17 December 2023 10:13 PM

Q Determine trend by 3-yearly moving average method from the following data relating to profit of an industry.

Soln

Year	Profit	3-Year moving total	3-Year moving avg
1981	85	–	–
1982	88	263	263/3 =
1983	90	273	273/3 =
1984	95	282	282/3 =
1985	97	285	285/3 =
1986	93	–	–

4-years moving average method:

Q2

Year	Production	4-Year moving total	2-Year moving total	4-Year moving average
1975	115	–		
1976	180	–		
1977	108	502	1008	1008/8
1978	99	506	1021	1021/8
1979	119	515	1071	1071/8
1980	189	556	1132	1132/8
1981	149	576	–	
1982	119	–		

vvv Imp **Fitting a straight line**

① Fit a straight line trend to the following

(1) Fit a straight line trend to the following data:

Year	Sales (y)	x	x^2	xy	trend value $y = 135 + 9.8x$
1989	110	-3	9	-330	
90	121	-2	4	-242	
91	116	-1	1	-116	
92	136	0	0	0	
93	140	+1	1	140	
94	157	+2	4	314	
1995	170	+3	9	510	
	$\Sigma y = 950$	$\Sigma x = 0$	$\Sigma x^2 = 28$	$\Sigma xy = 276$	

Let the linear trend line be $y = a + bx$ — (1)

$n = 7$ (odd no. of years)

we will assume Year 1992 as origin.

We will determine the value of a and b by using the following normal equations.

$$\Sigma y = na + b\Sigma x \quad — (2)$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad — (3)$$

Substituting the values in (2) and (3),

$$950 = 7a + b \times 0$$

or, $7a = 950$

or, $7a = 950$

$$\boxed{a = 950/7 = 135.71}$$

putting 'a' in (2) we get,

$$276 = a \times 0 + b \times 28$$

$$28b = 276$$

$$\boxed{b = \frac{276}{28} = 9.857}$$

$\therefore$ The ~~[illegible]~~ Linear trend line is

ans $\boxed{y = 135.71 + 9.857x}$

In case of even number of years

Year	Production (Y)	x	x^2	xy
1980	75	-5		
1981	83	-3		
1982 -1	109	-1		
1983 1	129	1		
1984 3	134	3		
1985 5	148	5		
	$\Sigma y =$	$\Sigma x =$	Σx^2	Σxy

	$\Sigma y =$	$\Sigma x =$	Σx^2	Σxy

$n = 6$ (even number of years).

~~Straight li~~ Linear trend line

$$y = a + bx \quad \text{--- (1)}$$

where a and b can be determined using following normal equations.

$$\Sigma y = na + b\Sigma x \quad \text{--- (2)}$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad \text{--- (3)}$$

— * —

Theory of Probability

Important formulas:

(1) Classical defn. of probability

$$P(E) = \frac{m}{n}$$

m = no. of favourable event

n = no. of outcomes.

ex: What is the probability of getting an even number when a dice is thrown once.

All possible outcome (n) = 6

favourable event (m) = 3

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favourable event (m) = 3

$$P(E) = \frac{3}{6} = 1/2 \text{ (ans)}.$$

$A \cap B = 0$

② Total probability in case of mutually exclusive events

A and B are two events,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

0

$$\boxed{P(A \cup B) = P(A) + P(B)}$$

③ Total probability in case of non-mutually exclusive events

$$\boxed{P(A \cup B) = P(A) + P(B) - P(A \cap B)}$$

④ Independent events A and B

$$\boxed{P(A \cap B) = P(A) . P(B)}$$

⑤ Conditional probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \checkmark$$

and $P(B|A) = \frac{P(A \cap B)}{P(A)} \checkmark$

and $P(B|A) = \frac{P(A \cap B)}{P(A)}$ ✓

(6) Baye's Theorem

$$P(A_i|B) = \frac{P(A_i)\,P(B|A_i)}{\sum_{j=1}^{n} P(A_j)\,P(B|A_j)}$$

$A_1 \; A_2 \; A_3$

Q Three boxes of the same appearance have the following proportions of black and white balls:

Box I : 5 B and 3 W
Box II : 6 B and 2 W
Box III : 3B and 5 W

one of the box selected at random and one ball draw.

(i) what is the probability that the ball is black.

(ii) Given the ball is black find the probability that it came from box III.

Let A_1, A_2 and A_3 be the event of selecting Box I, II & III resp.
and B is the event of drawing a black ball.

and B is the event of drawing a black ball.

A_1	A_2	A_3
5B, 3W	6B, 2W	3B, 5W
I	II	III

$P(B/A_1) = \frac{5}{8}$; $P(B/A_2) = \frac{6}{8}$; $P(B/A_3) = 3/8$

$P(A_1) = P(A_2) = P(A_3) = 1/3$

(i) $P(B) = P(A_1)\cdot P(B/A_1) + P(A_2)P(B/A_2) + P(A_3)P(B/A_3)$

$$= \frac{1}{3}\times\frac{5}{8} + \frac{1}{3}\times\frac{6}{8} + \frac{1}{3}\times\frac{3}{8}$$

$$= \frac{1}{3}\left[\frac{5}{8} + \frac{6}{8} + \frac{3}{8}\right]$$

$$= \frac{1}{3}\times\frac{\cancel{14}^{7}}{\cancel{8}_{4}} = \frac{7}{12}$$

(iii) $P(A_3|B) = \dfrac{P(A_3)\,P(B|A_3)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2) + P(A_3)P(B|A_3)}$

$$= \frac{\frac{1}{\cancel{3}}\times\frac{\cancel{3}}{8}}{7/12}$$

$= 1 \times \ldots 3 = \underline{3}$ (ans)

$$= \frac{1}{\cancel{8}_{2}} \times \frac{\cancel{12}^{3}}{7} = \frac{3}{14} \quad \text{(ans)}$$