1. **Time Series Analysis**
   1. **Estimation and Removal of Deterministic Components**
      1. **Testing the Presence of Trend, it’s Estimation and Removal**
         1. **Relative Ordering Test for the Presence of Trend**

* + - 1. **Estimation using Least Squares**

**Case 1:** Test for the presence of trend and estimate it if it’s present for consumption expenditure (in million dollars) for the United States for 1944 to 2000 using appropriate test and method. Obtain the de-trended consumption series. Also provide a simple trend based forecast for the consumption expenditure for the next 5 years.

**Case 2:** Test for the presence of trend and estimate it if it’s present for the following world development indicators for India: (time period)

1. Gross National Income (GNI) per capita based on Purchasing Power Parity (PPP) Exchange Rates (ER) measured in current USD,
2. Population Total,
3. Gross Domestic Product (GDP) (current USD),
4. Gross Domestic Product (GDP) Growth (annual %) and
5. Life Expectancy at birth (years)

Obtain the de-trended indicators.

* + - 1. **Estimation using Moving Averages**

**Case 3:** Test for the presence of trend and estimate it if it’s present for the annual sales measured in million USD for a trading company for 1994-2013. Obtain the de-trended sales. Also provide a simple trend based forecast for the annual sales for the next 3 years.

* + 1. **Testing the Presence of Seasonality, it’s Estimation and Removal**

* + - 1. **Freidman’s Test for the Presence of Seasonality**
      2. **Additive Decomposition using Least Squares**

**Case 4:** Test for the presence of trend and seasonality, and estimate them if they are present for the monthly World Airline Passengers from 1949-1960 using appropriate tests and methods. Obtain the additive decomposition of the original series viz. estimated trend, estimated seasonality, and estimated random component. Give a deterministic components based forecast for the monthly World Airline Passengers for the next 5 months.

* + - 1. **Additive Decomposition using STL in R**

**Case 5:** Test for the presence of trend and seasonality, and estimate them if they are present for the monthly World Airline Passengers from 1949-1960 using appropriate tests and methods. Obtain the additive decomposition of the original series viz. estimated trend, estimated seasonality, and estimated random component. Give a deterministic components based forecast for the monthly World Airline Passengers for the next 5 months.

**Case 6:** Test for the presence of trend and seasonality, and estimate them if they are present for the quarterly demand for an industrial good measured in thousand units for a manufacturing company for 2001-2005 using appropriate tests and methods. Obtain the additive decomposition of the original series viz. estimated trend, estimated seasonality, and estimated random component. Give a deterministic components based forecast for the quarterly demand for the industrial good for the next 2 quarters.

* + - 1. **Additive Decomposition using Decompose in R**

**Case 7:** Test for the presence of trend and seasonality, and estimate them if they are present for the monthly World Airline Passengers from 1949-1960 using appropriate tests and methods. Obtain the additive decomposition of the original series viz. estimated trend, estimated seasonality, and estimated random component. Give a deterministic components based forecast for the monthly World Airline Passengers for the next 5 months.

**Case 8:** Test for the presence of trend and seasonality, and estimate them if they are present for the monthly Wholesale Price Index (WPI) – Inflation, Base year 2004-05 for India using appropriate tests and methods. Obtain the additive decomposition of the original series viz. estimated trend, estimated seasonality, and estimated random component. Give a deterministic components based forecast for the monthly Whole Sale Price Index for the next 5 months.

* + - 1. **Comparison of different methods of Additive Decomposition in R**

**Case 9:** Compare the solutions for Case 4, Case 5 and Case 7.