Finding the Best Mathematical Forecasting Model for Ordering Non FMCG Items at an FMCG Retailer

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Abstract: The future of a company can be judged by precise planning and predictions. This is helpful to steer clear of hypothetical product reserves. Also, it supports to create a good schedule for production to attain demand of customers and various other factors of market. Similarly, the forecasting can help non-FMCG companies. The current research possesses tools, organization form and method that gain supply chain. Moreover, it aims on products that are expired, damages, and come back from customer. Without question, return product had huge influence on income and deficit. Consequently, this trouble can be solved by assessment of supply chain. By set up through various important parameters and by modifying accounting practice. Following analysis phase, innovative models of world about returning process were examined and in design phase these items can be incorporated into alternative solution. During production life cycle, it assists in finding company performance. To know about forecasting, in present work, we have adopted a mathematical model. In this modal, the forecast is under sales estimate then the bias is considered as the negative for company. Time series method provides an ideal solution for the problem for correlated data.

Keywords: Mathematical Forecasting Model, FMCG, Retailers

I. INTRODUCTION

Demand forecasting is the process to estimate about the future product and services depend on the past and present values. This term is also known to be as demand planning. According to the business forecasting and planning point "forecast and experience to estimate demand of various items in the supply chain. To make decisions about the demand planning, it take inventory optimization, ensures the availability of the product and the difference between the monitor forecast and actual sales. It also determines that how much revenue a company can earn in future. At the starting of the demand forecasting, many other activities such as warehousing, shipping, price, and most important supply planning to fulfill the demand of the customers. Getting close to the reality the key point is to improve the efficiency across the supply chain. The growing proof is that companies have implemented demand driven supply chain experience an increase in sales and improvement in working [1-4].

Inaccurate forecast result is associated with the inventory and had impact on the loss sales. Because of its structure it relies heavily on the forecast demand such as inventory management, procurement, manufacturing, capacity of planning, and transport planning. In this paper we are analysis the best method and strategy that can help to improve the performance of the forecast model [2-6].

To improve the accuracy organizations, need to track and analysis the forecast errors so that they can know about how the errors will be occur and what best solution will be implemented to reduce the error. The organization also needs to know that how the margin of error is occurs so the potential impact of forecast can be determined, and new action developed as well [3-7]. Therefore, the demand

of forecast accuracy is important, and it can be considered as robust measurement in the performance of the demand plan for other companies.

There are two objective of the research one study the behavior of the historical data in non-FMCG business and the second is to develop the forecasting model for each subcategory which is based on the behavior of the category.

Both objectives relate to each other. For the behavior of the historical data, we are gathered the 5 to 10 months of data of the companies who are using forecasting method. It is important to analysis the past problem and solution to determinate new one.

There are four types of the forecasting model which are used the organization, but time series and economics forecast model is known to be the best because it gives the most specific result but still not accurate. Our aim is to find out the model that gives us accurate result. For the annual sales, inventory, and maintenance accurate result is most important. It also impacts on the future growth of the business.

By achieving objective, the expected implication will be as follows:

- Cost saving efficiencies can increase the optimization inventory stock level.

- Correctly capture predictable structure from the history of demand forecast.

- Target actual demand value that will occur in the future

II.   LITERATURE REVIEW

Demand forecasting is the technique in which historical sales is used to estimate about the future values. In the business, demand forecasting provides a predicted amount of goods and services for the customers so that they get an idea about the purchase. Demand forecasting estimate about the turnover, profit, margin, cash flow, capital, and mitigation plan as well. It is related to the scientific basis and facts per events that should be consider [1].

Demand forecasting reduces the risk which is related to the business. The accuracy is important in this analysis because there are, any companies who survive alto and didn't get enough profit or success because they have not used the accurate value of revenues. To reduce this factor, multiple method of forecasting will be used. Accurate mathematical calculation is important.

A good forecasting helps a firm to make better planning which is related to the business goal. In the role of forecasting, accounting and functional areas are plays huge role in calculation. It also provides the reasonable data for the organization's capital investment and expansion. it is also providing the new way of formulation of pricing and advertisements strategies as well. Our aim is to use to provide the accurate calculation or mathematical solution for the business so that they can predict future easily. We have use three to four calculation method with graphical and bar charts [1-8].

Importance of forecasting

In the supply chain, it is important for the business to measure the accuracy of your demand forecast. Inaccurate demand forecast will lead to the high risk. It is also impact on the excess stock or other issues related to the services or products. Both are unwelcoming for the investor planners. The major issue of lack of growth is that management system or companies doesn't give exact values of the past and present sales therefore it doesn't show the correct result for the future. It is important to known in advance that where the company lie after few months so that company work harder in this filed. It also defines all the hurdles and difficulties that are occur in this way. Success business are only the one who have knowledge about the growth of the company, and it can be done through the forecasting. It uses your annual sales and provide you complete information [8-18]. There are many key responsibilities that demand forecast fulfill such as:

Improve customer satisfaction

In the stock scenarios customer have zero tolerance therefore demand forecasting help improved the satisfaction level. As we all known that if the customer is satisfied with the company product or services then it means that company get more profit and can grow in the market therefore customer known to be as the core element of the company. Forecasting helps you to analysis the performance and demand of the customer. After analysis and calculation forecasting gives you an idea about that how much your customer satisfied and in which aspects you need to improve. Through the forecasting, companies can improve their performance and can provide the services which customer demand more in the market [19].

Optimize inventory level

Setting the stock safety according to the accurate forecast will prevent the stock outs without holding any excess stock. It is important that companies known about their stock because if customer demand the product which is not available then it led to dissatisfaction of customer. It impacts on the performance of the company. forecasting helps you to analysis about the stock. It gives your complete information about the stock, which is needed to complete, or which is out of stock. When you have complete knowledge about the stock availability you can deal the customer in a better way. It is known to be as optimization of the inventory level, and it is the easiest way to manage the inventory [19].

Manage supplier lead times

To meet the plan of delivery, it is giving supplier a forecast annual inventory need. As the forecasting helps you to know about the inventory availability it is also guides you about the supplier. through the analysis it gives you annual report about the supplier. It shows that which inventory need to be deliver and which is far from the time. It is known to be as the supply management and for the performance efficient it needs to be accurate. Customer always want to get their product or services on time, and this can be possible through the forecasting analysis. We have calculated the company performance and stock through the mathematical calculation [19].

Prevent lost revenue

Out of the stock can lead to the high risk, it not only impact on the product sales but also companion items too. When the company unable to find out the revenue then it led to the risk. Through the calculating and analysis, we have found out the best way which keep the stock and revenue in efficient way. It is important for the company growth. This risk is also lead to the lack of performance. As we are using the three method of forecasting calculation, one of method concern to reduce the higher risk. It can be done by accurate annual report.

Forecast Accuracy

The main reason behind inaccuracy is irrelevant factors or wrong revenue. It can be led to the high risk or the lack of performance which is not beneficial for the company. There are basic rules that useful for the accurate demand forecast.

Forecast is more accurate when sales volumes are high

If a company only sales one or two unites of an item per day, then the random sale will be result in a large percentage forecast error. By the same method, the large volume can be lending to random variation. For example, if the 100 of the people buy the same product at the time, then the store has significance impact on the forecast accuracy, this mean that the demand is easier for the forecast for higher markets, and it is also convention for the small hardware stores. It also impacts on the discount rate. If the company offers more discount rate, then the accuracy will show more clear result. When your sale or provide the only one product to the customer then it will be easy to calculate the forecast

but for the large organizations where they can offer bundle of services, can be difficult for them to find more accurate result (refer figure 1) [2].
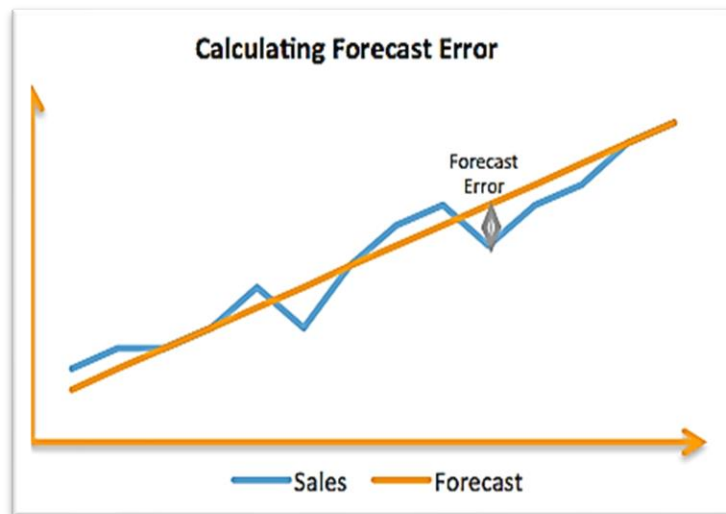

Figure 1: Forecast Error [19]

We are imposed mathematical calculation on both scenario to analysis how the result will be change and how much the risk rate occurs over the time. It difficult for the organization because the forecasting analysis shows the result of all the products at once which can be difficult to understand. For this purpose, graphical will be helpful.

Forecast accuracy improves with the level of aggregation

When the aggregation is over due to the time the same effect of larger volumes impact on the variation. This means that accuracy level if demand forecasting is depending on the group level of chain that stores use during the month. If it is higher than it means it show the more accurate result. The demand forecasting can be measure on the monthly or weekly rather the daily basis. If the company uses the daily basis calculation, then it does not show much clear result [2].

The reason behind the inaccurate result of daily basis is that some of the companies doesn't earn much on daily basis because they work with long term project rather than short term project which means on the daily base it may show little bit same result but on weekly and monthly it shows different result therefore it is always suggestion that forecasting analysis only apply on monthly basis. There are many large organizations who use the demand forecasting method on annual basis because they have larger project, duration with 1 months to 6 months. Therefore, it is useless to analysis on weekly base [2].

Short term forecast is more accurate than long term forecast.

A long-term forecast will change the chance of change not known yet having impact on future demand. The example of the long-term accuracy is weather dependent demand. as the weather change over the time therefore it could not show the clear result.

If the customer wants to know that want kind of cloth, will he buy for the summer then there is not accuracy of result that show about the summer changings. On the other hand, if we want to know about the releasement of ice cream to the grocery stores, we can determine through the short-term projects.

There are many chances occur that company lost their long-term project, or the contract will be change due to the demand therefore the forecast shows more accurate result with short term projects. For example, weather forecast known to be as the long-term project, but it is not stable due to change occur the time. Many forecasting companies' analysis the future weather but they have not shown accurate

results. The given forecasting in figure 2 show that how the short-term project will impact on the stores sales over the past few months.
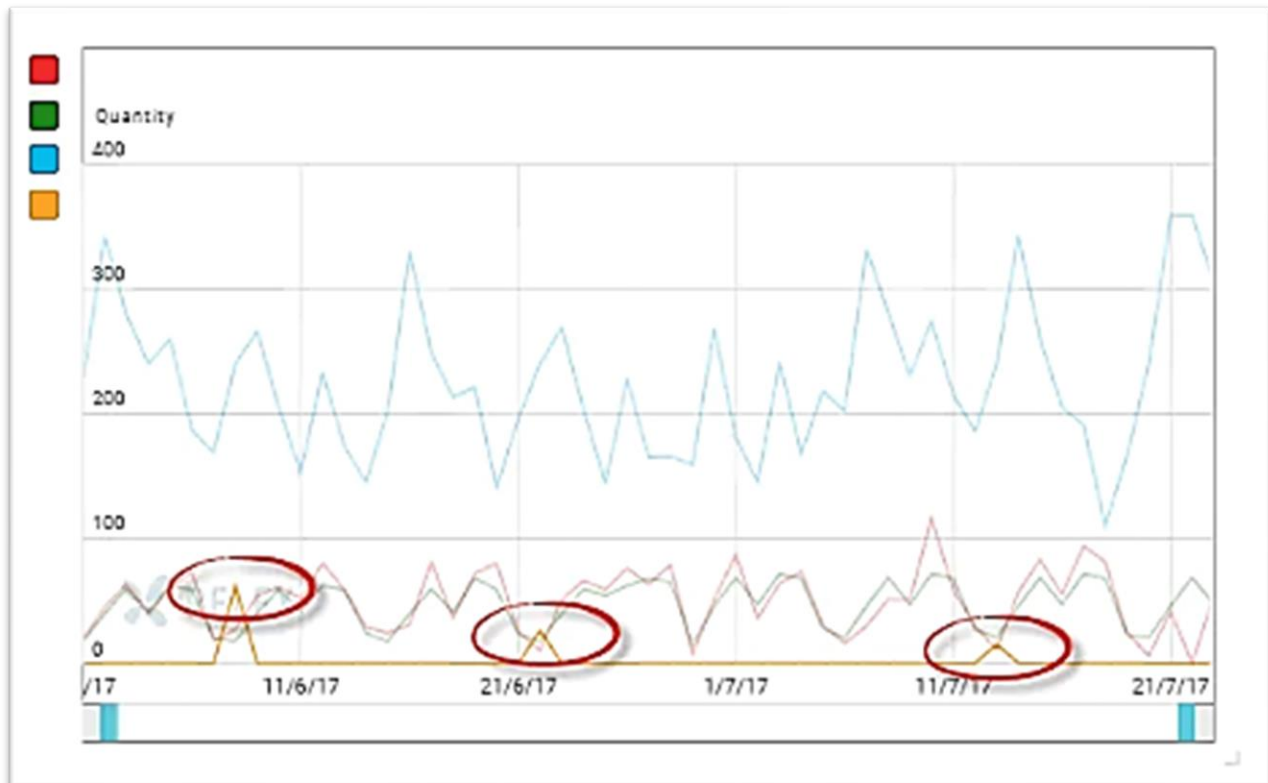

Figure 2: The daily forecast accuracy of the product in the store but there is still the systematic waste due to spoilage [2]

Forecast Factors

There are many factors of forecasting accuracy matrix but the most useful are forecast bias, mean average deviation, and mean average percentage error.

Forecast Bias is the difference between the sales and forecast. If the demand forecast is over to the estimate sales, then the bias is positive for the company. Of the forecast is under the estimate sales then the bias is considered to the as the negative for the company [3].

We can also demine the percentage of the forecast by estimating the sales and then divide into the total forecast by the total sales.

At the end the result shows the 100% result which mean that over the forecasting and result below the 100% then the under forecasting. In many cases, it is important to know that whether the bas is under the forecast or the over the forecast. It demands on the values or sales amount that company consider calculating. Where there are many advantages of bias, but it does not give you much information about the quality. we have mentioned the following formula for the forecast bias where annual sales consider as the forecast amount and then divided with the annual rate of sales that company earn throughout the month. It gives answer in percentage [3].

Forecast bias = £ (Forecast – Sales)

Forecast bias % = £Forecast / £Sales

MAD (Mean Absolute Deviation)

It is commonly used forecasting metric. This method shows the large error on the average. It is not useful for the comparisons, but it gives you the large error in the sales. For example, if the average error of 1000 unites may be considered at the higher risk if the products sell only about the 5,000 unite per period.

On the other hand, the marginal amount of the large error is 100,000 unite. First, we conduct all the sales price and then calculate its average. It gives use idea about the growing of the company. In which month company doesn't earn much these can be creating the average error (refer figure 3).
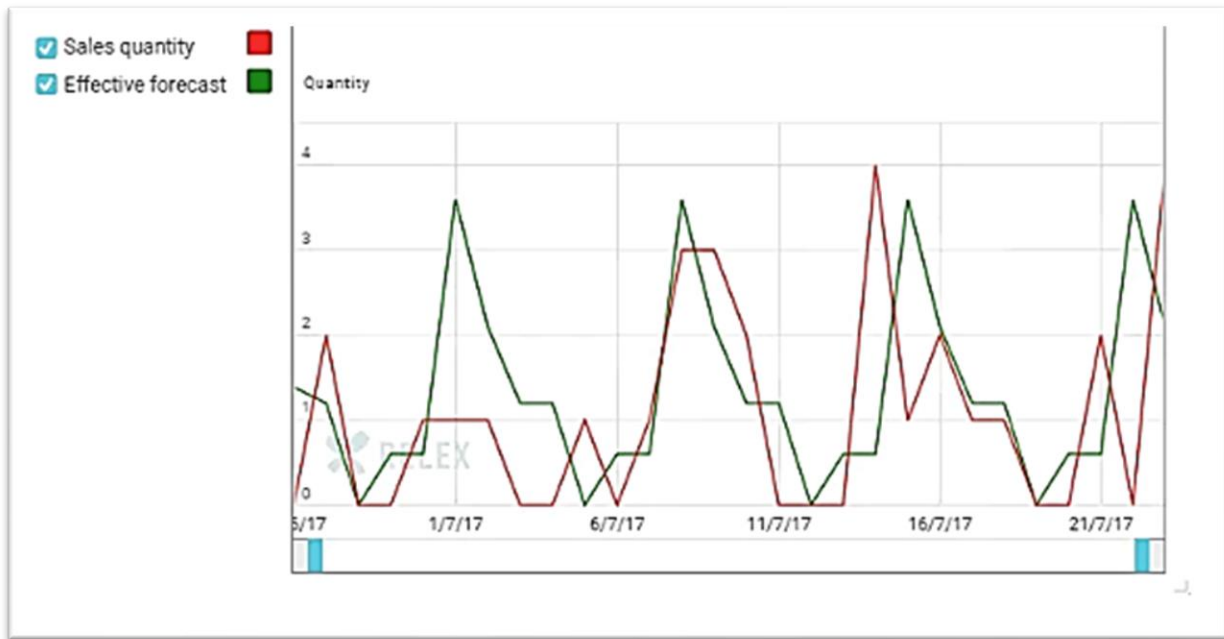

Figure 3: The daily forecasting is lower to the 2% and the week level accuracy is almost 66% [3]

MAPE (Mean absolute percentage error)

It expresses the error of the forecasting into the relation to the sale volume. It tells you that how many percentages point your forecasting have at that time on the average base. This is the probable signal of the most common used forecasting metric.

It gives you equal weight to all the items. At the same time, it gives you a very large error percentage if you include the slow sellers in the data step Following table is how that large error with the typical problem like when to us the MAPE metric for the slow seller.

It gives you the accurate score about the data set. It is not just selecting the right metric but also the gives accurate measuring result. The lower rate of the annual amount is 2%. It is considered as the error risk but if we calculate the monthly base, it can be increases [3].

Table 1: MAD

	Sales	Forecast	MAD	MAPE
Product A	28	14	14	50%
Product B	81	112	31	38%
Product C	222	196	26	12%
Average			24	33%

MAD = 1 / n £ (Forecast – Sales)

Forecast Methods

We have used the trend method in our project. It is method that takes assumption from the limited factors from the past trends and continues the prediction for future. In the prediction of the demand for a product, the trend analysis applies on the time series. It has three factors such as: graphics method, fitting trend equation, and liner trend. Figure 4 shows various forecast methods [5].
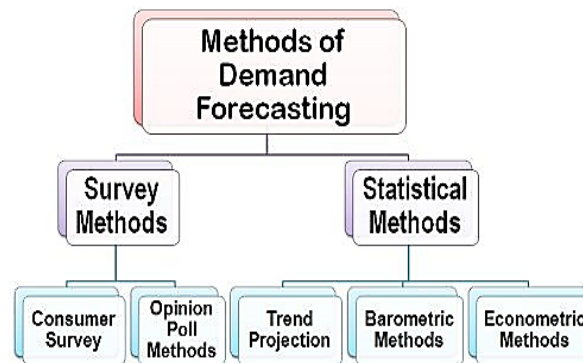

Figure 4: Forecast Method [5].

Consumer Survey

In the consumer survey, we conduct the survey from the customer about their point of view that how they appreciate the company performance, and how they like about them, and which thing they want to be change. The survey success depends on the questionnaire that we prepare. We have collected the consumer information from the company and prepare all the questionnaire. From the survey we can know that whether the consumer is satisfied with the company. it is also important for the companies to know about that what kind of change the consumer need and why.

Opinion Poll Method

Another method is opinion poll method. In this method we can use staff member of the company the stakeholders. To get the best result of the from this method is to conduct both survey opinion and then calculate the averages result from it. It gives the clear ideas about the performance of the company. from this method we can identify the ups and down of the company for example, stallholders talk about the time of delivery and the payment details if the company are pay the dues form the past months, then it is considered that it can pay in future as well [5].

Econometric Method

This method can sue the annual sales or the economy ups ad down of the company, it will help to identify that whether the company are performing well in the economic or not. it is also important. In this paper, we are calculated the economical of the company, of the next two months. It can be calculated by the acts and present prices and the revenue of the company. it will build the trust on the company if they are able to satisfy their customers (refer figure 5).
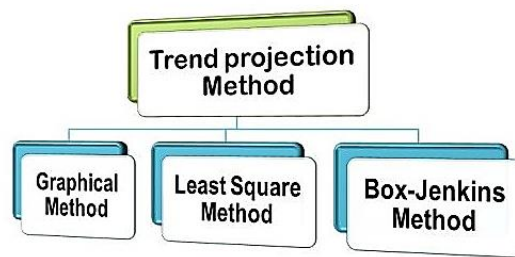
Figure 5: Trend Projection Method

Graphic method

It is the simple statistical method in which the annual sales data are plotted on the graph and then draw the linear line between it. The line draws with the free hand in n such a way that the distance between the points and the lines is at the minimum rate (refer figure 6).

Under this method, it is the assumed that the future sales impact on the growth or not. it also gives an idea about the new investment rate. This method is simple and inexpensive it is not considered will be reliable, this because the trend line is involved in the subjectivity and the personal bias of the researcher [5].

It is useful for use to determine the growth rate. We can find out the accurate result through the graph. In a graph we represent the demand value and the future prediction. The lower line shows that how the company decrease the performance in market and how the assets impact on the growth of the company, if the graph shows the upper line, then it means that company have efficient performance level over the competition.

Prediction pattern for the company like: Month sale: 2.5, 4.5, 6.5, 8.5, 10.5,

Demand in next month based on the past month performance. If the company has sale 48 in May, then it can be stated that June sale will be 48 as well. we have use company monthly performance and predict through the graph that how the growth of the company going.
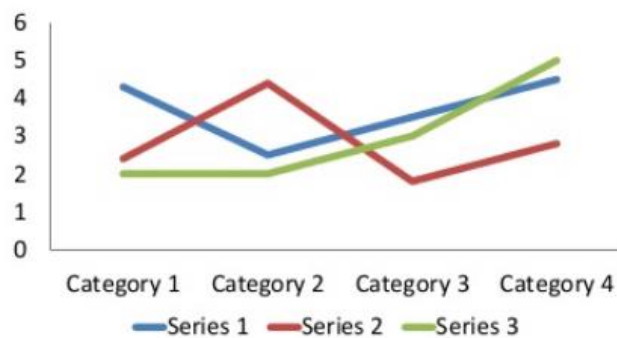
Figure 6: Demand Graph

Fitting trend equation or least square method

It is formal technique in which the trend line is fitted into the time series. The result of the time series depends on the trend line. If it is correct, then the time series is automatically accurate. The form of trend equation that can be fitted to the time series data can be determine the plotting sales data or may be trying different form of equation that best fit into the data. When the data is plotted into the graph the several trend will be occurred [7]. Consider 5 month of the company with sales.

Table 2: Fitting Trend

Month	Sales	Average
1	4	-
2	6	-
3	5	-
4	3	(4+6+5)/3=5
5	7	4.66

The same we have use in the further procedure to find out the average rate of the company.

Linear Trend

It works with the linear equation which is fitted into the trend series. It will be:

S = a+ b T

Where the S known to be as the annual sale, T is the time and ab and b are the constant values which are not change over the time.

Exponential Trend

It is used when the data is revealing the total sales which are increase or decreases over the time. It works either the total sales show the constant per unites on time or increases over the performance. It gives the answer in point. The main factor that uses in this method is annual sales and time which is remain constant.

To calculate the trend, we have used the equation:

Where;

F_{t+1} is the forecast value with time

A_t is an actual value of time and α is the constant

Regression Analysis

The component used in analysis is:

Y= Actual value; $\tilde{Y}$= predicted value; A= value of sales; B= change in Y result; E= error; Sy= standard error

Calculation of parameters:

$\tilde{Y}$= a + bX + e

$\tilde{Y}$= a+ bX2

E= Y- $\tilde{Y}$

$Sy=\sqrt{[\Sigma e2/(n-k)]}$

Where;

A= Y(mean)-b X(mean)

B= [ΣXY -n X (mean)Y(mean)]/[Σ(x2)-n(X(mean))2]

Yields according to the data

Y=506,39 + 0.0107 X

Sy= 387,189

Independently the estimation error in the standard deviation is almost 159,61 for the further months. It is considered as the higher rate of the month. the next month of sale in which the error occurs with the 18.3%. it is known to be as the average error.

It quite successful in the monthly basis. There is main five activities that are occur in this solution is insert, visual, multipack, stand and discount. In the growth rate, discount is also impact. In this process, insert represent the lower price of the customer for example in how many time customers buy that product with the lower price. The multipack is showing the packaging price for the one product. visual is the advertisement sales according to the customer satisfaction. The stand component is used in special days such as Christmas. These days set as the increase's sale growth. Companies can also higher rates [9].

Table 3: Collected Sales Data

Month	Return Product	1st Difference
January	5.3	-1.3
February	7.6	2.3
March	7.1	-453
April	6.7	1.0
May	7.4	-0.1
June	5.5	4.5
July	6.7	-1.0
August	6.8	611
September	7.7	-294
October	8.3	-2.1
November	6.2	2.9
December	7.2	-298
Mean of difference		24

Table 4: 1st Difference

Month	Return Product	2nd Difference
January	5.3	-1.2
February	7.6	4.1
March	7.1	-822
April	6.7	1.9
May	7.4	-2.5
June	5.5	3.2
July	6.7	-1.9
August	6.8	712
September	7.7	-310
October	8.3	-2.5
November	6.2	3.4
December	7.2	-201
Mean of difference		31

Box Jenkins Method

It is another forecasting method which is used with the short-term prediction or the project. The reason to use this method is that it works with the stationary time series sales data. It appears with the time. For this purpose, we have conducted or gathered the data from the annual sales and try to determine that how the company growing in the future, what kind of sales they use, or how the growth of assets company will be used. To find out the accurate result we need the exact amount of sale rate. This method also works with the time. If the time goes higher then growth of the company also goes higher [7].

Delhi Analysis

It is opposite to the regular panel where the direct communication must be involved. The management system and other stakeholder take part in this conversation and try to estimate the future value with the help of past sales. This method helps to eliminate the potential dominance of the vocal members [17]. The outside organization also involves in this problem. the process consists of the following step:

- The coordinator of the groups collects all the relent information and the summarize it.

- It also provides the answer of all the problem according to the summarize data

- The group must need to give feedback as the input to output experts.

- The final decision depends on the output of the group members.

Advantages:

- Can be change the predicted values, easily adapted and ambiguity.

Disadvantages:

- Accurate result is not possible, and it needs to use the judgmental approach

Can give false decision [17]. The multipack is showing the packaging price for the one product. visual is the advertisement sales according to the customer satisfaction [12]. The stand component is used in special days such as Christmas. These days set as the increase's sale growth. Companies can also higher rates.

Advantages:

- This method is more reliable, it can be calculated through the software and there are multiple independent factors occur

Disadvantages

- Aggregation is most complex and there is multiple regression in result [19].

III.   ADAPTED METHODOLOGY

The forecasting model is used to perform the decision and analysis the essential features. The existing model is not much effective in real time applications where the tradeoffs are essential between the decision quality and computational trackability. Forecast is needed throughout an organization. There are two stages that we used for the forecasting model such as forecasting measurement and inventory control. Many organizations face lack of computation method therefore, it should be accurate measurement. Several standardized methods for the forecasting are available. we have also conduct short run and long run computational theory which give the idea about the decision. It can be easy for the organization to select the right one. Almost all the decision depends on the forecast. In future al the decision may become optional, but it depends on the values that we collect. For the accurate result we need to select the accurate values for the survey and data. After collecting the data, we have performed calculation through which we can find the right solution. After that it is important that forecast method should be updated (refer figure 7) [4].

Data Collection Method

The method categorized in to three different groups such as historical or time series, qualitative and casual. We have used two methods for the non-FMCG items

Weighted Moving Average

It can help to reduce the older data and can sum with the 1.0. the equation which used for the calculation is: F t+1 = w1At + w2At-1+w3At-2+……W n At-n+1
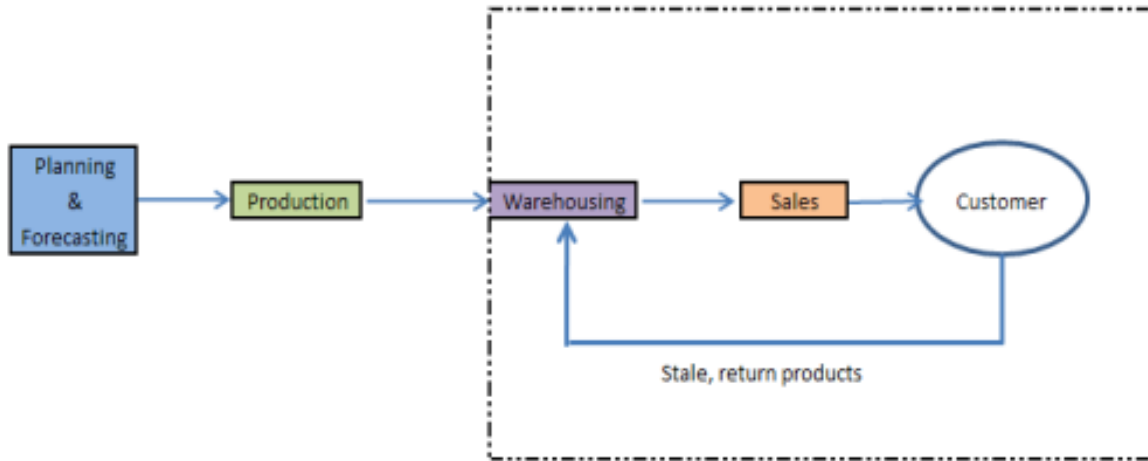

Figure 7: Graph: Structure of Forecasting

Exponential Smoothing

It gave the best fit forecast for the sale data. The line in the graph shows the actual sales and it seems confident for the actual values with the less error rates. We have assumed the most recent observation have the highest predicted value [4]. Therefore, the calculation will be:

F t+1 = F t + a(At-Ft)

Where we have used the Ft+1 as the forecast value for the time. At shows the actual value of the time series and for smoothing results. The result of the exponential depends on the emphasize you want to place with the recent data.

The data that we used to estimate the period are help full to select the right model. The obtain the validation method can be use as the parameter of the calculation. The difference between the value of time series and the predicted value can be consider as the period of the variable.

IV.   DATA ANALYSIS AND TECHNIQUES

The method categorized in to three different groups such as historical or time series, qualitative and casual [2-6].

* The trend: it shows the growth of the sales. The model that we used for the time series is:

  Y t=β0 + βt +ϵt

  where β represent the y-intercept, βt is the slope of the time series. € is used for the random error term. If we consider p in the formula, then the linear model should be appropriate. Seasonal factor: economy and seasonal activity can impact on the sales. It can be regular pattern. For the seasonal variation multiplicative model is used:

  Y t=Tt + St + Ct + Et

  Y t = Tt * St* Ct* Et

Where Y it is time series, Tt is trend component, St is seasonal component, Ct is cyclical compensation and Et consider as the random error of the time series.

- In this formula we have used trend slop as the growth of the product for example after the calculation of time series, if the result show downward trend line and slope then it is stated that our product performance is lower and vice-versa. (Dvorak, and Van Paasschen, 1996).

Table 5: Time Analysis

Class Name	Sku Status	Average rate 2020	Average 2019
Air Fryer	ACTIVE	12,635	5,507
BASIC PHONES	ACTIVE	38,800	27,343
Bbq Grill	ACTIVE	3,950	1,693
Blenders	ACTIVE	7,563	-
Blenders	ACTIVE	13,562	-
Blenders	ACTIVE	119,499	60,169
Deep Fryers	ACTIVE	7,706	4,014
Laptop Bags	ACTIVE	1,823	1,187
Laptop Bags	ACTIVE	2,087	1,107
Other Appliances Breakfas	ACTIVE	4,891	1,962
SMART PHONES	ACTIVE	3,644	942
SMART PHONES	ACTIVE	5,232	1,390
SMART PHONES	ACTIVE	5,428	3,558
SMART PHONES	ACTIVE	6,490	4,279
SMART PHONES	ACTIVE	6,853	4,348
SMART PHONES	ACTIVE	7,862	4,965
SMART PHONES	ACTIVE	8,323	3,010
SMART PHONES	ACTIVE	8,555	4,596
SMART PHONES	ACTIVE	9,162	5,287
SMART PHONES	ACTIVE	10,089	595
SMART PHONES	ACTIVE	10,575	1,901
SMART PHONES	ACTIVE	14,392	2,044
Vacuum Cleaner Drum – Wet	ACTIVE	3,982	468

Table 6: Regression Analysis of Air Flyer

SUMMARY OUTPUT of Air Fryer	
Regression Statistics	
Multiple R	0.888213017
R Square	0.788922363
Adjusted R Square	0.784783586
Standard Error	148.2385634
Observations	53

	df	SS	MS	F	Significance F
Regression	1	4188752	4188752	190.617	7.39E-19
Residual	51	1120708	21974.7		
Total	52	5309460			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-17.31901949	23.4033	-0.74	0.46268	-64.30304863	29.665	-64.303	29.665
X Variable 1	0.922814608	0.06684	13.8064	7.39E-19	0.788628663	1.057	0.78863	1.057
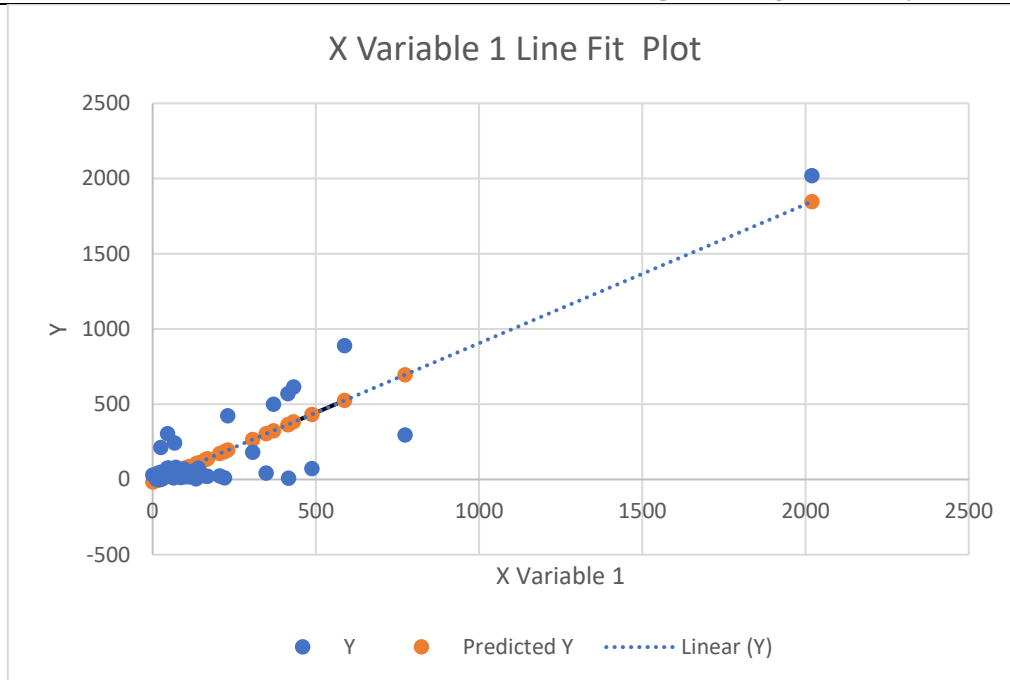
Figure 8: Air Fryer - Fit Plot

Table 7: Regression analysis BBQ Grills

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.97849
R Square	0.95745
Adjusted R Square	0.95661
Standard Error	57.2681
Observations	53.

	df	SS	MS	F	Significance F
Regression	1	3763227	3763227	1147.46	1.24E-36
Residual	51	167261	3279.63		
Total	52	3930488			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-8.4178	8.20025	-1.0265	0.30949	-24.881	8.0449	-24.881	8.0449
X Variable 1	0.97221	0.0287	33.8741	1.24E-36	0.91459	1.02983	0.91459	1.02983
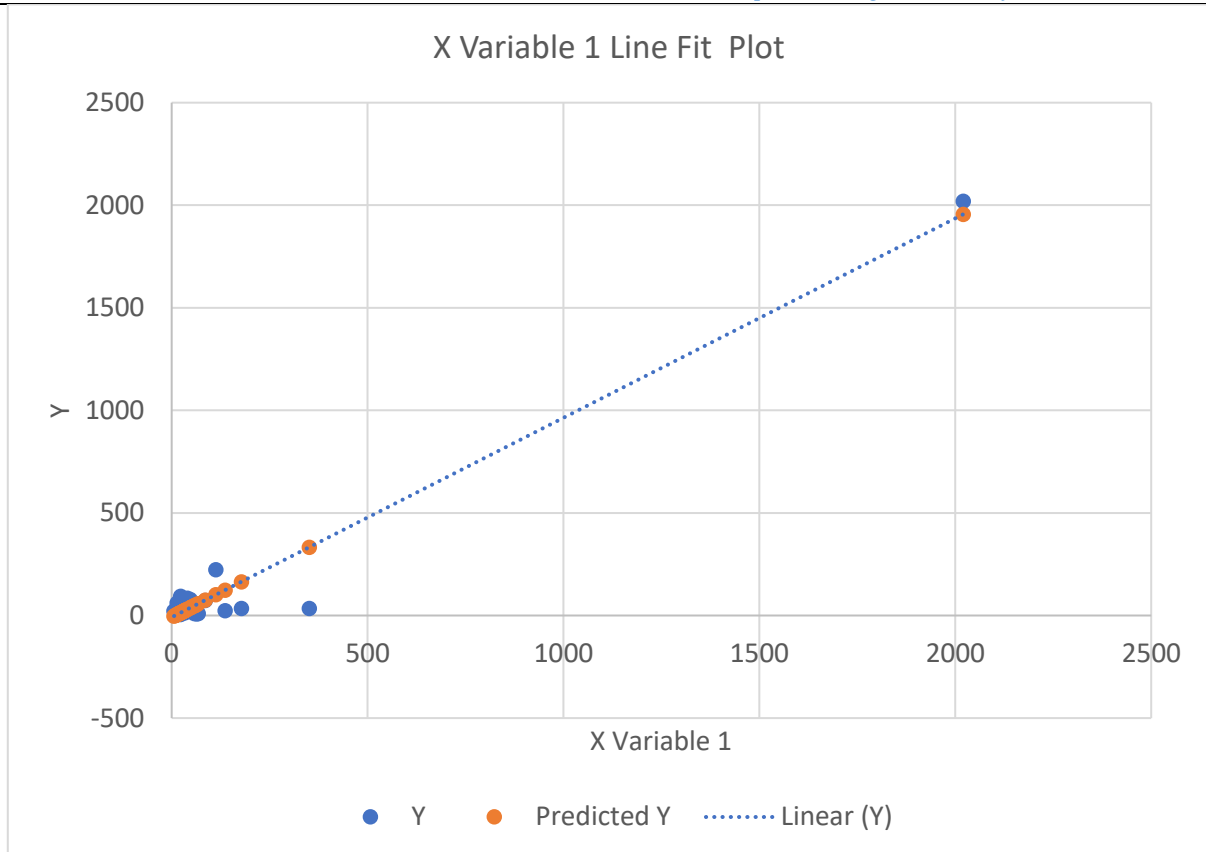
Figure 9: BBQ Fit Plot

Table 8: regression analysis Laptop bags

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.998038
R Square	0.996079
Adjusted R Square	0.996002
Standard Error	17.36019
Observations	53

	df	SS	MS	F	Significance F
Regression	1	3904627	3904627	12955.99	4.77E-63
Residual	51	15370.18	301.3761		
Total	52	3919997			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	10.71557	2.42437	4.419939	5.18E-05	5.848442	15.58269	5.848442	15.58269
X Variable 1	0.993251	0.008726	113.8244	4.77E-63	0.975733	1.01077	0.975733	1.010779
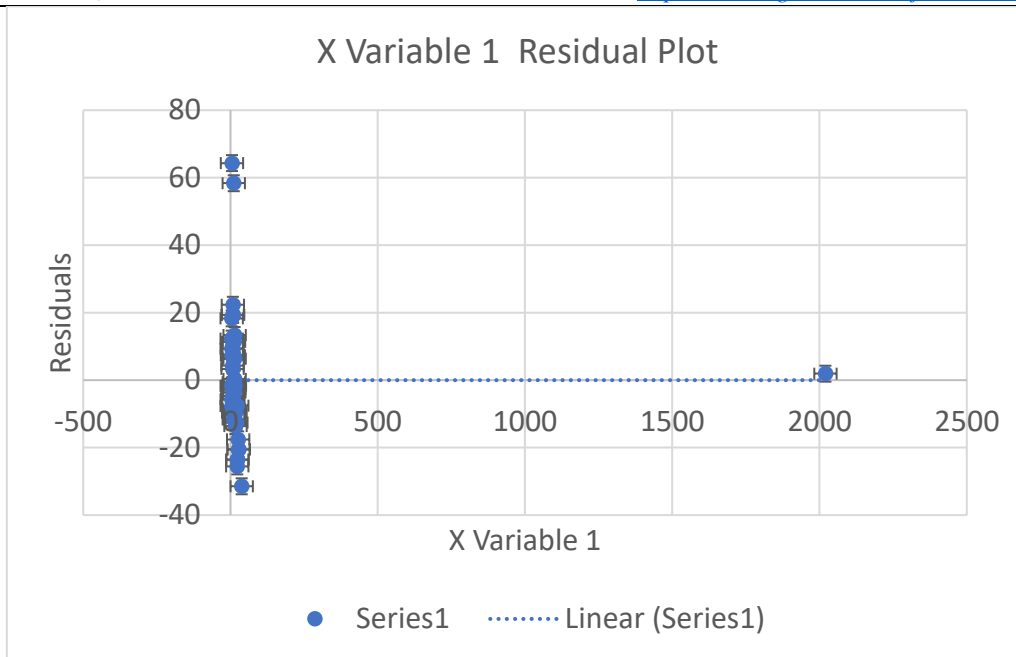
Figure 10: Laptop Bag - Residual Plot

Table 9: Regression analysis of smart phones

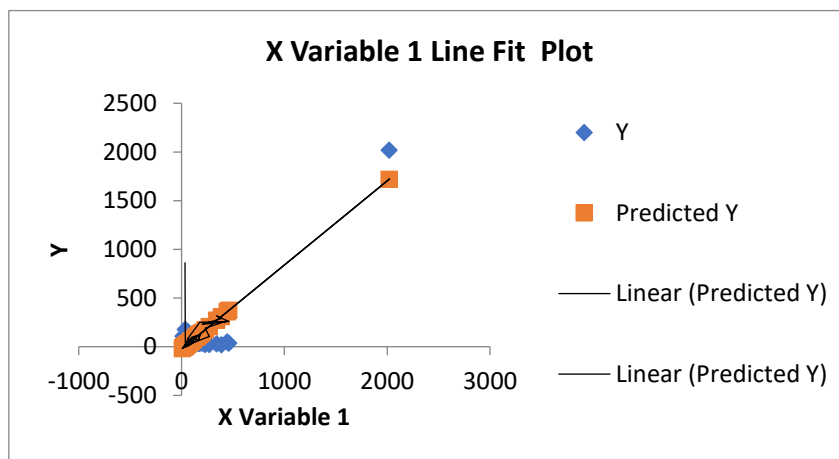| SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.901981
R Square	0.813571
Adjusted R Square	0.809604
Standard Error	123.0222
Observations	49

Figure 31: Smart Phones - Fit Plot

Table 10: regression analysis of basic phones

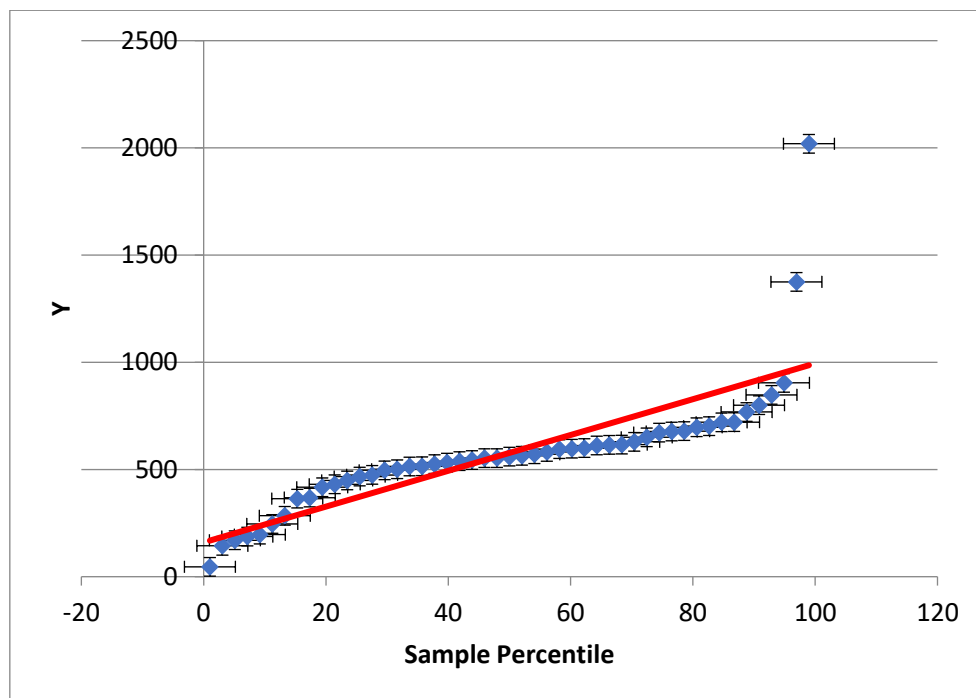| SUMMARY OUTPUT Regression Statistics	
Multiple R	0.640655
R Square	0.410439
Adjusted R Square	0.397895
Standard Error	235.6821
Observations	49

Figure 12: Normal Probability Plot

Comparison with 2020

As we compare the error and regression line with the actual performance of 2020, it is stated that mostly the laptop bags and BBQ grills product are sold more than other product. as the technology increases therefore the demand of smart phone increase as compared to the basic mobile phones but in 2020 the basic mobile sold more than latest products.

Table 11: comparison with actual value

Products	Regression line	Error	Forecast	Actual 2020
Air fryer	0.07	0.8	0.45	0.34
BBQ grills	0.9	0.02	0.31	0.39
Laptop bags	0.9	17.3	0.79	0.98
Smart phones	0.8	0.09	0.25	0.31
Basic phones	0.4	0.06	0.49	0.44

Table 12: interception

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-742.8619908	467.0773	-1.59045	0.127417	-1717.168095	231.4441	-1717.17	231.4441
18142	0.347328126	0.011129	31.21013	1.93E-18	0.324114067	0.370542	0.324114	0.370542

After the analysis of regression line, it has been concluded that SD error is increase which show that accuracy of the mean. Under the lower 95% of the performance almost 0.3% of product can take place which mean that 30% of the appliance increase their performance in 2020. The p-value give an idea that how much the sample data is occur in your population. In this analysis the p value is 0.12 which mean that almost 10% of the sample data has been occur or repeated.
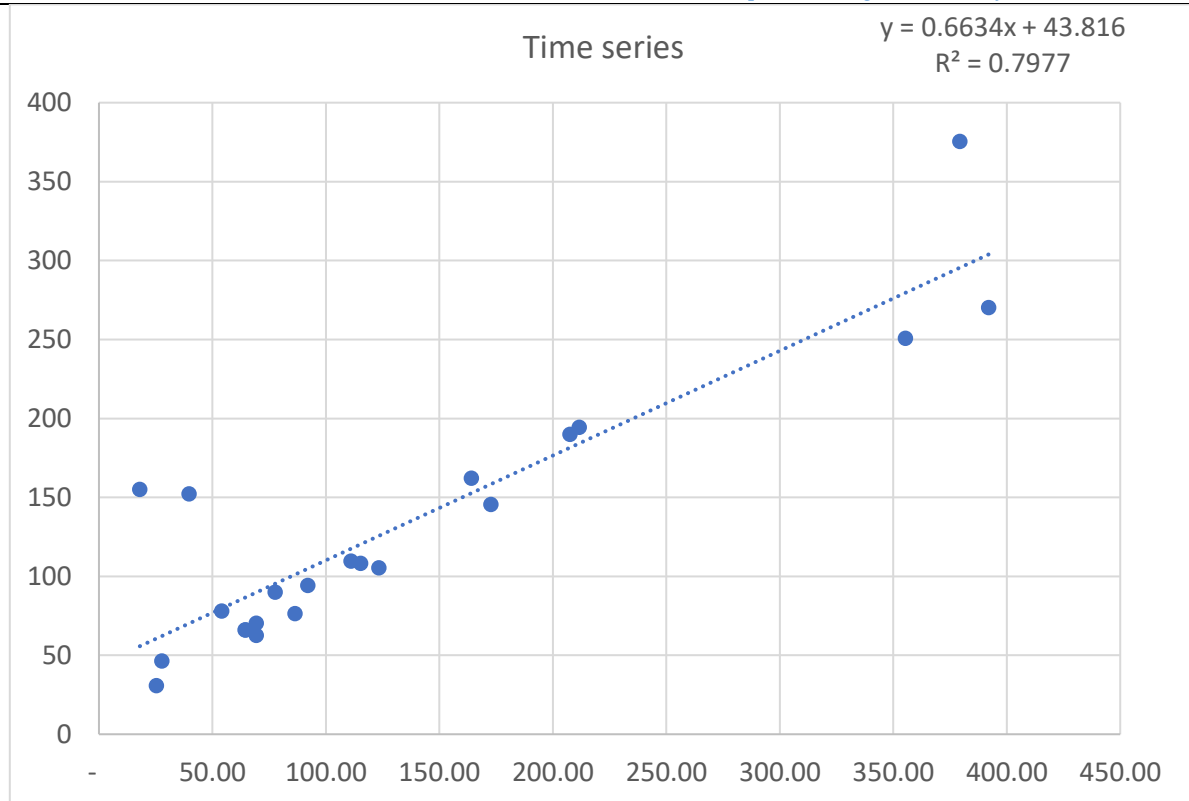
Figure 13: Time Serie

Qualitative Analysis

This is the primarily subjective which relay on the judgment of the human, survey of data or the comparative technique of the production bout the estimation of future. For the forecast the historical data may not be available. Therefore, this method is used to predict the success of the sales. Delphi method is useful component of the qualitative method [14].

For the executive judgment method, we have concluded the survey which is based on the questionnaire platform. In this questionnaire survey we have use following question:

- Which product is established goal?

  Almost 78% answered that laptop bags and smart phone are more reliable than others

- Which product has chance to grow in the market?

  82% audience stated that smart phones company has chance to grow in the market because the demand rate is increase day by day.

- Support and leadership board?

  Basic phones are more reliable and always use same strategy.

By using this technique, a company can be a virtual of the opinion because they don't meet face to face. It can be proceeding as follows:

- A panel of experiments can be used to find out the accurate answer fb the problem which is given by the company for the forecast. The growth of the sale in depend on the forecasting.

- The answer of the problem should be summarized and return the members without any identification of expert.

- After the summary, each person of the panel should maintain the revenue. After analysis the first forecast is submit to the new forecasting proposal behind the change [16].

- The last step that we consider is sales force composite. Qualitative method uses the knowledge and experience of the company's management system, and the member of the channel can increase the sale.

- In this method we have use the sale force regions, products, and the customer with individual needs. It is highly connected to the different factors in the environment. Suppose that the state of the economy and the intertest rate. These can be correlated between the demand and the environment need.

- Salespeople can make the forecast for each product of the company [16].

Moving Average Forecasting

We have applied the moving average method on the 2, 4, and 8 months. It has shown in following table. The graph of the moving average and error represent the higher risk level.it doesn't fit well into the actual return product percentage [17]. In the graph the average move because it represents the new month or the time.

- It uses little to sometime no trend

- Use for smoothing

On the other hand, this is the starting point of the forecasting. the equation of the moving average is:

$F_{t+1} = (M_t + M_{t-1} + M_{t-3})/4$

Where F_{t+1} represent the upcoming month of the forecasting. N is used for the number of periods. For example, in our survey we have used two months therefore n consider to as 2. A_t is for actual occurrence for the time series. The equation helps to find the average.

Table 13: Average forecasting

|	Week 1	Week 2
Smart phones	172.00	52
Smart phones	172.67	242
Smart phones	92.00	222
Smart phones	18.00	54
Smart phones	355.33	-
Laptop bags	379.33	-
Laptop bags	392.00	1,066
Laptop bags	39.67	72
Laptop bags	25.33	38
Laptop bags	27.67	9
Air fryer	86.33	29
Air fryer	115.33	45
Air fryer	123.33	185
Air fryer	77.67	116
Air fryer	69.33	69
Cleaner	64.33	48
Cleaner	64.67	91
Cleaner	69.33	54
Cleaner	54.00	49
Cleaner	111.00	105
Basic phones	164.00	8
Basic phones	211.67	220
Basic phones	207.50	264
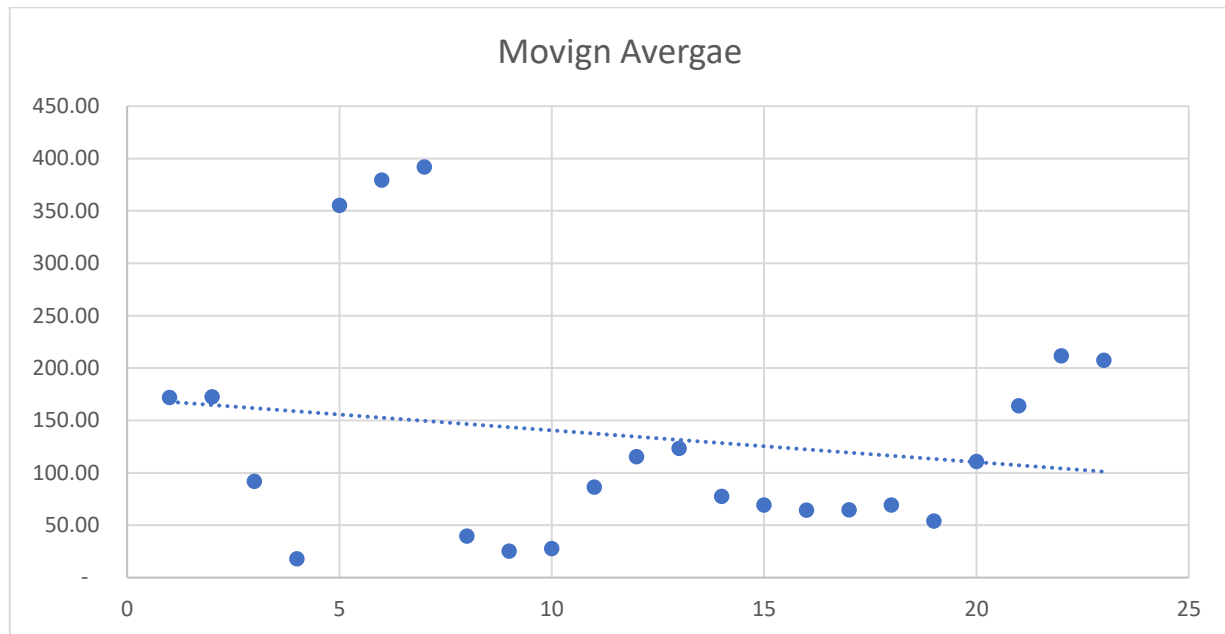
Figure 14: Moving Average of two month

Trend Analysis

To analysis the trend values we have use two products: laptop bags and smart phones. We have implemented weekly performance of both products The given table shows the difference between the sub methods [18].

The first difference of the actual value finds the mean of the 99. If we set this mean value in the following formula: M t+ m = M t + m*

Smart phone trend analysis:

First month =172   Mt=99 therefore the first trend line is 172 * 99= 17028

Second month=52   therefore, the trend line is 52* 99=5148

Laptop bags trend analysis

First month=27   27 * 99 = 2673

Second month=9   9 * 99= 891

Table 14: Forecast with Estimating Trends with 1st Difference

Forecast product	Actual	Forecast	Difference	Error
Smart phone	4.634	5.413	779	17%
Smart phones	4.376	6.912	2.5	58%
Smart phones	6.701	7.4	787	12%
Smart phones	3.472	7.1	3.7	107%
Smart phones	3.243	7.9	4.6	144%
Other application	3.519	6.1	2.6	76%
Other application	4.854	7.4	2.6	53%
Other application	5.385	7.6	2.2	43%
Other application	8.249	8.6	394	76%
iPhone	5.679	9.3	3.6	53%
iPhone	4.067	7.3	3.2	43%
iPhone	8.438	8.4	-10	5%
Total	62.620	89.886	27.266	44%

Return Product and Differences

The following table shows the return rate of products with the difference level. It helps to recognize the demand rate f each product and the accuracy level through the differences. The 1st difference means the 1 level of accuracy and return.

Table 15: Estimating difference 1st [18]

Month	Return Product	1st Difference
Smart phones	5.3	-5.2
Smart phones	7.6	3.9
Smart phones	7.1	-923
Smart phones	6.7	1.0
Smart phones	7.4	-2.473
Other applicants	5.5	3.0
Other applicants	6.7	-1.0
Other applicants	6.8	719
Other applicants	7.7	-293
iPhone	8.3	-2.6
iPhone	6.2	3.1
iPhone	7.2	-293
Mean of difference		21

Actual data of production and differences of 2nd

Table 16: Estimating Trend with 2nd difference

Month	Return Product	2nd difference
Smart phone	4.9	-
Smart phone	5.5	-
Smart phone	6.9	830
Smart phone	5.1	-3.2
Smart phone	5.3	2.0
Smart phone	2.5	-2.9
Other applicants	5.8	6.0
Other applicants	6.1	-2.9
Other applicants	8.0	1.5
Other applicants	7.0	-2.8
iPhone	5.1	-855
iPhone	7.8	4.5

Table 17: Estimate Forecast Trend

Forecast Product	Actual	Forecast	Difference	Error
Smart phone	4.634	5.413	779	17%
Smart phone	4.376	6.912	2.5	58%
Smart phone	6.701	7.4	787	12%
Smart phone	3.472	7.1	3.7	107%
Smart phone	3.243	7.9	4.6	144%
Other application	3.519	6.1	2.6	76%
Other application	4.854	7.4	2.6	53%
Other application	5.385	7.6	2.2	43%
Other application	8.249	8.6	394	76%
iPhone	5.679	9.3	3.6	53%
iPhone	4.067	7.3	3.2	43%
iPhone	8.438	8.4	-10	5%
Total	62.620	89.886	27.266	44%

As the summary the trend have the lower error risk then to 1st difference. It seems more comfortable with the return product amount data. There are two results of methods such as:

Table 18: Error Rates of Trend

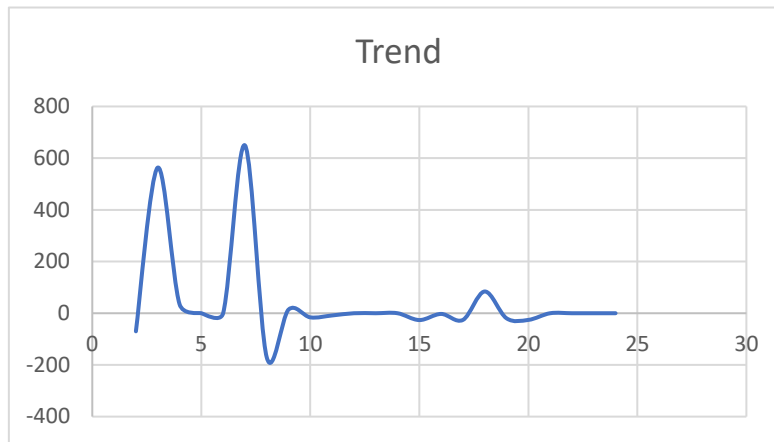| Method	Forecast	Error
Estimating Trends Difference	89.8	44%
Trend of 2nd Difference	81.8	32%

Figure 15: Predicted sales return of the month [18]

When we checked independently the estimation error in the standard deviation is almost 159,61 for the further weeks. It is considered as the higher rate of the week. The regression analysis again estimates the next week of sale in which the error occurs with the 18.3%. it is known to be as the average error.

There is main five activities that are occur in this solution is insert, visual, multipack, stand and discount. In the growth rate, discount is also impact. In the process, insert represent the lower price of the customer for example in how many time customers buy that product with the lower price.

Comparison of different method

Table 19: Comparison with different method

Method	Laptop bags	Smart phone
Trend analysis	In the trend analysis we have get the amount of 51148 in the second week but is higher than the other product. it shows that how much the product can be growing in the next month or week	It has lower trend analysis therefore it has 45% chance to grow.
Regression analysis	It has also the higher regression analysis and it shows that it has more interest level than other	Lower regression level mean that it has less intertest rate
Executive judgement	During the survey we have find out that people prefer other products than the laptop bags, but it is on the second position of the decision-making process.	Consumers prefer smart phones more than other.
Average mean	The higher rate of the laptop bags shows the more accuracy	The lower rate means that it has lack of accuracy.

Forecasting accuracy and validation

For the accuracy, we have use average mean method. the average of the smart phone of two months are: 172+52/2= 112.

If the forecast is known to be unbiased then we consider the error mean is zero. The error means the hypanthia can be perform in other way and it is depending on the assumption that we have selected. In our result it is fully optimized forecast instead of any situation raised. The number of forests result depend on the situation. It is obvious that that if the forecast is very good, but the actual value and other variables are difficult to manage. For this solution we have the WACC method which give use accurate results. There are many methods who is easy to use, and many are difficult to understand.

The average mean of the laptop bag of two month is: 27 + 9/2= 31.5

If we compare both accuracies, then it is clearly showing that smart phone has more accuracy level than the laptop bags. In many times the situation the situation is occur the forecast condition dons reliable but still it gives the accurate result. In the first difference we get 44% of the mean error but in the very next it has reduced. Or prediction may be at the false side. the acutance of the result will be verifying if it gives little bit change in predicted values [12]. The discount and the lower price customer have impact on the growth rate therefore it is the main reason why we get that much difference between the two results. The circulate objective of the problem is the loss of function with the various parts.

We can use many techniques for the error's merriment. The control limited of the data can be on one stand or the two-stand trad error. The number of errors indicate the forecasting process and the need of the restive process. We have the sue plotted chart to represent the error occur in the prediction values.

The dot shows that the values should be maintain under the control lite. the validation is used for telling the model more credibility. The feta hires of the time series high can be revalue during the examination tare mentioned din the above graph. an efficient approach of the modeling is to hold the most specific value. The data which are held out during the process are used as the parameters of the model. the forecasting model also use the testing process for the validation period. If the result is satisfactory then we used it for the further process.

V.   CONCLUSION

The method that we used is mean absolute and the mean square error. In the mean a bustle we have divide the predicted value to the actual value and then summarize the result. For the error total magnitude will be calculated. The foresting error represent to the values of the time sores and it show the less of the small errors. The mean standard error can be representing the diffidence between the value and the predicted value. The largest absolute value can be impact on the accurate result.

Demand forecasting estimate about the turnover, profit, margin, cash flow, capital, and mitigation plan as well. forecasting helps you to analysis about the stock. It gives your complete information about the stock, which is needed to complete, or which is out of stock. This risk is also lead to the lack of performance. If the company offers more discount rate, then the accuracy will show more clear result.

When your sale or provide the only one product to the customer. There are many large organizations who use the demand forecasting method on annual basis because they have larger project, duration with 1 months to 6 months. On the other hand, if we want to know about the releasement of ice cream to the grocery stores, we can determine through the short-term projects.

The main factor that uses in this method is annual sales and time which is remain constant. There is main five activities that are occur in this solution is insert, visual, multipack, stand and discount. In the growth rate, discount is also impact. In this process, insert represent the lower price of the customer for example in how many time customers buy that product with the lower price. we have conducted or gathered the data from the annual sales and try to determine that how the company growing in the future, what kind of sales they use, or how the growth of assets company will be used.

Several standardized methods for the forecasting are available. we have also conduct short run and long run computational theory which give the idea about the decision. After the analysis of regression line, it has been concluded that SD error is increase which show that accuracy of the mean.

Under the lower 95% of the performance almost 0.3% of product can take place which mean that 30% of the appliance increase their performance in 2020. For the forecast the historical data may not be available. The regression analysis again estimates the next week of sale in which the error occurs with the 18.3%. it is known to be as the average error.

Conflict of interest: We declare that we have no conflict of interest. This paper is the part of thesis submitted by Ahmed Meer under the supervision of Dr. Mohammer Balubaid to award the MSc. degree in Industrial Engineering at King Abdul Aziz University. The NOC to publish this paper has been issued by Dr. Mohammed A Balubaid, Associate Professor of Industrial Engineering, Vice Dean for Development, Acting Dean - The Applied College.

Ethical statement: We declare that we have followed ethical responsibilities.

REFERENCES

[1] Ellis, Kimberly (2010). Production Planning and Inventory Control. McGraw-Hill. ISBN 978-0-412-03471-8.

[2] Gordon, Wendy.(1943) Qualitative market research : a practitioner's and buyer's guide. Aldershot, Brookfield, USA : Gower

[3] Hague,Paul N.(2002) Market research : a guide to planning, methodology and evaluation. London, England: Kogan Page

[4] Kaligasidis, Angela Sasic; Taesler, Roger; Andersson, Cari; Nord, Margitta (August 2006). "Upgraded weather forecast control of building heating systems". In Fazio, Paul (ed.). Research in Building Physics and Building Engineering. Taylor & Francis, CRC Press. pp. 951–958. ISBN 978-0-415-41675-7.

[5] Lambin, J.-J., Chumpitaz, R., & Schuiling, I. (2007). Market – Driven Management, 2nd ed., London, England: Palgrave Macmillan.

[6] Marketing Science. (2004).Growing, Growing, Gone: Cascades, Diffusion, and Turning Points in the Product Life Cycle.Retrieved from: http://pubsonline.informs.org/doi/pdf/10.1287/mksc.1040.0057

[7] Mike Allen, Scott Titsworth, Stephen K. Hunt.(1959) Quantitative research in communication. Los Angeles, USA : SAGE

[8] Philip Hans Franses and Richard Paap.(1963) Quantitative models in marketing research. Cambridge, UK ; New York : Cambridge University Press

[9] Delurgio, s., bhame, C. (1991), Forecasting Systems for Operations Management.

[10] Dvorak, R., Van Paasschen, F. (1996). "Retail Logistics: One Size Doesn"t Fit All", The Journel of McKinsey Quarterly. Issue 2. pp.120-129

[11] Finch, B.J. (2006), Operations Now: Profitability, Processes, Performance, 2 ed., McGraw-Hill Irwin, Boston.

[12] Franzese, R.J., Kam, C. (2007), Modelling and Interpreting Interactive Hypotheses in Regression Analysis, University of Michigan Pres.

[13] Gregory, B. (2009), "Turkey: Analysing the emergence of an eastern delight", Planet Retail.

[14] Lambert, D.M., Cooper, M.C. (2000). Issues in Supply Chain Management", Industrial Marketing Management. 29 (1),pp. 65-83

[15] Mentzer, J.T. (2001), "Supply Chain Management", Journal of Business.

[16] Reiner, R., Fichtinger, J. (2009), "Demand Forecasting for Supply Processing Consideration Of Pricing And Market Information", Faculty of Economics, Enterprise Institute, University of Neuchatel.

[17] Tozan, H., Vayvay, O. (2007), "Analyzing Demand Variability Through SC Using Fuzzy regression and Grey GM(1,1) Forecasting Models", Information Sciences, World Scientific, pp.1088-1094.

[18] Bottani E., Rizzi A. (2008), "Economical Assessment of The Impact of RFID Technology and EPC System on The Fast-Moving Consumer Goods Supply Chain" International Journal of Production Economics, Volume 112, Issue 2, pp. 548-569

[19] Geisser, Seymour (June 1993). Predictive Inference: An Introduction. Chapman & Hall, CRC Press. ISBN 978-0-390-87106