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Case Study

A CASE STUDY ON FORECASTING CSP IN AN AUTOMOBILE INDUSTRY

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This is the case-study of an automobile Industry in India. The prices of Critical Spare Parts (CSP) are range from tens to hundreds of thousand rupees. As the equipment's operate, some critical spare parts need to be replaced due to wear and tear. If appropriate amount of critical spare parts are not prepared, machines may not be able to function, thus resulting in a waste of resources. However, estimation of the critical spare parts consumption is a complicated subject (Billinton and Ahllen, 1983). This investigation focuses on forecasting the critical spare parts and evaluating the prediction performance of different forecasting methods. Exponential smoothed model, Least Square method and moving average method (MA) are used to perform CSP demand prediction, so as to effectively predict the required number of CSP which can be provide as a reference of spare parts control. This investigation is verified by comparing the predicted demand and actual demand of critical spare parts in semiconductor factories.

Keywords: Critical spare parts, Exponential smoothed model, Least square method, Moving Average method (MA)

INTRODUCTION

As for data collection, the historical requirements of the spare part and the relevant factors in duration of 24 weeks from May 2013 to November 2013 are collected. The benchmark used in order to compare the different forecasting methods is the "average prediction accuracy", which is simply equal to 1-MAPE (Krajewski and Ritzman, 1999).

$$MAPE = \frac{1}{n} \cdot \sum_{t=1}^{N} \left[\frac{A_t - F_t}{A_t} \right]$$

$$PA = 1 - MAPE$$

Moving Average Method Prediction Result

As consider the length of data, 24 weeks are used for MA to derive the forecasted value of requirement, and compare the difference with the actual requirement (Blanchard *et al.*, 1995). The average prediction accuracy of the MA is shown as Table 1.

According to Table, the prediction average accuracy of 3-period of MA is 81.96%, 7-

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period of MA is 84.61% while the prediction accuracy of 5-period of MA is 84.69% which has better predict performance than other periods of MA, the result also indicate that the forecasting of CSP requirement is very difficult, not only because of the large data variation,

Figure 1: Moving Average Method Prediction Result

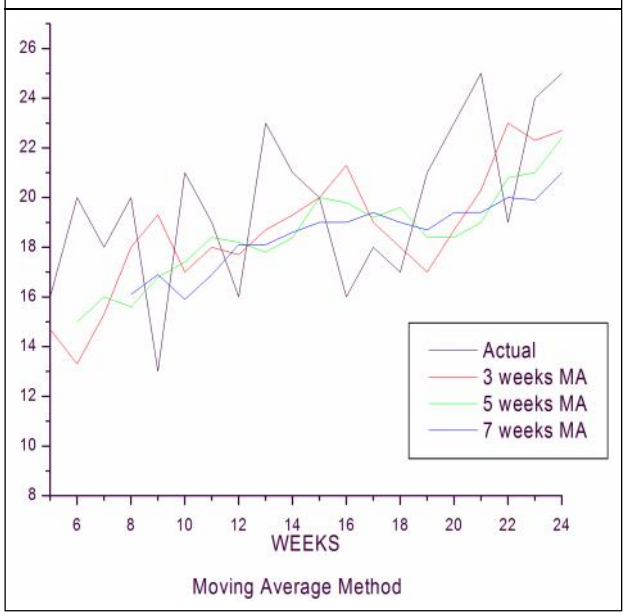


Figure 2: Single Exponential Smoothing Method Prediction Result

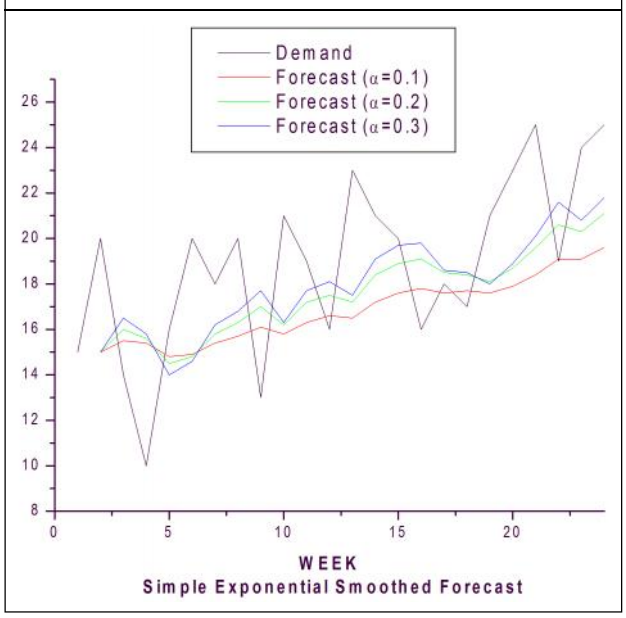
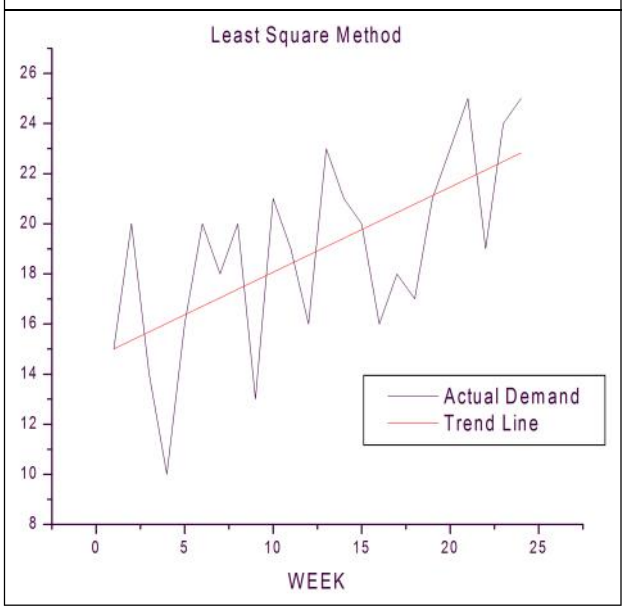


Figure 3: Least Square Method Prediction Result



but also the historical data might not enough to predict future demand accurately.

Single Exponential Smoothing Method Prediction Result

The Plot of demand and forecast with ~ = 0.1, 0.2 and 0.3 is shown in Figure. The plot shows the following characteristics:

- At ~= 0.3, noticeable swings are observed in the forecast as the demand dips and jumps. However, forecasts with ~:= 0.1 shows a more leveled behavior. Since with a higher value of ~, the recent demand observations have a higher weightage (than in the case of ~:= 0.1), the forecast sometimes respond unnecessarily to fluctuations in the demand which are random in nature. While tracking the demand is important, overdoing the same is not desirable.
- Forecasting with ~ = 0.1 clearly brings out a gradually rising trend in the demand. But there is a consistent lag in the forecast, e.g.,

when the demands were averaging around 23 in the last weeks, the forecast average is around 19. From the fifth to tenth week, while the demand average is 18, the forecast is around 15.5. The forecast with the higher value of ~ (0.3) also shows the response lag in time as well as in quantity.

Least Square Method Prediction Result

The prediction result accuracy obtain with least square method is about 85.74% which is quite better then accuracy obtained with the other methods earlier.

Table 1 shows the results of the investigation.

Table 1: The Average Prediction Accuracy from Various Methods

Method		MAPE	PA
Moving Average Method	3 Weeks	0.1803	81.96%
	5 Weeks	0.1530	84.69%
	7 Weeks	0.1538	84.61%
Exponential Smoothing Method	~ = 0.1	0.17696	82.30%
	~ = 0.2	0.17482	82.51%
	~ = 0.3	0.17642	82.35%
Least Square Method	0.1425	85.74%	

CONCLUSION

According to the Table 1, the Least square method have higher average accuracy of 85.74% than ESM and MA, the order from high to low average prediction accuracy of prediction methods is LSM, MA (5-period), MA (7-period), ESM and MA (3-period). It can be clearly understand when the data sets is few, the data variation is large and the value of some influential factors is unknown at the prediction timing of current term, Least Square Method might have better prediction performance than ESM and MA. In this investigation all the defects the of NNs clearly appears. In fact, in spite of they are considered as the best performing forecasting methods from the majority of the scientific authors, they don't well perform when data sets is few: a large training set is needed in order to take advantage of their peculiarities. In other cases, also traditional methods (as Moving Average) perform better.

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