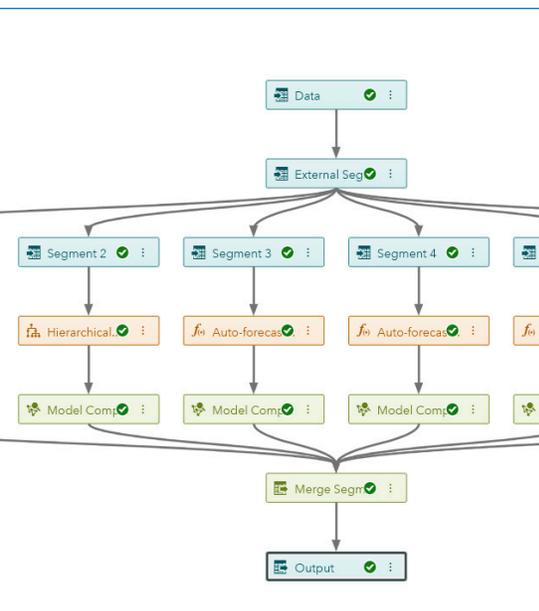


SAS® Visual Forecasting

Quickly and automatically generate large numbers of trustworthy forecasts so your organization can operate more efficiently and effectively



Many organizations need to process large numbers of time series for analysis, decomposition, forecasting, monitoring and data mining. SAS Visual Forecasting provides a resilient, distributed and optimized generic time series analysis scripting environment for cloud computing.

This solution includes automatic forecast model generation, automatic variable and event selection, automatic parameter optimization, automatic model selection and automatic forecast generation. It also provides advanced support for time series analysis, time series decomposition, time series modeling, signal analysis and anomaly detection (for IoT).

With SAS Visual Forecasting, you pick up the data once and run everything you need, taking advantage of in-memory, large-scale distributed processing. A scripting language optimizes and compiles your forecast based on where it is running.

What does SAS® Visual Forecasting do?

SAS Visual Forecasting generates large quantities of forecasts quickly, automatically and as accurately as can be reasonably expected given the nature of the behavior being forecast. Organizations can better plan for the future.

Why is SAS® Visual Forecasting important?

It provides an open forecasting ecosystem. The automation and scalability of SAS Visual Forecasting enable even the largest enterprise to operate an efficient and effective forecasting process for a broad range of planning challenges.

For whom is SAS® Visual Forecasting designed?

It is designed for any organization that needs large-scale forecasting and/or requires automation because of the large number of forecasts or a lack of skilled forecasters. Users can range from analysts responsible for the creation of the forecasts to the managers and directors responsible for overseeing the forecasting and planning processes.

Benefits

- Streamline your forecasting process.** The vast majority of time series can be forecast automatically. SAS Visual Forecasting automatically produces large-scale time series analysis and hierarchical forecasting with no human involvement. It requires fewer resources and reduces management tasks, while generating forecasts that are often as good as or better than those from a more manual process. Less manual intervention also decreases the chance of personal bias in the forecasting process.
- Focus efforts on high-value situations.** Forecast analysts don't have to manually build and monitor forecasting models for every time series. They can manage by exception, focusing efforts on strategic, high-value forecasts or problems that aren't suitable for automation.
- Improve planning.** Manage your organizational planning challenges by generating forecasts on an enterprise scale, as quickly and accurately as can reasonably be expected given the nature of the behavior being forecast. The software delivers results for millions of forecasts at breakthrough speeds so you can plan more efficiently and effectively for the future.
- Deliver forecasts that reflect reality.** SAS Visual Forecasting automatically selects the business drivers, holidays or events that aid in the forecasting process from variables supplied to the system. The forecaster can influence results through a highly flexible override capability, making adjustments to a specific filter or group of time series defined by attributes, not just by hierarchical variables. As a result, forecasts better reflect the intricacies of the situation.

Overview

SAS Visual Forecasting automatically analyzes large numbers of time series so forecasters don't have to diagnose each series. The software determines the forecasting models that are most suitable for the historic data. When doing hierarchical forecasting, holdout samples can be specified so that forecasting models are selected not only by how well they fit past data, but how well they are likely to predict the future.

An appropriate model is generated for each entity being forecast, based on user-defined criteria. Model parameters are automatically optimized. Any number of business drivers and events can be supplied and will be considered for inclusion in the models.

While other vendors provide some level of automatic forecasting, SAS has the ability to scale to even the largest organizations. No other forecasting solution can provide this level of automation, scalability and statistical sophistication.

Scripting language enables distributed processing

SAS Visual Forecasting provides a resilient, distributed and optimized generic time series analysis scripting environment. It supports fast, in-memory time series analysis.

By nature, distributed systems break up large files and process each piece separately. This is problematic for time series

analysis where the ordering of data is crucial. Time series analysis typically requires that time series data is stored contiguously in memory and in sorted order.

SAS Visual Forecasting shuffles the data so that each time series (or BY group) is copied into the memory of a single computing node. Each time series is executed on one thread of a node, and each node executes the compiled script for each of its assigned series. This makes time series analysis and forecasting possible on an enormous scale.

And the scripting language is optimized and compiled for the machine it is running on, so users don't have to rewrite code for different machines.

Automatic time series analysis and forecasting

The TSMODEL procedure includes several function packages, each designed to perform a particular task in the time series analysis process.

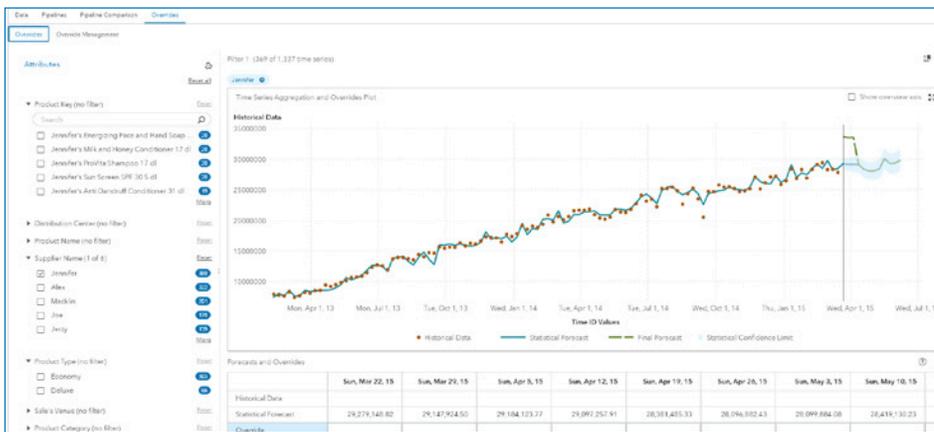
The TSMODEL procedure can convert time-stamped transactional data into a time series format, and then generate forecast models automatically. It can execute user-defined programs.

It also uses flexible hierarchies, so you can organize and manipulate data to achieve better, more targeted results.

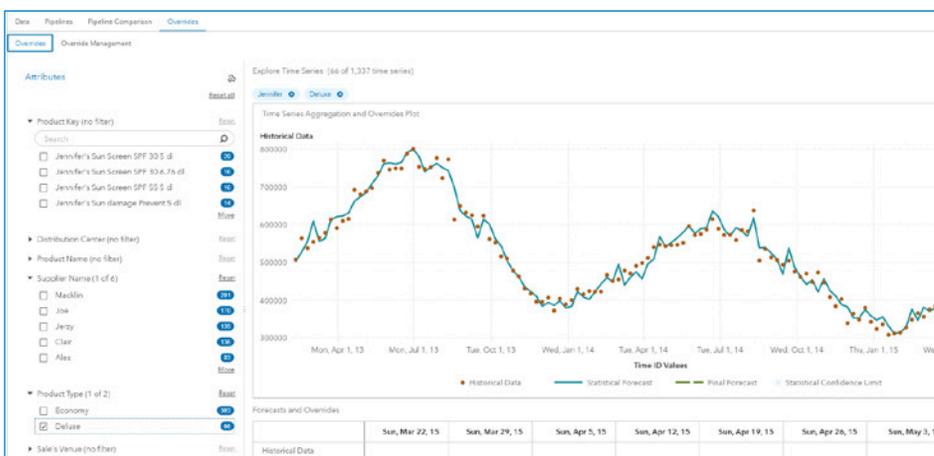
Neural networks and machine learning

Modeling strategy nodes incorporate the use of neural networks through a Panel Series Neural Network node, a Multistage forecasting node or a Stacked Model node.

These nodes allow you to generate features and train a neural network; create a forecasting methodology that combines signals from different types of models; and address problems that have both time series characteristics and a nonlinear relationship between the dependent and independent variables.



A highly flexible override capability reduces the level of manual effort required when making overrides on nonhierarchical variables.



Interactive time series exploration and analysis helps you understand the structure of your data prior to forecasting.

External segmentation of project data

Input data for a project can be partitioned into segments of similar time series based on the nature of the data (e.g., slow moving items, new items, seasonal items, etc.). Each segment can then be modeled separately in the project pipelines. This allows users to tune the modeling strategies to better model the patterns or characteristics of the time series in each segment.

Incorporate events in models

Model accuracy may be improved by adding events, such as holidays, retail promotions and natural disasters. Defining an event enables you to model the effect the event has on dependent time series. Default prebuilt events (such as major holidays) are included, and additional events can be added from an external event repository.

Highly flexible forecast override

Many forecasting software packages allow users to make manual adjustments to system-generated forecasts, but only through the forecasting hierarchy.

SAS Visual Forecasting includes a powerful capability that enables manual overrides to be made to a specific filter or group of time series defined by attributes, not just by hierarchical variables.

For example, an analyst in the apparel industry may want to adjust a forecast for all products of a certain color that is expected to be popular. Color is not typically a level of the forecasting hierarchy. With the override capability, a custom filter can be defined for products meeting the color attribute. Without this feature, if you wanted to apply an override to all products of a certain color, you would have to manually enter the override to each product.

Another example is sentiment, determined by text analysis of online reviews or user surveys. An analyst may want to increase (or decrease) forecasts for all products that have favorable (or unfavorable) sentiment.

Key Features

Large-scale time series analysis and forecasting

- Automatically generates large quantities of statistically based forecasts in a distributed, in-memory environment.
- Scripting language enables distributed, in-memory time series analysis.
- Shuffles the data so that each time series is copied into the memory of a single computing node.
- Optimized for the machine it is running on, so users don't have to rewrite code for different machines.

Flexible override facility

- Make customized forecast adjustments that are not limited by the structure of the forecasting hierarchy.
- Select filters based on attributes, such as location, brand, category, size, color, sentiment, quality, etc.
- Define override specifications, by filter and time period(s), for time series within a filter.
- Faceted search filters.
- Disaggregation of override using optimization model.
- Batch execution and incremental data updates.

Neural network/machine learning modeling strategy nodes

- Panel Series Neural Network node provides framework to generate features and train a neural network
- Multistage Forecasting node (neural network/regression and time series) provides a framework for creating a forecast that combines signals from different types of models.
- Stacked Model Forecasting node (neural networks and time series) addresses problems that have both time series characteristics and a nonlinear relationship between the dependent and independent variables.

API support for working with open source

- Analytical actions, SAS procedures and APIs are callable from SAS, Python, R, Java, JavaScript and Lua.

Time series analysis

- Autocorrelation and cross-correlation analysis.
- Seasonal decomposition and adjustment analysis.
- Count series analysis.
- Diagnostic tests for seasonality, stationarity, intermittency and tentative ARMA order selection.

Time frequency analysis

- Windowing functions.
- Fourier analysis for real and complex time series; short-time Fourier analysis.
- Discrete Hilbert transform.
- Pseudo Wigner-Ville distribution.

Time series modeling

- ARIMA models (dynamic regression and transfer functions).
- Exponential smoothing models; unobserved component models; and state-space models.
- Intermittent demand models with Croston's method.

Automatic time series modeling

- Automatic time series model generation.
- Automatic input variable selection, event selection and model selection.

Creating filters saves a lot of time and manual effort when overriding nonhierarchical variables.

API support for working with open source

While SAS Visual Forecasting has a broad range of forecasting models built-in, users can create their own customized models that perform well with their data. Analytical actions, procedures and APIs are callable from SAS, Python, R, Java, JavaScript and Lua.

Hierarchical reconciliation

Each series in the hierarchy is modeled and forecast individually. Forecasts are then reconciled at multiple levels of the hierarchy in a top-down fashion. Users can adjust a forecast at any level and apportion it to lower levels so the hierarchy maintains consistency, and individual forecasts (by products, locations, etc.) roll up to the top number. Without reconciliation, lower-level forecasts won't add up to the top-level forecast.

Includes additional forecasting procedures

SAS Visual Forecasting includes access to SAS Forecast Server procedures as well as procedures in SAS/ETS®, enabling you to address virtually any forecasting and time series analysis challenge.

[TO LEARN MORE »](#)

To learn more about SAS Visual Forecasting, view screenshots and see other related materials, please visit sas.com/visualforecasting.

Key Features (continued)

- Automatic parameter optimization.
- Automatic forecasting.

Singular spectrum analysis (SSA)

- Univariate SSA decomposition and forecasting.
- Multivariate and automatic SSA.

Subspace tracking (SST)

- Perform advanced monitoring (signal analysis) techniques for multiple time series.

Time interval evaluation

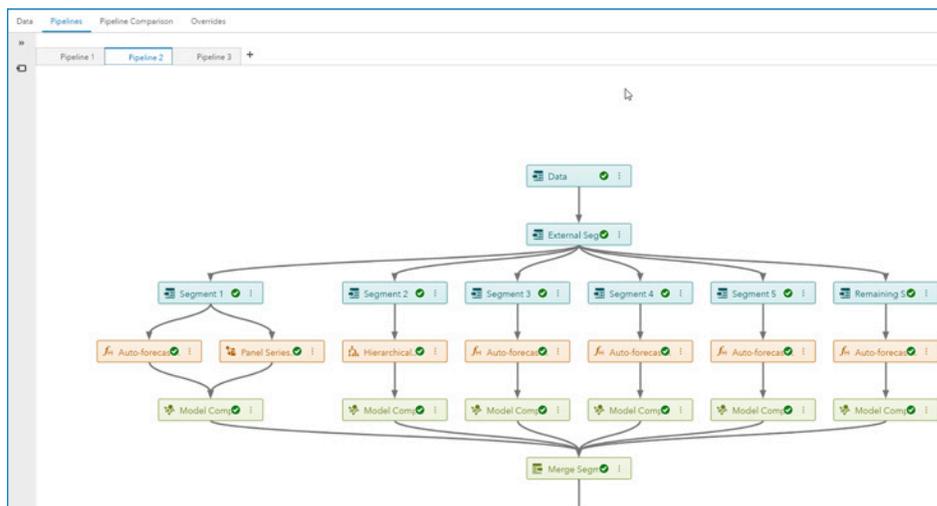
- Evaluate a variable in an input table for suitability as a time ID variable.
- Assess how well a time interval specification fits date/datetime values or observation numbers used to index a time series.
- Can be either specified explicitly as input to PROC TSMODEL or inferred by the procedure based on values of the time ID variable.

Hierarchical reconciliation

- Models and forecasts each series in the hierarchy individually.
- Reconciles forecasts at multiple levels of the hierarchy.

Distributed, accessible and cloud-ready

- Runs on SAS® Viya®, a scalable and distributed in-memory engine of the SAS Platform.
- Distributes analysis and data tasks across multiple computing nodes.
- Provides fast, concurrent, multiuser access to data in memory.
- Includes fault tolerance for high availability.



Interactively add nodes to a pipeline in a SAS Visual Forecasting process workflow.

To contact your local SAS office, please visit: sas.com/offices

