

## Product Overview

# Nostradamus Demand and Price Forecasting



Nostradamus is a neural network, short-term demand and price forecasting system, designed specifically for electric and gas utilities, system operators and power pools, cooperatives, energy marketers, and gas pipelines alike.

Leveraging a neural network solution allows users to track forecasts with actual values as well as update new information as it becomes available. The neural network algorithm learns the pattern of load or price changes from numerous weather variables as well as day of week, time of year, and holidays by learning from historical data. Other input data includes historical load, weather, price, customer/account, transmission, congestion, and generation data. During day to day operations, the system can augment what it has learned with new information (called “dynamic weighting adjustment”).

### Key Features

**Neural Network Technology** – Although Nostradamus employs sophisticated programming and mathematical techniques, prior experience or understanding of neural networks is not necessary to produce highly accurate forecasts. The neural technology recognizes relationships and applies this knowledge to produce accurate daily and hourly demand and price forecasts. This process can be executed automatically on a user-defined schedule.

**Automated Scheduling** – The AutoNOST feature provides the user with event-driven or time-based automation. The event-driven scheduling feature allows the user to schedule data acquisition, prepare

forecasts, and disseminate results, whenever new data is made available to the system. Users can also produce forecasts for multiple independent geographical regions and generate customized reports based on up-to-the-minute weather, demand, and price data. In addition, AutoNOST’s ability to schedule Microsoft Office macros opens up a multitude of possibilities to perform powerful data management capabilities.

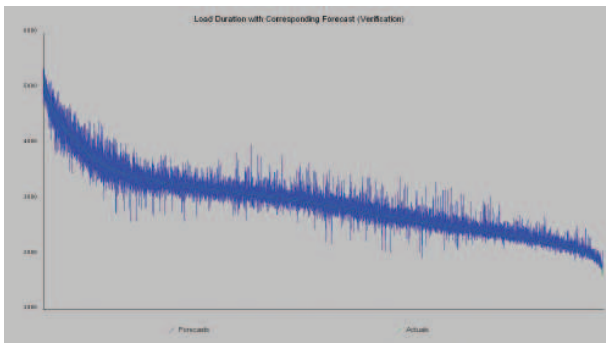
**Flexible Data Integration** – Users can quickly create a customized model set-up, forecast execution, and results processing. Users can integrate Nostradamus with most other third-party applications and data storage systems.

**Profile Manager** – Users can create, adjust, and maintain similar models to allow for easier use, including neural network inputs, error configuration settings, and holidays. This reduces model build and maintenance time.

**Sensitivity Analysis & Comprehensive Statistics** – Utilize the sensitivity of the neural network to track changes in data for a better understanding of relevant inputs and more accurate capture of forecast peaks and valleys. Users can also evaluate historical data to identify data anomalies and setup rules for error handling.

**Rules-based Error Handling** – Data issues are the rule, not the exception. Missing or “bad” data can come from any number of sources: meter reads, data historian/SCADA system, an enterprise database, etc. To counteract poor data quality, Nostradamus utilizes rules-based error handling and e-mail alert notification to identify, cleanse, and manage data in a way that can still produce accurate forecasts. Rules can be configured to utilize different data models in instances and situations identified by the user.

**Customized Reports/Graphs** – Analyze specific data areas with outputs sent to Excel, Access, and/or HTML using the Ventyx Report Agent.



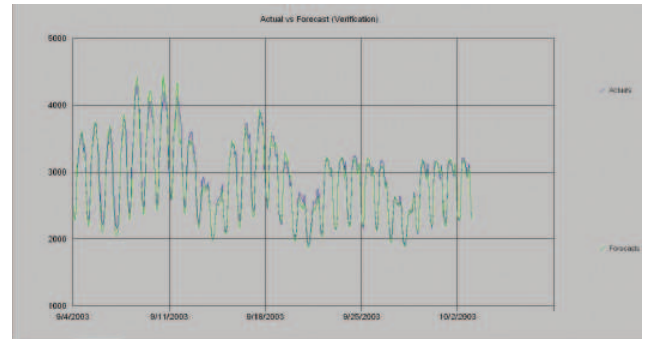
**Load Duration with Corresponding Forecast**  
The load duration curve is an excellent starting point for ensuring that the newly constructed model properly meets the peaks and valleys of the respective load patterns.

**Error by Time-Frame**

Viewing MAPE (Mean Absolute Percent Error) and MPE (Mean Percent Error) values plotted over certain time frames can indicate outlying months, days, or hours, as well as isolate where adjustments need to occur.

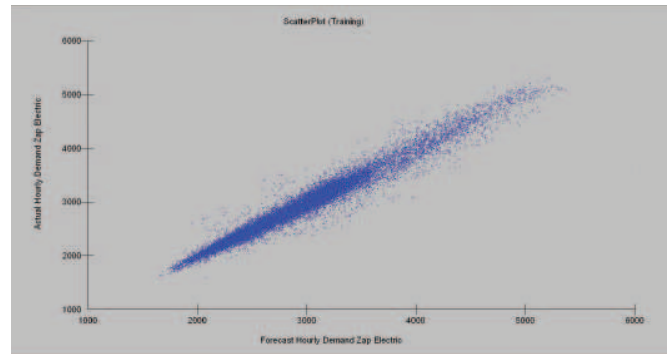
Type of Forecast	Typical Customer*
Gas Single-value Forecast by Day	Natural Gas LDCs, Pipeline Companies
Once-a-day Hourly for Electric Load	Electric Utilities
Next-hour/Intraday Forecast	Electric Utilities, ISO/RTOs
Price Forecast	Electric Utilities, Industrial, Commercial Participants

\*Represents typical use; however, different companies utilize forecasts for unique purposes.



**Actual vs. Forecast**

Actual vs. forecast plotted over time gives the finest detail needed to clearly isolate specific points in time where the new model is not measuring up, which allows users to make necessary changes.

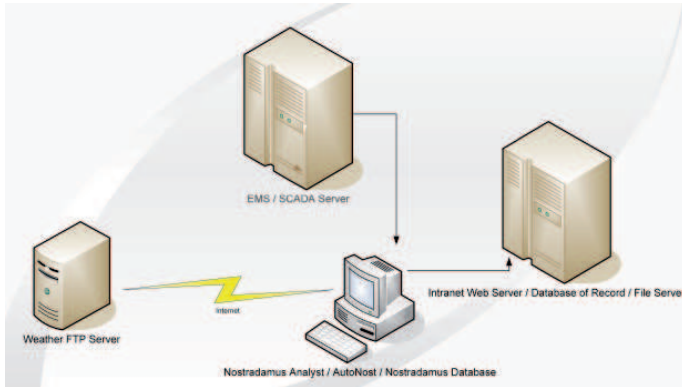


**Scatter Plot**

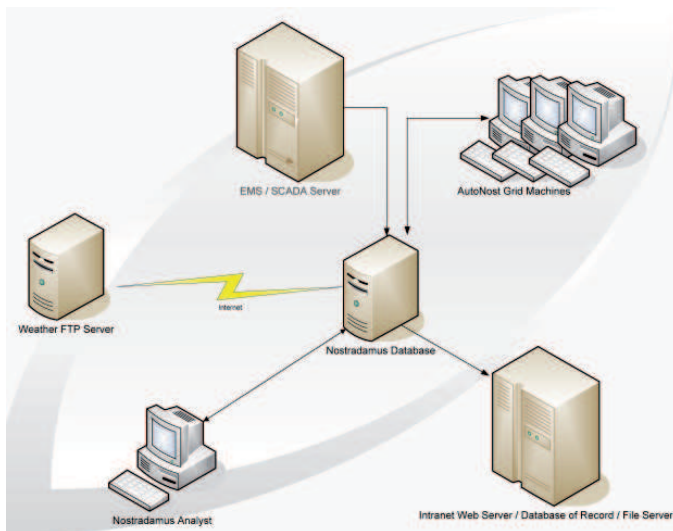
A scatter plot of the actual versus forecast can depict outer points immediately.

## Architecture

Desktop User solution includes the Nostradamus user interface, Oracle XE database, and AutoNOST (the automation scheduler engine). This version of Nostradamus will have all the elements needed installed on a single computer; however, with AutoNOST input data can be pulled and results can be published to other systems.



Enterprise Solution allows for significantly greater stability. This stability is required by utilities conducting forecasts each hour or even every minute. Nostradamus enterprise level will include the Nostradamus user interface, Oracle scripts, AutoNOST grid based engine.



## Redundancy/Concurrency

Redundancy- With the Nostradamus enterprise level solution AutoNOST can be run on multiple machines concurrently. This provides a level of redundancy that no other forecasting application can offer. If any given process fails then the proper staff is notified and the next process is executed by any other machine on the grid. This prevents the dreaded “stuck machine” and will ensure that the day to day process occur as usual, and allow I.T. staff to correct the problem at their leisure.

Concurrency – Another advantage of the AutoNOST system running on concurrent machines is that processes can be run simultaneously. With neural network applications a time consuming training must occur periodically. Given a system with many models and the need for forecasts to always occur there simply isn't time to go offline and retrain the neural network models. With the concurrency and automated retraining logic AutoNOST models can be scheduled to retrain and the newly retrained models will be used automatically to produce forecasts for their next scheduled time.

## Scalability

Nostradamus provides the user the ability to create unlimited number of weather stations, load areas, or price zones. Along with this, Nostradamus allows the user to create any number of models needed to predict any of these areas, also Nostradamus can predict monthly, daily, hourly, 30 minute, 15 minute, and 5 minute granularity data.

With the flexibility to add numerous models comes the possibility of hitting limits on data quantity; however, Nostradamus is based on an Oracle platform and is only limited by the amount of disk storage. With the ability to add additional AutoNOST grid computers highly dense process steps are guaranteed to execute and there is no need to worry about skipped processes.

## Integration

Nostradamus is designed around the automatic nature of the forecasting process; included in the AutoNOST engine is the ability to integrate with numerous systems. Built into this is the ability to directly integrate with Ventyx's RetailOffice, MarketManager, and Generation Manager. Along with those applications AutoNOST can push data to MS ACCESS, MS EXCEL, HTML, and any other Oracle data source. Nostradamus comes with some simple scripts to easily integrate with weather vendors, and has integrated with numerous other systems.

## Key Benefits

Nostradamus improves forecast accuracy and automatically performs powerful data management capabilities. Other benefits include:

- Automated business processes, resulting in a reduction of expensive labor-intensive activities;
- Reduced imbalance and penalty costs;
- Minimized demand capacity charges;
- Transparency in demand peaks/valleys and respective pricing;
- Diminished use of expensive peaking resources;
- Decreased energy costs as an energy consumer; and
- Increased revenue from supplying energy in high-priced markets.

In addition to the aforementioned tangible benefits, Nostradamus can be fully integrated with existing systems and operational within one week (including training), with no need to involve IT staff. Current users consistently compliment Nostradamus for its ease of use and expeditious deployment.



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