Creating a Daily Forecast to Improve Short Term Business Planning

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ABSTRACT

Depending on the requests of senior management, a forecast can be either short term or long term, reflecting a time range from days to years. Often, these forecasts are arranged in periods smaller than the entire forecast horizon to provide a basis for monitoring, analysis and revisions. For example, a yearly forecast may be broken down to an outlook for each month within that year. As each month passes, a simple analysis can determine if there are possible problems with the yearly forecast. If this forecast is the basis for the business plan, revisions to the business plan may be needed that can impact the decisions that determine the future direction of the company.

In the following case, the business problem that needed to be resolved was how to improve short-term business planning by predicting the outcome of a month during any day of the month in question. The solution to this challenge involved forecasting and tracking a daily pattern and SAS® software provided several options for forecasting daily data.

This paper illustrates the process of using SAS/ETS® software and actual railroad data to determine a daily pattern that supports improved short-term business planning.

INTRODUCTION

In today's competitive business environment, forecasting and planning have become essential factors in maintaining the viability of the firm. The forecast forms the basis for financial, capital, labor, and equipment planning. Business firms must be able to anticipate change and respond swiftly, since circumstances may limit the time available for taking action. With the internal and external climate changing daily, the decision-makers within the firm must be provided with updated information as it becomes available.

In order to keep the railroad running smoothly, the need arose to monitor a monthly forecast of railroad cars on the rail system as that month progressed. In other words, on the 7th, 15th or some other day of the month, given the statistics from the actual days that have elapsed, is the current forecast for that month still the best estimate, or is there a better estimate based on the trend exhibited in those first seven or fifteen days? For instance, by June 15, if total railroad cars moving on the system is 5% higher than the prediction for the first 15 days of June, should the prediction for the full month of June and subsequent months be revised? If the pattern for June were absolutely correct, this 5% excess for the first 15 days would imply that June would finish 5% above the forecast. The pattern of the daily forecasts within the month, therefore, is the significant element.

The planning questions that prompted this need were many. Are there enough boxcars or flatcars available to meet customers' requirements? Will the company need to lease equipment? Can some equipment be taken out of service? Do train crews need to be moved from one location to another? What are the predicted revenue and expenses for the month? These were short term questions that needed to be quickly recognized and resolved.

A computer system was already in place to record each day's number of railroad cars entering the rail system. Before the start of the month, a daily forecast was produced to track against each day's number of actual railroad cars to determine the feasibility of
reaching the monthly total. For some time, the creation of this daily pattern was a long and tedious process that involved graphically inspecting historical daily data, creating weights for weekdays, weekend days and holidays, and incorporating a judgmental forecast based on experience. What was needed was to replace this time-consuming, traditional method with an automatic process that could produce a reliable forecast without much re-analysis.

**THE PROCESS**

The first step involved researching computer applications that were capable of forecasting daily data. Several software packages were available that could identify weekly, monthly, or quarterly time series, and these applications could easily produce adequate forecasts. However, some of these packages could not identify daily data and had to be 'tricked' into providing daily forecasts. SAS/ETS provided two relatively simple, mechanical means for forecasting daily time series in the ARIMA and FORECAST procedures. These two procedures were considered for production of the daily forecasts and compared to the traditional method.

The analysis phase of the process used a time series containing each day's number of railroad cars carried on the system for the period January 1, 1990 through July 31, 1994. The forecast was based on the years 1990 through 1993, and 1994 was used to test the accuracy of the models. Also, the data were known to display seasonal patterns depending on month of year and day of week.

After experimenting and analysis of several different options in PROC FORECAST, Table 2 shows the coding used to generate the forecast. Due to the seasonal nature of the data, the winters method was chosen with the seasons defined as day within week and month within year.

**THE FORECASTS**

The importance of the output from these procedures is not in the daily level of railroad cars, but in the weight of each day within the month. A prediction for the total railroad cars for each month was predetermined outside this application, and the
SAS forecast forms the basis for constructing the days that will add up to the pre-decided month's total.

After the SAS procedures were run, the daily forecasts produced by the models were added up to monthly totals. The 31 forecasted days of January were added together for a monthly total for January and the weight of each forecasted day within that month was used with the pre-determined total to produce each day that will make up the daily projection. Table 3 shows an example of the use of the weights from the SAS forecast in a month that is made up of only seven days. The SAS daily forecast is predicting 34,444 railroad cars for the month, but the desired, pre-decided number of railroad cars for this month is 40,000. The daily weight is calculated by dividing each day's forecast by the total for the month. In this example, each day from the SAS output is divided by 34,444 to compute the weight. These daily weights are multiplied by 40,000 to determine the number of railroad cars that will add up to the 40,000. An easier way to arrive at these figures is to scale each day from the SAS model by the proportion of the pre-determined month's total to that of the SAS model. In this example, 40,000 would be divided by 34,444 and the factor (1.161) would be multiplied by the daily SAS forecast.

Table 3

<table>
<thead>
<tr>
<th>SAS daily forecast</th>
<th>Weight of each day from SAS forecast</th>
<th>Daily projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday 3,074</td>
<td>0.089</td>
<td>3,570</td>
</tr>
<tr>
<td>Monday 4,197</td>
<td>0.122</td>
<td>4,874</td>
</tr>
<tr>
<td>Tuesday 5,521</td>
<td>0.160</td>
<td>6,412</td>
</tr>
<tr>
<td>Wednesday 5,686</td>
<td>0.165</td>
<td>6,603</td>
</tr>
<tr>
<td>Thursday 5,578</td>
<td>0.162</td>
<td>6,477</td>
</tr>
<tr>
<td>Friday 5,512</td>
<td>0.160</td>
<td>6,401</td>
</tr>
<tr>
<td>Saturday 4,876</td>
<td>0.142</td>
<td>5,663</td>
</tr>
<tr>
<td>Total for Month</td>
<td>34,444</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 4 compares the forecast accuracy by month for each model tested. The measures of accuracy are mean absolute deviation, mean squared error and mean absolute percentage error. In each category, the first and second columns list the accuracy measures of the PROC FORECAST and PROC ARIMA, respectively. The third column shows the accuracy measures of the traditional system as a comparison to the computer-generated forecasts.

The underlined numbers in Table 4 indicate the most accurate forecasting method for each month. In about half the cases, the PROC FORECAST performed better than the traditional method. PROC ARIMA never performed better than the PROC FORECAST and the traditional method.
Some months may not be good indicators of accuracy due to the very unusual weather conditions that wreaked havoc on the railroad in early 1994. Due to the inconclusive results, the decision was made to put together a mechanized procedure for regularly running PROC FORECAST, but also, to continue to do the traditional method and to monitor the performance of both methods against the actuals. Both methods will continue to run concurrently until there is some comfort that the mechanized method is reliable and then, the traditional method will be discontinued.

**CONCLUSION**

As business chums in the fast paced, technologically connected corporate environment, the decision maker is constantly relying on up-to-the-minute information. The railroad business is no different. Each day the business situation needs to be reevaluated so that corrections and revisions may be made as quickly as possible. Because of the availability of the daily forecast, a business can monitor changes and quickly respond to variations from a detailed plan.

Of course, there are risks involved in forecasting daily data. This illustration is a simplified approach to developing a daily forecast. The biggest risk is that any one day may have many factors that can influence the actual outcome. Many factors are outside the realm of predictability, such as weather, employees taking sick days, strikes, computer crashes, etc. These items will impact results and must be handled outside the mechanical means of producing forecasts.

**REFERENCES**


**ACKNOWLEDGMENTS**

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