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# The Evaluation of Forecast Accuracy of a Non Statistical Method of Forecasting

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## Abstract

It is often assumed that the accuracy of formal statistical methods of forecasting is naturally superior to methods which are not based on statistical principles. Nevertheless, non statistical methods of forecasting are very widely employed in practice, especially within small businesses, because they are generally less sophisticated and easier to understand. This paper evaluates the accuracy of a simple rule of thumb that was employed by a British company in its forecasting procedure. The results are compared with the performance of statistical methods under different conditions in order to ascertain whether any improvements in forecast accuracy could be gained.

*Keywords*: Business forecasting, time series analysis.

## 1. Introduction

Throughout the twentieth century we have witnessed a boom in the development of statistical forecasting methods. Yet many businesses and industries still employ forecasting systems that are not based on statistical principles. The reason for this situation lies in the fact that many staff members who are responsible for forecasting systems, especially in small to medium businesses, often do not possess a formal training in statistics. This deficiency is often offset, to some extent, by the use of personal judgement honed by years of business experience. The methods of forecasting developed by these individuals may bare little resemblance to those prevalent in the forecasting literature, although they may still display a strong element of common sense. Such methods are often relatively simple procedures and can be understood easily by non-technical people. They are usually easy to implement and maintain in practice.

Where such an informal system is able to perform satisfactorily, a business may be reluctant to change. Why switch to a statistical method of forecasting if the associated gains are likely to be small or even non existent?

The focus of this paper is on a non-statistical method employed by a British company about twenty years ago for the purposes of short term forecasting (Snyder, 1973). Despite holding well over a thousand different lines in its inventory, the forecasting method applied by this company was basically a simple rule of thumb developed by a warehouse manager with extensive business experience. The approach gave plausible results in practice but alternative approaches had not been explored. The study described in this paper was therefore undertaken to test the heuristic method against statistically based alternatives.

## 2. The Heuristic Approach to Forecasting

Essentially, the company's method entails the determination of an annual growth factor which is then used to project past observations into the future. The formulae underpinning the method are:

$$\text{Growth}(t) = \sum_{i=t-h+1}^{t} \text{Sales}(i) \Big/ \sum_{i=t-m-h+1}^{t-m} \text{Sales}(i) \qquad \textbf{(Eq.1)}$$

$$\text{Pred.Sales}(t+i) = \text{Sales}(t+i-m) * \text{Growth}(t) \qquad \textbf{(Eq.2)}$$
$$\text{where } i = 1,2,..,m$$

$$\text{Pred.Sales}(t+i) = \text{Pred.Sales}(t+i-m) * \text{Growth}(t) \qquad \textbf{(Eq.3)}$$
$$\text{where } i > m$$

where $t$ represents the current period; $m$ the number of observations in one year; and $h$ represents the number of observations to be included in the summations where $h$ is less than or equal to $m$.

The method is illustrated on the artificial data in Table 1 where a forecast is required by the company for the month of April 1990. Assuming that $h$ represents three months, the growth factor is calculated by dividing the total sales for the first three months of 1990 by the total sales for the corresponding three months of 1989 as follows:

$$\text{Growth}(t) = (15 + 20 + 25) / (10 + 15 + 20) = 1.33$$

The one-step-ahead forecast for the month of April 1990 is then determined by multiplying the actual sales for the month of April 1989 by the growth factor, as follows:

$$\text{Pred. Sales}(t+1) = 25 * 1.33 = 32$$

Both steps are repeated every month on a rolling basis. Thus, at the end of April, the growth factor is updated by dividing the total sales for the months of February, March and April this year by the total sales in the corresponding three months in the previous year. This new updated growth factor is then applied to the actual sales figure for May in the previous year in order to produce a forecast for May this year.

**Table 1**
Sales for the past fifteen months.

| Month | Year 1989 | 1990 |
| --- | --- | --- |
| Jan | 10 | 15 |
| Feb | 15 | 20 |
| Mar | 20 | 25 |
| Apr | 25 | ? |
| May | 30 | |
| Jun | 30 | |
| Jul | 25 | |
| Aug | 20 | |
| Sep | 15 | |
| Oct | 10 | |
| Nov | 5 | |
| Dec | 5 | |

From this illustration, it can be seen that the heuristic method is not only very easy to understand but it is also very simple to apply in practice. Furthermore, the management of the company considered that it performed reasonably well, due possibly to several inherent characteristics of the approach.

The method accounts for changes in the level of the time series, ie. where a time series follows a particular trend, that trend is brought into account in the generation of forecasts by the growth factor. The method also accounts for seasonal effects. Where, for example, the sales figure for the previous month of April is high as a result of seasonal influences, then the forecast for the month of April this year will also be high. Finally, the method copes with business cycles, the effects of which are reflected in the changes to the growth over time. Under this method, the growth factor is updated every month as the actual sales figure becomes available and hence adapts to changes in the series caused by a business cycle.

Due to its simplicity and ability to cope with trends, seasonal effects and business cycles, the heuristic method presents us with an attractive approach to forecasting that may appeal to many businesses. The objective of this paper is to evaluate its performance against more formal statistical methods of forecasting.

## 3. The Study

The heuristic forecasting method was applied to 91 different time series originating from the forecasting competition conducted by Makridakis *et al.* (1982). The series, as summarized in Table 2, consist of 23 quarterly and 68 monthly series collected from various firms, industries and countries and include seasonal as well as non seasonal data. Furthermore, these time series have different starting and ending dates and involve different forecasting horizons as dictated by the Makridakis competition which are 8 quarters and 18 months for quarterly and monthly data respectively.

In accordance with the Makridakis competition, two kinds of forecast errors were calculated for the heuristic method. The first, known as "model fitting" errors, were calculated from the application of the heuristic method to the first $n - l$ observations of each time series where $l$ is equal to the forecasting horizon applicable to the data. The second was calculated for the forecasting horizon involving the last $l$ values of the time series. The one-step-ahead forecast errors used in both cases were obtained with:

$$\text{Error}(t) = \text{Sales}(t) - \text{Pred.Sales}(t) \qquad \textbf{(Eq.4)}$$

where Pred.Sales($t$) is the one-step-ahead forecast.

The main measure of accuracy used was the mean average percentage error (MAPE) defined as:

$$\text{MAPE} = \sum_{i=1}^{n} |\text{PE}(i)| \,/\, n \qquad \textbf{(Eq.5)}$$

where PE($t$) = 100 * Error($t$) / Sales($t$) and $n$ represents the number of observations.

It enables meaningful comparisons of performance between different forecasting methods on different types of time series. In order to obtain an overall measure of performance of the forecasting method, both sets of MAPEs calculated in relation to model fitting and forecasting horizons for each time series are averaged over the 23 quarterly series and 68 monthly series.

**Table 2**
Major classifications of the time series.

| Time interval between successive observations | Types of time series data | | | | |
|---|---|---|---|---|---|
| | Micro | Industry | Macro | Demo-graphic | Total |
| Quarterly | 5 | 2 | 11 | 5 | 23 |
| Monthly | 22 | 21 | 17 | 8 | 68 |
| Total | 27 | 23 | 28 | 13 | 91 |

The heuristic method was applied to the monthly data for four separate situations, namely $h$ = 1, 2, 3 and 6. The average MAPEs in relation to these applications are summarized in Table 3 together with the results of Holt-Winters and Parzen's methods of forecasting from the Makridakis study. It can be seen that the heuristic performs best when $h$ is equal to either 2 or 3 months. For short one-step-ahead forecasts, $h = 3$ is more efficient while $h = 2$ offers more accurate long term forecasts. However, the MAPE figures generally suggest that formal statistical methods such as the Holt-Winters and Parzen's methods are superior.

**Table 3**
Average MAPEs: 68 monthly data.

| | METHOD | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Model Fitting | 12.9 | 11.9 | 11.8 | 13.9 | 9.0 | 9.0 |
| Forecasting Horizons | | | | | | |
| 1 | 15.4 | 13.0 | 11.8 | 13.4 | 10.3 | 12.7 |
| 2 | 15.5 | 13.2 | 12.7 | 13.6 | 12.0 | 12.6 |
| 3 | 15.1 | 13.7 | 13.8 | 14.7 | 12.5 | 9.6 |
| 4 | 15.9 | 14.6 | 14.9 | 15.8 | 11.8 | 11.7 |
| 5 | 16.5 | 15.0 | 15.2 | 15.9 | 11.9 | 10.2 |
| 6 | 16.7 | 15.2 | 15.7 | 16.4 | 14.8 | 11.8 |
| 8 | 18.6 | 17.0 | 17.7 | 18.3 | 17.5 | 14.3 |
| 12 | 21.9 | 20.0 | 20.9 | 21.0 | 15.9 | 13.7 |
| 15 | 29.6 | 28.0 | 31.9 | 31.6 | 33.4 | 22.5 |
| 18 | 38.4 | 37.7 | 45.5 | 44.9 | 34.5 | 26.5 |

1: Heuristic method using $h = 1$
2: Heuristic method using $h = 2$
3: Heuristic method using $h = 3$
4: Heuristic method using $h = 6$
5: Holt-Winters method
6: Parzen's method

Table 4 summarizes the results for quarterly data. In this case, the heuristic method was applied for $h = 1$ and 2. The results are similar although the figures generally suggest that forecasts are marginally more accurate when $h = 1$. The Holt-Winters method is able to provide lower MAPEs for model fitting and short term forecasting but the heuristic method is able to generate more accurate long term forecasts. Nevertheless, Parzen's method outperforms the heuristic and Holt-Winters methods.

**Table 4**
Average MAPEs: 23 quarterly data.

| | METHOD | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Model Fitting | 13.0 | 11.9 | 7.3 | 7.7 |
| Forecasting Horizons | | | | |
| 1 | 8.9 | 9.7 | 8.9 | 6.8 |
| 2 | 10.6 | 12.1 | 9.1 | 7.6 |
| 3 | 14.5 | 16.3 | 17.1 | 12.0 |
| 4 | 19.6 | 20.3 | 25.6 | 16.5 |
| 5 | 25.8 | 25.9 | 32.6 | 21.1 |
| 6 | 31.3 | 31.2 | 37.2 | 20.4 |
| 8 | 44.2 | 44.3 | 40.3 | 21.0 |

1: Heuristic method using $h = 1$
2: Heuristic method using $h = 2$
3: Holt-Winters method
4: Parzen's method

## 4. Conclusions

The heuristic method, in this study, tended to be less accurate than formal statistical methods. However, Parzen's approach, although it consistently produces better results, would not be viable in business situations similar to the company in consideration where forecasts are required on a regular basis for over 1200 items. The most appropriate benchmark for large scale forecasting applications is the Holt-Winters method which, in this case, was generally superior to the heuristic approach although there were some important exceptions where longer forecasting horizons were involved. The results suggest that where businesses still employ heuristic approaches to forecasting, a change to statistical methods should be given serious consideration.

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