Research Journal of Engineering Sciences ISSN 2278 – 9472
Vol. **12(3),** 1-5, September **(2023)** *Res. J. Engineering Sci.*

Comparative analysis of Forecasting methods applicable to Electronics product

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Available online at: www.isca.in, www.isca.me
Received 20th March 2023, revised 28th April 2023, accepted 23th May 2023

Abstract

Forecasting is a method of estimating the future demand or statistics or metrics of a particular need based on past data or historical data. For any business organization, forecasting makes informed estimates or predictions of specific business metrics such as sales growth, or customer demand, or economy-wide forecasts for the coming year. This helps the business organization make sound business decisions, effective planning, and optimum utilization of resources. In this globalization era, electronics industry needs to trade-off among cost, quality, and availability of the product. Otherwise, competitors would take the position in the market. In order to remain in the driving market of the electronics goods production, every business organization should pay attention to demand forecasting methods to reduce the variation between actual and forecasted demand. Today cell phone is the most demandable and widely used electronic product in the world. In this regard, various forecasting methods related to cell phones had been studied in this research work. The existing demand forecasting techniques, namely qualitative forecasting methods were practiced by the retail stores. Thereafter various time series smoothing forecasting strategies had been utilized and on the basis of lowest Mean Absolute Deviation (MAD) value, the top forecasting method was selected. After analyzing the data, it has been identified that for customary cell-phone models, almost 50% are fitted to double exponential smoothing, 33% are fitted to single exponential smoothing, and 17% are fitted to naive forecasting. Similarly, it has been revealed that for conventional cell-phone models, nearly 33% are appropriate to double exponential smoothing as well as to naive forecasting, 17% are appropriate to single exponential smoothing, and the remaining are suited for three months moving average method. Regarding cumulative forecasting, it has been obtained that double exponential smoothing method is best fitted for both customary and conventional cell-phones. In the end, few recommendations for the current companies have been suggested in order to develop the forecasting strategies of the organizations.

Keywords: Electronics Product, Forecasting, Mean Absolute Deviation, Exponential Smoothing.

Introduction

Demand forecasting is a technique of making predictions or informed estimates that are predictive in determining the trends of future customer demand using historical data and other information. It is an important component in any business organization and plays a key role in pricing, business growth strategies, and market potential. The main objective of product forecasting is to reduce the variation between real and forecasted demand to meet customer needs properly[1]. But the difficulties arise with the shorter product life cycle. The rapid technological development in the electronics field makes business organizations even harder to sustain in this global competitive market. So, it is important for making decisions related to capacity planning, budgets, resource planning, inventory control and research and development, demand forecasting is crucial for any business organization functioning in such a volatile atmosphere[2].

Bangladesh Telecommunication Regulatory Commission (BTRC) reported in 2018 that "the country has over 157 million mobile phone subscribers and growing"[3]. Bangladesh is literally a mobile-first country. According to data from Stat Counter Global Stats, as of February 2017, more than 73% of internet users (Percentage of Internet Traffic) accessed the internet using mobile phones whereas the percentage was only 25% for desktop devices. Bangladesh Mobile Phone Importers Association (BMPIA) forecast that, "the value of legally imported handsets is expected to reach $748 million by 2020, reports the Daily Star and listed in the top 15 mobile phone users in the world"[4]. This scenario shows the potential business market of the cell phone in Bangladesh.

In Bangladesh, the electronics industry is one of the fastest-growing industries having great prospects. Among different electronic products, cell phone gets the most value from the users. The cell phone companies began the journey with the assembly of cell phones first. Later companies started manufacturing cell phone labeling with the tag "Made in Bangladesh" launched first by Walton in 2017 and after that other companies[5] started the business. This provides the evidence of market potentiality of the cell phone in Bangladesh.

But the companies are still using conventional inefficient forecasting approaches such as "qualitative forecasting". So, in this present analysis, the various "time series forecasting" approaches are applied to enhance the existing scenario of forecasting and make a comparative analysis with the present demand forecasting techniques.

Methodology

This research work was conducted with the objective of determining the demand forecasting methods related to electronics product. In this concern based on the market share, six dominated cell phone brands were selected for the study, namely "Huawei", "Nokia", "Oppo", "Samsung", "Symphony", and "Walton". Then the primary and secondary data were collected from respective organizations. The actual customer demand and their forecasted demand data were used to analyze the existing scenario of forecasting. Then the actual customer demand data were used to forecast customer demand by implementing time series forecasting methods. Mean Absolute Deviation (MAD) was utilized to measure the performance of different forecasting techniques and the method which has the minimum 'MAD value' was chosen as the best fitted method.

Strategy of forecasting: Basically, two methods are associated with demand forecasting, namely Qualitative Methods of Forecasting and Quantitative Methods of Forecasting. Qualitative methods consist mainly of subjective inputs, which often defy precise numerical descriptions. Whereas the quantitative methods of forecasting use historical data to forecast future demand, especially with numerical data and continuous pattern. There are two major types of quantitative forecasting models: time series models and causal models. Time series forecasting simply attempts to projecting past events into the future. These models analyze the trends of the past, with the assumption that the future trends will hold comparatively related trends to the past[6]. The required equations are provided in the following Table-1[6-8].

Mean absolute deviation (MAD): Mean Absolute Deviation is a commonly habituated estimation of forecasting accuracy and is easy to understand[8]. MAD is the mean of the errors generated by the forecast model over a series of time periods and is measured by the following equation[8]:

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

Where: A_t=Actual demand at time period t, F_t=Forecasted demand at time period t, and 'n'=Number of periods being used.

Data Analysis: The research was performed in six different cellphone organization retail stores in Sylhet. After several discussions with the organizations and for the ease of the study, two models of each organization were selected for analysis. The present methods of demand forecasting practiced by the organizations is presented in the following Table-2. Accordingly, the MAD values of the existing forecasting method as well as other forecasting techniques for various customary and conventional Cell phone models are calculated and the findings of the analysis are presented in Table-3, 4.

Table-1: Time series forecasting methods and required formulae.

Methods	Formula	Nomenclature
Naive	$F_{t+1} = D_t$	F_{t+1} = forecast for period t + 1 D_t = actual demand in period t n = total number of periods W_t = weight given for the time period t α, β = Smoothing constant S_t = Intercept value (level) for the time period t G_t = Slope value (trend) for the time period t $F_{t,t+x}$= The x-step forecast made in period t
Simple Moving Average	$F_{t+1} = \frac{\text{sum of last n demands}}{n} = \frac{D_t + D_{t-1} + D_{t-2} + \cdots + D_{t-n+1}}{n}$	
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)	$S_t = \alpha D_t + (1-\alpha)(S_{t-1} + G_{t-1})$ $G_t = \beta(S_t - S_{t-1}) + (1-\beta) G_{t-1}$ $F_{t,t+x} = S_t + xG_t$	

Table-2: Existing method of demand forecasting by organizations.

Organization	Name of model		Current practice of forecasting
	Popular	General	
Walton	Walton A	Walton B	Customer expectation
Oppo	Oppo A	Oppo B	Jury of Executive Opinions
Nokia	Nokia A	Nokia B	--
Huawei	Huawei A	Huawei B	Jury of Executive Opinions
Symphony	Symphony A	Symphony B	Sales Force Composite Method
Samsung	Samsung A	Samsung B	Expert's Opinion Method

Table-3: Popular (Customary) Cell Phone Models MAD Value.

Forecasting Techniques		MAD					
		Huawei A	Nokia A	Oppo A	Samsung A	Symphony A	Walton A
Existing Method		7.89	--	22.00	18.75	4.75	6.50
Naive		7.78	8.38	22.40	17.13	3.63	7.25
Simple Moving Average (Three Months)		9.78	11.20	16.00	14.75	4.88	9.00
Weighted Moving Average (Three Months)		8.67	11.50	16.80	14.75	4.63	7.75
Single Exponential Smoothing	α=0.10	9.78	10.63	13.80	26.38	5.25	6.38
	α=0.20	9.78	8.75	14.60	21.88	5.13	6.88
	α=0.30	9.33	8.13	15.00	19.00	4.75	7.13
	α=0.40	8.67	7.63	15.60	17.13	4.75	7.38
	α=0.50	8.22	7.38	16.00	15.88	4.63	7.38
Double exponential smoothing		7.67	7.50	16.60	12.75	5.25	7.88

Table-4: General (conventional) Cell Phones MAD Value.

Forecasting Methods		MAD					
		Huawei B	Nokia B	Oppo B	Samsung B	Symphony B	Walton B
Existing Method		6.00	--	5.80	14.00	5.00	6.14
Naive		5.83	5.50	7.80	6.75	2.67	4.86
Simple Moving Average (Three Months)		6.33	4.38	5.20	7.63	2.89	4.14
Weighted Moving Average (Three Months)		5.50	4.25	6.00	7.13	2.78	4.14
Single Exponential Smoothing	α=0.10	14.50	5.63	5.60	14.13	3.11	3.57
	α=0.20	10.00	5.13	5.60	8.88	3.00	3.43
	α=0.30	7.67	4.88	5.60	7.63	2.89	3.57
	α=0.40	6.67	4.63	5.40	7.13	3.00	3.71
	α=0.50	6.33	4.63	5.80	6.75	2.78	4.00
Double Exponential Smoothing		5.00	3.50	5.80	7.00	3.44	4.14

Results and discussion

The results of this study indicate that no single forecasting technique provides the best result. So, the organization must keep track their forecasting continuously and seek for the improvement. The synopsis of the findings is presented in the Table-5 and shown with pie chart:

Table-5: Best suited forecasting technique for individual model.

Techniques	Cell phone Models	
	Popular	General
Naive Forecast	Symphony A	Samsung B, Symphony B
Simple Moving Average (3 months)	-	Oppo B
Weighted Moving Average (3 months)	-	-
Single Exponential Smoothing (α=0.10 to 0.50)	Nokia A, Oppo A, Walton A	Walton B
Double Exponential Smoothing	Huawei A Samsung A	Huawei B Nokia B

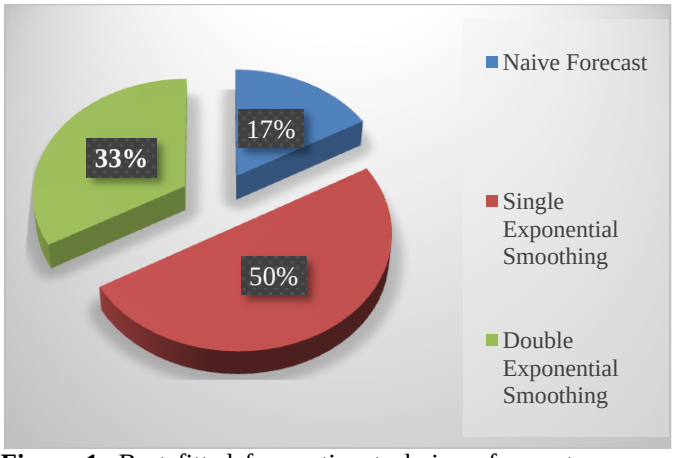

Figure-1: Best fitted forecasting technique for customary cell phones.

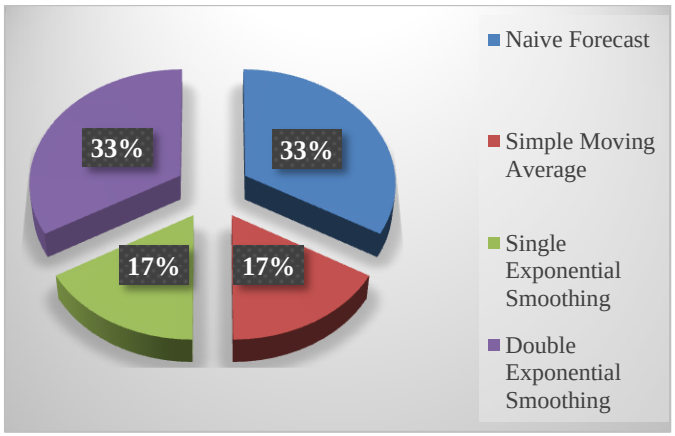

Figure-2: Best suited forecasting technique for General cell phones.

From Figure-1 and Figure-2 given above, it is said that only one or two technique is not suitable for all models. Each cell-phone model follows a unique forecasting technique that suits it best. Then, the cumulative forecasting analysis of each cell phone model was performed and the finding is given below in Table-6.

Table-6: Best Suited Forecasting Method for Cumulative Forecasting.

Cell-phone (cumulatively)	Best Suited Technique
Popular model	Double exponential smoothing
General model	Double exponential smoothing

The above Table-6 illustrates that double exponential smoothing is the most desirable technique among different forecasting techniques for cumulative demand forecasting analysis. Moreover, the individual demand analysis and cumulative demand analysis depict the scenario about the cell-phone customer's demand trend of Sylhet region.

Conclusion

The purpose of the current study was to determine the forecasting techniques applicable for cell-phone and accordingly a comparative analysis among different techniques was conducted. This study has identified that the current practices of demand forecasting are not well-fitted with sales data. As a result, organization often faces surplus or shortage problem. Surplus produces excess product or idle product over a period of time that incurs loss for an organization. Whereas shortage makes the customers disappointed with their service as a result shift, or switching to alternative organization. So, minimizing the gap between forecasted demand and actual sales is important for maintaining this balance.

After implementing several forecasting methods, the result shows that different cell-phone models are fitted for different forecasting techniques and cumulatively double exponential smoothing is the best. So, the organizations may learn from this study to improve their current situation of forecasting. Moreover, manager of the particular distribution area should have proper knowledge about demand forecasting techniques and demand forecasts should be reviewed and revised periodically. Managers can use safety stock to mitigate shortage.

These findings contribute in several ways to the understanding of demand management applicable for cell phones and provide a basis for improvement of forecasting for other electronic products. The research work has been done considering the different forecasting techniques only. Further study can be performed considering safety stock and inventory management.

Acknowledgment

The authors sincerely acknowledge to all the officers and stuffs of "distributors and showrooms of respective cell phone companies in Sylhet region" for their help and whole hearted co-operation during data collection.

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