ABSTRACT

Demand forecasting for short-term operational planning is a task not well understood or executed in most organizations. Generally speaking, corporate demand forecasters are viewed as gypsies reading a crystal ball clearer. Variability in demand for goods or services is one of the primary reasons organizations hold inventory or have excess capacity — either in fixed assets or human resources or both. Clearly, savings from more efficient operations. The savings result from reduced variance between forecast and actual results will lead to less cash invested in inventory and productive capacity. as well as reduced storage costs, expediting costs, service interruptions, obsolete inventory, and shipping expenses. The three dimensions of a demand forecast are product, including mix, geography or location, and time. Errors along any one or more of these dimensions are possible. However, in the final analysis, a forecast failure is measured by the magnitude of the actual demand less forecast demand. For example, an organization that distributes products throughout a large geographic area may experience any of the following discrepancies between forecast and actual demand. The table below represents only a subset of errors and consequences.

Total Demand > Forecast
- Lost Sales and Customer Confidence.
- Expediting Costs related to Materials and Production.
- Organizational Chaos.

Total Forecast > Demand
- Excessive Storage & Capacity Costs.
- Unnecessary Use of Capacity
- Obsolescence.
- "Fire Sales."
- Value Degradation.

Organizations use numerous strategies to overcome these problems. One option is to limit the number of distribution channels. For example, an organization may choose to sell only to mass merchandisers, and bypass grocery stores entirely. Another possible scenario calls for suppliers and customers to enter strategic alliances or partnerships. The techniques of JIT management, Total Quality Management and related techniques of Distribution Resource Planning and MRP II are yet other strategies for coping with uncertainty. Along these lines, the trade groups associated with the retail grocery industry are pushing the concept of Efficient Consumer Response, which is an effort to eliminate practices that add cost through the distribution channel. (As some in this industry have stated, information should replace inventory.) Wal-Mart is well known for its efficient inventory management, distribution, and ordering practices. However, despite all of these options, someone within an organization must still forecast demand.

Demand forecasting is an inexact art at best. Whatever the process selected, you forecast the future based on experiences. (This is somewhat like driving a car forward by looking in the rear-view mirror.)

In a popular text titled Distribution Resource Planning, Andre J. Martin outlines the following reasons for poor forecast results:
- Required adjustments are difficult to process.
- The business is promotion oriented. No system can help!!
- With constant product changes we cannot collect enough history to have a reasonable basis for forecasting.
- Nobody understands the underlying statistical methods.

Many practitioners also have difficulty dealing with outliers — those large spikes or deep valleys in the historical demand that make the variation around the mean so large (see for example the journal of The Academy of Marketing Science, Fall 1988).

Indeed there are numerous pitfalls in sales forecasting. However, with your intelligence and the data management, application design tools, and quantitative power of the SAS System, you can develop a manageable and reliable forecasting system.

THE SOLUTION

Data Management

Start with your sales history, wherever it is. Most large organizations will have history by product, by shipment location, by week. Now, adjust this data as needed to reflect what should have happened, not what happened. For example, if you shipped product to a customer from a secondary distribution center rather than the primary distribution center, make the adjustment.

You can use Base SAS to read the history, compare actual shipment locations to primary shipment locations, by customer, make the correction, and write the results to a new dataset for sales forecasting. You can use SAS/AF® to design a menu screen so users may select this task, and perform it for all shipments. To deal with changes in products over time, use SAS/FS® to develop a table of product changes. For
example if you previously sold a product in an 18-count case, but currently sell it in a 12-count case, change the history for the product to reflect shipments of 12-count cases. Allow a column on the screen for the "old" product code, the new product code, and a factor to use to account for the change in cartons sold. (In this instance, one 18-carton case is the equivalent of one and one-half 12-carton cases.) You can use the same screen to account for special items sold for a short time, in place of the standard product. Using the same SAS System products and design techniques, you can create a table of discontinued items to exclude from your forecasting dataset.

Remember, this is not the official history of the company; it is the dataset for forecasting. If you experienced a period of demand substantially exceeding supply and did not fill all items on all orders, adjust your history! Using SAS/AF, design a user maintained table, identifying the product, the distribution location, and the beginning and ending of the period during which the service interruptions occurred. Allow the user to enter a factor -- such as a percentage of orders filled. Before updating the forecasting dataset, adjust the history by dividing the actual shipments by the percentage of orders filled. If you frequently promote your product or service with price reductions or other incentives, develop a user maintained table of these events. Identify the item promoted, the beginning and end date of the promotion, and the promoted locations. This will allow you to use regression techniques to interpret history and forecast the future.

Data Analysis

Adjusting the history serves one purpose -- to allow you to use history to forecast the future with greater confidence. After you make the necessary changes to your history, identify the causes of outliers (usually promotion related) and develop the user-oriented selection panels and input screens, you can begin to use the statistical power of the SAS System to develop forecast models. Generally speaking, you will be looking for some of the following factors.

- Seasonal Patterns
- Identifiable cycles other than seasonal patterns
- Promotional or special event impacts
- Pre- and post-event impacts
- Significant competitive impacts

For short-term operational planning you will probably find the items above meet your needs. Occasionally, you may want to include macro-economic and demographic variables. However, you should be careful and not introduce too many variables. Doing so usually makes adds work without corresponding benefits. You must remember, this is a forecast for operational planning. The variables you use should have an impact on demand for your products over the next three to six months.

For most products, PROC ARIMA, using intervention variables (that is, "causal" regression variables) provides a rich set of possibilities. Now your task is to put this in the hands of the user. SAS/AF gives you the capability. Design a screen that allows the user to enter the "cycle" and regression variables. This input eliminates the need for user coding by hiding the coding intricacies of forecast model development. A user-oriented input screen, combined with the excellent training provided by SAS Institute, will provide users enough knowledge to use the power of these models. I know this for a fact. Another option you can use is the menu system that is an experimental release in version 6.06 and 6.09 of SAS/ETS®. If your business has shorter product life-cycles, such as PC's, computer games, women's fashions, or popular music, ARIMA probably will not be an appropriate technique. However, PROC MODEL will provide you with the power you require. And perhaps, linear regression models will be sufficient.

After your users specify the appropriate forecast models, an AF panel will allow them to run existing forecast models for all items at all locations (a monthly batch process, for example), or select only one item at one location for additional forecast model development and testing. Finally, you must deal with the inevitable exceptions (for example, a salesperson wants a promotional delivery to a customer at a time different from the remaining customers). Go back to the basics. You can use SAS/AFSP to develop a user-maintained table to identify the timing, the location, and the items associated with the exception. This will allow users to update the forecast, without re-running the entire forecast.

Now you will likely want to know about hardware usage -- storage space, CPU time, communication charges, etc. The statistical procedures use substantial computing resources. However, with SAS/CONNECT®, you can limit mainframe processing to monthly batch processes and printing large reports. All table maintenance and ongoing model development occur on a PC. This arrangement is especially satisfying for users who prefer PC's. As for disk space requirements, properly defined historical and forecast datasets will likely use less than 100 megabytes of storage on a PC. This should be sufficient to cover five years of history plus several forecast datasets, with each dataset looking forward two years, for approximately 200 SKUs from 10 shipping locations.

After all the design work, coding, and training, the proof will be in the results. When you place in users' hands the power to deliver highly accurate forecasts, (see the graph) you will be a hero.

I have focused on system development issues in this presentation: a discussion of business process issues requires another day. However, I trust this overview will assist you in tackling the exciting challenge of improving demand forecasting for your goods or services. Do you have any questions?

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