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Demand Sensing via C-B4 Pattern Analysis and SAS® Forecast Server

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ABSTRACT

C-B4 Monitoring is a new method for automatically monitoring and analyzing complex processes.

At the heart of the C-B4 Monitoring concept is the analysis of data patterns by the C-B4 network. Once the network is constructed, it captures all the significant dynamics and dependencies in the data. This information can be used by various applications.

This presentation focuses on the integration between SAS® Forecast Server and C-B4's pattern-recognition server, with respect to demand sensing and forecast control. Reference will be given to industrial, telecom, and retail organizations.

INTRODUCTION

Demand forecasting is a crucial process for retail networks, and encompasses all the links of the chains and sub-chains: raw materials, inventory, stocks, on-shelf inventory, and much more.

Since most retail firms use some demand forecasting software, achieving a competitive advantage is the desired goal of every demand analyst. Experience shows that 30–50% of forecasting is inaccurate, and this influences the accuracy of the aggregate, thereby affecting forecasting performance and inventory costs. Identifying bad forecasting and exceptions in demand and sales data relative to the normal behavior is vital for the improvement of demand forecasting tools and the focus of this short paper.

Today, the existence of a forecasting system, either for retail network or its subsidiary supply chain, is a basic operation tool. In order to plan the production rate, inventory levels, transportation needs, and other factors, it is crucial to have a demand-forecasting system. However, the standard, traditional system is statistically based and has inherent flaws:

- There is an assumption regarding some known distribution model, which is not always correct, and historical data is used to extrapolate future estimations.
- The way by which "irregular values" are treated is not always clear. Many times they are excluded so as to avoid deviations in the generated values. Other times they are simply "smoothed" out. This is particularly relevant to sales data that is often extremely noisy.
- The generated forecasts are usually based on an aggregation of values. Yet, action items often require a granular resolutions
- New trends in data are found too late to trigger a correcting action. There is a need for an "early detection" forecasting tool that can analyze hidden-patterns that often appear earlier in the data.

All these and other reasons result in a low level of confidence in the forecasts. The competitive advantage of a demand analyst is to achieve more accurate forecasts. The solution proposed here is based on the integration between SAS® Forecast Server and C-B4's pattern-recognition server, with respect to demand sensing and forecast control.

The propose solution can dramatically improve the level of forecast confidence, since its unique technology is based upon modeling the actual patterns in historical data and then use it to monitor and enhance the forecasts. The C-B4 server is designed to directly indicate exceptions, thus, reducing the time taken to detect and respond to changes and to produce accurate short, medium, and long-term forecasts.

PROPOSED SOLUTION'S CONCEPTS

At the core of the proposed patented technology stands a unique network-modeling server [1][2] that provides the basis for analyzing the dynamics of Key Performance Indicators (KPIs) within complex systems and processes. The server construction algorithm automatically optimizes the size vs. the statistical efficiency of the network model.

The network model provides a compact description of all the significant patterns in complex systems and processes. Once the model is constructed, it captures all the significant dynamics and dependencies in the data. This information can be used by various applications, such as monitoring, prediction control, classification and clustering. The network model obtained from this analysis is flexible, making it possible to implement different modules in a variety of demand-forecasting domains.

The proposed solution provides a reliable indication of where to look and where to direct one's efforts to improve the accuracy of demand forecasting. The unique technology enables the users to discover crucial information about historical data and the way a prediction was made based on that data. The used technology monitors and models patterns of data used to generate prediction values. It can identify cases where although the data values are acceptable, the patterns of data prior to the "prediction" event indicate some abnormality. This information is used to generate warning signals, prompting the users to examine the demand forecasts more closely, and to employ further refinement algorithms to them.

Identifying abnormalities in the actual way any prediction model works—by relating to the very specific demand pattern of each product—gives range of possible actions to be implemented by the demand analysts. The first distinguishing fact about the suggested methodology is that even if all values are within "acceptable" limits, and thus taken into consideration by a standard prediction module, it can be detected whether the pattern of the data is abnormal, and indicate whether special care is needed for the specific case.

Another characteristic of the proposed implementation is that since the user look into the very heart of each product's demand pattern, additional information regarding the demand may be manifested. This information can be of business value and enables the user to extract more competitive advantages over regular forecasting solutions. Moreover, by performing root-cause analysis, the user can identify the causes of change in behavior and incorrect forecasting. This can helps to indicate where these forecasts need to be further refined.

A REAL CASE STUDY USING SAS & C-B4 SERVERS

SAS is a leader in business analytics. In a joined case study SAS and C-B4 analyzed the retail data of a world-wide retail firm with hundreds of products for home usage holds. In this case study, the objective was to use the C-B4 server as an enhancement to SAS forecast server, which is often considered the best in the market.

SAS package has been used to conduct an ETL (Extract, Transform, Load) process on the data. Then the SAS forecast server constructed a demand model for each product and category. Finally, the C-B4 pattern-recognition server was applied to the forecast results, including residual analysis. The joint-solution achieved the following results:

- It provided early detection of anomalies in data patterns, which were the source for the generated estimation.
- It generated alerts where special intention needed to be given to a specific forecast, showing the ability to identify one out of thousands of products that needed correction.
- It directed the users to understand the root-cause of the low level of confidence given to a prediction by a traditional approach.

The proposed solution provided early predictions of problematic forecasts that could be dealt with in real time by a product analyst. Some of these problems could have been detected by human interference, but this would have been extremely time-consuming. The proposed solution accurately identified the time of the change-point in the data, enabling quick root-cause analysis.

The following Figure illustrates a real example for controlling a demand-forecasting system. The red points within the monitoring exception circle provide early indication that the forecast model is no longer valid for the considered product. As anticipated by the C-B4 alarm the actual sales that are marked by the black points exceed the forecast threshold.

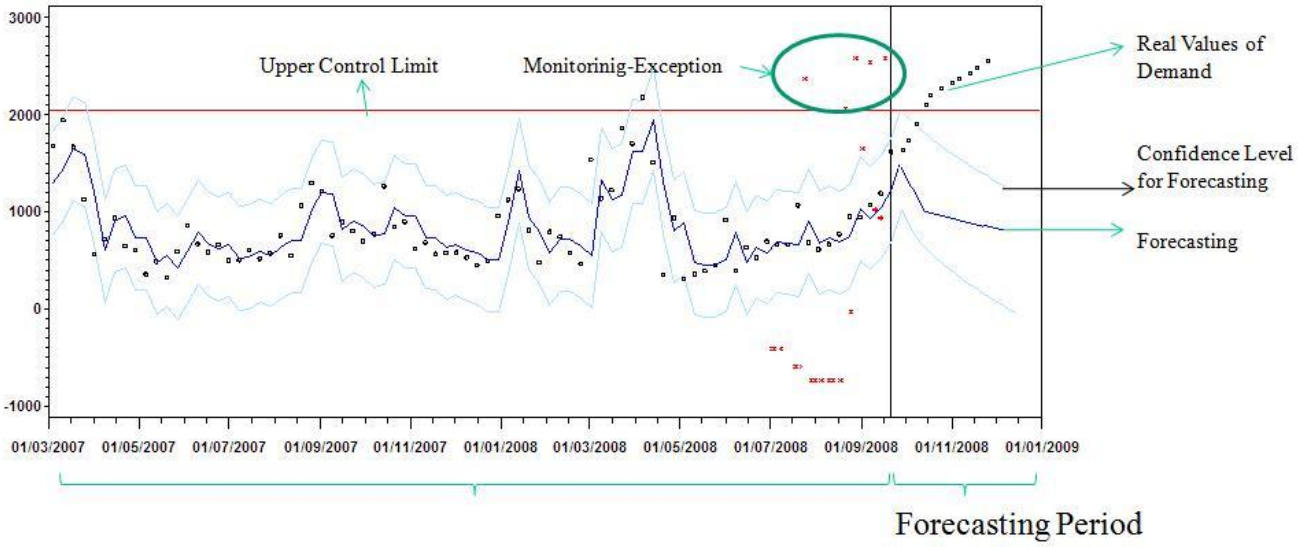

Figure 1. Real-life prediction of an anomaly (a few days before the actual event is noticeable)

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OTHER IMPLEMENTATIONS OF THE PROPOSED SOLUTION <HEADING 1>

In the above sections we explain how the C-B4 server can be integrated in a demand-forecasting system to model the actual behavior of demand or inventory levels of a group of products or services. In this section we shortly extend the scope of possible applications.

Monitoring the actual demand and inventory levels across various products and services provides knowledge regarding cause-and-effect phenomena. For example, finding hidden dependencies in the demand levels of different products can reveal cannibalism effects or complementary products. A correct business strategy can then be implemented straightforwardly. In a real data analysis of a leading retailer in the US the server analyzed the demand level of a cluster of 90 products. It was found that these products are associated to each other temporally – during the holiday period only. Such a dynamic clustering is based on pattern analysis and cannot be found by conventional clustering methods.

The server can provide a full understanding of the impact of a particular promotion (in addition to known aggregated data such as average demand). This allows the users to group products and services in a very accurate way.

Since the proposed solution deals with patterns of data and can correlate data such as time, date, place, coupon-related purchase, and many more KPIs, and since the proposed models detect both time-domain and space–domain correlations, clustering the appropriate products and services can be done to provide a competitive advantage.

External influences to demand patterns, such as promotions and new product introductions, are also managed effectively within the system with the minimum of human input.

CONCLUSION

Understanding and predicting customer demand is vital to manufacturers and distributors to avoid stock-outs and to maintain adequate inventory levels. While forecasts are never perfect, they are necessary to prepare for actual demand. To maintain an optimized inventory and effective supply-chain metrics, accurate demand forecasts are imperative.

Traditional systems are based on historical information and use statistical models to generate a stock forecast. The level of confidence the user has in this forecast determines whether he will act according to the predicted value or not. Often, the confidence level of a prediction is not as high as the analysts may desire, and certain corrections—either human or automatic procedures—are needed.

Moreover, retail or vendor management must deal with the delivery of hundreds or thousands of products, goods, and services, and it is impractical for them to monitor all the forecasts all the time.

In this short paper we propose a joint solution based on SAS Forecast Server and C-B4 pattern analysis engine. A real case study has been carried out with a leading international company and the results were extremely promising.

REFERENCES

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