The Evaluation of Forecasting Methods for Sales of Salted Butter Milk in Chhattisgarh, India

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Abstract

The purpose of in this paper is to identify most appropriate forecasting method for sales of salted butter milk in Chhattisgarh. Applying weekly data spreading over October 2011 to October 2012, on the sales of salted butter milk in liter. The forecasting method analyzed included: naïve model , moving average, double moving average, simple exponential smoothing; and semi average method. The accuracy of the forecasting method was measured using mean Forecast Error (MFE), mean Absolute Deviation (MAD), mean Square Error (MSE), root mean square Error (RMSE).

1. Introduction

Forecasting is a prediction of what will occur in the future. It is an uncertain process that is vital to survival in today's international business environment. Uncertainty demand of the product increases or decreases the production cost, customer satisfaction & employee moral etc. Managers try to forecast with as much accuracy as possible.

Forecasting is a critical component of Supply Chain Management. The supply chain involves everything that pertains to producing a product or service from a company's suppliers all the way to the customers. Forecasting help determine the amount of inventory to be kept on hand, how much product should be made. Inaccurate forecasting can lead to costly inventory buildup or stock outs. Both of these events are harmful in a business world where customer service is of almost importance.

1.1 Components of Demand Forecasting

- Time Frame
- Behavior and the possible existence of patters

Time Frame

The length of forecasting depends on product market changes and susceptibility to technological changes. The classifications are generalizations. Short, Mid and Long range is all relative to the business and what is being forecast.

Short to Mid – Range forecast are usually anywhere form daily to upto two years in legth. They are commonly used to determine production and delivery schedules and to establish inventory levels.
Long- range forecasts are generally over two years into the future. They are usually used for strategic planning. Strategic planning determines where the company is headed in the future. It is used to establish long- term goals plan new products enter new markets and develop new facilities & technology.
Behavior
Demand sometimes behaves in random and irregular ways. Other times it exhibits predictable behavior. The three main types of predictable behavior are trend, cycles and seasonal patterns.

A trend is a gradual, long-term, upward or downward movement in demand. A current trend is the steady increase in sales of personal computers over the past few years.

A cycle is an up and down movement in demand that repeats itself over a longer time span. Automotive sales often behave in cyclical pattern.

A seasonal pattern is a repetitive movement in demand that occurs periodically. Sales of winter sports equipment are seasonal by nature.

2. Literature survey

There has been a great deal of discussion in economic literature about applications of various forecasting models for forecasting desired issues. Several time series forecasting techniques such as naïve model, moving average, double moving average, simple exponential smoothing; and semi average method has been applied to forecasting. In a study, Cacatto et al. (2012) introduced the forecasting practices that have been used by food industries in Brazil and detected how these companies use forecasting methods. The

data were analyzed by multivariate statistics techniques using the SPSS software. They stated that the companies did not use sophisticated forecasting methods, the historical analysis model was the mostly used. In an attempt Ryu et al. (2003) evaluated the forecasting method for institutional food service facility. They are identifying the most appropriate forecasting method of forecasting meal count for an institutional food service facility. The forecasting method analyzed included: naïve model 1,2 and 3; moving average method, double moving method, exponential smoothing method, double exponential method, Holt's method, winter method, linear regression and multiple regression method. The accuracy of forecasting methods was measured using mean absolute deviation, mean squared error, mean percentage error, mean absolute percentage error method, root mean squared error and Theil's Ustatistic. The result of this study showed that multiple regressions was the most accurate forecasting method, but naïve method 2 was selected as the most appropriate forecasting method because of its simplicity and high level of accuracy. While Strasheim et al., (1992) introduced variety of alternative forecasting technique were evaluated for purpose of stock replenishment is an important function of part in the typical reordering motor vehicle spare parts with aim of selecting one optimal technique to be implemented in automatic reordering module of real time computerized inventory management system. A large number of forecasting technique were evaluated, namely simple moving average(Averages, Moving Averages, Double Moving Averages), Exponential Smoothing(Single Exponential Smoothing, Adaptive Exponential Smoothing, Double Exponential Smoothing (Brown's one 'parameter linear method and Holt's two parameter method), Triple Exponential Smoothing (Brown's one parameter quadratic method and Winter's three parameter trend and seasonality method)), linear Regression, Multiple Regression. The accuracy of forecasting methods was measured using statistical measures (mean error, mean absolute deviation, mean squared error), relative measures (percentage error, mean percentage error, mean absolute percentage error method) and others measures (Theil's U- statistic, Durban- Watson value and forecasting

3. Data Collection

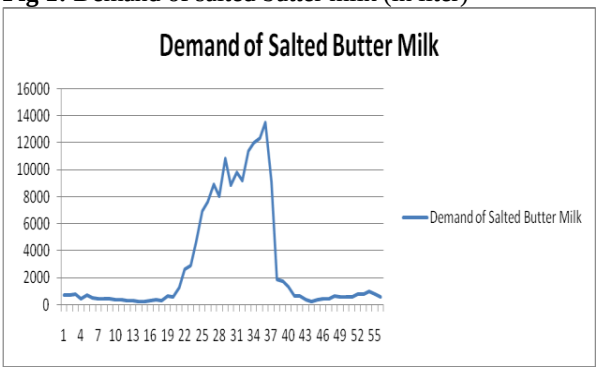
The data for this study were collected and recorded on weekly basis. The data contain sales of salted butter milk from October 2011 to October 2012. All the data was saved into an Excel spreadsheet.

Table 1: Demand of salted butter milk (in liter)

Week No.	Demand	Week No.	Demand
1	740.4	29	10804.2
2	722.4	30	8869.4
3	758.4	31	9835.8
4	465	32	9184.4
5	713.2	33	11352
6	544	34	12007.2
7	467	35	12366.8
8	469.2	36	13497.6
9	479	37	9156.6
10	353	38	1855
11	377	39	1715.8
12	292	40	1372
13	286	41	668
14	268	42	645
15	245	43	406.6
16	322.6	44	263
17	411	45	372.2
18	293.6	46	444
19	681.8	47	473
20	579.4	48	630.4
21	1278	49	588.2
22	2629	50	607
23	2901.8	51	607.6

24	4681	52	778.6
25	6914	53	788
26	7630	54	1014.4
27	8894	55	819.6
28	8054	56	588.6

Fig 1: Demand of salted butter milk (in liter)



4. Methodology

This study evaluated different forecasting model using salted butter milk demand data from Raipur dugdh sangh(Devbhog) at Raipur (Chhattisgarh).Weekly data from October 2011 to October 2012 were collected and used to forecast the salted butter milk demand. The forecast model used in the analysis included simple moving average method, double moving average method, single exponential method (α=0.1, α=0.2, α=0.3), semi average method, naïve Model. The most appropriate forecasting method was determined on the basis of accuracy. In this research, several common accuracy methods were used: mean forecast error (MFE), mean absolute deviation (MAD), mean square error (MSE) and root mean square error (RMSE). The ranking was assigned to each forecasting method.

4.1 Forecasting Methods

4.1.1 Moving Average Method.
The moving average method involves calculating the average of observations and then employing that average as the predictor for the next period. The moving average method is highly dependent on n, the number of terms selected for constructing the average. The equation is as follows:

$$F_{t+1} = (Y_t + Y_{t-1} + Y_{t-2} + \ldots\ldots + Y_{t-n+1})/n$$

Where:

F_{t+1} = the forecast value for the next period
Y_t = the actual value at period t
n = the number of term in the moving average

The optimal n value can be determine by interactive model that the smallest error. In some method the general approach has been to use MSE. In this study, the value of n taking 1, 2 and 3.

4.1.2 Double Moving Average Method.
Hanke and Reitsch (1998) recommended the use of the double moving average method to forecast time series data. Forecasting with a double moving average requires determining two averages. The first moving average is computed; a second moving average is calculated. Five equations are used in the double moving average:

$$M_t = F_{t+1} = (Y_t + Y_{t-1} + Y_{t-2} + \ldots\ldots + Y_{t-n+1})/n$$
$$M'_t = (M_t + M_{t-1} + M_{t-2} + \ldots\ldots + M_{t-n+1})/n$$
$$A_t = 2M_t - M'_t$$
$$B_t = \frac{2}{n-1}(M_t - M'_t)$$
$$F_{t+p} = A_t + B_t p$$

Where:

n = the number of period in the double moving average
Y_t = the actual series value at time period t
P = the number of period ahead to be forecast

4.1.3 Simple Exponential Smoothing Method.
The exponential smoothing method is a technique that uses a weighted moving average of past data as the basis for a forecast. This method keeps a running average of demand and adjusts it for each period in proportion to the difference between the latest actual demand figure and the latest value of the average. The equation for the simple exponential smoothing method is:

$$F_{t+1} = \alpha Y_t + (1-\alpha) F_{t-1}$$

Where:

F_{t+1} = the new smoothing value or the forecast value for the next period
α= the smoothing constant ($0 < \alpha < 1$)

Y_t = the new observation or actual value of the series in period t

F_t = the old smoothed value or forecast for period t

The accuracy of the simple exponential smoothing method strongly depended on the optimal value of (α).The preferred range for α is from 0.1 to 0.3. In this study, the value of α taking 0.1, 0.2 and 0.3.

4.1.4 Semi – Average Method.
According to this method, the original data are divided into two equal parts and the values of each part are then summed up and averaged. The average of each part is centered in the period of the time of the part from which it has been calculated and then plotted on graph. Then a straight line is drawn to pass through the plotted points. This line constitutes the semi – average trend line. When the number of year is odd, the middle year is not considered while dividing the data into two equal parts and obtaining the average.

4.1.5 Naïve Method.
Naïve method are forecasting techniques obtained with a minimal amount of effort and data manipulation and are based on the most recent information available (Shim, 2000). The naïve method uses data from the previous week to forecast the current week (one week lag):

$$F_{t+1} = Y_t$$

Where:

F_{t+1} = the forecast value for the next period
Y_t = the actual value at the next period

4.2 Measuring Forecasting Error

There is no consensus among researcher as to which measure is best for determining the most appropriate forecasting method (Levine et al., 1999). Accuracy is the criterion that determines the best forecasting method; thus, accuracy is the most important concern in evaluating the quality of a forecast. The goal of the forecasts is to minimize error. Forecast error is the difference between an actual value and its forecast value (Hanke & Reitsch, 1998).

Some of the common indicators used evaluate accuracy are mean forecast error, mean absolute deviation, mean squared error, and root mean squared error. Regardless of the measure being used, the lowest value generated indicates the most accurate forecasting model.

4.2.1 Mean Forecast Error.
Mean forecast error (MFE) is the mean of the deviation of the forecast demands from the actual demands.

$$\text{MFE} = \frac{\sum_{t=1}^{n}(Y_t - F_t)}{n}$$

Where:

Y_t = the actual value in time period t
F_t = the forecast value in time period t
n = the number of periods

4.2.2 Mean Absolute Deviation.
A common method for measuring overall forecast error is the mean absolute deviation (MAD). Heizer and Render (2001) noted that this value is computed by dividing the sum of the absolute values of the individual forecast error by the sample size (the number of forecast periods). The equation is:

$$\text{MAD} = \frac{\sum_{t=1}^{n}(Y_t - F_t)}{n}$$

Where:

Y_t = the actual value in time period t
F_t = the forecast value in time period t
n = the number of periods

4.2.3 Mean Square Error.
Jarrett (1991) stated that the mean square error (MSE) is a generally accepted technique for evaluating exponential smoothing and other methods. The equation is:

$$\text{MSE} = \frac{1}{n}\sum_{t=1}^{n}(Y_t - F_t)^2$$

Where:

Y_t = the actual value in time period t

F_t = the forecast value in time period t
n = the number of periods

4.2.4 Root Mean Square Error.
Root mean square error (RMSE) is the square root of MSE. This measures error in term of units that are equal to the original value (Jarrett, 1991).Symbolically, the equation is:

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(Y_t - F_t)}$$

Where:

Y_t = the actual value in time period t
F_t = the forecast value in time period t
n = the number of periods

5. Evaluation of Forecasting Method

In this study, the most appropriate forecasting method was selected on the basis of both level of accuracy and ease of use. The various forecasting method are using to forecast future demand of salted butter milk in Chhattisgarh, the accuracy of the forecasting method was assessed using mean forecast error (MFE), mean absolute deviation (MAD), mean square error (MSE), and root mean square error (RMSE).

In the case of forecasting of salted butter milk demand in Chhattisgarh, special consideration as to each method's ease of use was required, since the person in charge of forecasting usually has little time and-in some instances- little knowledge of how implement the forecasts.

Table 2: Summary of Forecast Accuracy (salted butter milk)

METHOD	MFE	MAD	MSE	RMSE
Simple Moving Average Method (n=2)	-1.6821	765.82	2823812	1680.42
Simple Moving Average Method (n=3)	-0.24405	981.43	3908031	1976.874
Simple Moving Average Method (n=4)	5.84643	1153.2	5019452	2240.41
Double Moving Average Method (n=2)	-5.4786	667.05	2140258	1462.96
Double Moving Average Method (n=3)	-3.2742	843.37	3362785	1833.79
Double Moving Average Method (n=4)	1.2567	1097.4	5104754	2259.37
Single Exponential Method(α=0.1)	174.100	2564.5	12039667.7	3469.822
Single Exponential Method(α=0.2)	10.5674	1830.6	7660178.71	2767.702
Single Exponential Method(α=0.3)	0.2531	1379.9	5354692.477	2314.020

Semi average Method	126.907	3106.7	16780524.3	4096.40
Naïve Model	-2.710	646.01	1893561.34	1376.067

6. Result and Discussion

In this study, four accuracy model- mean forecast error (MFE), mean absolute deviation (MAD), mean square error (MSE), and root mean square error (RMSE)-were adopted to assess the accuracy of forecasting methods. The smaller the forecast error, the more accurate forecasting method.

Table 3: Overall Ranking of Forecasting Method for salted butter milk

Method	MFE	MAD	MSE	RMSE	Ranking Total	Overall Ranking
Simple Moving Average Method (n=2)	4	3	3	3	13	2
Simple Moving Average Method (n=3)	1	5	5	5	16	3
Simple Moving Average Method (n=4)	8	7	6	6	27	7
Double Moving Average Method (n=2)	7	2	2	2	13	2
Double Moving Average Method (n=3)	6	4	4	4	18	4
Double Moving Average Method (n=4)	3	6	7	7	23	5
Single Exponential Method(α =0.1)	11	10	10	10	41	9
Single Exponential Method(α= 0.2)	9	9	9	9	36	8
Single Exponential Method(α =0.3)	2	8	8	8	26	6
Semi average Method	10	11	11	11	43	10
Naïve Model	**5**	**1**	**1**	**1**	**8**	**1**

Naïve Method using the last week of data to forecast the next week. It has the lag of one week. Naïve Method had small error (MFE = -2.710, MAD = 646.010, MSE = 1893561.34, RMSE = 1376.067) outperformed all the other methods.

Simple Moving Average Method (n=2) & Double Moving Average Method (n=2) was ranked second because it had small errors and the total ranking of the semi average method is 13 as shown in Table 3. So this method ranked is second.

Simple Moving Average Method (n=3) was ranked second because the total ranking of this method is 16 as shown in Table 3. When taking n value 3, single exponential method (SEM) obtained the third minimum errors (MFE= -0.24405, MAD = 981.4321, MSE = 3908031, RMSE = 1976.874) as shown in Table 2.

Double Moving Average Method (n=3) was ranked fourth because both total ranking is 18 as shown in Table 3. In simple moving average method with n=3 produced fourth smallest error as shown in Table 2.

Double Moving Average Method (n=4) produced large errors (MFE= 1.2567, MAD = 1097.47, MSE = 5104754, RMSE = 2259.37) as compare to Naïve Method, Simple Moving Average Method (n=2, 3) & Double Moving Average Method (n=3). So this method ranked is fifth.

Single Exponential Method (α=0.3) was ranked sixth because it had large errors (MFE = 0.2531, MAD = 1379.998, MSE = 5354692.477, RMSE = 2314.0208) and total ranking is 26 as shown in Table 3.

Simple Moving Average Method (n=4) was ranked seventh because both total ranking is 27 as shown in Table 3. In Simple Moving Average Method with n=4 produced seventh smallest error as shown in Table 2.

Single Exponential Method (α=0.2) was ranked eight because the total ranking of this method is 36 as shown in Table 3. Single Exponential Method (α=0.2) obtained the eight minimum errors (MFE= 10.5674, MAD = 1830.67, MSE = 7660178.71, RMSE = 2767.7027) as shown in Table 2.

Single Exponential Method (α=0.1) was ranked ninth because total ranking is 41 as shown in Table 3. In Double Moving Average Method with α=0.1produced ninth smallest error as shown in Table 2.

Semi average Method had large error (MFE = 126.907, MAD = 3106.73, MSE = 16780524.3, RMSE = 4096.40) as shown in Table 2. So this model ranked is tenth.

7. Conclusions

This study identified the most appropriate forecasting method based on accuracy and simplicity. The result showed that Naïve Method obtained the best accuracy; however, it was selected as the most appropriate forecasting method for sales forecasting of salted butter milk in Chhattisgarh.

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