Analysis of Time Series:

CHAPTER-7
ANALYSIS OF TIME SERIES

→ A series formed from a set of statistical data arranged in accordance with their time of occurance is said to be a time series.

→ A time series shows the relation between two variables, one being the time.

→ Components of Time series: (Factors affecting time series)
a. Secular Trend (size of population, volume of production)
b. Seasonal Variation (cold drinks and ice-cream highly demand in summer)
c. Cyclical fluctuation (Recession, depression)
d. Irregular fluctuation (fluctuation due to unual occurance such as war, strike, flood, earthquake, etc.)

→ Methods of Measuring Trends
1. Graphical or Free Hand curve Method
2. Semi-average Method.
3. Moving average Method
4. Least Square Method

* Least square method:

The equation of straight line trend is given by:

$$Y_c = a + bX$$

To find the value of a and b, we should solve the following two equations:

$$\Sigma Y = na + b\Sigma X \quad \text{—— (I)}$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2 \quad \text{— (II)}$$

Since, $\Sigma X = 0$

From eqn (I)

$$\Sigma Y = na + bx0$$

$$\Sigma Y = na$$

$$\therefore a = \frac{\Sigma Y}{n}$$

From eqn (II)

$$\Sigma XY = ax0 + b\Sigma X^2$$

$$\Sigma XY = 0 + b\Sigma X^2$$

$$\therefore b = \frac{\Sigma XY}{\Sigma X^2}$$

Where,

Y = actual value of Y

Y_c = computed value of Y (Trend Value)

a = Constant which is computed when $\Sigma X = 0$

b = Constant which is the change in Y corresponding to the change in X by one unit

X = time in case of time series analysis

2077 Q.No. 19 (Analytical)

Soln

Calculation of straight line trend

Year (t)	Profit (Y)	X = t-2009	X^2	XY	Trend values (Yc)	Short Term Fluctuation: Multiplicative = $Y/Y_c \times 100$	Short Term Fluctuation: Additive = Y-Yc
2006	60	-3	9	-180	61.08	98.23	-1.08
2007	72	-2	4	-144	66.15	108.84	~~-36845.85~~
2008	75	-1	1	-75	71.22	105.31	~~-30.31~~ 3.78
2009	65	0	0	0	76.29	85.20	~~-20.2~~ -11.29
2010	80	1	1	80	81.36	98.33	-1.36
2011	85	2	4	170	86.43	98.34	-1.43
2012	97	3	9	291	91.5	106.01	5.5
N=7	$\Sigma Y = 534$	$\Sigma X = 0$	$\Sigma X^2 = 28$	$\Sigma XY = 142$			

a. The straight line trend equation is given by:

$$Y = a + bX \quad \text{— (1)}$$

where, $\Sigma X = 0$

$$a = \frac{\Sigma Y}{N} = \frac{534}{7} = 76.29$$

$$b = \frac{\Sigma XY}{\Sigma X^2} = \frac{142}{28} = 5.07$$

Putting the value of a and b in eqn (1), we get

$Y_c = 76.29 + 5.07X$ is the required straight line trend.

b. Calculation of Trend Values :

$Y_c = 76.29 + 5.07X$

When,

For 2006, $X = -3$, $Y_c = 76.29 + 5.07 \times (-3) = 61.08$
For 2007, $X = -2$, $Y_c = 76.29 + 5.07 \times (-2) = 66.15$
For 2008, $X = -1$, $Y_c = 76.29 + 5.07 \times (-1) = 71.22$
For 2009, $X = 0$, $Y_c = 76.29 + 5.07 \times 0 = 76.29$
For 2010, $X = 1$, $Y_c = 76.29 + 5.07 \times 1 = 81.36$
For 2011, $X = 2$, $Y_c = 76.29 + 5.07 \times 2 = 86.43$
For 2012, $X = 3$, $Y_c = 76.29 + 5.07 \times 3 = 91.5$

d. Monthly increase in profit $= \frac{b}{12} = \frac{5.07}{12} = 0.4225\ (000)$
$= Rs.\ 422.5$

e. Cain of profit for 2015

$X = t - 2009 = 2015 - 2009 = 6$

$Y_c = 76.29 + 5.07X$
$= 76.29 + 5.07 \times 6$
$= Rs.\ 106.71\ (000)$
$= Rs.\ 106710$

2073 Q.No.16

Soln

Cal^n of straight line trend:

Year (t)	Sales (Y)	$X = t - 2009$	X^2	XY
2006	148	-3	9	-444
2007	207	-2	4	-414
2008	246	-1	1	-246
2009	329	0	0	0
2010	378	1	1	378
2011	476	2	4	952
2012	517	3	9	1551
N=7	$\Sigma Y = 2301$	$\Sigma X = 0$	$\Sigma X^2 = 28$	$\Sigma XY = 1777$

a. Using least square Method:

The straight line trend equation is given by:

$$Y = a + bx$$

Since, $\Sigma X = 0$

$$a = \frac{\Sigma Y}{N} = \frac{2301}{7} = 328.714$$

$$b = \frac{\Sigma XY}{\Sigma X^2} = \frac{1777}{28} = 63.46$$

so,

$Y_c = 328.714 + 63.46X$ is the required trend line equation.

b Sales for the year 2014 = ?

$X = t - 2009 = 2014 - 2009 = 5$

$Y_c = 328.714 + 63.46 \times 5 = 646.014$ (million)

c. Since, $b = 63.46 > 0$, it is a rising trend.

2077 Back Q.No.15

Sol^n

Calculation of trend values

Month (t)	Profit (Y)	$X = t - 5$	X^2	XY	Trend values (Y_c)
Jan = 1	60	-4	16	-240	60.02
Feb = 2	72	-3	9	-216	65.57
March = 3	75	-2	4	-150	71.12
April = 4	65	-1	1	-65	76.67
May = 5	80	0	0	0	82.22
June = 6	85	1	1	85	87.77
July = 7	95	2	4	190	93.32
Aug. = 8	103	3	9	309	98.87
Sept. = 9	105	4	16	420	104.42
N = 9	$\Sigma Y = 740$	$\Sigma X = 0$	$\Sigma X^2 = 60$	$\Sigma XY = 333$	

Using least square method:

The trend line equation is given by:

$Y = a + bx$

Since, $\Sigma X = 0$

$$a = \frac{\Sigma Y}{N} = \frac{740}{9} = 82.22$$

$$b = \frac{\Sigma XY}{\Sigma X^2} = \frac{333}{60} = 5.55$$

$\therefore$ $Y_c = 82.22 + 5.55X$ is the required equation.

Cain of profit for December:

December $(t) = 12$

$X = t - 5 = 12 - 5 = 7$

$Y_c = 82.22 + 5.55 \times 7 = 121.07$ (000)

Cain of trend values:

For Jan:	$X = -4$	$Y_c = 82.22 + 5.55 \times (-4) = 60.02$
For Feb:	$X = -3$	$Y_c = 82.22 + 5.55 \times (-3) = 65.57$
For March:	$X = -2$	$Y_c = 82.22 + 5.55 \times (-2) = 71.12$
For April:	$X = -1$	$Y_c = 82.22 + 5.55 \times (-1) = 76.67$
For May:	$X = 0$	$Y_c = 82.22 + 5.55 \times 0 = 82.22$
For June:	$X = 1$	$Y_c = 82.22 + 5.55 \times 1 = 87.77$
For July:	$X = 2$	$Y_c = 82.22 + 5.55 \times 2 = 93.32$
For Aug:	$X = 3$	$Y_c = 82.22 + 5.55 \times 3 = 98.87$
For Sep:	$X = 4$	$Y_c = 82.22 + 5.55 \times 4 = 104.42$

2069 Q.No.9

Soln

= Calculation of Trend values

Year (t)	Sales (in 000) (Y)	$X = 2(t - 2007.5)$	X^2	XY	Trend values (Y_c)
2005	12	-5	25	-60	10
2006	13	-3	9	-39	12.8
2007	14	-1	1	-14	15.6
2008	15	1	1	15	18.4
2009	22	3	9	66	21.2
2010	26	5	25	130	24
N=6	$\Sigma Y = 102$	$\Sigma X = 0$	$\Sigma X^2 = 70$	$\Sigma XY = 98$	

Using least square method:

The straight line trend equation is given by:

$$Y = a + bX$$

Since $\Sigma X = 0$

$$a = \frac{\Sigma Y}{N} = \frac{102}{6} = 17$$

$$b = \frac{\Sigma XY}{\Sigma X^2} = \frac{98}{70} = 1.4$$

$\therefore Y_c = 17 + 1.4X$ is the required equation.

Calculation of Trend values:

$Y_c = 17 + 1.4X$

For 2005, $X = -5$, $Y_c = 17 + 1.4 \times (-5) = 10$
For 2006, $X = -3$, $Y_c = 17 + 1.4 \times (-3) = 12.8$
For 2007, $X = -1$, $Y_c = 17 + 1.4 \times (-1) = 15.6$
For 2008, $X = 1$, $Y_c = 17 + 1.4 \times 1 = 18.4$
For 2009, $X = 3$, $Y_c = 17 + 1.4 \times 3 = 21.2$
For 2010, $X = 5$, $Y_c = 17 + 1.4 \times 5 = 24$

Cal^n of sales for 2012

$X = 2(t - 2007.5) = 2(2012 - 2007.5) = 9$

$Y_c = 17 + 1.4 \times 9 = 29.6$ (in 000)

$= 29.6 \times 1000 = Rs.\ 29600$

2065 Q.No.6

Sol^n

Years (t)	Sales in (000) (Y)	$X = 2(t - 2000.5)$	X^2	XY
1998	40	-5	25	-200
1999	52	-3	9	-156
2000	54	-1	1	-54
2001	52	1	1	52
2002	50	3	9	150
2003	53	5	25	265
N=6	$\Sigma Y = 301$	$\Sigma X = 0$	$\Sigma X^2 = 70$	$\Sigma XY = 57$

Using least square Method,

The straight line trend equation is given by:

$$Y_c = a + bX$$

Since, $\Sigma X = 0$

$$a = \frac{\Sigma Y}{N} = \frac{301}{6} = 50.167$$

$$b = \frac{\Sigma XY}{\Sigma X^2} = \frac{57}{70} = 0.8142$$

$\therefore Y_c = 50.167 + 0.8142X$ is the required equation.

Cal^n of sales for 2004:

$$X = 2(t - 2000.5).$$
$$= 2(2004 - 2000.5) = 7$$

$\therefore Y_c = 50.167 + 0.8142 \times 7 = 55.8664$ (in 000)
$= 55.8664 \times 1000$
$= Rs. 55,866.4$

Cal^n of sales for 2005:

$$X = 2(t - 2000.5)$$
$$= 2(2005 - 2000.5)$$
$$= 9$$

$\therefore Y_c = 50.167 + 0.8142 \times 9 = 57.4948$ (in 000)

$= 57.4948 \times 1000$

$=$ Rs. 57,494.8

The monthly basis trend equation is given by:

$$Y_c = \frac{50.167}{12} + \frac{0.8142}{12 \times 12} X$$

$$= 4.181 + 0.00565X$$

2077 Q.No.1 (Brief)

Sol^n

Given:

$X = t - 2009$

$Y = 42 + 3X$

Sales for 2016 = ?

$X = t - 2009 = 2016 - 2009 = 7$

$\therefore Y_c = 42 + 3 \times 7$

$= 42 + 21$

$= 63$ (in lakh)

$= 63$ lakhs

* Seasonal Index:

1. Simple Average Method
2. Multiplicative Model

Simple Average Method:

$$\text{Seasonal Index (SI)} = \frac{\text{Average}}{\text{Average of Average}} \times 100$$

where,

$$\text{Average} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

2074 Old Q. No. 6

Soln

Calculation of Seasonal Indices

Year	Spring	Summer	Fall	Winter
2012	8	10	7	5
2013	9	10	7	6
2014	10	11	7	6
2015	10	12	8	7
2016	11	13	9	8
Total	48	56	38	32
Average ($\bar{x}$)	9.6	11.2	7.6	6.4
SI				

Working Note:

$$\text{Average of Average} = \frac{\text{Sum of averages}}{\text{no. of average}}$$

$$= \frac{9.6+11.2+7.6+6.4}{4}$$

$$= 8.7$$

Calⁿ of Seasonal Index:

$$\text{Seasonal Index (SI)} = \frac{\text{Average}}{\text{Average of Average}} \times 100$$

$$\text{Spring} = \frac{9.6}{8.7} \times 100 = 110.34$$

$$\text{Summer} = \frac{11.2}{8.7} \times 100 = 128.74$$

$$\text{Fall} = \frac{7.6}{8.7} \times 100 = 87.36$$

$$\text{Winter} = \frac{6.4}{8.7} \times 100 = 73.56$$

The seasonal indices of spring and summer are higher than the base index whereas of fall and winter are lower than the base index.

2072(11) Q.No. 14 b.

Sol^n

Calculation of seasonal indices

Quarter	1988	1989	1990	1991	Total	Average($\bar{x}$)	SI
I	3.5	3.5	3.5	4.0	14.5	3.625	92.8
II	3.9	4.1	3.9	4.6	16.5	4.125	105.6
III	3.4	3.7	3.7	3.8	14.6	3.65	93.44
IV	3.6	4.8	4.0	4.5	16.9	4.225	108.16

$$\text{Average of Average} = \frac{\text{Sum of Averages}}{\text{Number of averages}} = \frac{3.625+4.125+3.65+4.225}{4}$$
$$= 3.90625$$

Cal^n of Seasonal Index (SI)

$$\text{Seasonal Index} = \frac{\text{Average}}{\text{Average of Average}} \times 100$$

$$\text{Quarter I} = \frac{3.625}{3.90625} \times 100 = 92.8$$

$$\text{Quarter II} = \frac{4.125}{3.90625} \times 100 = 105.6$$

$$\text{Quarter III} = \frac{3.65}{3.90625} \times 100 = 93.44$$

$$\text{Quarter IV} = \frac{4.225}{3.90625} \times 100 = 108.16$$

2072 old Q.No.9

Soln

Calculation of Seasonal Indices

Quarter	2008	2009	2010	2011	Total	Average($\bar{x}$)	SI
I	–	3.5	3.5	4	11	3.667	93.18
II	3.9	4.1	3.9	4.6	16.5	4.125	104.82
III	3.4	3.7	3.7	3.8	14.6	3.65	92.74
IV	3.6	4.8	4.5	–	12.9	4.3	109.26

$$\text{Average of Average} = \frac{\text{Sum of Averages}}{\text{Number of Averages}} = \frac{3.667+4.125+3.65+4.3}{4}$$
$$= 3.9355$$

Cal^n of Seasonal Index (SI)

$$\text{Seasonal Index (SI)} = \frac{\text{Average}}{\text{Average of Average}} \times 100$$

$$\text{Quarter I} = \frac{3.667}{3.9355} \times 100 = 93.18$$

$$\text{Quarter II} = \frac{4.125}{3.9355} \times 100 = 104.82$$

$$\text{Quarter III} = \frac{3.65}{3.9355} \times 100 = 92.74$$

$$\text{Quarter IV} = \frac{4.3}{3.9355} \times 100 = 109.26$$

∴ Quarter IV is seasonally high.

2072 old Q.No.9

Soln

Calculation of Seasonal Indices

Quarter	2008	2009	2010	2011	Total	Average($\bar{x}$)	SI
I	–	3.5	3.5	4	11	3.667	93.18
II	3.9	4.1	3.9	4.6	16.5	4.125	104.82
III	3.4	3.7	3.7	3.8	14.6	3.65	92.74
IV	3.6	4.8	4.5	–	12.9	4.3	109.26

$$\text{Average of Average} = \frac{\text{Sum of Averages}}{\text{Number of Averages}} = \frac{3.667+4.125+3.65+4.3}{4}$$
$$= 3.9355$$

Cal^n of Seasonal Index (SI)

$$\text{Seasonal Index (SI)} = \frac{\text{Average}}{\text{Average of Average}} \times 100$$

$$\text{Quarter I} = \frac{3.667}{3.9355} \times 100 = 93.18$$

$$\text{Quarter II} = \frac{4.125}{3.9355} \times 100 = 104.82$$

$$\text{Quarter III} = \frac{3.65}{3.9355} \times 100 = 92.74$$

$$\text{Quarter IV} = \frac{4.3}{3.9355} \times 100 = 109.26$$

∴ Quarter IV is seasonally high.

Now,

Adjusted SI = Unadjusted SI × K

Quarter I = 105.4 × 0.998253 = 105.21

Quarter II = 95.47 × 0.998253 = 95.30

Quarter III = 101.5 × 0.998253 = 101.32

Quarter IV = 98.33 × 0.998253 = 98.17

∴ Sum of Adjusted SI = 105.21 + 95.30 + 101.32 + 98.17 = 400

2067 Q.No.9

Soln

Calculation of Seasonal Indices using Multiplicative Model

	Trend Eliminated Values				
Year	Q_1	Q_2	Q_3	Q_4	
2001	-	-	85.21	90.25	
2002	128.12	91.72	85.13	106.14	
2003	117.45	92.75	83.02	104.29	
2004	120.48	92.03	-	-	
Total	366.05	276.49	253.36	300.68	Total
Average (Unadjusted SI)	122.02	92.16	84.45	100.23	398.86
Adjusted SI	122.37	92.42	84.69	100.52	400

Since, Sum of Unadjusted SI = 398.86 ≠ 400 adjustment is required.

$$\text{Adjustment Factor (K)} = \frac{400}{\text{Sum of Unadjusted SI}}$$

$$= \frac{400}{398.86}$$

$$= 1.00286$$

Now,

Adjusted SI = Unadjusted SI × K

For Q_1 = 122.02 × 1.00286 = 122.37

For Q_2 = 92.16 × 1.00286 = 92.42

For Q_3 = 84.45 × 1.00286 = 84.69

For Q_4 = 100.23 × 1.00286 = 100.52

∴ Sum of adjusted SI = 122.37 + 92.42 + 84.69 + 100.52 = 400

2061 Q.NO.6 Partial

Soln

Calculation of seasonal indices using Simple Method

Month	2001	2002	2003	Total	Average($\bar{X}$)	SI
Baisakh	12	15	16	43	14.33	104.88
Jestha	11	14	15	40	13.33	97.56
Ashadh	10	13	14	37	12.33	90.24
Shrawan	14	16	16	46	15.33	112.20
Bhadra	15	16	15	46	15.33	112.20
Aswin	15	15	17	47	15.67	114.69
kartik	16	17	16	49	16.33	119.52
Mangsir	13	12	13	38	12.67	92.73
Poush	11	13	10	34	11.33	82.92
Magh	10	12	10	32	10.67	78.09
Falgun	12	13	11	36	12	87.83
Chaitra	15	14	15	44	14.67	107.37

$$\text{Average of Average} = \frac{\text{Sum of averages}}{\text{no. of averages}} = \frac{163.96}{12} = 13.6633$$

Calculation of seasonal index:

$$SI = \frac{\text{Average}}{\text{Average of Average}} \times 100$$

$$\text{Baisakh} = \frac{14.33}{13.6633} \times 100 = 104.88$$

$$\text{Jestha} = \frac{13.33}{13.6633} \times 100 = 97.56 \quad \text{and so on...}$$

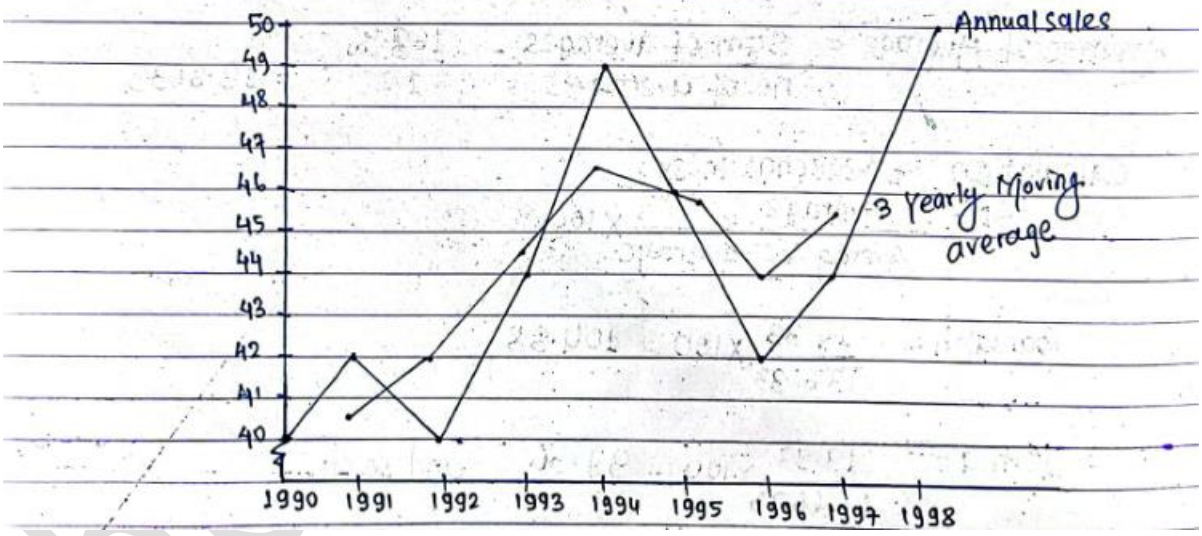
* Moving Average:

2066 Q. NO. 10

Sol^n:

Calculation of 3-Yearly Moving averages

Year	Annual Sales (000)	3-Yearly Moving Total	3-Yearly Moving average
1990	40	–	–
1991	42	122	40.67
1992	40	126	42
1993	44	133	44.33
1994	49	139	46.33
1995	46	137	45.67
1996	42	132	44
1997	44	136	45.33
1998	50	–	–

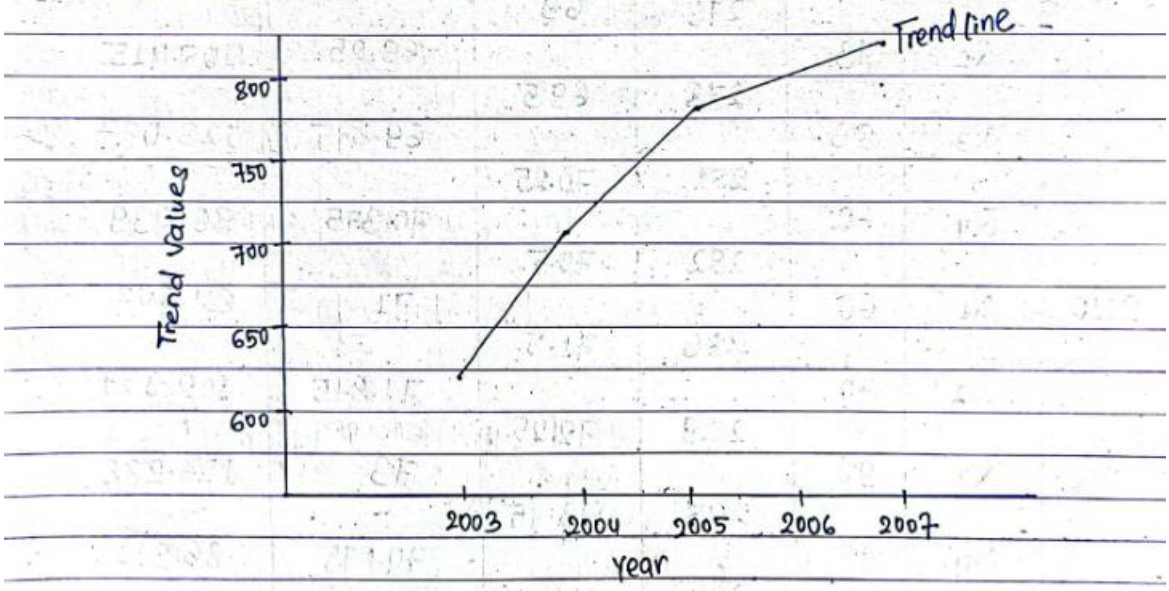


2072 old (11) Q.No.9

Sol^{n}

Calculation of 4-yearly centered moving average and short term fluctuations

Year (t)	Profit (000) (Y)	4-Years Moving Total	4-Years Moving average	Centered Moving Average (Y_c)	short-term fluctuation $Y - Y_c$
2001	506	-	-	-	-
2002	620	-	-	-	-
2003	673	2387	596.75	620.5	52.5
2004	588	2577	644.25	706.25	-118.25
2005	696	3073	768.25	776.375	- 80.375
2006	1116	3138	784.5	793.875	322.125
2007	738	3213	803.25	-	-
2008	663	-	-	-	-



2074 Q.No.17 (Analytical)

Soln

Calculation of trend values using 4-quarterly moving average

Year	Quarter	value (Y)	4-quarterly moving total	4-quarterly moving average	centered moving average (Y_c)	Trend elimination value = $\frac{Y}{Y_c} \times 100$
2008	Q_1	56				
	Q_2	70				
			266	66.5		
	Q_3	80			66.625	120.075
			267	66.75		
	Q_4	60			67.125	89.385
			270	67.5		
2009	Q_1	57			68.25	83.516
			276	69		
	Q_2	73			69.25	105.415
			278	69.5		
	Q_3	86			69.875	123.077
			281	70.25		
	Q_4	62			70.375	88.099
			282	70.5		
2010	Q_1	60			71	84.507
			286	71.5		
	Q_2	74			71.875	102.957
			289	72.25		
	Q_3	90			73	123.288
			295	73.75		
	Q_4	65			74.875	86.811
			304	76		

2011	Q_1	66			75.625	87.273
			301	75.25		
	Q_2	83			75.5	109.934
			303	75.75		
	Q_3	87				
	Q_4	67				

Calculation of Seasonal Indicies (SI)

Year	Trend Eliminated Values				
	Q_1	Q_2	Q_3	Q_4	
2008	-	-	120.075	89.385	
2009	83.516	105.415	123.077	88.099	
2010	84.507	102.957	123.288	86.811	
2011	87.273	109.934	-	-	
Total	255.296	318.306	366.44	264.295	Total
Average (Unadjusted SI)	85.099	106.102	122.147	88.098	401.446
Adjusted SI	84.792	105.720	121.707	87.781	400

Working Note:

Since, Sum of Unadjusted SI = 401.446 ≠ 400, the adjustment is requisted

$$\text{Adjustment Factor}(k) = \frac{400}{\text{Sum of Unadjusted SI}}$$

$$= \frac{400}{401.446} = 0.996398$$

Calculation of Seasonal Index (SI)

Adjusted SI = Unadjusted SI x k

For Q_1 = 85.099 X 0.996398 = 84.792

For Q_2 = 106.102 X 0.996398 = 105.720

For Q_3 = 122.147 X 0.996398 = 121.707

For Q_4 = 88.098 X 0.996398 = 87.781

∴ Sum of adjusted SI = 84.792 + 105.720 + 121.707 + 87.781 = 400

Decision:

The occupancy rate of total rooms in Q_1 and Q_4 are lower than the base index by 15.208% and 12.219% respectively.

The occupancy rate of total rooms in Q_2 and Q_3 are higher than the base level by 5.72% and 21.707% respectively.

2072 Q.No.18 (Analytical)

Soln

To justify in which company we should invest our money, we should to calculate the growth rate of net profit as well as consistency of net profit.

Computation Table:

Year			Company A			Company B		
(t)	$X = t - 2004$	X^2	Y_A	XY_A	Y_A^2	Y_B	XY_B	Y_B^2
2001	-3	9	16	-48	256	16	-48	256
2002	-2	4	32	-64	1024	16	-32	256
2003	-1	1	40	-40	1600	22	-22	484
2004	0	0	24	0	576	36	0	1296
2005	1	1	40	40	1600	40	40	1600
2006	2	4	32	64	1024	44	88	1936
2007	3	9	88	264	7744	48	144	2304
$N=7$	$\Sigma X = 0$	$\Sigma X^2 = 28$	$\Sigma Y_A = 272$	$\Sigma XY_A = 216$	$\Sigma Y_A^2 = 13824$	$\Sigma Y_B = 222$	$\Sigma XY_B = 170$	$\Sigma Y_B^2 = 8132$

Calculation of annual growth rate:

Since $\Sigma X = 0$,

$$b_A = \frac{\Sigma XY_A}{\Sigma X^2} = \frac{216}{28} = 7.71 \text{ (in million)}$$

$$b_B = \frac{\Sigma XY_B}{\Sigma X^2} = \frac{170}{28} = 6.07 \text{ (in million)}$$

Since, the annual growth rate of company A is greater than that of company B, I would invest in company A due to higher growth rate in Net profit.

Calculation of coefficient of variation of net profit:

Company 'A'

$$\text{Mean } (\bar{Y}_A) = \frac{\Sigma Y_A}{N} = \frac{272}{7} = 38.86 \text{ (in million)}$$

$$\text{Standard Deviation } (\sigma_A) = \sqrt{\frac{\Sigma Y_A^2}{N} - \left(\frac{\Sigma Y_A}{N}\right)^2}$$

$$= \sqrt{\frac{13824}{7} - \left(\frac{272}{7}\right)^2} = 21.56 \text{ (in million)}$$

$$\text{Coefficient of Variation } (CV_A) = \frac{\sigma_A}{\bar{Y}_A} \times 100$$

$$= \frac{21.56}{38.86} \times 100$$

$$= 55.48\%$$

Company 'B'

Mean $(\bar{Y}_B) = \frac{\Sigma Y_B}{N} = \frac{222}{7} = 31.71$ (in million)

Standard Deviation $(\sigma_B) = \sqrt{\frac{\Sigma Y_B^2}{N} - \left(\frac{\Sigma Y_B}{N}\right)^2}$

$= \sqrt{\frac{8132}{7} - \left(\frac{222}{7}\right)^2}$

$= 12.49$ (in million)

Coefficient of Variation $(CV_B) = \frac{\sigma_B}{\bar{Y}_B} \times 100$

$= \frac{12.49}{31.71} \times 100$

$= 39.39\%$

Based on Consistency of Net profit, we would invest in company B due to lower CV.