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Demand Forecasting and Ordering Solution in Fashion Industry

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***Abstract*- Demand forecasting in fashion industry plays a very important role for the manufacturer and distributor. It is very critical for the fashion manufacturing industry, in which the product demand is liable to change rapidly and unpredictably, especially for the worse. In fashion industry the life cycle of a product is very short, due to which forecasting has to be next to precise. Incorrect forecasting can result in huge stock pile ups and may result in significant loss for the company, due to which using correct forecasting method for a particular fashion industry becomes very important. In this paper we discuss about various forecasting techniques, their merits and demerits.**

Keywords- Demand Forecasting, Supply, Fashion, Ordering Solution, Prediction, Warehouse. Introduction

I. INTRODUCTION

Forecasting plays a very important and crucial role in fashion industry. Poor forecasting results in stock outs or high inventory, due to which a company can have huge losses. As such demand forecasting is a very popular research topic, many forecasting methods have been developed which results in better forecasting. In this paper we will discuss about the various forecasting techniques and will also discuss about their performance.

A. Definitions

Consequently, we are highlighting some of the key terms in our review paper which will be used and will affect the forecasting. Forecasting refers to the prediction of future sales on the basis of the historical data present [2]. Forecasting can be either short-term forecasting or long-term forecasting. Short duration forecasts are usually of two years of length. They are commonly used to determine production and delivery schedules, also establish inventory levels. Long-Range forecasts are generally for two years in future. They are usually used for strategic planning. Strategic planning determines where the company is to be headed in the future. It is used to establish long-term goals, plan new products, enter new markets and also develop new facilities & technology. [2]

- Demand forecasting refers to the prediction of the demand of a particular product, good or services that are being offered by a particular company [11].
- Warehouse is a commercial building that is used for the storage of goods.
- Time period of a forecast refers to the forecasting done for a particular period of time in future.
- Level of forecast is the level at which the demand forecasting has been done it can be at macro level (e.g. category), industry level and firm level.
- Seasonality [1] refers to the availability of products depending upon the environmental changes, it may differ with holidays, weather and the crowd at a particular geographical location (if it's a peak season in some city).
- Fashion trends [1] refers to the change in style in a certain period of time where customers urge to get the products which are worldwide famous for its style or wear. It increases the output of each and every store for that certain product.
- Cycles [11] are downward or upward swing in demand over a long period of time.
- Consumer behavior [1] can differ from consumer to consumer and we can't predict the exact demand of each customer rather we can predict demand the consumers as a whole.
- Data set demonstrates a set of demands that have arisen over succeeding years. This data has been collected on a quarterly basis and then compressed into yearly ones.
- Base demand [12] is simply the starting point of any demand.
- Reorder point [12] refers to the exact time when we need to order the stocks otherwise we might be short of at our warehouse and will be unable to fulfil the customer demand.
- Economic order quantity refers to the quantity we need to order to minimize inventory costs whilst matching the demands of the consumer.

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B. Applications

Forecasting has applications in a wide range of fields and can be used everywhere in the current industry to minimize input costs and maximize profits or else to predict the risks in finance industry, weather forecasting, political forecasting, or for the performance of players in sport industry [4]. With these many applications in each and every industry, business organizations are investing in highly to get the data adapted as per their need and extensive research is done for the same. Fashion industry is one of the most prominent industry where forecasting is used. Some situations where forecasting is used are:

- Supply chain management [2] ensures our inventory is filled as per the demand and we don't incur any uncertain loses.
- Economic forecasting [12] is used to predict the future conditions of certain important economy related terms like GDP, GNP and growth rate etc.
- Egain forecasting [12] refers to the calculation of the climatic heat in our surrounding which may affect development of any house or building.
- Product forecasting [12] caters to the need of marketing a new product in the market which takes into matter a variety of terms such as distribution, awareness and price etc.
- Sales forecasting [12] is projection of achievable sales revenue which may be proportional to the demand in the market.

We will be discussing different types of forecasting techniques and which technique is suitable for what type of industry and their accuracy after the data is forecasted. Our main focus would be highlighting the difference between these techniques and why certain techniques are much better to adapt with the modern trends.

II. PERFORMANCE MEASURES

To predict correctly we need to choose certain measures and techniques which is suitable for the type of data we use, the amount of data we have collected and the exact forecasting needs of us. After inspecting every factor, we need to select this measure and continue with our work, incorrect forecasting may lead to unbearable costs and may lead a company or an organization to a complete turmoil.

- Accuracy refers to the amount of exactness of our predicted outcome and we have various measures to actually calculate accuracy. MAPE, MAD, MSE, RMSE are the widely used accuracy measures and will be explained in the further paragraphs.
- MAD (Mean Absolute Deviation) It is the mean of differences between actual values and their average value and is used to calculate demand variability. where t equals time period; n being the number of periods forecasted; Yt is the actual value in time period t; Ft being the forecast value in time period t. [11] The smaller the MAD the better would be the result.

$$MAD= \Sigma (| Y_t-F_t |)/n \quad (1)$$

- MAPE (Mean Absolute Percentage Error) It is one of the widely used method for forecasting and people are comfortable with the fact that it is calculated on the base of percentage which makes it easier. [11]

$$MAPE= \Sigma (| Y_t-F_t |/ Y_t)/n \quad (2)$$

MAPE	Judgment of Forecast Accuracy
> 10%	Highly Accurate
11% to 20 %	Good forecast
21% to 50%	Reasonable forecast
51% or more	Inaccurate forecast

- MSE (Mean Square Error) It's the average of the squares or deviations, it's a risk function. where t equals time period; n being the number of periods forecasted; Yt is the actual value in time period t; Ft being the forecast value in time period t. [11]. The smaller the MSE value better would be the result.

$$MSE= \Sigma (Yt-F_t)^2/n \quad (3)$$

- RMSE (Root Mean Square Error) we need residuals to calculate this and residual is the difference between actual values and the predicted values. [11]
- Precision [13] refers to the closeness of two or more measurements to each other.

III. THE METHODOLY/APPROACH

Forecasting methods can be classified into two types. (i)Qualitative method [13] is a type of forecasting method based on judgments, opinions, intuition and requires a good estimate of future demand. They don't rely on any mathematical calculations but depends wholly on experience and expertise. (ii)Quantitative methods [13] are based on statistical models and are very much unbiased in nature, they depend on heavy computations.

Under qualitative methods we have four main types mainly- (i)Executive opinion which is where managers meet and create a forecast. (ii)Market survey uses interviews and preferences of customers to access demands. (iii) Sales force composite in which each salesperson estimates sales in his or her region. (iv)Delphi method is a method where a group of experts conclude to a single experiment.

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Under quantitative methods we have time series models which look at previous patterns of data and predict the subsequent based upon the model which is present in the data.

Consider the following sample data set for illustration.

YEAR	Q1	Q2	Q3	Q4	Total Demand
1	62	94	113	41	310
2	73	110	130	52	365
3	79	118	140	58	395
4	83	124	146	62	415
5	89	135	161	65	450
6	94	139	162	70	465

A. Naïve Forecasting

It assumes that demand in the next time period will be the same as in the previous time period. For example, if a retailer is selling 1000 tees in April, the naive forecast will be for 1000 tees in the month of May. [14] This approach is good because it rules out fluctuations of trends, cycles and random variations. An alternative type of naive forecasting would be by adding seasonality into account with a flat trend.

YEAR	ACTUAL DEMAND	FORECAST
1	310	
2	365	310
3	395	365
4	415	395
5	450	415
6	465	450
7		465

B. Simple Average Mean Method

The forecast of next period equals to the average of all the past historical data. For the first-time period our forecasting would be just a guess i.e. we are assuming a value by our own, for the second-time period we need to take the average of the previous time periods and subsequently we would be doing the same process.

YEAR	ACTUAL DEMAND	FORECAST
1	310	300
2	365	310
3	395	337.5
4	415	356.67
5	450	371.25

C. Simple Moving Averages

It is an upgrade of the traditional naive approach, in this approach instead of using the most current periods to predict demand for the next period, it uses the average demand from a series of foregoing periods to forecast the next periods demand. [14] It is called moving average because we need to recalculate the demand for each new period. It is used by many firms when the demand is quite stable from period to period. It fails to consider trends or seasonal effects. In this method, for the first forecast we take a guess of the demand and for the second year we take the naive approach and for the consequent years average of the previous terms are taken.

YEAR	ACTUAL DEMAND	FORECAST
1	310	300
2	365	310
3	395	337.5
4	415	380
5	450	405
6	465	432.5
7		457.5

D. Weighted Moving Average Method

The weighted moving average forecasts for the next period which equals to the weighted average of a specified number of most recent observations. In this we have assumed a 3-year weighted moving average and in the first forecast because of insufficient data we put a value randomly over there and for the 2nd and 3rd year we use naive method to calculate the demand and after that as we have sufficient data to calculate the demand we unfold 3 year weighted moving average.

YEAR	ACTUAL DEMAND	FORECAST
1	310	300
2	365	310
3	395	365
4	415	356.66
5	450	391.66
6	465	420
7		433.33

E. Exponential Smoothing Method

For this forecast is calculated by, New forecast = Last stages forecast +α (Last stages actual demand - Last stages forecast) [8] It only requires that you dig up to two pieces of data to apply it. An important feature of this method is that it includes a portion of every piece of historical data.

YEAR	ACTUAL DEMAND	FORECAST
1	310	300
2	365	301
3	395	307.4
4	415	316.16
5	450	326.04
6	465	338.43
7		351.09

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F. Neural Network

Nowadays with the advancement of technology artificial neural networks are used to use the capability of human brains to do a particular work or job. Artificial neural network is present in such system which can do the job of forecasting and is at a starting age of using this technology. [3]

G. Trend Protection

It is one of the techniques under linear regression. It is represented with a straight line passing through the historical data points which comes very near to the points. Ultimately, the formula to calculate a slope for the trend line (c) and the point where the line crosses the y-axis (d). This results in the straight-line equation

$$Y = c + dX \text{ [11]} \quad (4)$$

Where X demonstrates the values on the horizontal (time), and Y demonstrates the values on the vertical (demand). For the demonstration data, computations for c and d reveal the following, taking random values of d = 30

c = 200

Y = 200 + 30X

This equation can be used to forecast for any year into the future. For example: Year 6: Forecast = 295 + 30(6) = 475

Year 7: Forecast = 200 + 30(7) = 410

Year 8: Forecast = 200 + 30(8) = 440

Year 9: Forecast = 200 + 30(9) =470

H. Seasonal Index

It is one of the forecasting tool to calculate the demand for a given marketplace over the course of the year. Such an index is based from the past historical data which highlights the seasonal differences in consumption of a commodity. [11] Associative models assume that there is a relation of variable in different environments and based upon that it tries to forecast it. Associative forecasting models are there to identify related variables in order to predict the demands.

YEAR	Q1	Q2	Q3	Q4	Total Demand
1	62	94	113	41	310
2	73	110	130	52	365
3	79	118	140	58	395
4	83	124	146	62	415
5	89	135	161	65	450
6	94	139	162	70	465

IV. MEASURING FORECAST ACCURACY

A. Naïve Forecasting

Sr. No.	ACTUAL DEMAND (Ar)	Forecast demand(Fr)	MAD(| Ar-Fr|)	MAPE(100| Ar-Fr\Ar)	MSE(Ar-Fr)^2
1	310	300	10	3.23%	100
2	365	310	55	15.06%	3025
3	395	365	30	17.59%	900
4	415	395	20	4.81%	400
5	450	415	35	7.77%	1225
6	465	450	15	3.22%	225
TOTAL			165	51.68%	5875
MEAN			27.5	8.61%	979.17

B. Mean Sample Average

Sr. No.	ACTUAL DEMAND (Ar)	Forecast demand(Fr)	MAD(| Ar-Fr|)	MAPE(100| Ar-Fr\Ar)	MSE(Ar-Fr)^2
1	310	300	10	3.23%	100
2	365	310	55	15.06%	3025
3	395	337.5	57.5	14.56%	3306.25
4	415	356.667	58.33	14.05%	3402.39
5	450	371.25	78.75	17.50%	6201.55
6	465	387	78	16.76%	6084
TOTAL			337.42	81.16%	22120.19
MEAN			56.24	13.53%	3686.68

C. Simple Moving Average

Sr. No.	ACTUAL DEMAND (Ar)	Forecast demand(Fr)	MAD(| Ar-Fr|)	MAPE(100| Ar-Fr\Ar)	MSE(Ar-Fr)^2
1	310	300	10	3.23%	100
2	365	310	55	15.06%	3025
3	395	337.5	57.5	14.56%	3306.25
4	415	380	35	8.42%	1225
5	450	405	45	10%	2025
6	465	432.5	32.5	6.99%	1056.25
TOTAL			235	56.26%	10737.5
MEAN			39.12	9.71%	1789.59

D. Weighted Moving Average

Sr. No.	ACTUAL DEMAND (Ar)	Forecast demand(Fr)	MAD(| Ar-Fr|)	MAPE(100|Ar-Fr\Ar)	MSE(Ar-Fr)^2
1	310	300	10	3.23%	100
2	365	310	55	15.06%	3025
3	395	365	30	7.58%	900
4	415	369	46	11.07%	2116
5	450	399	51	11.33%	2601
6	465	428.5	36.5	7.85%	1332.25
TOTAL			228.5	56.12%	10074.25
MEAN			38.07	9.34%	1679.03

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E. Exponential Smoothing Average

Sr. No.	ACTUAL DEMAND (Ar)	Forecast demand(Fr)	MAD(|Ar-Fr|)	MAPE(100|Ar-Fr\Ar)	MSE(Ar-Fr)^2
1	310	300	10	3.23%	100
2	365	309	56	15.33%	3136
3	395	359.4	35.6	9.01%	1267.36
4	415	391.44	23.56	5.68%	643.12
5	450	412.64	37.56	8.30%	1395.76
6	465	446.25	18.75	4.02%	351.56
TOTAL			181.27	45.57%	6893.8
MEAN			30.21	7.60%	1148.96

F. Comparision Table.

Sr. No.	METHOD	MAPE	MAD	MSE
1	NAÏVE FORECAST	8.61%	27.5	979.17
2	MEAN SIMPLE AVERAGE	13.53%	56.24	3686.68
3	SIMPLE MOVING AVERAGE	9.71%	39.12	1789.59
4	WEIGHTED MOVING AVERAGE	9.34%	38.07	1679.03
5	EXPONENTIAL SMOOTHING	7.60%	30.71	1148.96

V. CONCLUSION

The naive model's strength includes giving us a base to work for other models against it. Other forecast models are very complex and prone to errors if we compare it to naive model. One can't just outperform naive in the case of ease of using this. Whereas in exponential smoothing requires storing of very little data and it emphasizes on the fact of using the most recent and up to date data. The simple moving average gives us the flexibility of giving a smoothed line for a temporary up and down price swings but is slower to quick price changes whereas the weighted mean average gives us the idea about trend change. Through our dataset, our results advices the use of MAPE for exponential smoothing, the use of MAD for naive forecast and we can use MSE for naive forecast as well as exponential smoothing for which the output will be very close to each other if we take much heavier dataset.

VI. REFERNCES

[1] Engy Shafik. Predictive Modeling of US Winter Apparel Sales Using Time Series Forecasting Method, North Calorina State University, Raleigh, North Calorina – 27695-8301

[2] Maria Elena Nenni, *, Luca Giustiniano and Luca Pirolo-Demand Forecasting in the Fashion Industry: A Review. International Journal of Engineering Business Management Special Issue on Innovations in Fashion Industry

[3] Na Liu, Shuyun Ren, Tsan-Ming Choi, Chi-Leung Hui, and Sau-Fun Ng. Sales Forecasting for Fashion Retailing Service Industry:
A Review. Institute of Textiles and Clothing, Faculty of Applied Science and Textiles, The Hong Kong Polytechnic University,
Hung Hom, Kowloon, Hong Kong

[4] Engin Yesil, Murat Kaya, Sarven Siradag. Fuzzy Forecast Combiner Design for Fast Fashion Demand Forecasting

[5] Agostino Bruzzone, Fransco Longo, Letizia Nicoletti, Alessandro Chiurco, Christian Bartolucci. Multiple Forecasting Algorithms for Demand Forecasting in the Fashion Industry (2013 8th EUROSIM Congress on Modelling and Simulation)

[6] J. Scott. Research Needs in Forecasting. Armstrong University of Pennsylvania, armstrong@wharton.upenn.edu

[7] R Fildes, K Nikolopoulos, SF Crone1 and AA Syntetos. Forecasting and operational research: a review. Journal of the Operational Research Society (2008) 59, 1150 –1172

[8] Mick Smith, Rajeev Agrawal. A Comparison of Time Series Model Forecasting Methods on Patent Groups. Department of Computer Systems Technology North Carolina A&T State University

[9] G. Vamsi Krishna. An Integrated Approach for Weather Forecasting based on Data Mining and Forecasting Analysis. International Journal of Computer Applications (0975 – 8887) Volume 120 – No.11, June 2015

[10] Nienke Adegeest. The Dynamics of Fashion Trend Forecasting Amsterdam Fashion Institute – International Fashion & Management – 2016

[11] http://mech.at.ua/Forecasting.pdf

[12] https://www.slideshare.net/knksmart/forecasting-slides

[13] http://www.threadpunter.com/supply-chain-management/quantitative-methods/

[14] https://www.bistasolutions.com/resources/blogs/5-statistical-methods-for-forecasting-quantitative-time-series/