Determination of Demand Forecasting Techniques Applicable For Electronics Product (Cell Phone) and Comparative Analysis

Chowdury M. Luthfur Rahman, Md. Jahedul Alam, Md.Rakib Hasan
Department of Industrial and Production Engineering
Shahjalal University of Science and Technology
Sylhet-3114, Bangladesh

clr-ipe@sust.edu, jahedul.sust.ipe035@gmail.com, rakibhasan4242@gmail.com

Abstract

Forecasting is an integral part of demand management since it provides an estimate of the future demand and the basis for planning and making sound business decisions in order to enable better planning and utilization of resources. To survive in the competitive market of mobile manufacturing, each company must follow a demand forecasting strategy of their own to sustain. In this concern, this research has been conducted in six cell-phone retail stores with the aim of determination of demand forecasting techniques applicable for cell phone.For this, the data were collected for a cycle of six months in the year of 2018. The qualitative forecasting technique was used by the retail stores as their current forecasting technique. Then the different time series smoothing forecasting techniques have been appliedand based on the lowest MAD value, the best forecasting technique was selected. Through analysis, it has been found that for popular cell-phone models about 50% are fitted tosingle exponential smoothing, 33% are fitted todouble exponential smoothing, and 17% are fitted to naive forecasting. In the same way, it has been found that for general cell-phone models about 33% are fitted to double exponential smoothing, 33% are fitted to naive forecasting, 17% are fitted to single exponential smoothing, and rests are fitted to three months moving average. For cumulative forecasting, it has been revealed that double exponential smoothing is best suited for both popular and general cell-phones. Finally, some recommendations for the studied organizations are suggested to improve the forecasting strategy of the organizations.

Keywords

Cell phone; Demand forecasting; Forecasting techniques; MAD.

1. Introduction

Forecasting provides an estimate of future demand and the basis for planning and sound business decisions. Since all organizations deal with an unknown future, some error between a forecast and actual demand is to be expected. Thus, the goal of a good forecasting technique is to minimize the deviation between actual demand and forecast (UK Essays, 2018). Today's technological development and global competition in markets, requires suppliers of products and services to introduce new products or to improve their current products in order to survive. Fast technological development in the high tech sector also makes this global competition even harder for firms in today's market place, because technology advances have shortened the life cycle for many products in this sector. Demand forecasting is crucial for firms operating in this environment who need to make decisions relating to future production capacity, marking budgets, human resource planning, and research and development (Jahanbin et al., 2013).

The world technology is changing very rapidly.One of the top blessings of technology is smartphone. Today's more than sixty mobile manufacturing company are present in the world. So in order to survive this competitive market each company must follow a strategy of their own to sustain in this environment. The company produces new products and launch at market as fast as possible. At the same time the company must concern about how many model the company produce and how much of each model. So demand forecasting is an important subject for any company.

Different statistics and data show that today Cell-phone sector is an extremely dynamic and innovative sector that both in the world and in Bangladesh, where demand is changing every day according to the new models and

competition is fierce. In cell-phone sector, traditional demand forecasting methods such as "qualitative forecasting" are often used which are inadequate and ineffective. So, in this study, the different quantitative forecasting techniques are applied to improve the present situation of forecasting.

1.1 Background of the Study

According to the World Bank 2017 report, Bangladesh is a country with 164.7 million people with an overwhelmingly large population. According to the World Fact book, over 65% of the Bangladeshi population is under the age of 35 (Ahmed et al., 2015). As smartphones become cheaper and cheaper, the number of smartphones users in the country will increase. Thus, Bangladesh is a country with enormous potential for the mobile phone market.

According to BTRC, the country has over 157 million mobile phone subscribers and growing. According to BTRC, the user of mobile internet is increasing day by day. The growth curve of mobile internet subscribers in 2018 is given below:

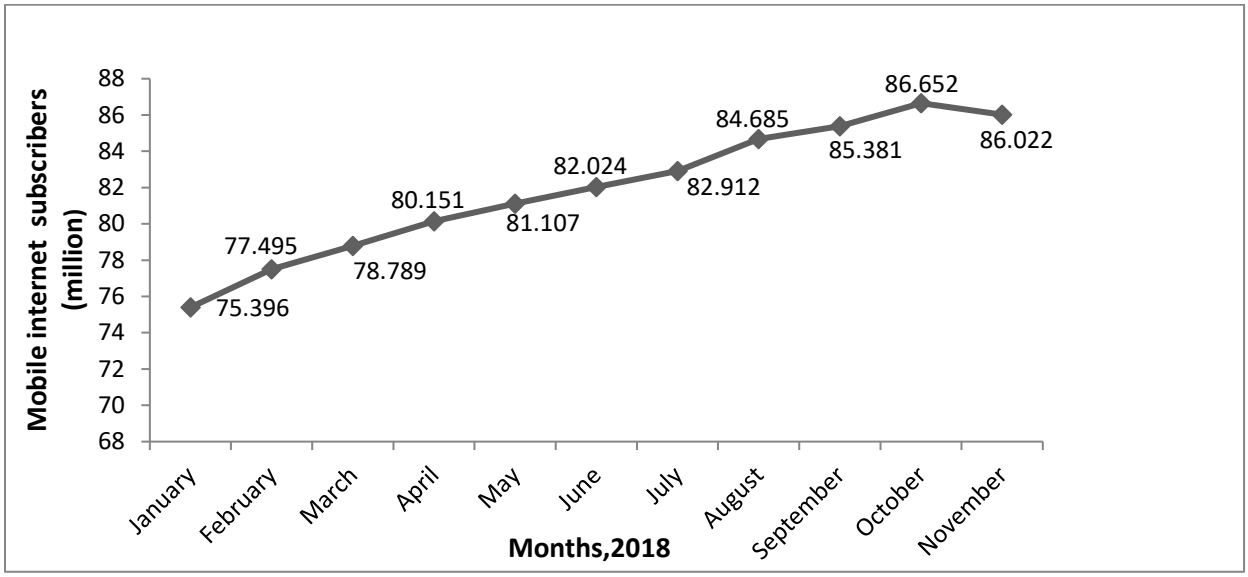

Figure 1. Growth curve of mobile internet subscribers in Bangladesh.

The figure above shows the growth curve of mobile internet subscribers in Bangladesh. In 2018, mobile internet subscribers increased by about 12 million. This is an indirect indication of increasing smart-phone users because in Bangladesh, most of the mobile operators are providing 3g and 4g internet service and basic phone is only incorporate with 2g network which is very slow in internet use. So, most of the people use smart-phones to use the internet. So, the growth curve indicates the rapid growth of smart-phone users in Bangladesh.

Hence, the research work concern is to different forecasting techniques applicable to different mobile phone company to reduce their inventory cost, improve service quality and overall gain profit for the company.

1.2 Objectives of the Study

The objectives of this study are:

- To study the current scenario of demand forecasting of various cell-phones and identify the problems with the existing method of forecasting.
- To analyze the different forecasting techniques applicable to cell-phones in order to select the best suited forecasting technique.
- To compare the current forecasting technique with the proposed technique

2. Literature Review

2.1 Concept of Forecasting

A forecast is a prediction of future events used for planning purposes.Forecasting methods may be based on mathematical models that use available historical data, or on qualitative methods that draw on managerial experience and judgments, or on a combination of both.Forecasts are useful for both managing processes and managing supply chains. At the supply chain level, a firm needs forecasts to coordinate with its customers and suppliers. At the process level, output forecasts are needed to design the various processes throughout the organization, including identifying and dealing with in-house bottlenecks.Forecasting customer demand is a difficult task because the demand for services and goods can vary greatly. For example, demand for lawn fertilizer predictably increases in the spring and summer months; however, the particular weekends when demand is heaviest may depend on uncontrollable factors such as the weather(Krajewski et al., 2013).

2.2 Approaches to Forecasting

There are two general approaches to forecasting: qualitative and quantitative. **Qualitative methods** translate the opinions of managers, expert opinions, consumer surveys, and salesforce estimates into quantitative estimates. **Quantitative methods** include causal methods, and time-series analysis. **Causal methods** use historical data on independent variables, such as promotional campaigns, economic conditions, and competitors' actions, to predict demand. **Time-series analysis** is a statistical approach that relies heavily on historical demand data to project the future size of demand and recognizes trends and seasonal patterns (Krajewski et al., 2013). In the study, the time series forecasting techniques has been used. The techniques are discussed in the following table:

Table 1. Time series forecasting techniques with equation

Forecast Techniques	Equation	Symbol Meaning
Naive Forecast	$F_{t+1} = D_t$	F_{t+1} = forecast for period t + 1 D_t = actual demand in period t n = total number of periods in the average W_t= weight for the period t α = smoothing constant S_t = value of intercept (level) at time t G_t = value of slope (trend) at time t α,β=smoothing constants $F_{t,t+\tau}$=the τ-step forecast made in period t
Simple Moving Average	$F_{t+1} = \frac{sum\ of\ last\ n\ demands}{n} = \frac{D_t + D_{t-1} + D_{t-2} + \cdots + D_{t-n+1}}{n}$	
Weighted Moving Average	$F_{t+1} = W_t D_t + W_{t-1} D_{t-1} + \cdots + W_{t-n} D_{t-n}$	
Single Exponential Smoothing	$F_{t+1} = \alpha D_t + (1-\alpha) F_t$	
Double Exponential Smoothing (Holt's Method)	$S_t = \alpha D_t + (1-\alpha)(S_{t-1} + G_{t-1})$ $G_t = \beta(S_t - S_{t-1}) + (1-\beta) G_{t-1}$ $F_{t,t+\tau} = S_t + \tau G_t$	

2.3Measures of Forecast Accuracy

Forecast accuracy is a significant factor when deciding among forecasting alternatives. Accuracy is based on the historical error performance of a forecast.One use for these measures is to compare the accuracy of alternative

forecasting methods. For instance, a manager could compare the results to determine one which yields the lowest MAD, MSE, or MAPE for a given set of data. Another use is to track error performance over time to decide if attention is needed. Is error performance getting better or worse, or is it staying about the same (Stevenson, 2012)?

Mean Absolute Deviation (MAD)

A common measure of forecast error that is fairly easy to compute is the mean absolute deviation (MAD). MAD is a widely used measure of forecast error and is easily understood and is easier to calculate. The expression is given below (Dilworth J, 1993):

$$MAD = \frac{\sum_{t=1}^{n} |A_t - F_t|}{n}$$

Where,

A_t = actual demand in period t

F_t = forecast demand in period t

n = number of periods being used

2.3 Review of Past Research Works Related to Demand Forecasting

Table 2. Review of past research work

Authors	**Research Title**	**Summary**
Pradeep Kumar Sahu, Rajesh Kumar (2014)	The Evaluation of Forecasting Methods for Sales of Sterilized Flavoured Milk in Chhattisgarh.	Applied naive model, moving average, double moving average, simple exponential smoothing; and semi average method. The accuracy of the forecasting method was measured using MFE, MAD, MSE, and RMSE and found that simple moving average Method is obtained as the best method (Sahu& Kumar, 2014).
Sunil Kumar Jaiswal, Md Saddam Sufi, Vinod Kumar (2015)	New Product Sales Forecasting in the Smart Phone Business: a Comparative Study of Present Methods	This paper is a comparative study of different models that are best suited for new product forecast on the basis of advantage and disadvantage and also it gives the knowledge about smart phone industries in India (Jaiswal et al., 2015).
M.A.Islam, M.M.A. KHAN, S.K. Nahar (2017)	Demand Forecasting Techniques Applicable to the Supplier of Industrial Products in Bangladesh (An Exploratory Study)	Applied simple moving average, weighted moving average, simple exponential smoothing; and double exponential smoothing. MAD was used as forecast accuracy measuring parameter and found that weighted moving average method is the best suited one for Angel Grinder GWS 8-600 and the simple moving average method is suitable for Hot Air Gun GWG 500-2 (Islam et al., 2017).
Nandita Barman, M. Babul Hasan (2018)	A Sophisticated Forecasting Method for a Garments Company in Bangladesh	Applied Exponential Smoothing, Holt's Method, Holt-Winter's and found that modified Holt-winter's method is obtained as the most appropriate forecast technique for the garments sector of Bangladesh (Barman &Hasan, 2018).

3. Methodology

The procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained (Rajasekar et al., 2013). For the study, six cell phone brands were selected based on their market share namely as Huawei, Nokia, Oppo, Samsung, Symphony, and Walton. Two cell phone models (one popular and one general) from each of the brands were chosen. Then the relevant data and information were collected through interview and data collection sheet. The actual sales and target sales data were used to analyze the current forecastingsituation. Then the actual sales data were used to generate different forecasting models. The performances of different forecasting techniques were compared with the help of MAD value. The forecasting technique that has the lowest MAD value was selected as the best suited forecasting technique.

4. Data Analysis and Findings

The research was deals with twelve cell-phones and the demography of the cell-phones are given below:

Table 3. Demography of the cell-phones

Sl. No.	Brand name	Name of model		Existing method of forecasting
		Popular	General	
01	Huawei	Huawei Y3	Huawei Y9	Jury of executive
02	Nokia	Nokia 5	Nokia 2	Not apply any forecasting method for individual model
03	Oppo	Oppo A71	Oppo F7	Jury of executive
04	Samsung	Samsung Galaxy J2	Samsung Galaxy J2 prime	Integration of judgment and statistical methods
05	Symphony	Symphony v130	Symphony v75	Field sales force
06	Walton	Walton E8i	Walton H7	User's expectation

Now the forecasting accuracy for different cell phone models is analyzed in the current situation and applying different forecasting techniques. The mean absolute deviation (MAD) is used as the comparative parameter. The following table contains the MAD value of different cell phone models in the present situation and applying different forecasting techniques:

Table 4. MAD value of different forecasting techniques for "Popular Cell phones"

Forecasting Techniques	**MAD**					
	Huawei Y3	**Nokia 5**	**Oppo A71**	**Samsung Galaxy J2**	**Symphony V130**	**Walton E8i**
Current situation	7.89	_	22	18.75	4.75	6.5
Naive forecast	7.78	8.38	22.4	17.13	3.63	7.25
Three months moving average	9.78	11.20	16	14.75	4.88	9
Three months weighted moving average	8.67	11.50	16.8	14.75	4.63	7.75
single exponential smoothing (α=0.1)	9.78	10.63	13.8	26.38	5.25	6.38
single exponential smoothing (α=0.2)	9.78	8.75	14.6	21.88	5.13	6.88
single exponential smoothing (α=0.3)	9.33	8.13	15	19	4.75	7.13
single exponential smoothing (α=0.4)	8.67	7.63	15.6	17.13	4.75	7.38
single exponential smoothing (α=0.5)	8.22	7.38	16	15.88	4.63	7.38
Double exponential smoothing	7.67	7.50	16.6	12.75	5.25	7.88

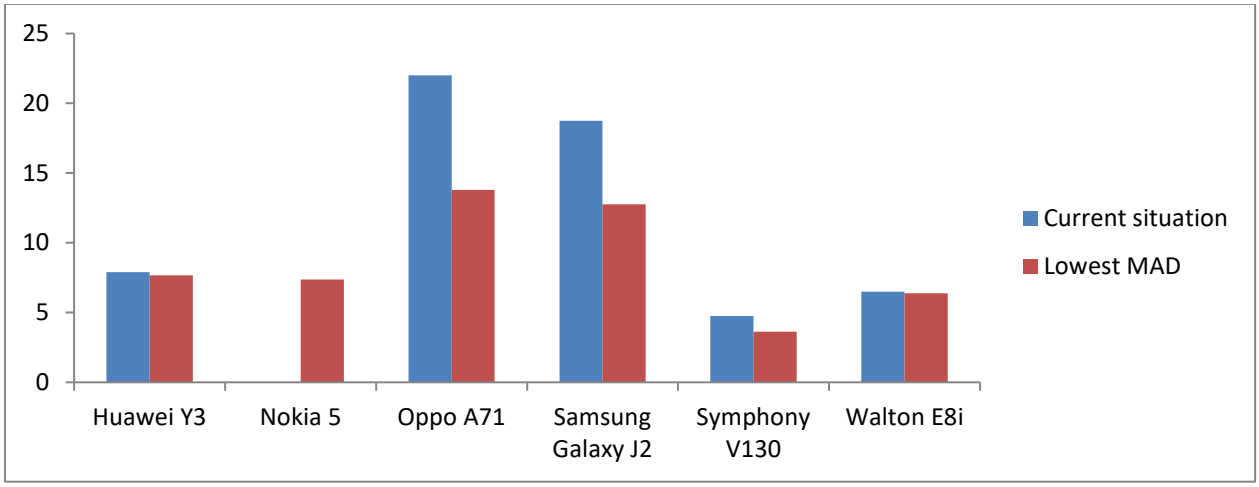

Figure 2. Forecasting accuracy comparisons for "Popular Cell phones".

Table 5. MAD value of different forecasting techniques for "General Cell phones"

Forecasting Techniques	MAD					
	Huawei Y9	**Nokia 2**	**Oppo F7**	**Samsung Galaxy J2 Prime**	**Symphony V175**	**Walton H7**
Current situation	6	_	5.8	14	5	6.14
Naive forecast	5.83	5.5	7.8	6.75	2.67	4.86
Three months moving average	6.33	4.38	5.2	7.63	2.89	4.14
Three months weighted moving average	5.50	4.25	6	7.13	2.78	4.14
single exponential smoothing (α=0.1)	14.5	5.63	5.6	14.13	3.11	3.57
single exponential smoothing (α=0.2)	10	5.13	5.6	8.88	3	3.43
single exponential smoothing (α=0.3)	7.67	4.88	5.6	7.63	2.89	3.57
single exponential smoothing (α=0.4)	6.67	4.63	5.4	7.13	3	3.71
single exponential smoothing (α=0.5)	6.33	4.63	5.8	6.75	2.78	4
Double exponential smoothing	5	3.5	5.8	7	3.44	4.14

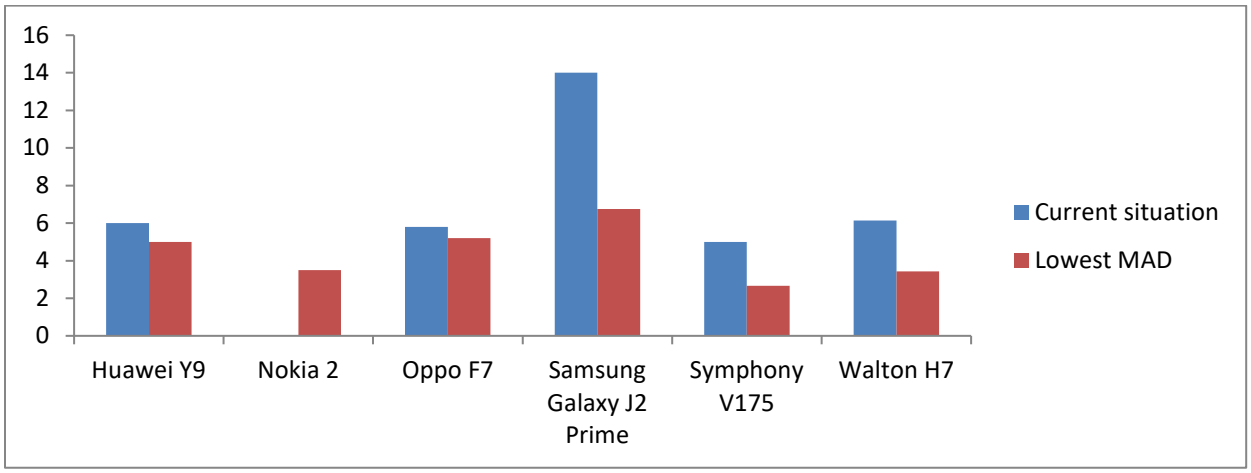

Figure 3. Forecasting accuracy comparisons for "General Cell phones".

From the analysis, it has been found that different forecasting technique that fit best for different cell-phone models. The summary of the over-all analysis is given in the following table 6:

Table 6. Summary of Findings of Different Cell-phone Models

Popular Model	Best Method	General Model	Best Method
Huawei Y3	Double Exponential Smoothing	Huawei Y9	Double Exponential Smoothing
Nokia 5	Single Exponential Smoothing (α=0.5)	Nokia 2	Double Exponential Smoothing
Oppo A71	Single Exponential Smoothing (α=0.1)	Oppo F7	Three Months Moving Average
Samsung Galaxy J2	Double Exponential Smoothing	Samsung Galaxy J2 Prime	Naive Forecast
Symphony V130	Naive Forecast	Symphony V75	Naive Forecast
Walton E8i	Single Exponential Smoothing (α=0.1)	Walton H7	Single Exponential Smoothing (α=0.2)

The summary of the findings are shown by pie chart, given below:

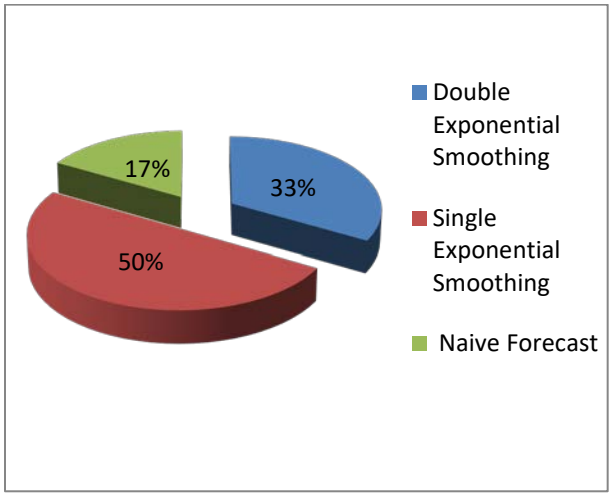

Figure 4. Popular cell phones fit forecasting technique percentage.

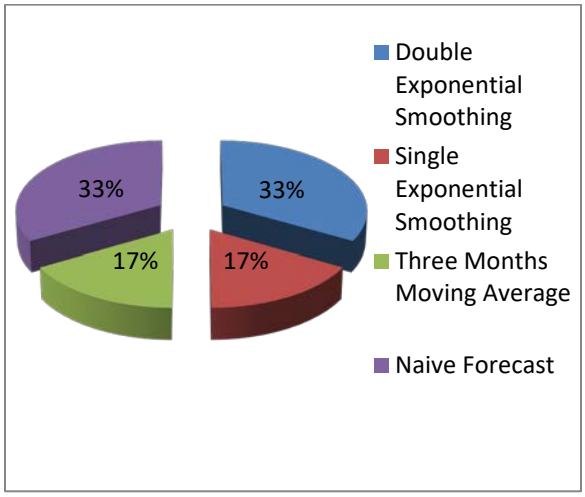

Figure 5. General cell phones fit forecasting technique percentage.

5. Conclusion

The research has been conducted on six organization's cell-phones. From the analysis, it has been found that the existing method of demand forecasting for cell-phones are not best suited with actual customer demand. By applying different forecasting techniques, it has been found that different forecasting techniques are fitted for different cell-phone models and the organization can't rely on one technique for different cell phones. So, the organizations may apply these best suited forecasting techniques to improve their present forecasting techniques.

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