Dt. 20.05.2021

Assignment

0. Analyse the stock prices data alloted to you.
1. Find the trend values of annual sales in million rupees of a trading organisation by fitting an appropriate trend equation.

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Annual Sales	80	84	80	88	98	92	84	88	80	100
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Annual Sales	84	96	92	104	116	112	102	114	108	126

2. The following table gives the yield-rate of rice in West Bengal for a number of years. Determine the trend values by means of moving averages of an appropriate period.

Year	Yield of rice (Kg. per hectare)	Year	Yield of rice (Kg. per hectare)
1951-52	920	1957-58	991
52-53	971	58-59	967
53-54	1243	59-60	960
54-55	959	60-61	1184
55-56	1025	61-62	1085
56-57	1082		

3. From the following table showing the monthly receipts of state govt.s in India, obtain seasonal indices using ~~i) Ratio-to~~

(i) Ratio-to-moving average method

(ii) Ratio-to-trend method

Total Receipts of State Governments in India (Rs. Cr)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1952	23	39	82	17	18	16	20	17	12	22	20	18
1953	25	26	105	20	22	20	26	18	23	29	15	16
1954	32	36	93	21	21	22	29	21	13	27	27	21
1955	32	42	99	24	24	23	29	24	21	28	32	21

4. The seasonal indices of the sales of garments of a particular type in a certain shop are given below:

Quarter	Seasonal Index
Jan - Mar	97
Apr - June	85
July - Sep	83
Oct - Dec	135

If total sales in first quarter of a year be worth Rs. 15 K, determine how much worth of garments of this type should be kept in stock by the shop-owner to meet the demand for each of the other three quarters of the year.

Time Series Analysis
Assignment = 1

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Q (1) To fit a polynomial we calculate the first four order differences for the values of y_t in excel file :-

From the table of Δy_t, $\Delta^2 y_t$, $\Delta^3 y_t$, $\Delta^4 y_t$ we calculate the corresponding values of estimated σ^2 :-

$$V_r = \frac{\mu_2'(\Delta^r y_t)}{\binom{2r}{r}}.$$

Here,

$$V_1 = \frac{\mu_2'(\Delta y_t)}{2} = 55.26316.$$

$$V_2 = \frac{\mu_2'(\Delta^2 y_t)}{6} = 53.8141$$

$$V_3 = \frac{\mu_2'(\Delta^3 y_t)}{20} = 56.77647$$

$$V_4 = \frac{\mu_2'(\Delta^4 y_t)}{70} = 59.66071$$

Also we can say from the plot of y_t that a 2 degree polynomial will fit the ~~trend~~ time series.

The normal equations are—

$$\Sigma y_t = na + b\Sigma t + c\Sigma t^2$$

$$\Sigma t y_t = a\Sigma t + b\Sigma t^2 + c\Sigma t^3$$

$$\Sigma t^2 y_t = a\Sigma t^2 + b\Sigma t^3 + c\Sigma t^4$$

from table, $n = 20$, $\Sigma y_t = 1928$

$\Sigma t y_t = 2536$, $\Sigma t^2 y_t = 263352$

$\Sigma t = 0 = \Sigma t^3$, $\Sigma t^2 = 2660$, $\Sigma t^4 = 634676$.

To solve,

$$1928 = 20a + 0 + 2660c$$

$$2536 = 0 + 2660b + 0$$

$$263352 = 2660a + 0 + 634676c$$

$$\Rightarrow b = \frac{2536}{2660} = 0.95338$$

$a = 93.1196$, $c = 0.02466$

The trend eqn. is —

$$y_t = 93.1196 + 0.95338t + 0.02466t^2$$

[Origin is ~~at 1994~~ at the mid point of 1994 & 1995 with a unit $= \frac{1}{2}$ year]

Q(2) From the time plot of yield of rice w.r.t year we can see that the periods are 2, 3, 4.

So we take the average –

$$\frac{2+3+4}{3} = \underline{3 \text{ period}}$$

and the 3 year moving averages are given in the excel file.

Q(3)(a) Here, we apply Ratio – Moving average method for the given data → in excel file.

→ Firstly we assume, the data to follow Multiplicative Model i.e.

$$Y_t = T_t \times S_t \times C_t \times I_t$$

→ By calculating MA of period 12 we have the estimates of combined effect of trend (T_t) and cyclic variation (C_t) also the variation due to irregular factors (I_t) are reduced.

→ By dividing Y_t by MA of period 12 we get the seasonal variation (S_t).

$$\frac{Y_t}{MA(P=12)} = \frac{Y_t}{T_t \times C_t \times I_t} = S_t.$$

Seasonal indices $= S_t \times 100\%$

$$\text{Correction Factor} = \frac{1200}{\text{sum of indices}}$$

Q 3(b) Here, we apply Ratio to trend Method.

→ firstly we assume, the data to follow Multiplicative Model i.e.

$$Y_t = T_t \times S_t \times C_t \times I_t.$$

~~[Also, assume here~~

→ We fit a trend on yearly values,

Trend eq^n:-

$$y = a + bt$$

Normal eq^n:-

$$n = 9$$

$$\Sigma t = 0$$

$$\Sigma y_t = na + b\Sigma t$$

$$\Sigma t^2 = 20$$

$$\Sigma t y_t = a\Sigma t + b\Sigma t^2$$

$$\Sigma t y_t = 25.25$$

$$\Rightarrow a = \frac{\Sigma y_t}{n} = 29.396$$

$$b = \frac{\Sigma t y_t}{\Sigma t^2} = 1.2625$$

Trend eq^n:-

$$T_t = 29.396 + 1.2625\,t.$$

[Original at midpoint of 1953 & 1954 with a unit of $= \frac{1}{2}$ year].

For the year 1952, $t = -3$.

$$T_t = 29.396 - 3(1.2625)$$

$$= 25.6085$$

This is the value between June & July.

Monthly increment $= \frac{b}{6} = \frac{1.2625}{6} = 0.2104$

For July month of 1952,

$$25.6085 - \frac{1}{2} \times \text{monthly increment}$$

$$= 25.6085 - \frac{b}{12}$$

$$= 25.6085 - 0.10521$$

$$= 25.50329.$$

For January of 1952,

$$25.50329 - \left(\frac{b}{6} \times 5\right)$$

$$= 24.9512$$

New trend eq^n:

$$T_t = 24.9512 + \frac{b}{6} \times t$$

$$= 24.9512 + 0.2104.t$$

[Origin at January, 1952 unit = 1 month]

→ By dividing Y_t by trend values we have seasonal values. Now averaging them we get Average Seasonal values.

[by averaging we successfully wipe out the cyclical and Irregular variations]

→ Seasonal Index (S.I.) $= \text{avg}\left(\frac{Y_t}{T_t}\right) \times 100$

Correction factor (CF) $= \frac{1200}{\text{sum (Seasonal Indices)}}$

Adjusted Seasonal Index = S.I. × CF.

Q(4) This is a business model. So we can ~~think~~ assume Multiplicative Model here.

$$Y_t = T_t \times C_t \times S_t \times I_t.$$

The given data is one year data. So Cyclical ~~—~~ (C_t) is absent and trend (T_t) can be assumed to be ~~—~~ constant.

So,

$$Y_t = K \times S_t$$

[Irregular variation canbe ignored for only 4 data points].

$$\Rightarrow \frac{Y_t}{S_t} = K$$

Given, $Y_{t_1} = 15000$; $S_{t_1} = 97$, $S_{t_2} = 85$, $S_{t_3} = 83$, $S_{t_4} = 135$

$$\frac{Y_{t_2}}{Y_{t_1}} = \frac{S_{t_2}}{S_{t_1}} \Rightarrow Y_{t_2} = \frac{85}{97} \times 15000$$

$$= 13144.329$$

(for Apr-June)

$$\frac{Y_{t_3}}{Y_{t_1}} = \frac{S_{t_3}}{S_{t_1}} \Rightarrow Y_{t_3} = \frac{83}{97} \times 15000$$

$$= 12835.0515$$

(for July-Sept.)

$$\frac{Y_{t_4}}{Y_{t_1}} = \frac{S_{t_4}}{S_{t_1}} \Rightarrow Y_{t_4} = \frac{135}{97} \times 15000$$

$$= 20876.28866.$$

(For Oct-Dec)