1. FORECASTING BY THE USE OF TIME SERIES ANALYSIS

Time series analysis helps to identify and explain:

(i) Any regular or systematic variation in the series of data which is due to seasonality–the "Seasonals".
(ii) Cyclical patterns.
(iii) Trends in the data.
(iv) Growth rates of these trends. Unfortunately, most existing methods identify only the seasonals, the combined effect of trends and cycles and the irregular or chance component. That is, they do not separate trend from cycles.

This is not to say that those other effects are not to some degree manageable. The suggestion is rather that the analysis for trend and seasonal effects and the projection of these two sets of forces should be understood to be the first step in the forecast and that, taking into account such cyclical and residual forces as may be manageable, further refinements may be made.

Many statisticians consider time series analysis a somewhat useless tool. One critic, M. J. Moroney said that "Economic forecasting like weather forecasting in England is only valid for the next six hours or so. Beyond that it is sheer guesswork."

In any event, although the limitation of time series analysis must be understood, the importance and usefulness of the procedures should not be underestimated. The analysis serves two purposes:

1. It does provide an initial approximation forecast that takes into account those empirical regularities which may, with reasonable assurance, be expected to persist.
2. After the trend and seasonal effects have been identified and measured, the original data may be adjusted for these influences, yielding a new historical time series consisting of the trend and seasonally adjusted data. This new time series may be helpful in the analysis and interpretation of cyclical and residual influences.

It should be noted that this method of forecasting can be used only when several years' data for a product or product line are available and when relationship and trends are both clear and relatively stable.

2. OPINION POLLING

Opinion poll is the survey of opinion of experts, i.e., knowledgeable persons in the field whose views carry lot of weight. For example, a survey of opinion of sales representatives, wholesalers, retailers, etc., will be of great help in formulating demand projections. The Survey Research Centre of the University of Michigan conducts an annual pool regarding the future plans of consumers. The answers to many questions are translated into short-run demand for colour television sets, automobiles and other consumer products.

3. CAUSAL MODELS

A causal model is the most sophisticated kind of forecasting tool. It expresses mathematically the relevant causal relationship, and may include pipeline considerations (i.e., inventories) and market survey information. It may also directly incorporate the results of a time series analysis.

The causal model takes into account everything known of the dynamics of the flow system and utilises predictions of related events such as competitive action, strikes and promotions. If the data are available, the model generally includes factors for each location in the flow chart and connects these by questions to describe overall product flow. If certain kinds of data are lacking, initially it may be necessary to make assumptions about some of the relationships and then track what is happening to determine if the assumptions are true. Typically, a causal model is continually revised as more knowledge about the system becomes available.

4. EXPONENTIAL SMOOTHING

This method is an outgrowth of the recent attempts to maintain the smoothing function of moving averages without their corresponding drawbacks and limitations. Exponential smoothing is a special kind of weighted average and is found extremely useful in short-term forecasting of inventories and sales.

When this method is applied and we wish to forecast the value of a time series for the period $t + 1$ on the basis of information available just after the period t, the forecast is best considered as a function of two components: the actual value of the series for period t and the forecasted value for the same period made in the previous period $t – 1$. The use of both realised and estimated values available now for predicting future values is better than the use of either alone, since the actual value in period t might have been unduly influenced by random factors and, or the conditions that led to the forecast for period, t, may not hold any longer.

Smoothing Process: The steps in smoothing process are:

1. The exponentially smoothed value at time period t is denoted by S_i. The smoothing process begins by assigning $S_1 = X_1$ at the first time period. For the second time period,

   $$S_2 = \alpha X_2 + \beta S_1$$

   and for any succeeding time period t, the smoothed value S_i is found by computing.

   $$S_t = \alpha X_t + \beta S_{t-1}$$

   This is the basic equation for exponential smoothing. The weights employed to compute this estimate are called smoothing constants, denoted by alpha and beta with $\alpha + \beta = 1$. For determining the value of α, the rule of thumb followed is that when the magnitude of random variations in the series is large. We should select small α so that the smoothed value S_t will reflect S_{t-1} to a greater extent than it reflects X_t. When we have a moderately stable process, a larger alpha should be selected. It should be noted that the value of α employed often falls within the range 0.10 – 0.60. The value of alpha is often determined by means of simulation with the purpose of minimizing the variance. The system of weighing is given below:

Time period	Weights $\alpha = 0.2$	$\alpha = 0.5$
t	$\alpha\beta^0 = 0.2$	0.5
t – 1	$\alpha\beta^1 = 0.16$	0.25
t – 2	$\alpha\beta^2 = 0.128$	0.125
t – 3	$\alpha\beta^3 = 0.1024$	0.0625
t – 4	$\alpha\beta^4 = 0.8192$	0.03125

2. ΔS_t which denoted the difference between the current smoothed value and the preceding one is calculated by using the relation:

   $$\Delta S_t = S_t - S_{t-1}$$

3. Trend estimate or the new trend is calculated as follows:

   $$T_t = \alpha \Delta S_t + \beta T_{t-1}$$

4. The forecast for t +1 denoted as S'_t is calculated as follows:

   $$S'_t = S_t + \left(\frac{\beta}{\alpha}\right) T_t$$

   It should be noted that when annual data are involved, S_t constitutes the final forecast for the period t +1. Correlation has to be made for seasonal variations if the series relate to quarterly of monthly data.

5. The forecasting error is calculated using:

   $$e_{t+1} = S'_t + S_{t+1}$$