Decreasing the Error of Sales Forecasting by Fitting the Data

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Abstract: This research plan was done in the industrial production company named Beta. This company owns four branches; therefore, the population is Beta Company and its four branches and 2007, 2008, 2009, 2010 and 2011 were selected as samples. The method was the analytical-descriptive; therefore, data analysis was done in several stages as follows;A: Sales forecasting for 2007, 2008, 2009, 2010 and 2011 with different methods including Naïve, simple moving average, weighted moving average and exponential smoothing methods. B: Error of sales forecasting of the above-mentioned methods are calculated and compared. C: Since the Company owns four branches, at this stage, the statistics of customers' referring each branch per hour is regarded as the independent and the real sales amount per hour as the dependent variables. D: using the mathematical relations, we achieve an equation with which the company can forecast the sales rate and minimize the error of prediction, which is called as "fitting". E: Finally, the results achieved from fitting are compared with the predictions to determine whether fitting data can affect the error of sales forecasting. The results show that fitting the sales data results in decreasing the error of sales forecasting by using the least square method.
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1. Introduction

Sales forecasting is an organizational activity that is stated as the first step in marketing programs and is executable for all the work domains and is considered as an art and a comparative advantageous which results in prioritizing of the organization. Even if the prediction does not always have a formal and correct form, it plays a significant role in programming and decision-making. Therefore, prediction is considered as a useable activity for the high-rank management and for all the internal tasks of the organization especially the marketing. Every manager deals with prediction in his decision-making. Some of these predictions are easy yet some complicated and difficult. The predictions can be done for a short-time or a long-time period. Of course, prediction never fit with reality and the predictor should try to minimize the error of prediction (Tull, D. S. (1967).

The scholars of management have invented different techniques for forecasting so far and gave them to the managers. Each technique has its own application through which more successful forecasts can be done. Managers should try to select a responsive forecasting model which is in accordance with the activities and needs of the organization. In most of the cases a simple model can present better results than a complicated model. Therefore, one of the main issues managers are dealing with is forecasting the future events so that they present and administer appropriate programs through getting aware of the changes (Gardner, E.S. and Anderson, E.A. (1997).

Every successful research must be provided with necessary information. The information is adapted through collected data. The connective circle is between one question and finding a scientific response and adapting information. Data collection methods depend on the research question and the research type (Coope, I.D. (1993).

In descriptive research, variables are chosen and observed; they are not usually manipulated by the researcher; therefore, no condition is created for the events. The population is extensive and unlimited in such researches and sampling is the main element of these researches. The domain of descriptive researches is unlimited and extensive. Therefore, some scholars believe that they include all types of research methods except the historical and experimental methods. The researcher tries to report whatever is seen without any manipulation or mental inference and to take the objective results from the situation (Armstrong, J. S., Brodie, R. and McIntyre, S. (1987).

The researcher's aim is the objective, real and regular description of the specifications of a situation or a subject in descriptive researches. In other words, in such researches the researcher tries to report "what there is" without any interference or mental inference and takes the objective results from the situation. The reason for carrying out such researches is to answer such questions as "how much", "which", "what is happening?" The descriptive research describes and interprets what there is and pays attention to the conditions or the available relations, common ideas, current procedures of observed effects or developing

procedures and its attention is firstly focused on the present; although, the past events and works that are related to the available conditions are also studied and examined.

Table1: of Error of Forecasting in Different Forecasting Methods (2007-2011)

Year	Simple Average Method	Moving Average Method	Moving Weighted Average Method	Exponential Smoothing Method	Naïve Method
2007	13612	7000	4663	5323	7100
2008	12696	6621	6486	10243	4700
2009	5536	6966	5783	6253	6800
2010	9043	5767	10033	5768	5400
2011	7051	7298	6566	8227	4750

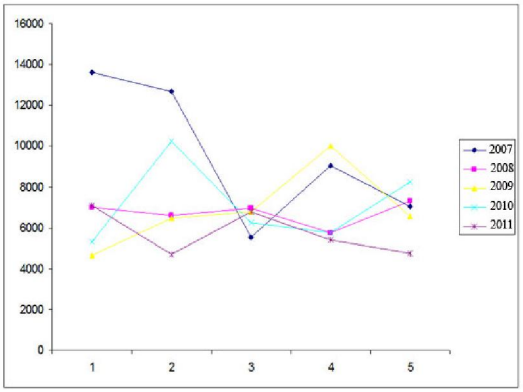

Figure 1: Comparing Diagram of Error of Forecasting in Different Forecasting Methods (2007-2011)

Fitting Data:
This method defines the mathematical relation between dependent and independent variables and the simplest relation is a linear relation.

$$\frac{\sum y_i}{n}=\frac{\sum \alpha}{n}+\frac{\beta\sum X_i}{n}\Rightarrow \bar{y}=\alpha+\beta\bar{X}_i \quad , \quad a=\bar{y}-\beta\bar{X}_i$$

$$\frac{\delta\sum e_i^2}{\delta\beta}=-2\sum X_i(y_i-\alpha-\beta X_i)=0$$

$$\sum X_i y_i=\alpha\sum X_i+\beta X_i^2$$

$$\sum X_i y_i-\bar{y}X_i=\beta(\sum X_i^2-\bar{X}\sum X_i)$$

$$\beta=\frac{\sum X_i y_i-\bar{y}\sum X_i}{\sum X_i^2-\bar{X}\sum X_i}$$

And

$$\beta=\frac{n\sum X_i y_i-\sum X_i y_i}{n\sum X_i^2-(\sum X_i)^2}$$

$$\alpha=\frac{\sum y_i-\beta\sum X_i}{n}$$

$$\alpha=\bar{y}-\beta\bar{X}$$

$y_i^e=\alpha+\beta_1X_1+\beta_2X_2$, if there is a relation between a dependent and independent variable, the estimated equation is used.

$$\sum e^2=\sum[y_i-(\alpha+\beta_1X_1+\beta_2X_2]^2$$

$$\frac{\delta\sum e^2}{\delta\alpha}=-2\sum(y_i-\alpha-\beta_1X_1-\beta_2X_2)$$

The necessary condition for minimizing the collection of squares is that the derivate is zero. As a result we will have:

$$\sum y_i=\sum\alpha+\beta_1\sum X_1+\beta_2\sum X_2$$

$$\frac{\delta\sum e^2}{\delta\beta_1}=-2\sum X_1(y_i-\alpha-\beta_1X_1-\beta_2X_2)=0$$

$$\sum X_i y_i=\alpha\sum X_1+\beta_1\sum X_1^2+\beta_2\sum X_1X_2$$

$$\frac{\delta\sum e^2}{\delta\beta_2}=-2\sum X_2(y_i-\alpha-\beta_1X_1-\beta_2X_2)=0$$

$$\sum X_2 y_i=\alpha\sum X_2+\beta_1\sum X_1X_2+\beta_2\sum X_2^2$$

If the guaranteed equation is

$y_i^e=\alpha+\alpha_1X_i+\alpha_2X_i^2$ the sum of squares will be:

$$\min=\sum e^2=\sum(y_i-\alpha-\alpha_1X_i-\alpha_2X_i^2)^2$$

$$\frac{\delta\sum e^2}{\delta\alpha}=-2\sum(y_i-\alpha-\alpha_1X_i-\alpha_2X_i^2=0$$

The necessary condition for minimizing is that the derivatives are equal to zero. Therefore we will have:

$$\sum y_i=\sum\alpha+\alpha_1\sum X_i+\alpha_2\sum X_i^2$$

$$\frac{\delta\sum e^2}{\delta\alpha_1}=-2\sum(y_i-\alpha-\alpha_1X_i-\alpha_2X_i^2)-X_i=0$$

$$\sum X_i y_i=\sum\alpha X_i+\alpha_1\sum X_i^2+\alpha_2\sum X_i^3$$

$$\frac{\delta\sum e^2}{\delta\alpha_1}=-2\sum(y_i-\alpha-\alpha_1X_i-\alpha_2X_i^2)-X_i^2=0$$

$$\sum X_i^2 y_i=\sum\alpha X_i^2+\alpha_1\sum X_i^3+\alpha_2\sum X_i^4$$

In order to achieve the estimated equation that is related to branches of the related company, we should regard the information of company's

customers as well as the real sales rate per hour as the criterion. The following amounts have been calculated;

$$\sum X_i = 129 \qquad \sum y_i = 199800 \qquad \sum X_i^2 = 4205$$
$$\sum X_i^3 = 138483 \qquad \sum X_i^4 = 4604897 \qquad \sum X_i y_i = 64804$$
$$\sum X_i^2 y_i = 212425400$$

Regarding the calculations the main equation of forecasting is as follows;

$$y_i = 199442 + 0.004 X_i + 0.085 X_i^2$$

Now, based on the achieved forecasting equation, we calculate the forecasting amount per year;

1. Calculating the rate of sales forecasting for 2007
The real sales rate in 2007 is equal 199800 although the amount of forecasted sales is equal to 200856 based on the above-mentioned equation. The error of forecasting in 2007 is equal to 1077.
2. Calculating the rate of sales forecasting for 2008
The real sale rate in 2008 is equal to 200600 although the sales forecasting amount was equal to 201756 and the error of forecast is equal to 1156 in 2008
3. Calculating the rate of sales forecasting for 2009
The real sale rate in 2009 is equal to 203800 although the sales forecasting amount was equal to 204257 and the error of forecast is equal to 457 in 2009.
4. Calculating the rate of sales forecasting for 2010
The real sales rate in 2010 is equal to 203900 although the sales forecasting amount was equal to 201132 and the error of forecast is equal to 2768 in 2010.
5. Calculating the rate of sales forecasting for 2011
The real sale rate in 2011 is equal to 221500 although the sales forecasting amount was equal to 216427 and the error of forecast is equal to 5037 in 2011.

The Comparison Table of Real and Forecasting Sales after Fitting the Data (2007-2011)

Year	Real Sale	Forecasted Sale	Error of Forecasting
2007	199800	200856	1056
2008	200600	201756	1156
2009	203800	204257	457
2010	203900	201132	2768
2011	221500	216427	5037

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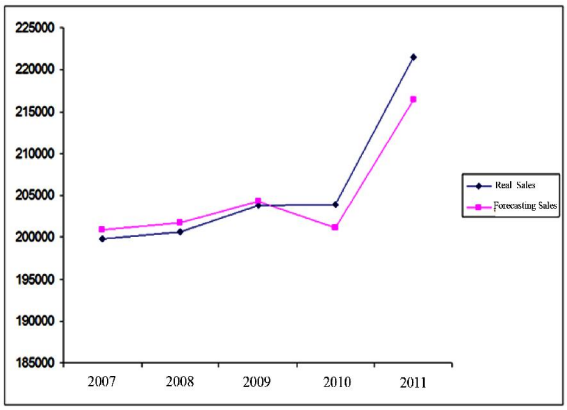

Figure 2. The Diagram of Comparing Real and Forecasting Sales after Fitting Data (2007-2011)

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