Unit 4

Time Series:– arrangement on statistical data in chronological order.

$y(t) = fn(t)$ Ex– Sale $[y(t)]$ of a store.

$y(t)$ → value of the Phenomenon; t → time

Mathematical models of Time series

1) Additive Hypothesis/Model

$$y_t = T_t + S_t + C_t + R_t$$

2) Multiplicative "

$$y_t = T_t * S_t * C_t * R_t$$

3) Mixed Model

Any random combination (NO Repetition)

$$y_t = T_t C_t + S_t R_t$$

$$y_t = T_t + S_t C_t R_t$$

$$y_t = T_t + S_t + C_t R_t$$

T_t → Trend Value

S_t, C_t, R_t → seasonal, cyclic, Random fluctuation

Components of Time Series

① Secular Trend/Long Term Movement

↑ or ↓ in long period of time

{Ex– Medical Advancement, currency circulation, inflation.}

② Periodic changes/ Short Term Fluctuations

repeat after some time in a regular manner

A. Seasonal Variation

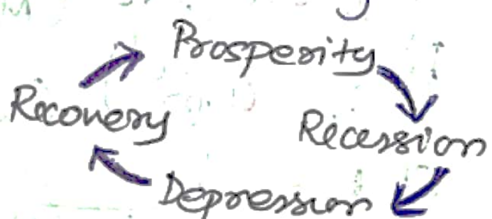
have same pattern repeated every YEAR

{Ex- Icecream sales ↓ in winter.}

B. Cyclic Variation

Oscillatory movement in time series with a period > 1 year.

Ex – Business Cycle



③ Irregular/Random component

Ex – Earthquake, CORONA.

Uses of Time Series Analysis

1) study past behaviour & predict variation

2) The segregation & study of various components to plan the execution & policy decisions

Problems of Time series An

→ What caused change?

→ study, analysis, measure INDEPENDENTLY

③ compare actual current performance & analyse it

④ predict behaviour of the phenomenon in the future

⑤ compare changes in the value of different time/places

Measurement of Trends

① Graphical Method (seeing graph & predicting)

② Method of semi-average

Finding average & predicting

③ Method of curve Fitting by principle of Least Squares – Let y_t be the value of the variable corresponding to time 't'

① straight Line $\rightarrow y_t = a + bt$

② Second Degree Parabolla $\rightarrow y_t = a + bt + ct^2$

③ k^{th} Degree Polynomial $\rightarrow y_t = a_0 + a_1 t + a_2 t^2 - - a_k t^k$

④ Exponential Curve $\rightarrow y_t = ab^t$

⑤ 2nd Degree curve fitted to the Logarithm $\rightarrow y_t = ab^t c^t$

⑥ Growth Curves $\rightarrow$

a) $y_t = a + bc^t$ (Modified Exponential curve)

b) $y_t = a.(b^{c^t})$ (Geometry curve)

c) $y_t = \frac{k}{1+e^{(a+bt)}}$ (Logistic curve)

Fitting of straight Line with least Square Method

Let $y_t = a + bt$. Taking Σ

n series value

$\Sigma y_t = \Sigma a + \Sigma bt$

$\Sigma y_t = na + \Sigma bt$ — ②

$\Sigma y_t \cdot t = nat + b\Sigma t^2 \Rightarrow \Sigma y_t t = a\Sigma t + b\Sigma t^2$ ③

Eqn ② & ③ are normal eqn for getting a & b