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TRENDS

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Welcome to *Trends*, the e-newsletter from Business Forecast Systems. *Trends* puts more than two decades worth of forecasting knowledge, experience and expertise at your fingertips every other month. Watch this space for tips & techniques, information & insight, observations & opinions and more. Thanks for reading!

Forecasting 101: The MAPE, the MAD and the BIC

Using Within-Sample Statistics to Compare Alternative Forecasting Models

This article explores how within-sample statistics can be used to compare and contrast different forecasting models. It examines three important statistics—the MAPE, the MAD and the BIC. Learn what these statistics are, how they work and how to apply them as illustrated in a real-life example.

[Read more...](#)

Moving Beyond Excel for Improved Forecasting

In an illuminating article, two Australian companies in very different industries—Cardinal Health and Freedom Furniture—discuss how forecasting with Excel spreadsheets was failing to meet their business needs. Hepke Poutsma, Senior Homewares Planner at Freedom Furniture explains

"Like most companies, we used Excel as our forecasting tool. While Excel is quite flexible (easy to change and manipulate) and easy to understand and work with, we suffered from many unintentional human errors. The spreadsheets got bigger and bigger all the time and the program used to crash resulting in frequent restarts and loss of valuable time."

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Judgmental Adjustments to Statistical Forecasts: Best Practices



Under increasing pressure to produce accurate forecasts while at the same time navigating tricky political waters as senior management demands direct input into those forecasts, many forecasters face the challenge of how to best apply judgment to statistical forecasts. Indeed, this has consistently been a hot topic at the Forecasting Summit, resulting in lively, well-attended sessions. In the accompanying article, *When and How Should Statistical Forecasts Be Judgmentally Adjusted?*, Dr. Sanders, a scheduled presenter for the September Forecasting Summit, addresses this topic.

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Forecast Pro Tips and Tricks

How much data does Forecast Pro need to generate an accurate forecast in Expert Selection mode?



Forecast Pro requires that you provide a demand history for each item to be forecasted. Some Forecast Pro users have access to demand histories going back decades—others have product life cycles lasting less than 12 months. The amount of historical data available often has a direct bearing on the selection of an appropriate forecasting technique and the accuracy of the forecasts. This article examines how data length impacts Forecast Pro's Expert Selection procedure and discusses alternative forecasting approaches to consider when your access to demand history is limited.

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Forecasting News: Foresight



May 2006

[Forecasting 101: The MAPE, the MAD and the BIC](#)

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Calendar of Events

Forecast Pro Training

Product training workshops teach you how to use Forecast Pro most effectively.

[Forecast Pro Training](#)

July 24-25, 2006
Boston, Massachusetts USA

[Forecast Pro Training](#)

September 11-12, 2006
Brussels, Belgium

[Forecast Pro Training](#)

September 28, 2006
Boston, Massachusetts USA

Forecasting Seminar

This comprehensive course covers all aspects of business forecasting.

[Forecasting Seminar](#)

May 8-10, 2006
San Francisco, California USA

[Forecasting Seminar](#)

September 26-27, 2006
Boston, Massachusetts USA

Forecasting Summit

Forecasting Summit offers a unique combination of education, discussion, instruction and perspectives on business forecasting for practitioners.

[Forecasting Summit 2006](#)

September 25-27, 2006
Boston, Massachusetts USA

Forecast Pro Appearances

Look for Forecast Pro at the following events.

[PMSA Conference](#)

May 21-24, 2006
Hilton Head Island, SC USA

Are you an analyst or manager who has been searching for a high-quality forecasting journal? If the options you've seen so far are either too blatantly commercial or too rigidly technical then you owe it to yourself to check out the newest publication specifically for practicing forecasters—*Foresight: The International Journal of Applied Forecasting*.

Foresight is a publication of The International Institute of Forecasters (IIF), the leading non-profit clearinghouse of international forecasting theory, research and practice standards. *Foresight* bridges the gap, offering readable articles that focus on practical applications of forecasting methods, on forecasting processes in organizations and on ways to improve forecasting performance.

Foresight is the essential read for professional forecasters!

For a limited time, *Trends* readers can receive a special one-year subscription rate of \$75—more than 20% off the regular subscription.

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Lighter Side

An economist is an expert who will know tomorrow why the things he predicted yesterday didn't happen today.
- Evan Esar



I'm the company troubleshooter. Today I've got to take care of the economic reality. It doesn't fit our economic forecast!

[International Symposium on Forecasting](#)

June 11-14, 2006
Santander, Spain

[Forecasting Summit 2006](#)

September 25-27, 2006
Boston, Massachusetts USA

[APICS Conference](#)

October 29-31, 2006
Orlando, Florida USA

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[Innovation 2006. International Forecasting and Simulation Conference](#)

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Forecasting 101: The MAPE, the MAD and the BIC

Using Within-Sample Statistics to Compare Alternative Forecasting Models

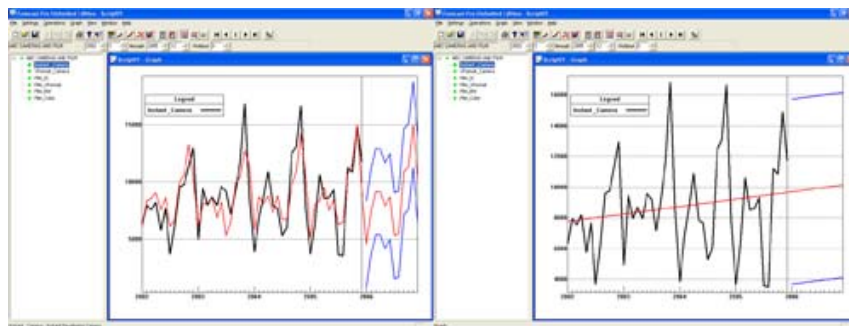
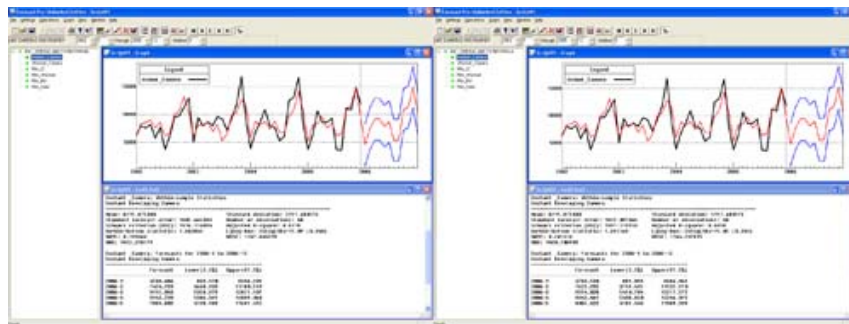


Figure 1

In the last issue of *Trends* this column presented the two graphs above to introduce the concept of *fitted values*. We explained that the black line is the historic demand for instant cameras on a monthly basis and that the red line represents the fitted values during the historic period and the forecasted values for future periods. We also commented that the fitted values show how the forecasting model “tracks” the history and can provide insight into how well the model captures the structure in the data.

The graph on the left is using exponential smoothing model to generate the fitted values and forecasts. The graph on the right is using a straight line. A quick visual inspection should convince us that the exponential smoothing model fits the data substantially better than the straight line and by extension will likely yield more accurate forecasts.

But what if the differences are more subtle?



NA model

LA model

Figure 2

Figure 2 shows the fitted values and forecasts generated using two different exponential smoothing models. The graph on the left is using an “NA” model (Non-trended, Additive seasonality) and the graph on the right using an “LA” model (Linear trend, Additive seasonality). To compare these models we will examine three within-sample statistics—specifically the MAPE, the MAD and the BIC.

The MAPE (Mean Absolute Percent Error) measures the size of the error in percentage terms. A MAPE of 0.19 tells us that on average the difference between the fitted values and the actual values is 19%. Many companies use the MAPE to measure error because it is easy to interpret and conveys information even when you don't know a product's demand volume. However, the MAPE is scale sensitive and becomes meaningless for low-volume data or data with zero demand periods.

The MAD (Mean Absolute Deviation) measures the size of the error in units. A MAD of 1472 tells us that on average the difference between the fitted values and the actual values is 1472 units. The MAD is a good statistic to use when analyzing a single product's forecast. However, if we aggregate MAD over multiple items we need to be careful about high volume products dominating the results.

When aggregating error measurements across products some corporations establish weights to reflect the various products relative importance to the corporation. This is an excellent practice.

In our example the MAPE and MAD for the LA model are both slightly lower than for the NA model. This tells us that the LA model is fitting the historic data slightly better than the NA model. Does this mean that the LA model will forecast more accurately? Not necessarily!

Generally speaking, the more complex a forecasting model is (i.e., the greater the number of estimated parameters) the better it will fit the historic data. However, you should keep in mind that if you build a model that is too complex for the data, it will *fit* the data better than a model of the proper complexity but not *forecast* as well. Selecting a model that is too complex for the data is known as *overfitting* the model.

The BIC (Bayesian Information Criterion) is designed to address the issue of overfitting. It is used to select the model likely to forecast most accurately from within a given model family (e.g., to select between different forms of exponential smoothing or to select between different forms of Box-Jenkins). The BIC rewards goodness-of-fit to the historic data and penalizes model complexity. After calculating the BIC for the models under consideration, you select the model that minimizes the statistic.

In our current example the BIC for the NA model is lower than the BIC for the LA model. Thus we would expect the NA model to forecast more accurately than the LA model.

Forecast Pro's Expert Selection algorithm often uses the BIC to select a specific model from within a model family. When selecting between model families, Expert Selection either uses a rule-based approach or an out-of-sample test. Out-of-sample testing will be the subject of this column in the next issue of *Trends*.

The BFS Forecasting Seminar, "Business Forecasting: Techniques, Applications and Best Practices" is a comprehensive course designed to teach business forecasters a conceptual background and understanding of statistical forecasting and its applications. Among the topics covered in the seminar are the MAPE, the MAD and the BIC. For a complete course description and agenda [click here](#).

About the author:

Eric Stellwagen is Vice President and Co-founder of Business Forecast Systems, Inc. (BFS) and co-author of the Forecast Pro software product line. He consults widely in the area of practical business forecasting—spending 20-30 days a year presenting workshops on the subject—and frequently addresses professional groups such as the University of Tennessee's Sales Forecasting Management Forum, APICS and the Institute for Business Forecasting. Recognized as a leading expert in the field, he has worked with numerous firms including Coca-Cola, Procter & Gamble, Merck, Blue Cross Blue Shield, Nabisco, Owens-Corning and Verizon, and is currently serving on the board of directors of the International Institute of Forecasters (IIF).

Streamlining your forecasting process

Dinesh Shah

Forecasting customer demand is a critical business function. For manufacturing, distribution, and retail businesses, accurately forecasting future customer demand is a fundamental step in achieving good customer service at a reasonable cost based on an affordable level of inventory.

Forecasts of customer demand drive decisions on which items to purchase (including when, and how many) and which products to make or buy (again, including when and how many). Any business needs reasonably accurate forecasts to plan and be able to meet its customer requirements cost-efficiently.

The reality is that forecasts can never be 100% accurate all of the time. Forecasting future demand directly or indirectly involves trying to predict many uncontrollable variables that ultimately influence sales—such as economic factors, weather, government regulations, competitor activities, consumer preferences and trends, new products, and promotional activities. No one can be expected to be able to predict these factors accurately all the time, if at all.

At the same time, inaccurate sales forecasts are costly, resulting in excess inventories, stock-outs, low productivity and poor customer service, and often cause friction between the sales/marketing function and supply/manufacturing function in any business.

Is achieving accurate forecasts a case of mission impossible? In today's competitive world, the majority of companies of all sizes use ERP (Enterprise Resource Planning) systems to plan and monitor their day-to-day operations.

RIGHT: Tony Johnson

BELOW: Cardinal's custom sterile packs are made-to-stock to customer specification.



When it comes to forecasting customer demand, these systems offer very basic functionality—if any—which in most cases falls short of meeting the forecasting requirements of the business.

Realising the need for achieving accurate forecasts, companies tend to use intelligent and highly paid sales / marketing executives to gather sales data to massage into a Lotus or Excel spreadsheet to develop a forecast, often a complicated process that takes a few days. More often than not,





Hepke Poutsma



95% of this time is spent gathering data and only 5% of time in evaluating results. The consequence is that most companies suffer from forecasts that are 95% of the time “lousy” and perhaps 5% of the time “lucky.” Despite this, many companies accept these lacklustre results and do very little to improve the quality and accuracy of their sales forecasts, unnecessarily wasting precious resources.

But why do companies sit back and accept these results when it is possible to combat the mission impossible and streamline the forecasting process to improve the quality and accuracy of the sales forecasts?

Perhaps you need to justify the investment? If you regularly suffer from high inventories, stock-outs, poor customer service, and/or urgent replenishment orders, this is justification enough. But if you still need convincing, try to estimate systematically how much safety stock in your business can be reduced by improving forecast accuracy. Be realistic in your assessment. You will find that a 10-15% improvement in forecast accuracy can pay for your investment in a matter of days.

In a recent seminar hosted by Supply Chain Business Solutions, two companies—Cardinal Health Australia 200 Pty. Ltd. and Freedom Furniture—described how they went about streamlining their respective forecasting processes.

Cardinal Health

Cardinal Health is a part of a global organisation supplying goods and distribution services to the health industry. In Australia, they predominantly supply hospitals and surgeries with operating theatre related disposables, suction systems, respiratory circuits, and customised procedure-specific sterile packs. They provide products to 800+ customers from four distribution warehouses around Australia.

Because of the nature of the products supplied, Cardinal's customers expect 100% on-time and in-full deliveries, and most expect to receive them the next day, explained Tony Johnson, Australia and New Zealand Logistics Manager for Cardinal Health Australia.

“We have to meet these expectations in spite of the fact that some of our imported goods and materials have lead times in excess of three months. Goods are (generally) light but bulky and do not lend themselves to airfreight. Therefore for both customer service and eco-

nomics viability it is very important to have the correct quantity in the right warehouse when required”.

“Our product range consists of 700+ custom sterile packs, which are made-to-stock to customer specification. They are manufactured in Sydney from imported and locally sourced raw materials. They are stocked in one of four distribution warehouses closest to the customer for whom they are made. The forecasting requirements for them are relatively simple as we only need to forecast them at a single level in the supply chain. However it is imperative that the forecasts match real demand as closely as possible since, due to the customer's reliance on these products, it is totally unacceptable to stock out”

“We also supply 800+ imported finished products, which are stocked in all four distribution warehouses. Here the forecasting requirements are more complex as we need to forecast sales for each of the products from each warehouse for the purpose of deciding how much stock to keep at each of the warehouses. We then aggregate these forecasts to a national to make purchasing decisions.”

“We also have 300+ imported indent products which are generally shipped direct to customer. We do not need to forecast them nor stock them as they are purchased against customer orders only.”

“Our initial forecasting tool was on spreadsheets. While this method is very user-friendly and flexible to use, we quickly realised that using spreadsheets for forecasting had severe shortcomings including being highly prone to human errors and producing forecasts, which were not that good.”

“When Cardinal Health separated from Baxter Healthcare, we had to purchase and install our own ERP system. The ERP system had a forecasting module but it had serious limitations in meeting our forecasting requirements. For example, it could not handle forecasting at multi-levels i.e. warehouse and national level, a fundamental requirement for forecasting our imported finished products. We could only use a single forecasting model for all of our products. While a model like simple moving average was OK for our custom sterile products, it was not appropriate for imported finished goods.”

“Also, much of our business is through tenders so we needed to have the capability of overriding forecasts to cover probability of future increases or shifts in demand. While the ERP system was capable of cursory single level overrides, these were lost every time the forecast process was refreshed, resulting in loss of valuable time and added frustration.”

“The end result was inaccurate and unreliable forecasts leading to high inventories, frequent stock-outs, and high freight costs to expedite deliveries as well as continuous trans-shipping of stocks between warehouses, poor managerial productivity and unsatisfactory customer service. Something had to be done”.

“We started to look for a forecasting tool which offered:

- Multi-level forecasting - currently used at three levels (product group, national, site) but could quite easily be used at more levels e.g. sales territory, customer etc.



ABOVE: The Freedom Group consists of brands such as Bay Swiss, Capt'n Snooze and Freedom Furniture.

- Intelligent "best fit" forecasting model selection
- Ability to capture data at whatever level best suits. e.g. customer, site etc.
- Capability of saving overrides (which can be at multiple levels and have multiple methods for application e.g. absolute, differential, percentage) for reapplication after statistical forecasts are refreshed.
- Flexibility in structure of input files and hierarchy.
- Ability to provide output in multiple formats.
- Ease of use, both for setting up and learning the product.

"On top of meeting these requirements we needed to find a tool which was proven and did not cost an arm and a leg. We found Forecast Pro, which met all our requirements at a cost of under \$10,000. It only took a couple of days of training and just a couple months of elapsed time to implement it."

"However, having the right forecasting tool was just the start. While it took away the drudgery of working with spreadsheets and overcame the limitations of the forecasting capabilities of our ERP package, we needed to clearly understand our forecasting requirements and had to design an effective forecasting structure and process to suit. We needed to make sure that the data we fed into it was relevant and accurate. Above all, we needed to clearly define the responsibilities for forecasting and make sure that forecasting was a team effort and not just an individual one."

"After 18 months of implementation of an effective forecasting process aided by Forecast Pro, we have achieved significant reduction in freight costs (greater than 22% reduction), increased inventory turns leading to a 10% reduction in warehousing costs and improved customer service from greater than 100 items on backorder at the worst levels to less than 5 currently," Tony Johnson concluded.

Freedom Furniture

Under the Freedom Group are well-known Australian brands such as Bay Swiss, Capt'n Snooze and of course Freedom Furniture. Overall, the group has 236 outlets, four manufacturing facilities, about \$800M of sales turnover, \$100+ M of imports and seven distribution centres. Forecast Pro is used to forecast the retail sales generated in over 60 Freedom Furniture stores.

Hepke Poutsma, Senior Homewares Planner is responsible for forecasting the Homewares range of products, which has about 5000 products sold across 60+ stores in Australia and New Zealand. He described how they have streamlined their forecasting process.

"Like most companies, we used Excel as our forecasting tool. While Excel is quite flexible (easy to change and manipulate) and easy to understand and work with, we suffered from many unintentional human errors. The spreadsheets got bigger and bigger all the time and the program used to crash resulting in frequent restarts

and loss of valuable time. Because of the sheer size of the forecasting job we had to do, it was taking us a very long time to develop forecasts and it was a very tedious job indeed. Even then, we could only see numbers and it was not a visual presentation, which most of us would prefer.”

“Our sales are highly seasonal. We also continuously introduce new products to suit changing customer preferences. As we do not have many products with two years or longer history, it is difficult for any statistical forecasting tool to identify seasonality, let alone at a product level. So we needed a tool which not only calculate seasonality patterns, but also is able to apply relevant seasonal profiles to products with limited sales history.”

“Since retail business is highly promotion- and clearance driven, any forecasting tool to be used must be able to account for such event-driven sales increases. With the size of forecasting task at Freedom, we needed a tool which was also very flexible to set up and at the same time easy to use.”

“One of our requirements was the ability of the software supplier to understand the retail environment we were operating in and provide value-adding assistance in implementing the forecasting tool and the overall forecasting process”.

“However, we decided to go for a trial before deciding on a full-scale implementation. This proved very useful for us in deciding how to break up the forecasting task, how to use appropriate seasonal profiles and how to structure the overall forecasting process. It also enabled us to compare the accuracy of the forecasts generated by Forecast Pro vs. the accuracy of forecasts generated by our own Excel-based system being used at the time, with the former being sufficiently better for the majority of the sample items. I believe this phase is vital, particularly in large scale forecasting jobs such as what we have at Freedom. Just applying sophisticated forecasting algorithms without doing solid homework can lead to serious disillusion.”

“We had to pay particular attention to forecasting of new products. As everyone knows, forecasting new products is a very difficult task and requires a high degree of educated guesswork. However, the software helps us in this area by applying relevant seasonality patterns and allowing us to implement a weekly forecasting cycle so that we can react quickly if the sales turn out to be very different from forecasts.

After about four months of existence, new

products are merged with what we call existing products, which are forecasted on a monthly cycle.”

“We have now implemented the new forecasting process facilitated by Forecast Pro for over 18 months and have seen some very good results in the areas of inventory and customer service. The process has enabled us to overcome the limitations of our Excel based forecasting process being used previously. It now takes a matter of minutes rather than hours to generate statistical forecasts.

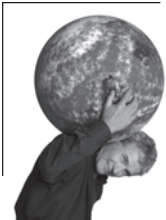
This has enabled our planners to spend majority of the time in reviewing statistical forecasts and identifying products that need attention. The graphical presentation has also significantly increased the efficiency of the planners.”

“While in today’s highly competitive business environment, a clever forecasting tool is very much a necessity in most businesses, it will never replace the need for human intelligence. After all, future demand patterns do not always follow the past demand patterns and good forecasts can only result from applying quantitative techniques in combination with your own knowledge of your products and the markets you are operating in. You need to design and implement an effective forecasting process, which accommodates both and above all, good teamwork is a pre-requisite in streamlining your forecasting process,” Hepke concluded.

The advantages of streamlining your forecasting process are endless. When getting started, acknowledging the need is only the first step; make sure to clearly understand your forecasting needs, especially if you are going to invest in a forecasting tool. There are many horror stories about failed implementations, so you need to be certain that the tool will be capable of meeting your needs. Go for a trial or a pilot implementation if you are not sure.

Remember however, that investing in a forecasting tool is just a start, you need to design a forecasting structure that is likely to give you the best forecasts and then implement a sound forecasting process. Above all, you will need clearly defined accountabilities, capable and motivated people and effective teamwork to reap benefits that can come from good forecasts.

Dinesh Shah is a Director and Principal Consultant of Supply Chain Business Solutions, distributors of Forecast Pro. He can be contacted by phone on (02) 9541 0522 or by email dinesh@supplychainbusinesssolutions.com.au. ■



SPECIAL FEATURE

WHEN AND HOW SHOULD STATISTICAL FORECASTS BE JUDGMENTALLY ADJUSTED?

INTRODUCTION by Feature Editor, Nada Sanders

Preview: In her introduction to this feature section, Nada explains the challenges of judgmentally adjusting statistical forecasts, and the problems that can occur if the process is not done correctly.



Nada R. Sanders is Professor of Operations Management and Logistics at the Raj Sooin College of Business at Wright State University. Nada is author of numerous articles, in journals such as *Decision Sciences*, *Journal of Business Logistics*, *Supply Chain Management Review*, *Omega*, *Interfaces*, *International Journal of Production and Operations Management*, *Journal of Behavioral Decision Making*, and others. She has written chapters for books and encyclopedias and is co-author of the book *Operations Management*, in its 2nd edition. Her expertise includes business forecasting and demand planning, best ways of combining managerial judgment with statistical forecasts, the use of forecasting software in business organizations, and supply chain strategy.

Managers today are under greater pressure to deliver accurate forecasts than ever before. Accurate forecasting has always been a critical organizational capability that enables effective business planning (Armstrong, 2001; Fildes and Hastings, 1994). Managers have historically relied on forecasts to help them identify new market opportunities, anticipate future demands, schedule production more effectively, and reduce inventories.

Over the past few years, however, forecasting has become especially critical as competitive market pressures create the need to improve forecast accuracy (Sanders and Manrodt, 2003a). Information technology (IT) has enabled forecasts to drive entire supply chains and enterprise-resource-planning systems, placing greater importance on the forecasts (Lee, 2004). At the same time, global competition has created an environment characterized by uncertainty, rapidly shifting markets, and compressed cycle times. Customers are increasingly demanding shorter response times, improved quality, and greater product choice. The result has been a sharp rise in the complexity of the forecasting process, in which historical data is often

of limited value in predicting the future, and managers have difficulty producing accurate forecasts.

Accurate forecasting has always been a critical organizational capability.



Forecasting today is more challenging because of

- increased global competition,
- rapidly changing markets,
- shorter cycle times,
- higher consumer expectations,
- information technology and e-commerce.

How should managers produce their forecasts? They can choose from two broad categories of forecasting methods: *managerial forecasts*, which are based on opinion, and *statistical forecasts*, which are based on mathematical modeling. Each category has its strengths and weaknesses. With managerial forecasts, managers can incorporate soft or inside information, which can be a valuable predictor

in changing environments (Webby and O'Connor, 1996). They can also respond to last minute changes in the environment. However, because managerial forecasts are subjective, they are often biased (Armstrong, 1985; Hogarth, 1987). Just consider the manager who is optimistic the day after a large sale, but pessimistic the day after a slump. Such events often lead managers to inadvertently bias their forecasts, which can degrade accuracy.

Managerial forecasts can respond to the latest changes in the environment but can be biased.



Strengths of Managerial Forecasts:

- Responsive to latest changes in environment
- Can include inside information
- Can compensate for one-time or unusual events

Weaknesses of Managerial Forecasts:

- Human cognitive limitations (e.g., limited attention span, limited memory, misunderstanding causal relationships)
- Biases (e.g., lack of consistency, optimism, wishful thinking, political manipulation)

Unlike managerial forecasts, statistical forecasts are based on mathematical principles and are typically generated by the software packages available (Sanders and Manrodt, 2003b). Statistical methods are consistent, objective, and unbiased. They are particularly effective for generating forecasts for a large number of SKUs (stock-keeping-units), when managerial forecasts would be time consuming and costly. However, statistical methods are based on historical data and are not effective when conditions in the market change. A new competitor could enter the marketplace, for example, or a snow storm could delay a shipment. Each approach has its strengths, and the best forecasting methods

Statistical forecasts are objective and consistent but are only as good as the data upon which they are based.

Strengths of Statistical Forecasts:

- Objective
- Consistent
- Can process large amounts of data
- Can consider many variables and complex relationships



Weaknesses of Statistical Forecasts:

- Slow to react to changing environments
- Only as good as the model formulation and available data
- Can be costly to model soft information
- Require technical understanding

integrate both approaches. Increasingly, successful forecasting relies on the use of composite methodologies that incorporate a range of information from traditional

statistical computations to judgmental assessments of markets. Forecasting methods that combine managerial and statistical forecasts offer such an alternative.

Managerial and statistical forecasts can be combined in different ways to take advantage of their strengths. One method of combining them is to take a mathematical average of the results of the two methods to generate a forecast. Another method is to use managerial opinion as an input to the forecasting model. By far the most popular method in practice, however, is managerial adjustment of statistical forecasts. Managers take statistical forecasts, for example, those generated with software packages, and adjust them up or down based on their opinions. This adjustment is often called a managerial override, and managerial adjustment of statistical forecasts is the most popular method of forecasting in practice. In fact, in a survey of managers, Sanders and Manrodt (1994) found that 91 percent of respondents made managerial adjustments to statistical forecasts.

Managerially adjusting statistical forecasts can often improve forecast accuracy by including information not available to the statistical model. On the other hand, if not performed correctly, adjustments can degrade accuracy because of the biases inherent in human judgment. Managers should follow the established guidelines or principles for correctly adjusting statistical forecasts to take advantage of the strengths of the two methods without allowing biases to degrade forecast accuracy. Basically, there are correct and incorrect ways to managerially adjust statistical forecasts. Given the prevalence of managerial adjustment of statistical forecasts in practice and the

Managerially adjusting statistical forecasts is the most popular method in practice.

- Managerially adjusting statistical forecasts can improve accuracy.
- If not performed correctly, managerial adjustments can degrade accuracy.
- Managers must follow the dos and don'ts of judgmental adjustments.



importance of understanding the guidelines for proper adjustment, we are devoting the Special Feature of this issue of FORESIGHT to addressing how and when managers should adjust statistical forecasts. Our feature article by Paul Goodwin of Bath University is "How to Integrate Management Judgment with Statistical

Forecasts.” He provides fundamental information on how to combine the two forecasting approaches. Goodwin’s article is followed by two commentaries. In the first, Dilek Önkal and M. Sinan Gönül of Bilkent University, discuss why and when forecasts are adjusted. In the second, Nigel Harvey of University College London, addresses how to improve the quality of judgmental adjustments and the problems that can arise when practitioners adjust their own initial judgmental forecasts on the basis of statistical information. This Special Feature concludes with two commentaries from practicing forecasters. The first is a commentary by Anthony Lee of AstraZeneca Pharmaceuticals, followed by a commentary from Lucy Kjolso of Brooks Sports, Inc. These forecasters offer insights from their organizational experiences in how judgmental adjustments are most effectively applied. Finally, the article by Tom Ross in the following section on Forecasting Processes offers a case study of the integration of statistical and judgmental forecasts.

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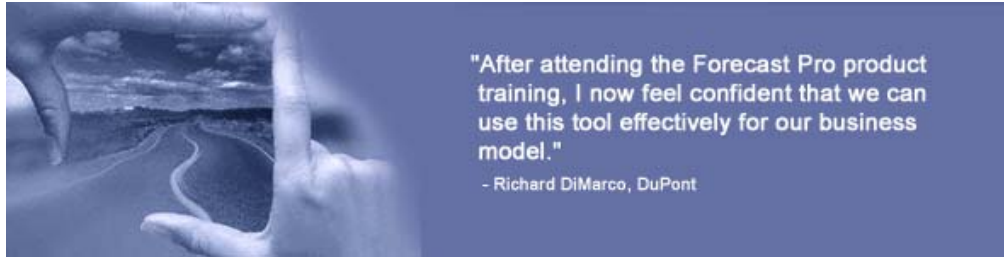
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Forecast Pro Tips and Tricks

How much data does Forecast Pro need to generate an accurate forecast in Expert Selection mode?

Forecast Pro requires that you provide a demand history for each item to be forecasted. The minimum amount of historical data required is a single data point. There is no hard and fast data length limitation (i.e., the length of the history is only limited by the amount of RAM in your computer).

Forecast Pro's Expert Selection only considers *time series methods*. A time series method is a forecasting technique which generates forecasts based solely on an item's past demand history. Time series methods considered in Expert Selection mode include different forms of exponential smoothing, Box-Jenkins models, the Croston's model, discrete data models and moving averages. Methods not considered in Expert Selection mode include event models (which provide adjustments for promotions, business interruptions or other irregular occurrences), dynamic regression models (which allow you to incorporate explanatory variables), topdown approaches (which allow you to use aggregate-level forecasts to improve lower level forecasts) and curve fitting. When one of these methods is called for, Expert Selection should not be used.

The amount of historical data available often has a direct bearing on how Expert Selection chooses the appropriate forecasting technique. Below, we will examine how different data length scenarios impact Expert Selection's forecasting approach and discuss alternative approaches you may wish to consider. The article will conclude with a discussion of cases where you might consider discarding some of the historical data.

For simplicity, our discussion will assume that we are forecasting monthly data, however, the principles apply equally well to other periodicities.

1) Forecasting with less than two years worth of demand history.

Generating an accurate forecast for an item with less than two year's worth of history can be challenging. When there are four or fewer data points, Expert Selection will use a moving average—there simply is not enough data to allow more in depth modeling. With between 5 and 23 months worth of data, Expert Selection will consider a variety of both trended and nontrended models, however, it will not consider seasonal models. Until you have at least two observations of each month Expert Selection cannot automatically determine whether the data are seasonal. Thus, in cases where you have less than two years worth of data and you know the data to be seasonal, you should not use Expert Selection.

In this case, appropriate alternatives include using topdown approaches, applying user-defined seasonal patterns via the weighting transform, supplying surrogate demand histories or judgmentally adjusting the Expert Selection forecasts. If you have 17 or more months worth of data (1 year plus 5 periods) you could also dictate that a seasonal exponential smoothing model be used. All of these approaches are fully supported in Forecast Pro.

2) Forecasting with more than two year's worth of demand history.

Expert selection generally works quite well with more than two years worth of data and the majority of Forecast Pro users rely upon it. Having said that, if you have between two and three years worth of seasonal data and the seasonality is not very pronounced, you will want to keep an eye on Expert Selection. If Expert Selection opts for a nonseasonal model for data you know to be

seasonal, you will want to override the selection and dictate that a seasonal method such as Winters exponential smoothing be used. Remember, your knowledge of the data is important—to Forecast Pro it is simply a stream of numbers.

3) Cases where you might consider discarding data

Many forecasters are much too quick to throw away historical data. Most of the forecasting methods in Forecast Pro are adaptive and give the current data more emphasis than the more distant past when calculating the forecasts. Retaining the older data is important to help establish the rate of change in the data.

On the other hand, there are times where discarding the earliest data is appropriate. These times include:

A. When you have more than 7 years worth of history. Expert selection uses time series methods and using more than 7 years of history does not usually improve time series forecasts.

B. When there are distinct start-up behaviors. Some product launches have very distinct start-up behaviors. For example, pharmaceutical drugs often have very high sales immediately after the drug is approved as distributors build initial inventories. After this “pipeline fill”, sales reflect the demand pattern generated by pharmacies reordering as patients fill prescriptions. Discarding the initial pipeline fill data makes sense if you are trying to forecast the prescription filling demand.

C. Cases where there is a radical change in the data. Some industries experience radical changes that make the older demand history irrelevant in terms of forecasting the future. For instance, the breakup of a monopoly, the advent of new technology rendering a product obsolete or other sudden dramatic changes in the market may necessitate throwing away the now irrelevant past history.

Forecast Pro product training workshops cover all aspects of Forecast Pro, including topics such as how data length impacts the forecast model. To learn more about the Forecast Pro product training workshop [click here](#).

About the author:

Eric Stellwagen is Vice President and Co-founder of Business Forecast Systems, Inc. (BFS) and co-author of the Forecast Pro software product line. He consults widely in the area of practical business forecasting—spending 20-30 days a year presenting workshops on the subject—and frequently addresses professional groups such as the University of Tennessee’s Sales Forecasting Management Forum, APICS and the Institute for Business Forecasting. Recognized as a leading expert in the field, he has worked with numerous firms including Coca-Cola, Procter & Gamble, Merck, Blue Cross Blue Shield, Nabisco, Owens-Corning and Verizon, and is currently serving on the board of directors of the International Institute of Forecasters (IIF).