

Demand Forecasting

■ General considerations:

1. Factors involved in demand forecasting
2. Purposes of forecasting
3. Determinants of demand
4. Length of forecasts
5. Forecasting demand for new products
6. Criteria of a good forecasting method
7. Presentation of a forecast to the management
8. Role of macro-level forecasting in demand forecasts
9. Recent trends in demand forecasting
10. Control or management of demand

■ Methods of demand forecasting

■ Approach to forecasting

- Demand Forecasting: Accurate demand forecasting is essential for a firm to enable it to produce the required quantities at the right time and arrange well in advance for the various factors of production, viz., raw materials, equipment, machine accessories, labour, buildings, etc.

In a developing economy like India, supply forecasting seems more important. However, the situation is changing rapidly.

Factors involved in Demand Forecasting

1. How far ahead?
 - a. Long term – eg., petroleum, paper, shipping. Tactical decisions. Within the limits of resources available.
 - b. Short-term – eg., clothes. Strategic decisions. Extending or reducing the limits of resources.
2. Undertaken at three levels: (1) Macro-level (2) Industry level eg., trade associations (3) Firm level
3. Should the forecast be general or specific (product-wise)?
4. Problems or methods of forecasting for “new” vis-à-vis “well established” products.
5. Classification of products – producer goods, consumer durables, consumer goods, services.
6. Special factors peculiar to the product and the market – risk and uncertainty. (eg., ladies’ dresses)

Purposes of forecasting

■ Purposes of short-term forecasting

- a. Appropriate production scheduling.
- b. Reducing costs of purchasing raw materials.
- c. Determining appropriate price policy
- d. Setting sales targets and establishing controls and incentives.
- e. Evolving a suitable advertising and promotional campaign.
- f. Forecasting short term financial requirements.

■ Purposes of long-term forecasting

- a. Planning of a new unit or expansion of an existing unit.
- b. Planning long term financial requirements.
- c. Planning man-power requirements.

Demand forecasts of particular products form guidelines for related industries (eg., cotton and textiles). Also helpful at the macro level.

Determinants of Demand

1. Non-durable consumer goods:

A. Purchasing power – disposable personal income (personal income – direct taxes and other deductions). Discretionary income : Disposable income less (a) imputed income and income in kind, (b) major fixed outlay payments, (c) essential expenditures such as food and clothing.

B. Price.

C. Demography: $d = f(Y, D, P)$ Eg., cotton cloth vs. cost of food grain.

2. Durable consumer goods:

A. Choice between (a) using the goods longer by repairing it, or (b) disposing it off and replacing it with a new one.

- Determinants of Demand
- Length of forecasts
- Short-term forecasts – upto 12 months, eg., sales quotas, inventory control, production schedules, planning cash flows, budgeting.
- Medium-term – 1-2 years, eg., rate of maintenance, schedule of operations, budgetary control over expenses.
- Long-term – 3-10 years, eg., capital expenditures, personnel requirements, financial requirements, raw material requirements. (Most uncertain in nature)

Forecasting demand for new products – Joel Dean

1. Project the demand for a new product as an outgrowth of an existing old product.
2. Analyse the new product as a substitute for some existing product or service.
3. Estimate the rate of growth and the ultimate level of demand for the new product on the basis of the pattern of growth of established products.
4. Estimate the demand by making direct enquiries from the ultimate purchasers, either by the use of samples or on a full scale.
5. Offer the new product for sale in a sample market, eg., by direct mail or through one multiple shop organisation.
6. Survey consumers' reactions to a new product indirectly through the eyes of specialised dealers who are supposed to be informed about consumers' need and alternative opportunities.

Criteria of a good forecasting method

1. Accuracy – measured by (a) degree of deviations between forecasts and actuals, and (b) the extent of success in forecasting directional changes.
2. Simplicity and ease of comprehension.
3. Economy.
4. Availability.
5. Maintenance of timeliness.

Presentation of a forecast to the Management

- In presenting a forecast to the management, a managerial economist should:
 1. Make the forecast as easy for the management to understand as possible.
 2. Avoid using vague generalities.
 3. Always pin-point the major assumptions and sources.
 4. Give the possible margin of error.
 5. Avoid making undue qualifications.

6. Omit details about methodology and calculations.
7. Make use of charts and graphs as much as possible for easy comprehension.

Role of Macro-level forecasting in demand forecasts--Various macro parameters found useful for demand forecasting:

1. National income and per capita income.
2. Savings.
3. Investment.
4. Population growth.
5. Government expenditure.
6. Taxation.
7. Credit policy.

Recent trends in demand forecasting

1. More firms are giving importance to demand forecasting than a decade ago.
2. Since forecasting requires close cooperation and consultation with many specialists, a team spirit has developed.
3. Better kind of data and improved forecasting techniques have been developed.
4. There is a greater emphasis on sophisticated techniques such as using computers.
5. New products' forecasting is still in infancy.
6. Forecasts are usually broken down in monthly forecasts.
7. In spite of the application of newer and modern techniques, demand forecasts are still not too accurate.
8. The usefulness of personal feel or subjective touch has been accepted.
9. Top-down approach is more popular than bottom-up approach.
 - Control or management of demand
 - The key to management of demand is the effective management of the purchases of final consumers.
 - The management of demand consists in devising a sales strategy for a particular product. It consists in devising a product, or features of a product, around which a sales strategy can be built. Product design, model change, packaging and even performance reflect the need to provide what are called strong selling points.

Methods of demand forecasting

1. Survey of buyers' intentions
2. Delphi method
3. Expert opinion
4. Collective opinion
5. Naïve models
6. Smoothing techniques
 - a. Moving average
 - b. Exponential smoothing
 1. Analysis of time series and trend projections
 2. Use of economic indicators
 3. Controlled experiments
 4. Judgemental approach

Methods of demand forecasting Though statistical techniques are essential in clarifying relationships and providing techniques of analysis, they are not substitutes for judgement. What is needed is some common sense mean between pure guessing and too much mathematics.

1. Survey of buyers' intentions: also known as Opinion surveys. Useful when customers are industrial producers. (However, a number of biases may creep up). Not very useful for household consumers.

Limitation: passive and "does not expose and measure the variables under management's control"

2. Delphi method: it consists of an effort to arrive at a consensus in an uncertain area by questioning a group of experts repeatedly until the results appear to converge along a single line of the issues causing disagreement are clearly defined. Developed by Rand Corporation of the U.S.A in 1940s by Olaf Helmer, Dalkey and Gordon. Useful in technological forecasting (non-economic variables).

Delphi method

Advantages

1. Facilitates the maintenance of anonymity of the respondent's identity throughout the course.
2. Saves time and other resources in approaching a large number of experts for their views.

Limitations/presumptions:

1. Panelists must be rich in their expertise, possess wide knowledge and experience of the subject and have an aptitude and earnest disposition towards the participants.
2. Presupposes that its conductors are objective in their job, possess ample abilities to conceptualize the problems for discussion, generate considerable thinking, stimulate dialogue among panelists and make inferential analysis of the multitudinal views of the participants.

3. Expert opinion / "hunch" method To ask "experts in the field" to provide estimates, eg., dealers, industry analysts, specialist marketing consultants, etc.

Advantages:

1. Very simple and quick method.
2. No danger of a "group-think" mentality.

4. Collective opinion method Also called "sales force polling", salesmen are required to estimate expected sales in their respective territories and sections.

Advantages:

1. Simple – no statistical techniques.
2. Based on first hand knowledge.
3. Quite useful in forecasting sales of new products.

Disadvantages:

1. Almost completely subjective.
2. Usefulness restricted to short-term forecasting.
3. Salesmen may be unaware of broader economic changes.

5. Naïve models

Naïve forecasting models are based exclusively on historical observation of sales (or other variables such as earnings, cash flows, etc). They do not explain the underlying casual relationships which produces the variable being forecast.

Advantage: Inexpensive to develop, store data and operate.

Disadvantage: does not consider any possible causal relationships that underlie the forecasted variable.

3-naïve models

1. To use actual sales of the current period as the forecast for the next period; then, $Y_{t+1} = Y_t$
2. If we consider trends, then, $Y_{t+1} = Y_t + (Y_t - Y_{t-1})$
3. If we want to incorporate the rate of change, rather than the absolute amount; then, $Y_{t+1} = Y_t (Y_t / Y_{t-1})$

6. Smoothing techniques

Higher form of naïve models:

A. Moving average: are averages that are updated as new information is received. With the moving average a manager simply employs, the most recent observations, drops the oldest observation, in the earlier calculation and calculates an average which is used as the forecast for the next period.

Limitations:

1. One has to retain a great deal of data.
2. All data in the sample are weighed equally.

B. Exponential smoothing: uses *weighted average* of past data as the basis for a forecast.

$$Y_{t+1} = aY_t + (1-a) Y'_t \text{ or}$$

$$Y_{\text{new}} = a Y_{\text{old}} + (1-a) Y'_{\text{old}},$$

where,

- ☐ Y_{new} = exponentially smoothed average to be used as the forecast
- ☐ Y_{old} = most recent actual data
- ☐ Y'_{old} = most recent smoothed forecast
- ☐ a = smoothing constant

Smoothing constant (or weight) has a value between 0 and 1 inclusive.

- Exponential smoothing
- The following rules of thumb may be given :
 1. When the magnitude of the random variations is large, give a lower value to “a” so as to average out the effects of the random variation quickly.
 2. When the magnitude of the random variation is moderate, a large value can be assigned to the smoothing constant “a”.
 3. It has been found appropriate to have “a” between 0.1 and 0.2 in many systems.

Advantages:

Exponential smoothing is a forecasting method easy to use and efficiently handled by computers. Although a type of moving average technique, it requires very little record keeping of past data. This method has been successfully applied by banks, manufacturing companies, wholesalers and other organizations.

7. Analysis of time series and trend projections

- The time series relating to sales represent the past pattern of effective demand for a particular product. Such data can be presented either in a tabular form or graphically for further analysis. The most popular method of analysis of the time series is to *project the trend* of the time series. a trend line can be fitted through a series either visually or by means of statistical techniques. The analyst chooses a plausible algebraic relation (linear, quadratic, logarithmic, etc.) between *sales* and the independent variable, *time*. The trend line is then projected into the future by extrapolation.
- Popular because: simple, inexpensive, time series data often exhibit a persistent growth trend.
- Disadvantage: this technique yields acceptable results so long as the time series shows a *persistent tendency to move in the same direction*. Whenever a *turning point occurs*, however, the *trend projection breaks down*.

The real challenge of forecasting is in the prediction of turning points rather than in the projection of trends.

- Analysis of time series and trend projections
- Four sets of factors: secular trend (T), seasonal variation (S), cyclical fluctuations (C), irregular or random forces (I). O (observations) = TSCI

Assumptions:

1. The analysis of movements would be in the order of trend, seasonal variations and cyclical changes.
2. Effects of each component are independent of each other.

8. Use of economic indicators

The use of this approach bases demand forecasting on certain economic indicators, eg.,

1. Construction contracts sanctioned for the demand of building materials, say, cement;
2. Personal income for the demand of consumer goods;
3. Agricultural income for the demand of agricultural inputs, implements, fertilizers, etc.; and
4. Automobile registration for the demand of car accessories, petrol, etc.

Steps for economic indicators:

1. See whether a relationship exists between the demand for the product and certain economic indicators.
2. Establish the relationship through the method of least squares and derive the regression equation. ($Y = a + bx$)
3. Once regression equation is derived, the value of Y (demand) can be estimated for any given value of x .
4. Past relationships may not recur. Hence, need for value judgement.

■ Limitations:

1. Finding an appropriate economic indicator may be difficult.
2. For new products – no past data exists.
3. Works best when the relationship of demand with a particular indicator is characterized by a time lag.
Eg., construction contracts will result in a demand for building materials but with a certain amount of time lag.

9. Controlled experiments

- Under this method, an effort is made to vary separately certain determinants of demand which can be manipulated, e.g., price, advertising, etc., and conduct the experiments assuming that the other factors remain constant.
- Example – Parker Pen Co.
- Still relatively new and untried:
 1. Experiments are expensive as well as time consuming.
 2. Risky – may lead to unfavourable reaction on dealers, consumers, competitors, etc.
 3. Great difficulty in planning the study. difficult to satisfy the condition of homogeneity of markets.

10. Judgemental approach

■ Required when:

1. Analysis of time series and trend projections is not feasible because of wide fluctuations in sales or because of anticipated changes in trends; and
2. Use of regression method is not possible because of lack of historical data or because of management's inability to predict or even identify causal factors.

Even statistical methods require supplementation of judgement:

1. Even the most sophisticated statistical methods cannot incorporate all the potential factors, e.g., a major technological breakthrough in product or process design.
2. For industrial products – if the management anticipates loss or addition of few large buyers, it could be taken into account only through judgement approach.
3. Statistical forecasts are more reliable for larger levels of aggregations.

Approach to forecasting

1. Identify and clearly state the objectives of forecasting.
2. Select appropriate method of forecasting.
3. Identify the variables.
4. Gather relevant data.
5. Determine the most probable relationship.
6. For forecasting the company's share in the demand, two different assumptions may be made:
 - (a) Ratio of company sales to the total industry sales will continue as in the past.
 - (b) On the basis of an analysis of likely competition and industry trends, the company may assume a market share different from that of the past. (alternative / rolling forecasts)
7. Forecasts may be made either in terms of units or sales in rupees.
8. May be made in terms of product groups and then broken for individual products.
9. May be made on annual basis and then divided month-wise, etc.

METHODS OF FORECASTING

1. Too much emphasis should not be placed on mathematical or statistical techniques of forecasting. Though statistical techniques are essential in clarifying relationships and providing techniques of analysis, they are not substitutes for judgment.
2. Forecasting also should not be left entirely to the judgment of the so-called experts.

What is needed is some commonsense mean between pure guessing and too much mathematics.

Various Methods of Forecasting

1. Survey of Buyer's Intentions (Opinion Surveys):

The most direct method of estimating demand in the short-run is to ask customers what they are planning to buy for the forthcoming time period – usually a year. This is very useful when bulk of the sales is to industrial producers. Here the burden of forecasting is shifted to the consumer. In this method, customers may tend to exaggerate their requirements. Customers are numerous, making the method too laborious, impracticable and costly. This method “does not expose and measure the variables under the management's control”.

Delphi Method: This is a variant of the opinion poll or survey method. In Delphi Method, an attempt is made to arrive at a consensus of opinion. The participants are supplied with responses to previous questions from others in the group by a leader. The leader provides each expert with opportunity to react to the information given by others, including reasons advanced, without disclosing the source.

2. The Collective Opinion also called as Sales Force Polling or Expert Opinion polls.
3. Analysis of Time Series and Trend Projections
4. Use of Economic Indicators – Regression Analysis and Economic Model Building.

5. Controlled Experiments – Test Marketing.
6. Judgemental Approach

Advantages & Disadvantages of Delphi Method:

Delphi method has some exclusive advantages:

- a) It facilitates anonymity of the respondent's identity. This enables respondents to be frank and forthright in giving their views.
- b) It facilitates posing the problem to the experts at one time and have their response – nearly as good as pooling the panelists together. In one case 620 experts from different background such as policy-makers, technologists, scientists, economists, administrators and advisers were consulted.

However, Delphi method presumes these two conditions: 1) panelists must be rich in their expertise, having wide knowledge of the subject and are sincere and earnest in their disposition towards the participants.

2) The conductors are objective in their job, possess skill to conceptualize the problems for discussion to generate considerable thinking, stimulate dialogue among panelists and make inferential analysis of the numerous views of the participants.

Collective Opinion or Sales Force Polling or Expert Opinion Polls

Salesmen are required to estimate expected sales in their territories. Salesmen being the closest to the customers, have most intimate feel of the market. The estimates of individual salesmen are consolidated to find out the total estimated sales. These estimates are reviewed to eliminate the bias of optimism or pessimism. Thereafter they are further revised in the light of factors proposed change in prices, product design, advertising budget, expected change in competition, changes in purchasing power, income distribution, employment, population etc. The final forecast will emerge after all these factors are taken into account. The method is known as collective opinion as it takes advantage of the collective wisdom of salesmen, departmental heads like production manager, sales manager, marketing manager, managerial economist and top executives, as well as dealers and distributors.

Advantages:

1. The method is simple and does not involve the use of statistical techniques.
2. The forecasts are based on first-hand knowledge of salesmen and others directly connected with sales.
 - a. The method is useful in predicting sales of new products. Here, salesmen will have to depend more on their judgement than in the case of existing products.

Disadvantages:

1. It is subjective. Salesmen may underestimate the forecast if it is to be used to decide their quotas.
2. This method can only be used for short-term forecasting.
3. Focus of salesmen is centered round the present trend, and they don't think about the future. They may even lack the breadth of vision for looking into the future.

Analysis of Time Series and Trend Projections

A firm which has been in existence for some time, will have Accumulated data on sales pertaining to past time periods. Such Data when arranged chronologically, yield 'time series'. Time Series of sales represent the past pattern of effective demand for a Particular product. Such data can be presented graphically or in Tabular form. The most popular method of analysis of time series is To project the trend of the time series data. A trend line

can be fitted through a series either visually or by means of statistical techniques such as method of least squares. The analyst chooses a plausible algebraic relation (linear, quadratic, logarithmic, etc.) between *sales* And the independent variable, *time*. The trend line is then projected into the future by extrapolation. This method is popular because it is simple and inexpensive. The basic assumption is that the past rate of change will continue in the future. Thus the technique yields acceptable results so long as the time series shows a persistent tendency to move in the same direction.

The real challenge in forecasting is in the prediction of turning points rather than trends. Four sets of factors influence the time series – trend, seasonal variations, cyclical fluctuations and irregular or random forces. The basic approach is to treat the original time series data as (O) observed data as composed of four parts : secular trend (T), seasonal factor (S), cyclical element (C) and an irregular movement (I). It is

Assumed that the elements are bound in multiplicative relationship.

$$O = TSCI .$$

First compute the Trend (T),

Eliminate trend $TSCI/T = SCI$

Now calculate seasonal index; eliminate (S) $SCI/S = CI$. A cycle is then fitted to the remainder which also contains an irregular effect (I).

The trend and seasonal factor can be forecast but the prediction of cycles is hazardous as there is no regularity in its behaviour.

There are two assumptions in this approach:

1. The analysis of movements would be in the order of trend, seasonal variations and cyclical changes;
2. The effects of each component are independent of each other.

To predict trend by the Method of Moving Averages

Under this method, either 3-year, 4-year or 5-year moving average is calculated. First moving total of the values in the group of years is calculated, each time giving up the first preceding year from the group. Then it is divided by the number of years in the group.

Year	Demand ('000)	3-yearly moving Total	3-yearly moving average (Trend)
1991	10	--	--
1992	12	36	12
1993	14	42	14
1994	16	45	15
1995	15	51	17
1996	20	54	18
1997	19	60	20
1998	21	--	--

Estimation of Trend by the Method of Least Squares

Q. The annual sales of a company are as follows:

Year	1991	1992	1993	1994	1995
Sales '000	45	56	58	46	75

Using the method of least squares, fit a st. line trend and estimate the annual sales of 1997.

Year	Sales y	1990 = 0 Time- Deviation x	x^2	xy	Estimated Trend'000 $Y=45 + 5x$
1991	45	1	1	45	50
1992	56	2	4	112	55
1993	78	3	9	234	60
1994	46	4	16	184	65
1995	75	5	25	375	70

$$n = 5 \quad \Sigma y = 300 \quad \Sigma x = 15 \quad \Sigma x^2 = 55 \quad \Sigma xy = 950$$

$\Sigma y = n.a. + b \Sigma x \dots 1$ $\Sigma xy = a \Sigma x + b \Sigma x^2 \dots 2$ Substituting the computed values we have, $300 = 5a + 15b \dots 3 \quad (x \ 3)$ $950 = 15a + 55b \dots 4$ Multiplying (3) by 3 we have $900 = 15a + 45b$ $950 = 15a + 55b$ Therefore, $10b = 50, \quad b = 5$ Substituting $b = 5$ in (3) $300 = 5a + 15(5)$ $300 = 5a + 75$ $5a = 225 \quad a = 45$	<i>St. line equation is $Y = a + bx$</i> <i>Substituting the values of a and b,</i> $Y = 45 + 5x$ <i>Therefore,</i> $Y_{1991} (x=1) = 45 + 5(1) = 50$ $Y_{1992} (x=2) = 45 + 5(2) = 55$ $Y_{1993} (x=3) = 45 + 5(3) = 60$ $Y_{1994} (x=4) = 45 + 5(4) = 65$ $Y_{1995} (x=5) = 45 + 5(5) = 70$ $Y_{1996} (x=6) = 45 + 5(6) = 75$ <i>Forecast for the year 1997</i> $Y_{1997} (x=7) = 45 + 5(7) = 80$ <u><i>i.e. Rs.80,000/-</i></u>
--	---

Use of Economic Indicators

The use of this approach bases demand forecasting on certain economic indicators following these steps:

1. See whether a relationship exists between demand for the product and the economic indicator.
2. Establish the relationship through the method of least squares and derive the regression equation.
Assuming the relationship to be linear, the equation will be $Y = a + bx$
3. Once the regression equation is derived, the value of
Y i.e. demand can be estimated for any given value of x.

Draw back: Finding an appropriate economic indicator may be difficult. For new products it is inappropriate as no past data exists.

Suppose a company manufacturing tractors finds that a relationship exists between sale of tractors and Farm Income Index published by CSO. Table below shows the number of tractors sold and the corresponding farm income index 1988 through 1992. Regression equation is calculated as follows:

Year	Farm Income Index (x)	Sales of Tractors (y)	X ₁	Y ₁	x ₁ y ₁	x ₁ ²
1988	100	110	10	11	110	100
1989	110	130	11	13	143	121
1990	140	150	14	15	210	196
1991	150	160	15	16	240	225
1992	200	180	20	18	360	400
n = 5			ΣX ₁ =70	ΣY ₁ =73	ΣX ₁ Y ₁ =1063	ΣX ₁ ² =1042

The equations to be solved simultaneously are:

$$\Sigma y_1 = n.a. + b \Sigma x_1 \dots\dots(1)$$

$$\Sigma x_1 y_1 = a \Sigma x_1 + b \Sigma x_1^2 \dots\dots(2)$$

Substituting the various values, we get,

$73 = 5a + 70b \quad (x14) \dots(3)$ $1063 = 70a + 1042b$ $1022 = 70a + 980b$ $62b = 41 \quad b = 41/62 = 0.66$ Substituting the value of b in (3) $73 = 5a + 70(0.66) = 5a + 46.2$ $5a = 73 - 46.2 = 26.8$ $a = 26.8/5 = 5.36$ $a = 5.36 \quad b = 0.66$	$y_1 = 5.36 + 0.66x_1$ $Y = 10(5.36) + 0.66(x/10)10$ $= 53.6 + 0.66x$ If the index of farm income becomes 210, sale of tractors will be $Y = 53.6 + 0.66(210)$ $= 53.6 + 138.6$ $= 192 \text{ tractors.}$
---	---

- Various steps to be followed in our approach to Forecasting
- 1) Identify and clearly state the objectives of forecasting – long-term, short-term, market share or industry as a whole.
 - 2) Select appropriate method of forecasting.
 - 3) Identify variables affecting demand for the product and express them in appropriate forms.
 - 4) Gather relevant data or approximations to relevant data to represent the variables.
 - 5) Through the use of statistical techniques, determine the most probable relationship between the dependent and independent variables.
 - 6) Prepare the forecast and interpret the results.
 - 7) For forecasting company's share in the demand, two different assumptions are made:
 - a) ratio of company's sales to industry's sale will continue as in the past.

b) On the basis of analysis of likely competition and industry trends, company may assume a different market share.

It is advisable to have two different forecasts based on these two assumptions.

- 8) Forecast may be either in physical units or in rupee sales. Rupee sales may be converted to physical units dividing by sale price.
- 9) Forecasts may be made in terms of product groups and then subdivided into individual products based on past percentages
- 10) Forecast can be made on annual basis and subdivided monthwise.
- 11) For monthwise break-up of new products
 - a) statistics of other firm's data, if available, may be made use of or
 - b) some survey may be necessary.

SALES FORECASTING

Demand Forecasting

- Demand forecast forms the basis of all Supply chain
- All push processes in the supply chain are performed in anticipation of customer demand, whereas all pull processes are performed in response to customer demand.
- For push processes, a manager must plan the level of activity, be it production, transportation, or any other planned activity, for pull processes, A manager must plan the level of available capacity & inventory but not the actual amount to be executed

So for both the instances the first step a manager must take is to forecast what customer demand will be.....

Characteristics Of Forecast

- Forecasts are always wrong

Thus include both the expected value of the forecast and a measure of forecast error.

- Longer forecasts are usually less accurate than the short term forecasts.
- Aggregate forecasts are usually more accurate
- Forecasts are integral part of decision making- It involves two important decisions

(a) determining the appropriate level of aggregation (b) determining the forecast horizon.

Elements of a Good Forecast



Steps in the Forecasting Process



Components Of A Forecast and Forecasting Methods

When a firm knows about its customers' past behavior, however sheds light on their future behavior. Demand does not arise in vacuum. Rather, customer demand is influenced by a variety of factors & can be predicted, at least with some probability.

Companies must balance objective & subjective factors when forecasting demand. A company must take numerous factors that are related to the demand forecast. Some of these factors are:

1. *Past Demand*
2. *Lead time of product*
3. *Planned advertising or marketing efforts*
4. *State of the economy*
5. *Planned price discounts*
6. *Actions that competitors have taken*

Time Horizon For Forecasting

The key factor in choosing a proper forecasting approach is the time horizon for the decision requiring forecasting. Forecasts can be made for various timeframes : Short-term / Mid-term / Long-term

Short-term Forecasting

- Short-term(1 day to 3 months), managers are interested in forecasts for disaggregated demand(for specific product, for specific geography, etc)
- Little time to react to errors in demand forecast, so the forecasts need to be as accurate as possible.
- Time series analysis is often used.
- In absence of historical data managers use judgment methods.

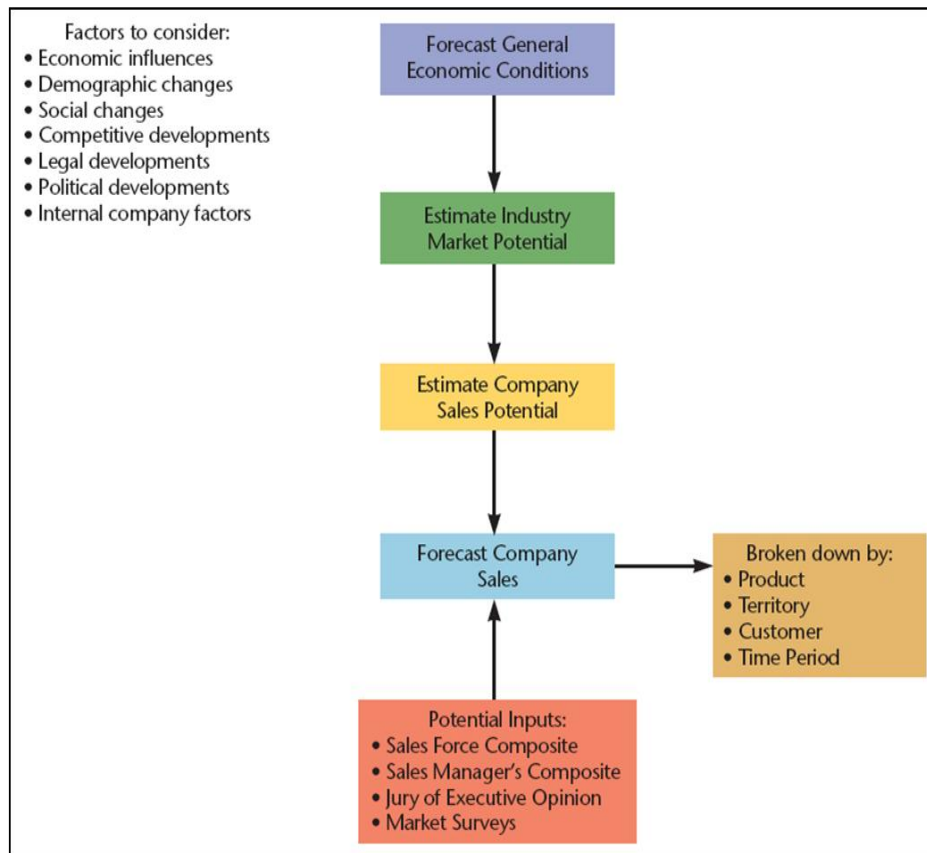
Medium-term Forecasting

- Time horizon for medium-term(3 months to 24 months).
- Relates to aggregate planning(sales & operations planning).
- Medium term forecast is used to build up seasonal inventory.
- Both time-series and causal methods are used.

Long-term Forecasting

- Time horizon exceeding two years.
- Long term forecasts are used for process selection, capacity planning & location decisions.
- Judgment models & causal models are used.

Sales Forecasting Model



Forecast Methods

Forecast methods are classified as follows:

1. Qualitative Forecasting
2. Quantitative Forecasting

Qualitative Forecasting Methods

- Qualitative forecasting methods are primarily subjective and they rely on human expertise and judgment.
- Most appropriate when little historical data are available like in the case of demand forecasts for new products
- Popular qualitative forecasting methods are: Delphi, Market research, judgment methods

Methods of Forecasting Demand

Qualitative Methods:

1- Survey of buyers intention: marketer ask buyers about how many units that they would like to purchase from ABC company's products for coming period of time.

- ☐ Well defined buyers
- ☐ Limited in number

☐ Advantage: Simple and Easy

☐ Disadvantage: buyers might change their opinions, there is no enforcement on buyers to buy that much, buyers might over or under estimate.

2- Test Marketing: this research method is heavily preferred when company offers a new product to the market (innovation).

- ☐ Before offering product to the market, marketers need to get some real feedback from market.
- ☐ Marketer: choose a specific region or a store to test the product in real market conditions.
- ☐ Advantage: provide real feedbacks about customers reactions and make estimates upon that.
- ☐ Disadvantage: no control over who will purchase our new product.
- ☐ Rivals might get aware of it and company lose all of its competitive advantage.

3- Sales force composite:

- ☐ Marketers have sales managers or representatives at different sales territories (districts/region) and marketers believe that sales managers know their territory better than anybody else.
- ☐ Marketers ask respective sales manager to forecast expected sales in their own territories. The total of all these estimates basically gives company's sales/demand forecast for next period.
- ☐ Advantage: simple
- ☐ Disadvantage: forecasting requires especial education and training, most managers have lack of education on this issue sometimes managers
 - 1- Over estimate: More than sales potential
 - ☐ Over production (extra cost)
 - ☐ Additional cost for keeping stock.
 - 2- Under estimate: Less than sales potential
 - ☐ Demand do not match
 - ☐ Shift to competitors and decrease in sales and decrease in profitability.

4- Executive method (jury of executive method):

Company forms a committee to make forecast from members from different departments (marketing, accounting, R&D, production) Make their own forecast and send to committee at a written form Committee members come together and discuss forecasts and agree one of the estimates or come up with a new estimate for whole company.

- ☐ Advantage: easy and simple to use.
- ☐ Disadvantage: estimates are for whole markets and difficult to separate them to specific market or product line;
 - ☐ Reliability and accuracy of estimate depend on how up-to-date;
 - ☐ Members can easily influence each other (objectivity is in question).

5- Delphi method:

Very similar to jury of executives method but this time members are both inside and outside the company. Members do not know each other and never come together. A moderator from company organize all the contacts. Moderator prepare data and send it to members to make their own estimate. Members send their estimate to moderator as a written form and moderator makes analysis on estimates and form a new data set and conditions and send back to members for further estimate. This will continue until all members agree on same forecast. (it is suitable for long-term forecasts).

- ☐ Advantage: No group pressure, more objective
- ☐ Disadvantage: Takes long time.

Quantitative Methods

Within quantitative models two types are commonly used in forecasting applications:

1. Time-series
2. Causal

Time series method of forecasting uses historical data to make forecasts. It is assumed that the future is going to be very similar to the past. Causal forecasting model shows the cause for demand and its relation to other variables. Usually regression is used for modeling the cause-and-effect behavior.

Time-series method

Decomposition of Time-series Data: Demand is decomposed following a systematic part that can be predicted and a random part that cannot be predicted.

$$\text{Demand} = \text{Systematic part} + \text{Random part}$$

While breaking time series into components, the three most common patterns observed are trend form, level form & seasonal form

- **Seasonality:** A seasonal pattern(e.g., quarter of the year, month of the year, week of the month, day of the week) exists when demand is influenced by seasonal factors.
- **Trend:** During the growth and decline stages of the product life cycle, a consistent trend pattern in terms of demand growth or demand decline can be observed.
- **Level :** It is difficult to capture short term patterns that are not repetitive in nature. In short run, sometimes there is a swing, which could be in either direction, upward or downward, and it usually has momentum that lasts for a few periods

Causal Method

- Causal forecasting model show the cause for demand and its relation to other variables. Usually, regression is used for modeling the cause-and-effect behavior.

Examples: Soft drink can be related to the average summer temperature.

Rainfall can give us an estimate of crop and in turn an estimate of the demand for consumer durables in the rural areas.

Forecast Error

Future demand has a component that is systematic in nature, which forecasting attempts to predict. Even with the best forecasting methodology, one will still not be able to predict some part of demand, which is known as “random” demand since it is unpredictable in nature. Forecast error for one particular period, period t, is quantified as follows:

$$\text{Forecast error}(t) = \text{Demand}(t) - \text{Forecast}(t)$$

Time-series Forecasting Models: Time-series analysis is one of the most widely used quantitative methods of forecasting. Four cases consisting of one or more pattern of data:

1. Systematic component of demand= Level(Moving average or Exponential smoothing)
2. Systematic component of demand= Level + Trend
3. Systematic component of demand= (Level+ trend) * seasonal factor(Winter’s model)