



MANAGERIAL ECONOMICS

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Lecture No - 16 : Demand Forecasting

Session Outline

- Demand Forecasting

Quantitative methods of Demand forecasting

- Subjective methods can be used only when past data is not available.
- When past data is available , it is advisable that firms should use statistical tools as it is more scientific and cost effective.
- Depends on time series of past sales.

Quantitative methods of Demand forecasting

- Trend Projections:
- Component of time series data
- **Secular trend** – Change occurring consistently over a long time and is relatively smooth in its path.

Quantitative methods of Demand forecasting

- **Trend Projections: component of time series**
- **Seasonal trend** : Seasonal variation in the data within a year.
- **Cyclical trend** : Cyclical movement in the demand for a product that may have to tendency to recur in a few years.

Quantitative methods of Demand forecasting

- **Trend Projections:** component of time series
- **Random Events:** natural calamities, social unrest- no trend of evidence, hence create random variation in the trend.

Quantitative methods of Demand forecasting

- Component of Time series – $Y = T + S + C + R$
- Or $Y = TSCR$
- $\text{Log } Y = \text{Log } T + \text{Log } S + \text{Log } C + \text{Log } R$

Quantitative methods of Demand forecasting

- **Trend Projections: Methods**
 - **Graphical Methods:** past values of variable in different time is plotted in a graph and movement of the series assessed and future values are forecasted.

Quantitative methods of Demand forecasting

- **Trend Projections: Methods**
 - **Least Squares Method** : tool to estimate the coefficient of a linear function based on minimization of squared deviations between best fitting line and original observations given.

Quantitative methods of Demand forecasting

- **Trend Projections: Methods**
 - **ARIMA Method : Box and Jenkins method**
 - Stage 1 – Underlying trend in the series is removed with first differences of successive observations
 - Stage 2 – Possible combinations will be created on the basis of autoregressive terms, moving average terms and number of differences in the original series for adequate fit to the series.

Quantitative methods of Demand forecasting

- **Trend Projections: Methods**
 - **ARIMA Method : Box and Jenkins method**
 - Stage 3 – Parameter estimation – Least square methods
 - Stage 4 – Goodness to fit is tested on the basis of residuals generated , repeat if not a good fit.
 - Stage 5 – Use the coefficient to forecast future demand.

Quantitative methods of Demand forecasting

- **Smoothing Techniques**

- Series do not show continuous trend – seasonal and random variations
- This technique is used to smoothen these variations and then forecasting of future values.

Quantitative methods of Demand forecasting

- **Smoothing Techniques**

- **Moving average : forecasts on the basis of demand values during recent past.**
- **$D_n = \sum_{i=1}^n D_i/n$**

Quantitative methods of Demand forecasting

- **Smoothing Techniques**

- **Weighted Moving average** : forecasts on the basis of weights of the recent observations.

- $D_n = \sum_{i=1}^n D_i W_i / n$

Quantitative methods of Demand forecasting

- **Smoothing Techniques**

- Exponential smoothing: assigns greater weight to most recent data as to have realistic estimate of the fluctuations.
- Weight vary between zero to one.
- $F_{t+1} = aD_t + (1-a)F_t$
- $F_{t+1} = 0.30D_t + 0.70F_t$

Quantitative methods of Demand forecasting

- **Barometric Techniques**

- **DEFINITION:- “The prediction of turning points In one economic time series through the use of Observations on another time series called the Barometer of the Indicator”.**

Quantitative methods of Demand forecasting

- **Barometric Techniques**

- An index is constructed of relevant economic indicators and forecast future trends on the basis of these indicators.
 - Leading indicators
 - Coincident indicators
 - Lagging indicator

Quantitative methods of Demand forecasting

- **Barometric Techniques**

- **Leading Indicators :**

- Series that go up or down ahead of other series.

- **Coincidence indicators:**

- Series that moves up or down simultaneously with level of economic activities

- **Lagging Indicators:**

- Series which move with economic series after a time lag

Quantitative methods of Demand forecasting

- **Econometrics Methods**

- **Regression Analysis:** relates a dependent variable to one or more independent variables in the form of linear equation.
- **Instruments to casual forecasting.**

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis**
 - Simple /Bivariate Regression Analysis
 - Non linear analysis
 - Multiple regression analysis

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis**
 - **Problems:**
 - Multicollinearity
 - Autocorrelation
 - Heteroscedasticity
 - Specification of error
 - Identification problem

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis – Problems**

- **Multicollinearity**

- Two or more explanatory variables in the regression model are highly correlated
- Thus impact of each individual independent variable on the dependent variable becomes difficult to ascertain
- Example: Consumption of an individual is affected by “income” and “wealth” of the individual
- Thus, detection and removal of multicollinearity is important.
- Multicollinearity can be removed by inclusion or omission of variables, additional data, increase sample size and intervention of advanced statistical tools.

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis – Problems**

- **Autocorrelation:**

- Is the condition when error terms (“e”) in the regression equation are found to be serially correlated. Also called “Serially Correlated”.
- Can occur in both time series as well as cross sectional data
- Detected by Durbin Watson test

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis – Problems**

- **Heteroscedasticity**

- Classical regression model assumes that variance of error terms is constant for all values of the independent variables in the model. If variables have different variances, they are heteroscedastic.
- Heteroscedastic disturbances lead to a biased estimator of the true variance
- There is no particular rule for detection. Mostly detected by intuition, experience
- Can be overcome by running a Weighted Least Square Regression

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis – Problems**

- **Specification error**

- Occurs when one or more independent variables in a regression model is omitted or when the structural form is wrongly constructed
- Example-1: In a demand forecasting regression of consumer, omitting “income” of consumer leads to specification error.
- Example-2: A demand function is non linear. If it estimated to be linear, it leads to specification error.

Quantitative methods of Demand forecasting

- **Econometrics Methods : Regression Analysis – Problems**

- Identification problem

- Example: If it is required to determine the effect of quantity demanded of a good when its price is increased by say 10%.
- Historical data of monthly demand and price will not give the solution as price is part of a multi-equation system. Supply of the good also needs to be taken into account to avoid biased parameters.

Quantitative methods of Demand forecasting

- **Econometrics Methods : Simultaneous equation methods**
 - Based on the guiding principle that in any economic decision every variable influences every other variable
 - Example-1: Decision on optimal advertisement expenditure depends on expected sales volume. Volume of sales is influenced by advertisement.
 - Example-2: Quantity demanded of tea depends on price of coffee and price of coffee gets influenced by quantity of demanded of tea.

Quantitative methods of Demand forecasting

- **Econometrics Methods : Simultaneous equation methods**
 - Given the existence of simultaneous and two way relationships, it is not possible to capture such relationships using single equation models. Hence the need for simultaneous equation methods
 - A typical simultaneous equation model may comprise of:
 - Endogenous variables
 - Exogenous variables
 - Structural equations
 - Definitional equations

Quantitative methods of Demand forecasting

- **Econometrics Methods : Simultaneous equation methods**
 - **Endogenous variables:**
 - Are those which the system seeks to predict
 - Are included in the model as dependent variables
 - Number of equations in the model must equal the number of endogenous variables
 - **Exogenous variables:**
 - Those that are given from outside the model

Quantitative methods of Demand forecasting

- **Econometrics Methods : Simultaneous equation methods**
 - **Structural equations:**
 - Are those equations which seek to explain the relation between a particular endogenous variable and other variables in the system
 - **Definitional equations:**
 - Those equations which specify relationships that are considered to be true by definition

Limitation of demand forecasting

- **Past data and events are not always true predictors of future**
- **Change in Fashion**
- **Consumer's psychology**
- **Uneconomical**
- **Lack of forecasting experts**
- **Lack of past data for forecasting**

Demand Forecasting - Summary

- **Summary**
 - Forecasting is an operations research technique of planning and decision making
 - Demand forecasting is a scientific and analytical estimation of demand for a product/service for a specified period of time
 - Is categorized based on
 - level of forecasting – Firm, Industry, Economy
 - Time period – Short term, medium term , long term
 - Nature of goods – Capital goods, consumer goods, etc

Demand Forecasting - Summary

- **Summary**
 - **Techniques of demand forecasting**
 - **Qualitative**
 - Consumer's Opinion Survey - Census Method, Sample Method
 - Sales force Composite
 - Expert opinion methods
 - Market Simulation
 - Test Marketing

Demand Forecasting - Summary

- **Summary**
 - **Techniques of demand forecasting**
 - **Quantitative**
 - Trend Projections - Graphical methods, Least Squares Method, ARIMA Method
 - Smoothing Techniques - Moving average, Weighted Moving average, Exponential smoothing,
 - Barometric Techniques
 - Econometrics Methods - Regression Analysis - Simple /Bivariate analysis, Non linear analysis, Multiple regression analysis

Session References

Managerial Economics: Geetika, Ghosh and Choudhury