Chapter – III

SALES FORECASTING

3.1 OVERVIEW OF SALES FORECASTING PROCESS

Ideally the sales forecasting process needs different kinds of information from different departments. This could be done by integrating different departments by means of common information system. The business functions of departments like production, sales, purchasing, planning, finance and logistics, supply chain department are different ones, the strategies used by them also differ. While integrating the functions, all the departments share their information on a central information system which is joined with central database warehouse. As all functions work towards the same target, sharing information facilitates productive work. Coordination can be achieved by a central information system. Furthermore sales forecasting also runs on information like marketing, sales, production planning and logistics. All departments need the sales forecasting to plan their activities effectively. Integration of coordination may be the best way to achieve integrated and interactive forecast. The managers at the different functional areas will make the decisions using the data available in the central repository. The various decisions that are to be taken by the managers and the needs of the decisions at various functional areas are shown in the table 3.1

Table 3.1

Sales forecasting need in different managerial functions

	Marketing	Sales	Finance/ Accounting	Production/ Purchasing	Logistics
Needs	Annual plans(updated monthly or quarterly) for new and existing products or product changes, promotional efforts, channel placement, and pricing	Identifying the sales target for the sales Force.	Projecting cost and profit levels and capital needs	Planning the development of plant and equipment	Planning the development of storage facilities and transportation Equipment. .Specific decisions of what products to move to what locations and when
Level	Product or product line	Territory	Corporate, division, product line	Strategic unit	Strategic unit
Horizon	Annual	1–2 years	1–5 years	1–3 years	Daily, weekly, Monthly and Yearly
Interval	Monthly or quarterly	Monthly or Quarterly	Monthly or quarterly	Quarterly	Daily, weekly and Monthly
Form	Dollars	Dollars Dollars	Dollars	Units	Units/Weight/Volume

The activities that can be forecast in the area of marketing are annual plans, product changes, promotional changes, channel placement and pricing; in the area of sales, identifying the sales target for the sales force; and in the area of finance, accounting projects the cost and profit needs and the capital needs; in the area of production and purchasing are planning the development of plant and equipment; and finally in the area of logistics and planning the development of storage facilities and transportation and equipment and specific decisions of what product to move to what location. In order to predict and take the decisions in different functional areas different forecasting techniques can be used which are discussed later in this chapter.

3.2 IMPACT OF SCM ON SALES FORECASTING

Supply chain is driven by customer needs. In order to ship products to customers who demand them in a dynamic and rapidly changing set of channels, strategic planning of the inventories becomes essential. The model products are available when the customer wants them. Smooth supply chain management is the result of well combined individual managerial functions like planning, organizing and controlling. They are important factors for effective supply chain management[1]. An exact estimation and reliable predictions of product volume and related services are therefore important for efficient functioning; and such estimations are nothing but forecasts. Demand / Sales forecasting is a crucial factor to any firm. It is a basic factor for the whole planning process and for the control of various sectors of a company such as production, supply, purchasing, marketing and finance. Decisions made in these sectors influence each

[1] Sean A. Murphy, "Supply chain 2010: Building on the lessons learned", Supply chain management review, December 2009, Pp: 1-9.

other either directly or indirectly. Variability in product demand influences several factors which are coming under these sectors such as inventory needed for production (Production department), capital needs (Finance department) or special kind of strategies like outsourcing (Supply department). Forecasting is necessary for a variety of decisions, strategic decisions involving such things as constructing a new plant, developing more supplier capacity, expanding internationally, and other long-run company wide considerations. Forecasts for this type of decisions are highly aggregated estimates of general business trends over the long term. A framework for some of the differences is provided in the table 3.2[2].

Table 3.2

A framework for forecasting

Nature of the decisions	**Strategic business**	**Sales and operation planning**	**Master production scheduling and control**
Level of aggregation	Total sales or output Volume	Product family units	Individual finishing goods and components
Top management involvement	Intensive	When reconciling functional plan	Very little
Forecast Frequency	Annual or less	Monthly or Quarterly	Constantly
Management investment in the forecasts	Very large	Moderate	Minimal
Cost of data processing and acquisition	High	Moderate	Minimal
Useful techniques	Management judgment, economic growth models	Aggregation of detailed forecasts, customer plans	Projection techniques (moving averages, exponential smoothing)

[2] Fliedner G, "Hierarchial forecasting: Issues and use guidelines", Industrial management and data systems, 101(1), pp: 5-12.

The general principle indicated here is that the nature of the forecast must be matched with the nature of the decision. The level of aggregation, the amount of management review, the cost, and the time frame of the forecast needed really depends on the nature of the decisions being made[3]. Moreover, the source of the forecast can vary by need as well, as indicated by the useful techniques in the above table 3.2. The frequency and the number of forecasts made in the need for most short term operating decisions don't warrant extensive management involvement, so computer-generated forecasts are utilized. Strategic decisions, on the other hand, are less frequent and involve more risk, thus justifying the use of more expensive procedures and management involvement[4].

3.3 REASONS FOR UNDERTAKING SALES FORECASTS

Businesses are forced to look well ahead in order to plan their investments, launch new products, decide when to close or withdraw products and so on. The sales forecasting process is a critical one for most businesses and the critical areas where sales forecasting is necessary in a company are discussed in the following section.

3.3.1 Sales forecasting need in Planning

Manufacturing industries work on principle to satisfy customer demand by appropriate supply. According to Mentzer and Moon (2005), companies consider the sales forecasting as integral part of this process. End customers create demand and it can be increased by activities like

[3] Thomas E. Vollmann, William L.Berry, D. Clay Whybark and F.Robert Jacobs, Manufacturing planning and control systems for supply chain management, McGrawhill, Fifth edition.

[4] Ulrich Kusters, B.D. McCullough, Micheal Bell, "Forecasting software: past,present and future", International journal of forecasting, 2006,Pp: 1-17.

promotions. Hence marketing focuses on end customers for creating demand. To meet this created demand supply should be sufficient and smooth. Different management functions like manufacturing, purchasing and logistics work together to maintain the supply. Different suppliers also play an important role in this chain. A constant flow of information runs through the complex structure of different management functions and the parties involved in this. According to Mentzer and Moon, (2005) this flow starts with demand and ends with supply functions. This flow of information is managed by sales and operational process (S&OP). Sales forecasting serves as the initial seeding to the S&OP process. The forecasting may originate from a study of past demand history. As the marketing function originates and manages the demand toward final customer, the necessity of sales forecasting arises from the demand side. Based on the sales forecasting, supply side prepares the capacity plan. The capacity plan is nothing but the capabilities to satisfy demand using maximum possible inputs via information net both forecasting and capacity plans studied out to consider strategies. Mentzer and Moon, (2005) describe two major plans in this process, operation plan and demand plan respectively. Considering different information collected from time to time and strategies undertaken, the demand plans are given out from S & OP system. The demand plans make marketing and supply departments understand future product launching and action needed to achieve corporate strategies. Based on the information available; the operation plan is given out from S&OP to supply functions. This plan consists of different functional plans. Smooth running of S&OP needs accurate forecasting. Continuing with Mentzer's S&OP model, Armstrong (1983), shows how forecasting process is correlated to formal planning. Planning is a set of activities in company. Planning decides goals and action is taken accordingly. Wood, Robley (1980), Ven and Andrew (1980), Armstrong

(1983) describe four steps in planning: 1) specify objectives; 2) generate strategies; 3) evaluate strategies and take actions accordingly; 4) monitor results. Commitment towards the basic goal is a key towards success. But still the accurate forecast plays a major role in successful planning and achieving of the final goal. One needs to understand the difference between planning and forecasting. According to Armstrong (1983), forecasting is the process to give estimates and planning is the process to prepare strategies based on these estimates.

3.3.2 Sales forecasting need in financial planning

Forecasting and planning are essential to good decision making, as a result financial manger has to use history oriented financial statement with a suitable model. One of the model that is followed is Francis-Rowell(FR) model. The objective of this model is to generate pro forma financial statements that describes the future financial condition of the firm for any assumed pattern of sales. The FR model is composed of ten sectors they are 1) Industry sales 2) Production sector 3) Fixed capital stock requirements 4) Pricing 5) Production costs 6) Income 7) New financing required 8) Risks 9) Costs of financing and 10) Commong stock valuation[5].

3.3.3 Sales forecasting need in production /purchasing

The production and the aggregate planning are closely related with demand forecasting. According to Mentzer and Moon (2005) both long and short term forecasting are commonly used in production and planning. When production planning of selected product range; related functions like

[5] Jack clark farncis and Dexter R.Rowell, A simultaneous equation model of the firm for financial analysis and planning, Financial management, Spring 1978.

selection of right supplier, developing relations with supplier and planning the cost structure of manufacturing plant are important. It can take many years to set the whole process and hence the long term forecasting is important. Plans are dependent on future sale of products which will be produced and marketed. During short term forecasting, the production plans depend on purchasing forecast. Wisner and Stanley (1994), indicate that forecasting and purchasing are closely related. It reveals the importance of forecasting in the process of preparation of master purchase plan. Purchasing action includes time lags due to shipping and logistic action from suppliers and hence purchasing department needs to know the forecasting for planning so that no stockout will occur. This helps in smooth production without stockouts.

3.3.4 Sales forecasting need in logistics

The logistic department is considered responsible for both storage and distribution toward the destination from site of storage of produced goods. Therefore logistics department needs forecast. Both short and long term forecasts are needed while planning. Long term planning is needed to decide storage capacity of warehouse and services together. Transportation services are also needed to be considered while this is being planned. Based upon the production plan, logistic department prepares own service plan and hence forecasting plays an important role in logistics planning. On urgent basis and for small SKUs, the short term forecasting comes into picture. This planning ranges from daily (in some severe conditions) to weeks or months based on orders. Usually companies either purchase specialized logistic facilities from third party logistic providers or prepare them on their own. While purchasing or renting such facilities, company should know the characteristics of services needed. This can be known

from the production forecast.

3.3.5 Sales forecasting need in Marketing

The marketing success is based on capability of company to satisfy customer demand and needs. Conditions like stockouts and low innovativeness may decrease demand and loss of sales can occur[6]. Considering this principle a company plans its activities. Marketing plans are based on current demand, derived demand, competitors pricing and different promotions. To yield from marketing plan, knowledge of the forecasting is needed. Normally annual levels could be considered and intervals can be either monthly or quarterly, depending on the product.

3.4 FACTORS FOR SELECTING THE FORECASTING MODEL

There are two major types of forecasting, which can be broadly described as macro and micro: Macro forecasting is concerned with forecasting markets in total. This is about determining the existing level of market demand and considering what will happen to market demand in the future. Micro forecasting is concerned with detailed unit sales forecasts. This is about determining a product's market share in a particular industry and considering what will happen to that market share in the future. The selection of which type of forecasting and the forecasting accuracy depend on several factors:

[6] Marshall Fisher, Kumar Rajaram, Accurate retail testing of fashion merchandise: Methodology and application, Marketing science, Vol.19, No.3, 2000, Pp: 266-278.

3.4.1 Time Horizon

Most researchers agree that the longer the time horizon, the less accurate the forecast. However, most of the researchers disagree on which method to choose for a given time horizon. However Armstrong contends that simple econometric models are superior for long range forecasts. Chambers, Mullick and Smith[7] argue that simple growth curves are also an accurate means of generating long term forecasts, whereas short term forecasts are provided by time series methods.

3.4.2 Data availability

Some researchers say that more accurate forecasts are possible when a greater amount of data is available[8]. However Markridakis and Hibson found no support for this contention in the series they studied. Possibly longer data series are more likely to involve changes in the underlying forces affecting the series that "confuse" a forecasting method and result in a loss of accuracy.

3.4.3 Type of product

Most of the authors agree that one of the key factors affecting forecast accuracy is the historical stability of a series. Forecasts of unstable series are inaccurate. Stability can be measured in many ways, most simple is judgemental assessment derived from an inspection of a scatter diagram of historical sales. More formal methods of assessing stability are also available, including autocorrelation and "runs" analysis.

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[7] Armstrong J.Scott(1978), Long range forcasting, New York: John Wiley & Sons Inc.
[8] Chambers J.C., S.K. Mullick and D.D. Smith(1971), How to choose right forecasting technique, Harvard Business review, 49(July-August), 45-71.

Sales series also can be classified according to whether they represent sales of durable or non durable goods. Previous studies have not considered this factor, but it is unclear which type of series is more amenable for extrapolation forecasts. However durable goods are subject to volatility and erractic pattern of demand.

3.4.4 The time horizon that the sales forecast is intended to cover

Forecasting next weeks' sales or trying to forecast what will happen to the overall size of the market in the next five years.

3.4.5 The position of the products in its life cycle.

Forecasting products at the "introductory" stage of the product life cycle, less sales data and information may be available for products at the "maturity" stage when time series can be a useful forecasting method.

3.5 CREATING THE SALES FORECAST FOR A PRODUCT

The first stage in creating the sales forecast is to estimate market demand for a product that is estimating the total volume that would be bought by a defined customer group, in a defined geographical area, in a defined time period, in a given marketing environment. This is sometimes referred to as the Market Demand Curve. For example, consider the UK Overseas Mass Market Package Holiday Industry. Market demand from the above definition is Customer Group : Customers Who Buy an Air-Inclusive Package Holiday. Geographical Area: Customers in the UK. Defined Time Period : A calendar year. Defined Marketing Environment : Strong customer spending in the UK but overseas holidays affected by

concerns over international terrorism. Recent data for the UK Overseas Mass Market Package Holiday market suggests that market demand can be calculated as follows: Number of Customers in the UK: 17.5 million per calendar year, Average Selling Price per Holiday: £450. Estimate of market demand: £7.9 billion (customers x average price).

The second stage in the forecast is to estimate company demand. Company demand is the company's share of market demand. This can be expressed as a formula:

Company Demand = Market Demand x Company's Market Share.

--- Equation 3.1

For example, taking our package holiday market example, the company demand for First Choice Holidays in this market can be calculated as follows: First Choice Holidays Demand = £7.9 billion x 15% Market Share = £1.2 billion. A company's share of market demand depends on how its products, services, prices, brands and so on are perceived relative to the competitors. All other things being equal, the company's market share will depend on the size and effectiveness of its marketing spending relative to competitors[9].

The third stage is then to develop the Sales Forecast. The Sales Forecast is the expected level of company sales based on a chosen marketing plan and an assumed marketing environment. Note that the Sales Forecast is not necessarily the same as a "sales target" or a "sales budget". A sales target (or goal) is set for the sales force as a way of defining and encouraging sales effort. Sales targets are often set some way higher than

[9] Dalrymple, Douglas J, "Sales forecasting methods and accuracy", Business Horizon, December, Pp: 69-73.

estimated sales to "stretch" the efforts of the sales force. A sales budget is a more conservative estimate of the expected volume of sales. It is primarily used for making current purchasing, production and cash-flow decisions. Sales budgets need to take into account the risks involved in sales forecasting. They are, therefore, generally set lower than the sales forecast.

3.5.1 Obtaining information on existing market demand

As a starting point for estimating market demand, a company needs to know the actual industry sales taking place in the market. This involves identifying its competitors and estimating their sales. An industry trade association will often collect and publish (sometime only to members) total industry sales, although rarely listing individual company sales separately. By using this information, each company can evaluate its performance against the whole market. This is an important piece of analysis. Say, for example, that Company A has sales that are rising at 10% per year. However, it finds out that overall industry sales are rising by 15% per year. This must mean that Company A is losing market share – its relative standing in the industry. Another way to estimate sales is to buy reports from a marketing research firm such as AC Neilsen, Mintel etc. These are usually good sources of information for consumer markets – where retail sales can be tracked in great detail at the point of sale. Such sources are less useful in industrial markets which usually rely on distributors.

3.5.2 Estimating Future Demand

Standard marketing theory says that end user demand arises from a matching of customer needs by companies and their products[10]. At the aggregate level, such need satisfaction is measured by the factors of the

[10] Dominique M. Hanssens, Order forecasts, Retail sales and the marketing mix for consumer durables, Journal of forecasting, Vol.17, Pp. 327-346.

market and company that is making the product available to the right audience at the right price and with value proposition.

Sales = F[Price, Competitors price, Supply] ---- Equation 3.2

Price measures the demand curve, which is expected to be fairly steep in a competitive market for consumer durables. The sales vary as the price vary, similarly sales vary with other factors like competitors price, supply etc.,

A common method of preparing a sales forecast has three stages:

(1) Prepare a macroeconomic forecast – That happens to overall economic activity in the relevant economies in which a product is to be sold.

(2) Prepare an industry sales forecast – That happens to overall sales in an industry based on the issues that influence the macroeconomic forecast;

(3) Prepare a company sales forecast – based on management expects to happen to the company's market share. Sales forecasts can be based on three types of information:

   a. Customers, intentions to continue buying products in the industry
   b. Customers actually doing in the market
   c. Customers, intentions in the past about the market

There are many market research businesses that undertake surveys of customer intentions and sell this information to businesses that need the data for sales forecasting purposes. The value of a customer intention survey increases when there are a relatively small number of customers, the cost of reaching them is small, and they have clear intentions. An alternative way of measuring customer intentions is to sample the opinions of the sales force or to consult industry experts

3.6 FORECASTING METHODS AND TECHNIQUES

The ability to model and perform decision modelling and analysis is an essential feature of many real-world applications ranging from emergency medical treatment in intensive care units to military command and control systems. Existing formalisms and methods of inference have not been effective in real-time applications where tradeoffs between decision quality and computational tractability are essential. In practice, an effective approach to time-critical dynamic decision modelling should provide explicit support for the modelling of temporal processes and for dealing with decisions[11]. Almost all managerial decisions are based on forecasts. Every decision becomes operational at some point in the future. So it should be based on forecasts of future conditions. Forecasts are needed throughout an organization -- and they should certainly not be produced by an isolated group of forecasters. Neither is forecasting ever "finished". Forecasts are needed continually, and as time moves on, the impact of the forecasts on actual performance is measured; original forecasts are updated; and decisions are modified, and so on. For example, many inventory systems cater to uncertain demand. The inventory parameters in these systems require estimates of the demand and forecast error distributions. The two stages of these systems, forecasting and inventory control, are often examined independently. Most studies tend to look at demand forecasting as if this were an end in itself, or at stock control models as if there were no preceding stages of computation. Nevertheless, it is important to understand the interaction between demand forecasting and inventory control since this influences the performance of the inventory system.

[11] Brian P.Mathews, A. Diamantopolous, Judgemental revision of sales forecasts: Effectiveness of forecast selection, Journal of forecasting, vol.9, Pp: 407-415(1990).

The decision-maker uses forecasting models to assist in decision-making process. The decision-making often uses the modeling process to investigate the impact of different courses of action retrospectively; that is, "as if" the decision has already been made under a course of action. That is why the sequence of steps in the modeling process. For example, the output (which is the result of the action) must be considered first. It is helpful to break the components of decision making into three groups: Uncontrollable, Controllable, and Resources (that defines the problem situation). Different decision making models are to be used by the forecaster to predict the future, using the uncontrollable, controllable and resources.

Forecasting is a prediction of what will occur in the future, and it is an uncertain process. Because of the uncertainty, the accuracy of a forecast is as important as the outcome predicted by the forecast. A number of standardized methods for forecasting are available. They differ in terms of the relative accuracy in forecasting over the long run versus the short run, the level of quantitative sophistication used, and the logic base (historical data, expert opinion or surveys) from which the forecast is derived. Those methods could be categorized into three different groups: historical or time series, qualitative, and casual.

3.6.1 Historical or Time series methods

Time series analysis provides an ideal solution to the problem of serially correlated data. The advantage of time series modeling over the other econometric methods of obtaining forecasts has been demonstrated.

Geurts and Ibrahim[12] in their most recent work in time series modeling followed the box-jenkins method whereby seasonality in data is accounted for by using stochastic difference operator of the form. However, the use of this operator may be ineffective or even inappropriate in certain situations, especially those cases in which the seasonality in the data is not homogeneous[13].

According to Mentzer (2003), it is not possible to forecast every product with the same time series technique and that is why different time series technique for each product are needed. He also pointed out that there are many techniques available in the general category of time series analysis. Time series techniques have common characteristics and endogenous techniques. It means that time series technique looks at the patterns of the history of actual sales (or the series of sales through time- thus, the term time series). These patterns can be identified and projected to derive forecast. Time series techniques looks only on patterns that are the parts of the actual history. Despite which time series technique used they are all examined by four basic time series patterns: level, trend, seasonality and noise.

3.6.2 Time series analysis

Many businesses prepare their sales forecast on the basis of past sales. Time series analysis involves breaking past sales down into four components:

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[12] Guerts M.D. and I.B. Ibrahim(1971), " Comparing the box-jenkins approach with the exponentially smoothed forecasting model with an application to howai tourists,Journal of marketing research, 12(May),Pp.182-187

[13] S.G. Kapoor, P.Madhokm and S.M. Wu. Modelling and forecasting sales data by time series analysis, Journal of marketing research, Vol. XVIII(February 1981),94-100.

1) The trend: Trend means sales are growing, Here the attention is restricted to forecasting a time series that demonstrate linear trend. The model for such a time series is

$$Yt = \beta o + \beta t + \epsilon t \quad \text{---} \quad \text{Equation 3.3}$$

In this model the βo represents the y-intercept and βt the slope of the time series εt is the random error term in time t. If the p value is calculated, using the formula from the Excel sheet small(less than alpha) it can be concluded that a linear trend model is appropriate.

2) Seasonal or cyclical factors: Sales are affected by swings in general economic activity (e.g. increases in the disposable income of consumers may lead to increase in sales for products in a particular industry). Seasonal and cyclical factors occur in a regular pattern. Such variations principally arise due to calendar, climatic or economic factors. When these patterns can be anticipated, they should be accounted for in the forecasting model in order to improve the accuracy of the forecasts. Two models account for trend, seasonal and cyclical variations. They are additive model and multiplicative model.

Additive model

$$Yt = Tt + St + Ct + Et \quad \text{----} \quad \text{Equation 3.4}$$

Multiplicative model

$$Yt = TtStCtEt \quad \text{----} \quad \text{Equation 3.5}$$

In these models

Yt = The time series value at time t

Tt = The trend component of the time series at time t

St = The seasonal component of the time series at time t.

Ct = The cyclical component of the time series at time t.

Et = The random error component of the time series at time t.

The major difference between the two models is how one views the effect of the cyclical and seasonal variations on trend. An additive model is more appropriate when the seasonal and cyclical variations do not change in proportion to the time series values, whereas a multiplicative model is more appropriate if they do. For example when the electric consumption is cyclical then it uses additive model, but when the cost of the electricity varies depending on the price then it uses multiplicative model.

3.6.3 Qualitative methods

According to Ballou (2004), qualitative method is primarily subjective; they rely on human judgments, intuition, surveys or comparative techniques to produce qualitative estimates about the future. The information related to factors are non qualitative and subjective. Historical data may not be available for the forecast and this non scientific nature makes it difficult to standardize and validate for accuracy. However, such method may be necessary to predict the success of new products, government policy changes or the impact of new technology. Initially, forecasts of demand on the internet were often made using qualitative methods as the internet had little historical data on which to base forecast. These methods are of choice for medium to long range forecasting. Since qualitative method is based on human judgments, intuition, surveys or comparative techniques, the Delphi method is important to mention.

Delphi method is used within the company and it is based on prediction of mid to long-term industry sales levels. By using this technique a company can bring virtual jury of executive opinion, because they do not meet face to face. The aim of this distance is to allow every member the use of his or her reasoning to develop a forecast without the influence of strong personalities. According to Mentzer (2003) Delphi method is used for

forecasting, the input of experts, either internal or external to a company, it proceeds as follows:

1. A panel of expertise from different departments of the company should write answer to the question being investigated about forecast for product or sales as well as all the reasoning behind this forecast. (Mentzer, 2003)

2. The answers of the panel should be summarized and returned to the members of the panel without any identification of which expert came up with which forecast. (Mentzer, 2003)

3. After receiving the summary of replies, each person of the panel either maintains his or her forecast or re-evaluates the first forecast and submits the new forecast as well as the reasoning behind changing forecast in writing. (Mentzer, 2003)

Sales force composite: Mentzer (2003) discusses another qualitative forecasting method that uses the knowledge and experience of a company's salespeople, management and other channel members who make sales forecasts. In this approach sales force team accumulates sales forecasts for the particular regions, products and also customers of individual salespeople. Via help of independent distributor, sales people make forecast for every separate product of the company.

Casual Methods

Chopra and Meindl (2001) point out that the demand forecast is highly connected with the different factors in the environment. For example, the state of the economy and interest rate. This method is correlated between demand and environment and used to estimate which environmental factors will be used to forecast future demand. As an

example they said that pricing of product is strongly correlated with demand and companies can use casual method to decide the impact of price promotions on demand. Ballou(2004) describes that casual models come in a variety of forms: statistical, in the case of regression and economic models; and descriptive, as in the case of input-output, life cycle and computer simulation models. All those models derive their validity from historical data patterns that establish the association between the predicting variables and the variable to be forecast. The problem with this forecasting model is that it is difficult to find truly casual variables for forecasting. Casual variables which lead the forecasted variable in time are even more difficult to find. (Ballou, 2004)

3.7 Combine method or Simulation forecasting

According to Chopra and Meindl (2001), a firm can combine casual methods and time series method to answer question like a) the impact of price promotion b) Impact of competitor opening the store nearby Basically it is difficult to decide exact forecasting method and other studies shows that combination of different methods or using multiple forecasting methods is more effective for forecast (Chopra & Meindl, 2001). The selection of the best forecasting method for one particular situation is not an easy task and that is why sometimes more than one method may be appropriate. To provide guidance, Armstrong[14] (2001c) used the findings to develop a flow chart to aid the selection of the most appropriate forecasting method for particular situation. The first issue that the analyst needs is to find how many data points are available. If not, judgmental procedures are used. For judgmental procedures, issues are whether the situation involves interaction among decision makers and whether large

[14] Armstrong J.Scott(1978), Long range forecasting, New York: John Wiley & Sons Inc.

changes are involved. For large changes, is policy analysis involved, and if it is, what is the best source of evidence?

There are common techniques in evaluating and assessing forecasting[15]: Moving averages, Time series analysis and Exponential smoothing. The techniques are simple mathematical means for converting past information into forecasts[16]. The procedure is often called statistical forecasting models and can easily be incorporated into demand management activities.

There was no one model that consistently outperformed all the others for all series and one conclusion was very clear: simple methods do better than more sophisticated models for detailed forecasts, especially over short periods, some of the forecasting models are discussed below.

3.7.1 Moving average forecasting

Moving average and exponential smoothing forecasting are both concerned with averaging past demand to project a forecast for future demand. This implies the underlying demand pattern, at least for the next few days or weeks, is constant with random fluctuations above the average. Thus the objective is to smooth out the random fluctuations while being sensitive to any possible changes that may be taking place with the underlying average.

The moving average model for smoothing historical demand proceeds, as the name implies, by averaging a selected number of past

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[15]Manufacturing planning and control systems for supply chain management(fifth edition) by Thomas E.Vollmann, Willaim L. Berry, D. Clay Whybark, F. Robert Jacobs, Pp: 29- 35.

[16] Borkov K.Elements of stochastic modelling, world scientific publishing, 2003. Christoffersen P., Elements of financial risk management, academic press, 2003. Holton g., Value-at-risk: Theory and practice, academic press, 2003.

periods of data. The average moves because a new average can be calculated whenever a new periods demand is determined. Whenever a forecast is needed, the most recent past history of demand is used to do the averaging. The following equation shows the model for finding the moving average. The equation shows the moving average forecast always uses the most recent n periods of historical information available for developing the forecast. X-period moving average forecast at the end of period t+1 is

$$F_{t+1} = (Y_t + Y_{t-1} + Y_{t-2} + Y_{t-3})/4 \quad \text{---} \quad \text{Equation 3.6}$$

3.7.2 Exponential smoothing forecasting

The exponential smoothing model for forecasting doesn't eliminate any past information, but so adjusts the weights given to past data that older data get increasingly less weight hence the name exponential smoothing[17]. The basic idea is a fairly simple one and has a great deal of institutive appeal[18]. Each new forecast is based on an average that's adjusted each time whenever there is a new forecast error. For example, if we forecast 90 units of demand for an item in a particular period and that item's actual demand turns out to be 100 units, an appealing idea would be to increase our forecast by some portion of the 10-unit error in making the next period's forecast. In this way, if the error indicated demand was changing, this would begin to change by random variations around the mean.

[17] William L. Berry and Friedhelm W. Bliemel. Selecting exponential smoothing constants: An application of pattern search, International journal of production, 1974, Vol.12, No.4, Pp: 483-499.

[18] Brown R.G, Smoothing forecasting and predictions of discrete time series, Eglewood cliffs, New jersey, Printice hall inc, 1965.

The proportion of error that will be incorporated into the forecast is called the exponential smoothing constant and is identified as alpha. The model for computing the new average appears in the equation as described in it. The following equation gives the most common exponentially smoothed average which is again the forecast for the next and subsequent periods[19]. The idea behind exponential smoothing is to reduce the random effects associated with an individual point of the time series by calculating a smoothed value that in some sense is more representative of the period. This smoothed value, Lt, is generated using a weighted average of the actual value for the time period Yt, and the forecast value for the period Ft. This smoothed value, Lt, becomes the forecast for the next time period, t+1 that is Ft+1= Lt. The weight given to the current period's actual value, Yt, denoted by α, is called the smoothing constant. Thus the weight given to the current periods forecast value Ft, is (1-α), which excel calls the damping factor. The forecast for the period t+1 is then given by the recursive relationship[20].

$$F_{t+1} = L_t = \alpha Y_t + (1-\alpha) F_t \quad \text{----- Equation 3.7}$$

Where

α = The smoothing constant

T = Current period (the period for which the most recent actual demand is known)

F_{t+1} = Exponential smoothing forecast made one period previously (at the end of period t-1)

Since (1-α) is a fraction, the weight given to past terms decrease as

[19] Winters P.R, Forecasting sales by exponentially weighted moving average, Management science, vol.6, P.324.

[20] Geffrion A.M, A Summary exponential smoothing, Indsutrial engineering journal, vol.13, p.223.

they become more distant from the present. The forecasts generated from exponential smoothing depend on the modelers, choice for the smoothing constant α. When α is large, greater weight is given to the current periods, actual value, so the forecast tracks changes in the time series quite rapidly. When α is small, less weight is given to the current periods, actual value, resulting in relatively small changes in the forecast, hence the forecast track time series change quite slowly.

3.7.3 Relative strength index

A technical momentum indicator that compares the magnitude of recent gains to recent losses is an attempt to determine oversold and undersold conditions of an asset. It is calculated using the following formula:

$$RSI = 100 - 100/(1+RS) \text{ --- Equation 3.8}$$

RS is the average of x days up closes and the average of x days down closes

3.7.4 Rate of change

Rate at which variable changes over a specific period of time can also be expressed as a ratio between a change in one variable relative to a corresponding change in the other. Graphically, rate of change is represented by a slope of line.

$$\text{Rate of change} = Vi / (Vi - n) * 100 \text{ --- Equation 3.9}$$

Vi = Value today

$Vi\text{-}n$ = Value n days ago

3.8 SELECTING THE RIGHT FORECASTING MODEL

The selection and implementation of the proper forecast methodology has always been an important planning and control issue for most firms and agencies[21]. Often, the financial well-being of the entire operation rely on the accuracy of the forecast since such information relies likely to be used to make interrelated budgetary and operative decisions in areas of personnel management, purchasing, marketing and advertising, capital financing, etc. For example, any significant over-or-under sales forecast error may cause the firm to be overly burdened with excess inventory carrying costs or else create lost sales revenue through unanticipated item shortages. When demand is fairly stable, e.g., unchanging or else growing or declining at a known constant rate, making an accurate forecast is less difficult. If, on the other hand, the firm has historically experienced an up-and-down sales pattern, then the complexity of the forecasting task is compounded. There are two main approaches to forecasting. Either the estimate of future value is based on an analysis of factors which are believed to influence future values, i.e., the explanatory method, or else the prediction is based on an inferred study of past general data behavior over time, i.e., the extrapolation method. For example, the belief that the sale of doll clothing will increase from current levels because of a recent advertising blitz rather than proximity to Christmas illustrates the difference between the two philosophies. It is possible that both approaches will lead to the creation of accurate and useful forecasts, but it must be remembered that, even for a modest degree of desired accuracy, the forecasting model has to be accurately chosen.

[21]Borovkov K., Elements of Stochastic Modeling, World Scientific Publishing, 2003.Christoffersen P., Elements of Financial Risk Management, Academic Press, 2003.Holton G., Value-at-Risk: Theory and Practice, Academic Press, 2003

3.8.1 Performance Measures for Forecasting

If the forecast error is stable, then the distribution of it is approximately normal. With this in mind, sales data can be plotted and then analyzed on the control charts to see if there might be a need to revise the forecasting method being used. To do this, if we divide a normal distribution into zones, with each zone one standard deviation wide, then one obtains the approximate percentage expected to find in each zone from a stable process.

3.8.2 Modeling for Forecasting with Accuracy and Validation Assessments:

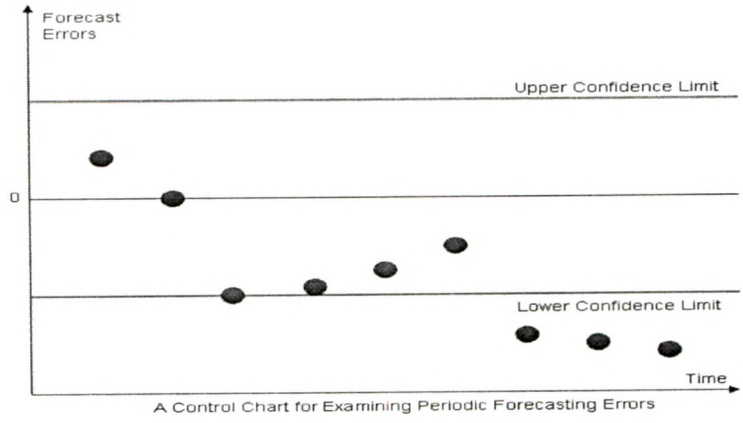
It is stressed repeatedly that good forecasts lead to good decisions in supply chain. The importance of forecast evolution and combination techniques follows immediately. If the forecast is unbiased, then the forecast error has a zero mean. A variety of tests of the zero mean hypothesis can be performed, depending on the assumtions. In practice, it is unlikely that there will ever be fully optimized forecast: instead, situations often arise in which a number of forecasts are composed and possibly combined. Even for very good forecasts, the actual and forecast values may be very different. This highlights the inherent limits to forecastability, which depends on the process being forecast: some processes are: inherently easy to forecast, while others are hard to forecast. In other words sometimes the information on which the forecaster conditions is very valuable, and sometimes it is not.

The crucial object in measuring forecast accuracy is the loss function associated with various pairs of forecast and realizations[22]. In addition to the shape of the loss function, the forecast horizon is of crucial importance. There are few techniques for measuring the errors which are discussed below.

Control limits could be one-standard-error, or two-standard-error, and any point beyond these limits (i.e., outside of the error control limit) is an indication of the need to revise the forecasting process, as shown below:

Figure – 3.1

A Zone on a Control Chart for Controlling Forecasting Errors



A Control Chart for Examining Periodic Forecasting Errors

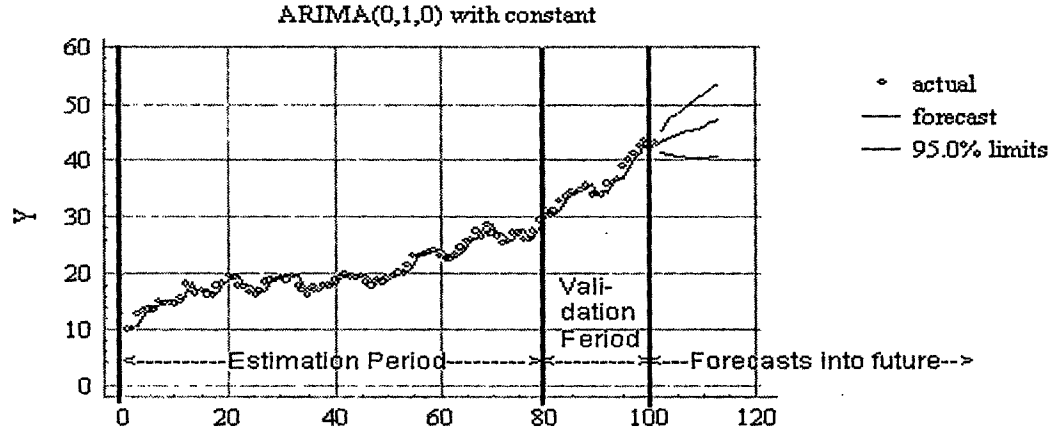
The plotted forecast errors on this chart, not only should remain within the control limits, they should not show any obvious pattern, collectively. Since validation is used for the purpose of establishing a model's credibility it is important that the method used for the validation is, itself, credible. Features of time series, which might be revealed by examining the above graph, with the forecasted values, and the residuals

[22] Diebold F.X. and Lopez. J (1996), "Forecasting evaluation and combination", In G.S. Maddala and C.R. Rao, Handbook of statistics, Amsterdam : North Hollad, 241-268.

behavior, condition forecasting modeling. An effective approach to modeling forecasting validation is to hold out a specific number of data points for estimation validation (i.e., estimation period), and a specific number of data points for forecasting accuracy (i.e., validation period). The data, which are not held out, are used to estimate the parameters of the model, the model is then tested on data in the validation period, if the results are satisfactory, and forecasts are then generated beyond the end of the estimation and validation periods. As an illustrative example, the following graph depicts the above process on a set of data with trend component only: Estimation Period, Validation Period, and the Forecasts.

Figure - 3.2

Time Sequence Plot of Y



In general, the data in the estimation period are used to help select the model and to estimate its parameters. Forecasts into the future are "real" forecasts that are made for time periods beyond the end of the available data. The data in the validation period are held out during parameter estimation. One might also withhold these values during the forecasting analysis after model selection, and then one-step-ahead

forecasts are made. A good model should have small error measures in both the estimation and validation periods, compared to other models, and its validation period statistics should be similar to its own estimation period statistics. Holding data out for validation purposes is probably the single most important diagnostic test of a model: it gives the best indication of the accuracy that can be expected when forecasting the future. It is a rule-of-thumb that one should hold out at least 20% of data for validation purposes.

Another commonly used approach for performance of forecasting technique is to select a forecasting technique for which historic forecast error for time period t, denoted as t, is the difference between the actual value of the time series for the period yt, and the value that would have been forecasted for the period using a particular forecasting approach, Ft that is

$$T = Yt - Ft \quad \text{-- Euation 3.10}$$

Other most popular measures used to evaluate forecast errors are the mean squared error (MSE), the mean absolute deviation(MAD), the mean absolute percent error(MAPE), and the largest absolute deviation(LAD), in the mean squared error approach, the squares of the T values are averaged[23], while in the mean absolute deviation approach the absolute values for T are averaged.

In the mean absolute percent error approach, the absolute values for are divided by the corresponding actual values, Yt; these values are then

[23] Fourt Louis A and Joseph W.Woodlock, "Early prediction of market share success for grocery products", Journal of marketing , 25(October 1960), 31-38.

multiplied by 100% to give the absolute percentage the forecast varies from the actual value. Averaging these percentages gives the MAPE. To find the largest absolute deviation, simply find the largest of the absolute values. These four measures are summarized in the following

Table 3.3

Methods for evaluating forecasting errors

Measure	Description
Mean Squared error(MSE)	Averages the squared difference of the forecast values from the actual values
Mean absolute deviation(MAD)	Averages the absolute values of the differences of the forecast values from the actual values
Mean absolute percent error (MAPE)	Averages the absolute percentage differences of the forecast values from the actual values
Largest absolute deviation(LAD)	Finds the largest absolute difference between the forecast and the actual values

The forecasting approach with the lowest MSE, MAD, MAPE or LAD is the best one for that corresponding measure of performance. If one forecasting approach is superior to the others using all four of the measures, clearly this approach is most reliable for forecasting future values. It is possible, however that one forecasting approach may have the lowest value using another criterion. Therefore, it is important to know which performance measure to use to evaluate the forecasting approach.

Both the MSE and the MAD performance measure look at the total magnitude of the forecast error. The MSE approach gives greater weight to

larger deviations, however, since the forecast errors are squared in calculating this total. Thus the MSE is preferred over the MAD when the modeler wishes to give larger forecast errors proportionately more weight than small errors[24].

In contrast to the MSE and MAD, the MAPE considers the forecast errors relative to the corresponding values of the time series value may count less than small error based on a small time series value. The MAPE performance measure is generally used when the values of the time series show wide variations.

While the MSE, MAD and MAPE performance measures consider all forecast error in their calculations, the LAD performance measure is determined by the single largest absolute deviation. Therefore it is used when we are interested in selecting a technique for which all forecast errors fall below some threshold value[25].

Ideally, organizations which can afford to do so will usually assign crucial forecast responsibilities to those departments and/or individuals that are best qualified and have the necessary resources at hand to make such forecast estimations under complicated demand patterns. Clearly, a firm with a large ongoing operation and a technical staff comprised of statisticians, management scientists, computer analysts, etc. is in a much better position to select and make proper use of sophisticated forecast techniques than is a company with more limited resources. Notably, the

[24] Findly D.F(1985), Model selection for multi step ahead forecasting in identification and system parameter estimation, 7th IFAC/ FORS symposium 1039-1044.
[25] Findly D.F (1985), "Model selection for multi-step ahead forecasting", in identification and system parameter estimation, 7th IFAC/ FORS symposium, 1039-1044.

bigger firm, through its larger resources, has a competitive edge over an unwary smaller firm and can be expected to be very diligent and detailed in estimating forecast (although between the two, it is usually the smaller firm which can least afford miscalculations in new forecast levels). A time series is a set of ordered observations on a quantitative characteristic of a phenomenon at equally spaced time points. One of the main goals of time series analysis is to forecast future values of the series. A trend is a regular, slowly evolving change in the series level. Three general classes of models that can be constructed for purposes of forecasting or policy analysis are examined. Each involves a different degree of model complexity and presumes a different level of comprehension about the processes one is trying to model. Many of us often either use or produce forecasts of one sort or another. Few of us recognize, however, that some kind of logical structure, or model, is implicit in every forecast. In making a forecast, it is also important to provide a measure of how accurate one can expect the forecast to be. The use of intuitive methods usually precludes any quantitative measure of confidence in the resulting forecast. The statistical analysis of the individual relationships that make up a model, and of the model as a whole, makes it possible to attach a measure of confidence to the model's forecasts. Once a model has been constructed and fitted to data, a sensitivity analysis can be used to study many of its properties. In particular, the effects of small changes in individual variables in the model can be evaluated. For example, in the case of a model that describes and predicts interest rates, one could measure the effect on a particular interest rate of a change in the rate of inflation. This type of sensitivity study can be performed only if the model is an explicit one. In Time-Series Models we presume to know nothing about the causality that affects the variable we

are trying to forecast. Instead, we examine the past behavior of a time series in order to infer something about its future behavior. The method used to produce a forecast may involve the use of a simple deterministic model such as a linear extrapolation or the use of a complex stochastic model for adaptive forecasting.