V. Activities

1) Complete the following table using 5 yearly moving average method.

Year	Production	5 yearly moving total	5 yearly moving average (trend value)
2004	620	—	-
2005	713	-	-
2006	833	3811	762.2
2007	835	3936	787.2
2008	810	3949	789.8
2009	745	3922	784.4
2010	726	3944	788.8
2011	803	-	-
2012	860	-	

2) Let us fit equation of trend line for above data.

Let the equation of trend line be $y = a + bx$ ... (i)

Here n = 9 (odd), one middle year 2008 and h = 1

Year	y	x	xy	x^2
2004	620	-4	-2480	16
2005	713	-3	-2139	9
2006	833	-2	-1666	4
2007	835	-1	-835	1
2008	810	0	0	0
2009	745	1	745	1
2010	726	2	1452	4
2011	803	3	2409	9
2012	860	4	3440	16
Total	6945	6	926	60

The normal equations are

$\Sigma y = na + b \Sigma x$

As, $\Sigma x = 0$, $a = \frac{\sum y}{n} = \frac{6945}{9} = 771.67$

Also, $\Sigma xy = a\,\Sigma x + b\,\Sigma x^2$

As, $\Sigma x = 0$, $b = \frac{\Sigma xy}{\sum x^2} = \frac{926}{60} = 15.43$

∴ The equation of trend line is $y = 771.67 + 15.43x$.

3) Let us fit equation of trend line for the data given below.

Year	Production	x	xy	x^2
2006	19.3	-9	-173.7	81
2007	20.9	-7	-146.3	49
2008	17.8	-5	-89	25
2009	16.1	-3	-48.3	9
2010	17.6	-1	-17.6	1
2011	17.8	1	17.8	1
2012	18.3	3	54.9	9
2013	17.3	5	86.5	25
2014	21.4	7	149.8	49
2015	19.5	9	175.5	81
Total	186	0	9.6	330

Let the equation of trend line be $y = a + bx$ ..... (i)

Here n = 10 (even), two middle years are 2010 and 2011, and h = 1 The normal equations are $\Sigma y = na + b\Sigma x$

As $\Sigma x = 0$, $a = \frac{\Sigma y}{n} = \frac{186}{10} = 18.6$

Also, $\Sigma xy = a\Sigma x + b\Sigma x^2$

As $\Sigma x = 0$, $b = \frac{\Sigma xy}{x^2} = \frac{8.6}{330} = 0.029$

Substitute values of a and b in equation (i) the equation of trend line is

$y =$ 18.6 + (0.029) x

To find trend value for the year 2016, put x = 11 in the above equation.

$y = 18.6 + (0.029)$ (11)

$= 18.6 + 0.319$

$= 18.919$

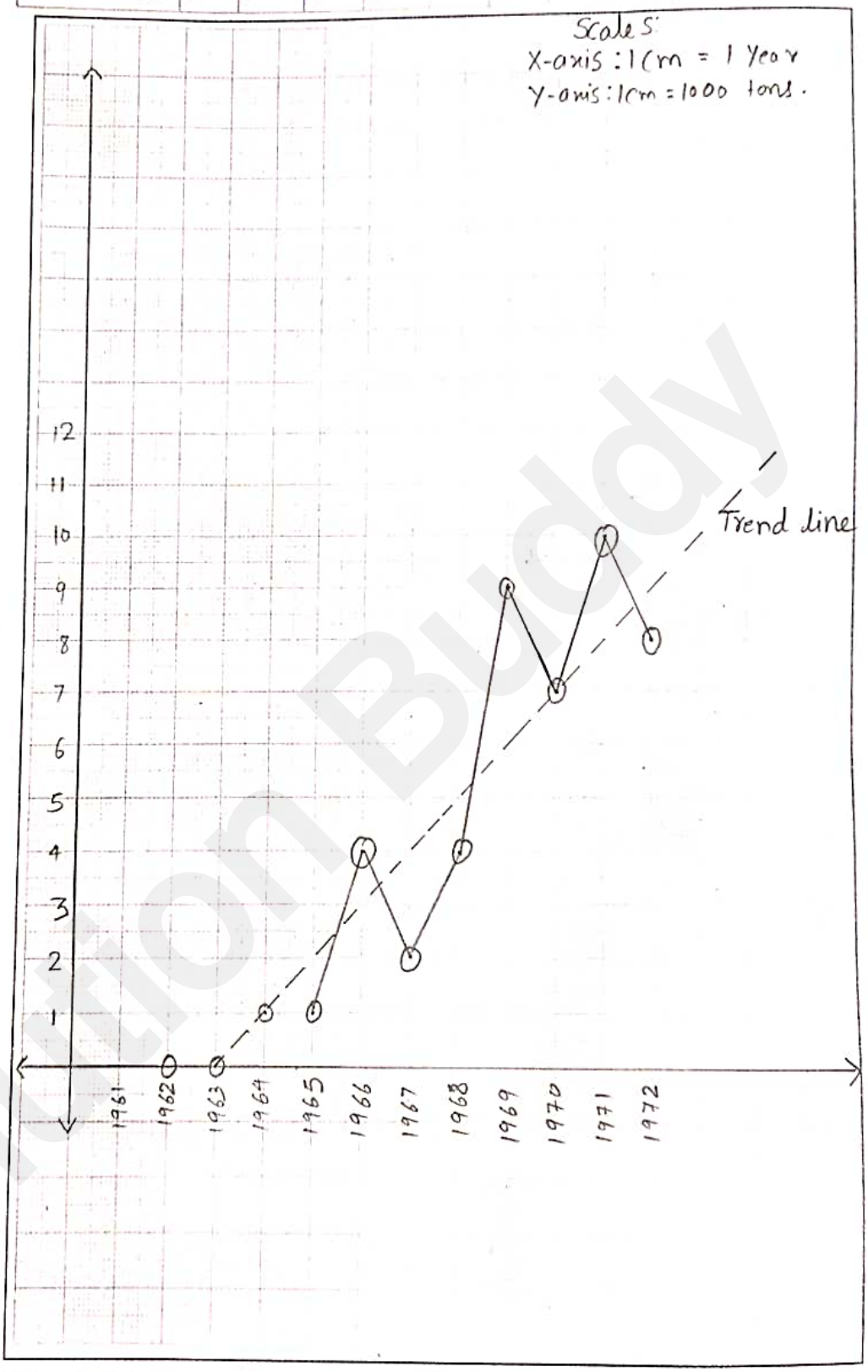
4) Complete the table using 4 yearly moving average method.

Year	Production	4 yearly moving total	4 yearly centred total	4 yealy centred moving avg (trend values)
2006	19.3		-	
		-		
2007	20.9			-
		74.1		
2008	17.8		146.5	18.3125
		72.4		
2009	16.1		141.7	17.7125
		69.3		
2010	17.6		139.1	17.3875
		69.8		
2011	17.8		140.8	17.6
		71		
2012	18.3		145.8	18.225
		74.8		
2013	17.3	-	151.3	18.9125
		76.5		
2014	21.4		-	
2015	19.5	-		

B. Solve the Following

Q.1 Following data gives the production of bleaching powder ('000 tons) for the year 1962 to 1972. Fit a trend line by graphical method for the following data.

YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
PRODUCTION	0	0	1	1	4	2	4	9	7	10	8



Q.2 Obtain the trend line for the above data using 3 yearly moving Average.

YEAR	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
PRODUCTION	0	4	4	2	6	8	5	9	4	10	10

Year t	Production Y_t	3-Yearly moving total	3-Yearly Moving avg. - Trend Value
1976	0	-	-
1977	4	8	2.6667
1978	4	10	3.3333
1979	2	12	4.0000
1980	6	16	5.3333
1981	8	19	6.3333
1982	5	22	7.3333
1983	9	18	6.0000
1984	4	23	7.6667
1985	10	24	8.0000
1986	10	-	-

Q.3 Fit a trend line by the method of least squares to the time series. Also, obtain the trend value for the number of crimes in the year 1993.

Year	Number of crimes ('000)
1981	40
1982	42
1983	43
1984	42
1985	44
1986	44
1987	43
1988	46
1989	47
1990	45
1991	46

In the given Problem, $n = 11$ (odd), middle t-value is 1986, $h = 1$, $u = \frac{t - \text{middle value}}{h} = \frac{t - 1986}{1} = t - 1986$

We obtain the following table.

Year t	Production Y_t	$u = t - 1986$	u^2	$u \cdot Y_t$	Trend Value $Y_t = a' + b'u$
1981	40	-5	25	-200	41.0457
1982	42	-4	16	-168	41.6002
1983	43	-3	9	-129	41.1547
1984	42	-2	4	-84	42.7092
1985	44	-1	1	-44	43.2637
1986	44	0	0	0	43.8182
1987	43	1	1	43	44.3727
1988	46	2	4	92	44.9272
1989	47	3	9	141	45.4817
1990	45	4	16	180	46.0362
1991	46	5	25	230	46.5907
Total	482	0	110	61	-

From the table, $\Sigma Y_t = 482$, $\Sigma u = 0$, $\Sigma u^2 = 110$, $\Sigma u \cdot Y_t = 61$

The two normal eq.^{n} are $\Sigma Y_t = na' + b'\Sigma u$, $\Sigma u \cdot Y_t = a'\Sigma u + b'\Sigma u^2$

$482 = 11a' + b'(0)$ ....(i) & $61 = a'(0) + b'(110)$ — (ii)

From (i), $a' = \frac{482}{11} = 43.8182$

From (ii), $b' = \frac{61}{110} = 0.5545$

∴ The equation of trend line is $Y = a' + b'u$

i.e. $Y = 43.8182 + 0.5545\,u$; where $u = t - 1986$

For $t = 1993$, $u = 1993 - 1986 = 7$

∴ $Y = 43.8182 + 0.5545(7) = 47.6996$

Sign of Teacher :