of historical data or forecast horizon.
- No limit on the number of events or regressors.

SAS® High-Performance Forecasting System Requirements

To learn more about SAS High-Performance Forecasting system requirements, download white papers, view screenshots and see other related material, please visit www.sas.com/hpf.