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THE IMPACT OF FORECASTING METHODS ON DEMAND PROJECTION IN FAST FOOD RESTAURANT

Ishtiyag Otudi¹, Abdulaziz Almaktoom²

^{1,2} College of Business, Effat University, Qasr Khuzam St., Kilo. 2, Old Mecca Road.

P.O.BOX 34689, Jeddah 21478, Saudi Arabia.

Email: [1eatoodi@effat.edu.sa](mailto:eatoodi@effat.edu.sa), [2abalmaktoom@effatuniversity.edu.sa](mailto:abalmaktoom@effatuniversity.edu.sa)

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ABSTRACT

Forecasting involves the generation of set of numbers that corresponds to a future occurrence. This study investigates the various forecasting methods as well as how to choose the most effective forecasting method. After formulating the hypothesis: all forecasting methods have different effectiveness. Quantitative methodology was used and the impact of forecasting model selection was tested by using a computer simulation model. The data was obtained from a restaurant. Moreover, articles related to the research topic were analyzed. The results show how demand forecasting affects inventory replenishment decisions by the retailers, and production decisions by the supplier under different forecasting method. There are multiple models such as Naïve Approach, moving averages, weighted moving averages and exponential smoothing. Analyses of the simulation output indicate that the selection of the forecasting model influences the performance and demand patterns faced by retailers. The results also help manager's select suitable forecasting models to improve performance. The results support the hypothesis of the study.

INTRODUCTION

Forecasting is identified as Supply Chain Management process which is acknowledged as skill for using in development of local capacity in the affected communities [1]. Forecasting is a prediction or an estimation of an actual value in a future time period or for another situation. Forecasting is the form of statement that reveals future value of interest for a specific time period that is used as prime output in decision process of SCM [2]. A forecasting is the fundamental step of demand management that optimizes the customer satisfaction through capabilities of Supply Chain [3]. Researchers focused on the most of the aspects of SCM, after then forecasting is still need to be

addressed in research field of Supply Chain. Forecasting methods should be evaluated in the situations for which they will be used. Underlying the evaluation procedure is the need to test methods against reasonable alternatives. Evaluation consists of four steps: testing assumptions, testing data and methods, replicating outputs, and assessing outputs [4].

Sales forecasting is a management function which is a key contributor to corporate success [5]. Accurate sales forecasts allow a company to provide high levels of customer service, avoid lost sales or stock-out situations, and prevent customers from going to competitor. Moreover, if demand can be predicted accurately, it can keep both channel partners and final customers satisfied. The forecasting techniques have increased both in number and complexity, so managers have to choose the most appropriate technique [6].

Several studies have showed the importance of sharing information between customers and suppliers in supply chains and forecast data. Long-term capacity forecasts are considered important for firms applying make-to-order strategies, while short-term material forecasts are important when applying make-to-stock strategies. As a result, the importance of forecast data depends on how it is used in the manufacturing planning and control processes. Supply chain performance is typically related to metrics reflecting cost, tied-up capital and customer service [7]. The supplier needs to use corrective actions to compensate for poor customer service such as rush orders and preventive actions such as safety stocks and extra capacity. The use of these corrective and preventive actions helps in good customer service performance even if the demand is uncertain [8].

Study done by Lee, Song, and Mjelde [9] predicts the number of visitors to an international tourism Expo to be held in Korea in 2012. Forecasting demand for such a mega-event involves using both quantitative forecasting models and qualitative technique because of data limitations. Combining quantitative techniques with willingness-to-visit (WTV) surveys predicts the Expo demand at 8.9 million visitors. In comparison using the Delphi method, experts predict Expo demand at 6.8 million visitors. For this study, the Delphi method provides more conservative estimates than estimates from combining quantitative techniques with WTV. Policy implications presented are directed toward Expo planners and practitioners in terms of demand and supply side, application of these results in the decision-making process, and future challenges surrounding demand forecasting.

Albarune and Habib [10] study demonstrates forecasting practices in supply chain management (SCM) at various areas, particularly Life science, Retail Chain, and FMCG. The authors depict the scenario of forecasting practices based on secondary data and represents SCM role, demand management, collaborative coordination, etc. In addition, the study reveals the limitation and few practical solutions on forecasting to be useful in the business organization. The practice of forecasting in the mentioned three sectors is limited though there are enormous opportunities to use this managerial technique along with the SCM strategy. Forecasting could be used in other than direct materials requirement such as spare parts, office stationery etc. which are untapped area in the organization.

Therefore, this study attempts to investigate the effects of using forecasting methods on demand and to compare the effectiveness of these forecasting methods and clearly understand the types of forecasting and their effect. It tries to identify challenges that face forecasting methods and make some recommendations to choose the best method.

METHODOLOGY

The research is a scientific and systematic search for information that is related to a specific topic. In other words, a research is a scientific investigation. Research methodology is a way to solve the research problem and how research is done scientifically. Consequently, it is necessary for all researchers to know the methodology that will be used in the research as the main purpose of the research methodology is to find out answers for the questions through the application of scientific procedures.

This research paper explores 6 forecasting methods and how to choose the most effective one. The hypotheses of the study are forecasting methods have different effectiveness on demand. Forecasting methods has an impact on demand.

The study involves collecting data form articles, journals and books as secondary data to support or reject the hypotheses as well as using simulation technique for quantitative data. Consequently, mixed research methodology will be used.

The basic outcome of this research will be the knowledge which will enable the researcher to specify his own research problem in a meaningful way. It will help researchers and people who are interested in getting more references and information about the importance of using different forecasting methods.

Approach of Research

The current research has adopted the mixed approach of methodology. As a result, quantitative and qualitative methodology will be utilized. The study is considered a cross-sectional research as it is based on constructing a simulation technique to get primary data from the source directly.

There are two main approaches to research, quantitative approach and the qualitative approach. The quantitative approach can be classified into inferential, experimental and simulation approaches. The purpose of inferential approach is to form a data base from which to infer relationships of population. Experimental approach is characterized by greater control over the research as some variables are manipulated to observe their effect on other variables. The term 'simulation' refers to "the operation of a numerical model that represents the structure of a dynamic process. Simulation approach, the current research methodology involves the construction of an artificial environment within which relevant information and data can be generated. Simulation approach is useful in building models for understanding future conditions.

Research Design

The preparation of a research design facilitates research to get maximal information. The research design is the overall strategy has been chosen to combine the different components of the study in a coherent and logical way. The objective of research design is to direct and guide the collection of data.

The means of obtaining information are analyzing articles concerning forecasting on demand. And forecast simulation technique will be used as there are several forecast methods will be compared to each other to identify the method which most closely show the actually obtained outcome.

Data Collection

The data was collected from two sources namely primary data and secondary data. The primary data source can be obtained from case study approach. There are some forecast formulas are used for standard forecast simulation. The target firm is a restaurant from where we obtained the forecasting data about each kind of sandwiches monthly and for three quarters.

The secondary data sources are obtained from different articles, books, reports and journals to discuss and understand forecasting methods and the impact of forecasting methods.

Simulation Technique

Forecast simulation technique will be used. The data will be obtained from the target restaurant. Several forecast methods will be compared to each other in an excel sheet to identify which method will show the actual outcome or even being close to actual data. There are six forecast formulas for standard forecast simulation all of them will be used as well as error forecasting. The major statistical methods used for demand forecasting are six forecast formulas:

- I. Simple Moving Average
- II. Weighted Moving Average
- III. Simple Exponential Smoothing
- IV. Double Exponential Smoothing
- V. Trend Projection (Regression)
- VI. Decomposition Model

In addition, measuring forecasting accuracy by using Mean Absolute Deviation (MAD), Mean squared error (MSE) and forecast accuracy by calculating average of error (E).

Forecasting

Forecasting is a decision-making tool. It is used by many businesses to help in budgeting, planning, and estimating future growth. Therefore, it is important for companies to have a clear vision for the future. Forecasting is predicting

the future based on past. Advantages of using forecasting are to increase productivity, keeps a company up-to-date, learn from past experience, as well as improve customers' satisfaction.

In General, there are two main type of forecasting. First type, qualitative forecast is based on expert's opinion and judgment hiring qualified professional who provide certain activity that can give us information to predict the future such as crass root, historical analogy, market survey, and Delphi method. Second type, quantitative forecast based on past numerical data is available.

RESULT AND DISCUSSION

This case represents production line of food industry sector. A restaurant that is located in Jeddah Saudi Arabia. The restaurant is planning to improve its business and apply forecasting to predict the future so the company identified the need to apply a scientific forecasting method. The study is focused on 3 products big burger, cheese burger and big mac. After examining the production and sales data, this study decided to use quantitative method. Then four techniques are being applied to forecast for three quarters. These techniques are: simple moving average, simple exponential smoothing, and Trend projection (regression). Next, MAD is being used to measure forecasting accuracy and help in choosing the most accurate forecasting method.

Findings

The analysis of the data is the determination of the best forecasting model to use. There are various models including the Naïve Approach, the moving average, weighted moving average and exponential smoothing. All are compared with the original forecast in deriving of the BIAS, MAD, MSE, MPE, MAPE and RMSE.

Of the six, the best method to determine the forecast errors is the mean square error; however, due to its magnitude and size of data it is recommendable to use the square root value of MSE, which leads to RMSE. Notably, the method that records the least RMSE is the most appropriate in forecasting the product.

Big Burger Model Analysis

The study used 8 methods of forecasting and analyzed the forecasting errors and the result is tabulated in Table 1 as Big Burger Model Analysis. The forecast graph of Big Burger is illustrating in Figure 1. From the analysis, it can be observed that between the moving average models, both the 3-period moving average and the 5-period moving average have similar magnitude of error and hence is just better to use the three-period moving average rather than 5 moving average. The study also found that between the two-period weighted moving average and the four-period weighted moving average, the 4-period weighted moving average was better than the 2-period moving average. This is because the 4 period had the lower root mean square error of 1557.33 which was smaller than 2-period weighted moving average. In comparing the 6-

forecasting model, it was observed that the linear regression had the smallest root mean square error (RMSE) of 1408.728. The 3-period moving average had the second smallest root mean square error (RMSE) of 1544.978 and the forecast model with the highest forecast error is the naïve with 1890.221. This means that the best model to be applied in forecasting the big burger was linear regression model since it had the smallest root mean square error.

Table 1: Big Burger Model Analysis

Forecast Accuracy	Naïve	3MA	5MA	2WMA	4WMA	SES	DES	Regression
BIAS	-43.3429	-21.7524	-21.7524	-26.4762	-26.6371	41.28468	780.4854	83.55529
MAD	1585.86	1287.676	1287.676	1415.657	1305.449	1282.425	2225.526	1229.081
MSE	3572935	2386958	2386958	2765071	2425275	2326353	8076591	1984516
MPE	-7.71487	-5.7289	-5.7289	-5.71448	-6.06568	-6.20642	8.045252	-5.65767
MAPE	32.46568	26.20408	26.20408	28.88174	26.82046	27.30377	43.85346	24.6294
RMSE	1890.221	1544.978	1544.978	1662.85	1557.33	1525.239	2841.934	1408.728

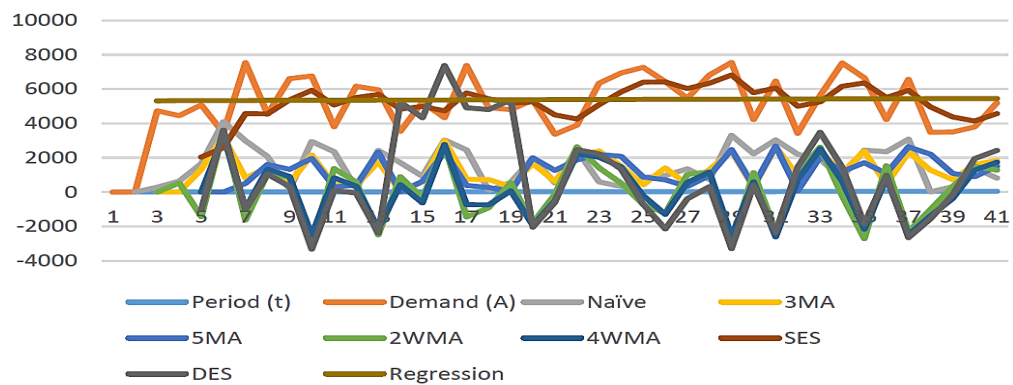


Figure 1: Forecast Graph of Big Burger *The Forecast Was Based on All Approached Naïve Approach, The Moving Average, Weighted Moving Average and Exponential Smoothing

Considering the Big Burger, the forecast was based on all approached Naïve Approach, the moving average, weighted moving average and exponential smoothing. It is clear that all have quite high level of errors. With the highest being Double Exponential Smoothing (DES) with a RMSE of 2841 while the lowest was the use of regression analysis which was at 1408.

Beef Burger Model Analysis

Table 2 and Figure 2 demonstrate the Beef Burger model analysis and forecast graph of Beef Burger respectively. There are 8 forecasting methods were used to analyze the forecasting errors. Based on the results, it can be observed that between the moving average models, both the 3-period moving average and the 5-period moving average have similar magnitude of error and hence is just better to use the three-period moving average rather than 5 moving average. The result shows that between the two-period weighted moving average and the 4-period weighted moving average, the 4-period weighted moving average was better than the 2-period moving average. This is because the 4 period had the lower root mean square error of 822.9469 which was smaller than 2-period weighted moving average. In comparing the 6-forecasting model, it was observed that the linear regression had the smallest root mean square error (RMSE) of 766.2648. The 4-period weighted moving average had the second smallest root mean square error (RMSE) of 822.9469 and the forecast model with the highest forecast error is the double exponential smoothing model with 1570.533. This indicates that the best model to be applied in forecasting the beef burger was linear regression model since it had the smallest root mean square error.

Table 2: Beef Burger Model Analysis

Forecast Accuracy	Naïve	3MA	5MA	2WMA	4WMA	SES	DES	Regression
BIAS	-34.8286	-36.8286	-36.8286	-37.5238	-34.0629	10.72024	410.2684	59.51872
MAD	951.2286	686.3143	686.3143	800.6286	709.5771	718.3125	1138.893	644.2979
MSE	1179729	679181.9	679181.9	852899.4	677241.6	686037	2466574	587161.8
MPE	-7.50122	-6.09451	-6.09451	-6.39461	-6.18852	-5.40033	8.395133	-4.31749
MAPE	31.43706	23.6895	23.6895	26.94052	24.24722	25.06892	38.38984	21.93568
RMSE	1086.153	824.125	824.125	923.5255	822.9469	828.2735	1570.533	766.2648

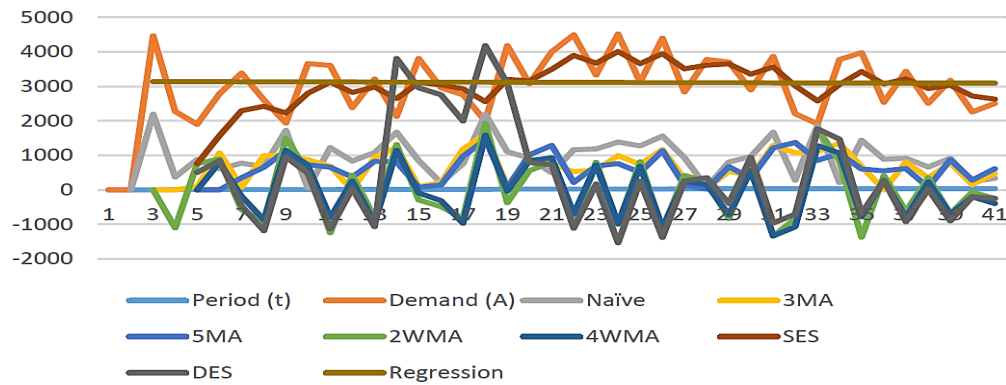


Figure 2: Forecast Graph of Beef Burger *Double Exponential Smoothing (DES)

Similar to the Beef burger, the model summary reflected significant level of errors with the highest being Double Exponential Smoothing (DES) at 1570, followed by 1086 through Naïve approach and while the moving averages were closely similar at around 820. The lowest RMSE recorded was Regression analysis through at 766. This showed the level of low error involved in the model development.

Cheese Burger

There are 8 methods of forecasting were used to analyze the forecasting errors and the results are tabulated in Table 3. The forecast graph of Cheese Burger is illustrating in Figure 3. Through the analysis, it can be observed that between the moving average models, both the 3-period moving average and the 5-period moving average have similar magnitude of error and hence is just better to use the three-period moving average rather than 5 moving average. Also, between the two-period weighted moving average and the four-period weighted moving averages, the 4-period weighted moving average was better than the 2-period moving average. This is because the 4 period had the lower root mean square error of 720.5875 which was smaller than 2-period weighted moving average. In comparing the 6-forecasting model, it was observed that the linear regression had the smallest root mean square error (RMSE) of 603.5654. The 4-period weighted moving average had the second smallest root mean square error (RMSE) of 720.5875 and the forecast model with the highest forecast error is the double exponential smoothing model with 1240.544. Thus, the best model to be applied in forecasting the cheese burger was linear regression model since it had the smallest root mean square error.

Table 3: Cheese Burger Model Analysis

Forecast Accuracy	Naïve	3MA	5MA	2WMA	4WMA	SES	DES	Regression
BIAS	-37.5714	-2.81905	-2.81905	-28.5333	-5.34857	37.87957	414.3479	29.13802

MAD	669.457 1	644.8	644.8	626.876 2	621.868 6	611.105 3	972.200 3	496.6383
MSE	658004. 8	574046. 5	574046. 5	539848. 5	519246. 4	494586. 3	153894 8	364291.2
MPE	- 8.59325	- 6.96678	- 6.96678	- 6.57573	- 6.82509	- 6.15052	11.6416 8	-6.33334
MAPE	31.2466 9	30.3940 3	30.3940 3	29.2737 8	29.3935 3	29.6616 3	43.9447 5	23.76378
RMSE	811.175	757.658 6	757.658 6	734.743 8	720.587 5	703.268 3	1240.54 4	603.5654

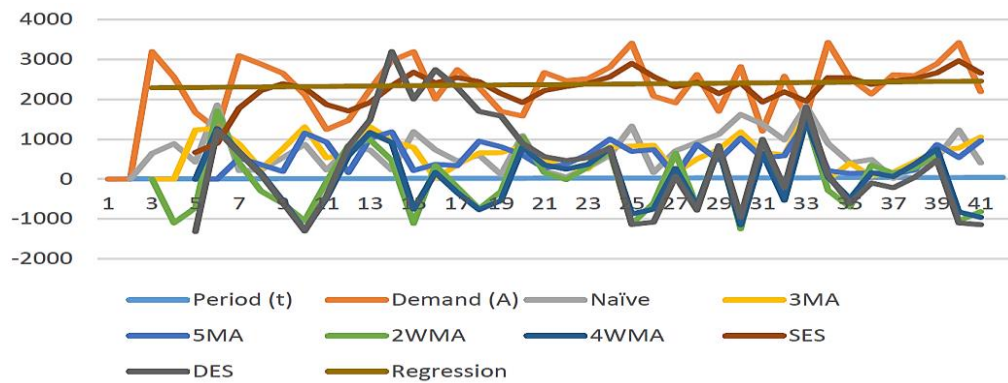


Figure 3: Forecast Graph of Cheese Burger

Cheese Burger like the rest had low regression error. According to the model summary, regression had the lowest error based on the RSME. This can be attributed to the fact that there must be an independent and dependent variable for the forecast to be carried out. The Double Exponential Smoothing (DES) recorded the highest level on all aspects from Bias to RMSE. With a high RMSE of 1240 the forecast approach should be the least desired due to the probability of errors.

CONCLUSION

The study was created to highlight the importance of forecasting. Forecasting is critical to the organization's success. Sales forecasts are inputs to financial planning however demand forecasts drive decisions in many areas and impact human resource decisions. Determining the time horizon of the forecast is an important step in the forecasting system. Most forecasting techniques assume that there is some underlying stability in the system. As a result, a combination of qualitative and quantitative forecasting techniques is usually the most effective approach.

There are multiple models, including Naïve Approach, moving averages, weighted moving averages and exponential smoothing. Data analysis is the basis for determining the best predictive model to use. Compare all these data with the original predictions of BIAS, MAD, MSE, MPE, MAPE and RMSE. The research results show that the best method to determine the prediction error is the mean square error. However, due to the magnitude and size of the data, it is recommended to use the square root value of MSE, which leads to

RMSE. Particularly, the method that records the least RMSE is the most appropriate in forecasting the product.

Challenges that face forecasting are forecasting is not constrained by production, decision maker's intuition, emotions, personal experiences may involve forecasting, the provided forecasting value and the management of forecast sometimes has errors and uncertainty due to behavioral attitudes of users, the marketing department initiates the forecast at beginning of the process. However, there is minimum lack of internal and external forecast collaboration. Demand sometimes behaves in a random, irregular way. Demand behaviors are trends, cycles, and seasonal patterns. Trends are the easiest patterns of demand behavior to detect and are often the starting points for developing forecasts

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