NDA 1 2025

LIVE

MATHS

STATISTICS

CLASS 2

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Crack
EXAMS

COEFFICIENT OF VARIATION

It is sometimes useful to describe variability by expressing the standard deviation as a proportion of mean, usually a percentage. The formula for it as a percentage is

$$\text{Coefficient of variation} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

CORRELATION ANALYSIS

If two quantities vary in such a way that fluctuation in one are accompanied by fluctuation in other, these quantities are said to be correlated. The statistical tool by which the relationship between two or more than two variables studied is called correlation.

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COVARIANCE

The covariance between two variables

x and y with n pairs of observations

$x_1, x_2, x_3 \dots x_n$ — Mean $= \bar{x}$

$y_1, y_2, y_3 \dots y_n$ — Mean $= \bar{y}$

$$\text{Cov}(x, y) = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{n} = \left(\frac{\Sigma x_i y_i}{n} - \bar{x}\,\bar{y}\right)$$

KARL PEARSON CORRELATION COEFFICIENT

(#)

$$r=\frac{\operatorname{Cov}(x,y)}{\sqrt{\operatorname{Var}(x).\operatorname{Var}(y)}}=\frac{\Sigma\left(x_i-\bar{x}\right)\left(y_i-\bar{y}\right)}{\sqrt{\Sigma\left(x_i-\bar{x}\right)^2\cdot\Sigma\left(y_i-\bar{y}\right)^2}}$$

represented by 'r'.

$$=\frac{n\Sigma xy-\left(\Sigma x\right)\left(\Sigma y\right)}{\sqrt{\left\{n\Sigma x^2-\left(\Sigma x\right)^2\right\}\left\{n\Sigma y^2-\left(\Sigma y\right)^2\right\}}}$$

CHARACTERISTICS OF CORRELATION COEFFICIENT

$-1 \leq r \leq 1$

If $r = -1$, then there is perfect negative correlation between x and y i.e. corresponding to an increase (or decrease) in one variable, there is a proportional decrease (or increase) in the other variable.

(inversely related)

If $r = 1$, then there is perfect positive correlation between x and y i.e. corresponding to an increase (or decrease) in one variable, there is proportional increase (or decrease) in the other variable.

(directly related)

If $r = 0$, then x and y are not correlated i.e. the changes in one variable are not followed by changes in the other.

CHARACTERISTICS OF CORRELATION COEFFICIENT

$-1 \leq r \leq 1$

If $0 < r < 1$, then there is a positive correlation between x and y i.e. and increase (or decrease) in one variable corresponds to an increase (or decrease) in the other.

→ not proportional increase or decrease

If $-1 < r < 0$, then there is negative correlation between x and y i.e. an increase (or decrease) in one variable corresponds to decrease (or increase) in the other.

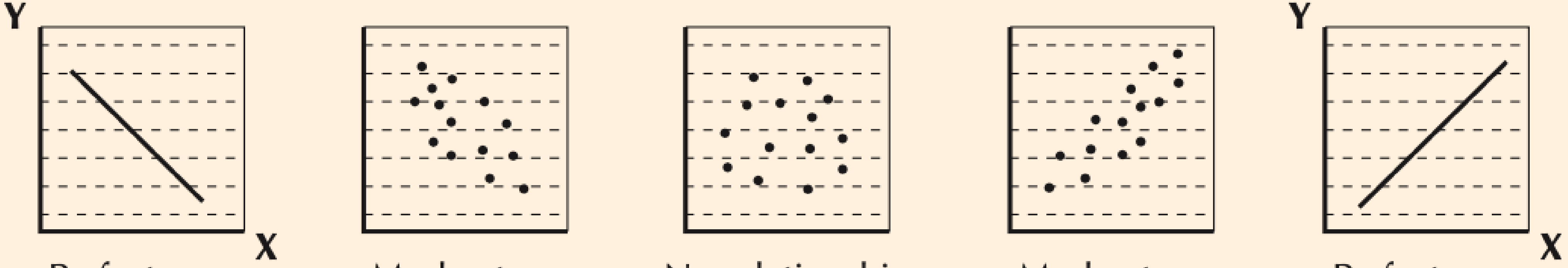
CHARACTERISTICS OF CORRELATION COEFFICIENT

Correlation

← **Strength of relationship** →

Negative | Positive

Perfect	Very large	Large	Medium	Small	Zero	Small	Medium	Large	Very large	Perfect
–1.00	–.75	–.50	–.30	–.10	0.0	+.10	+.30	+.50	+.75	+1.00



Perfect negative relationship	Moderate negative relationship	No relationship	Moderate positive relationship	Perfect positive relationship
$r = -1$	$-1 < r < 0$	$r = 0$	$0 < r < 1$	$r = 1$

REGRESSION ANALYSIS

Line of regression of y on x: The line of regression of y on x gives the best estimate of the value of y given value of x and is given by

$$y-\bar{Y}=b_{yx}(x-\bar{X});b_{yx}=r.\sigma_y/\sigma_x$$

slopes

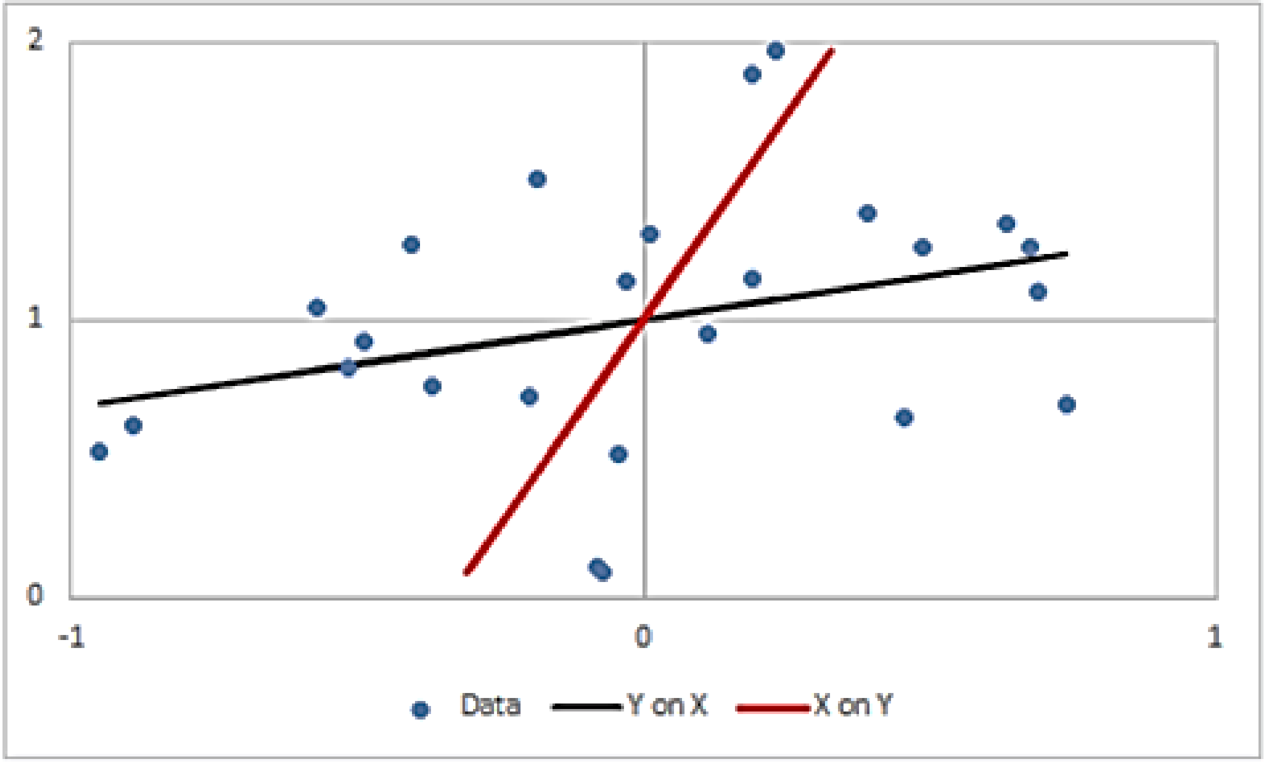
$y = mx+c$

Line of regression of x on y: The line of regression of x on y gives the best estimate of the vaule of x for given value of y is given by

$$x-\bar{X}=b_{xy}(y-\bar{Y});b_{xy}=r.\frac{\sigma_x}{\sigma_y}$$

slopes

$x = my+c$



COEFFICIENTS OF REGRESSION

y on x :

$$r_1 = b_{yx} = r.\frac{\sigma_y}{\sigma_x} = \frac{Cov(x,y)}{\sigma_x^2} = \frac{n\Sigma x_i y_i - \Sigma x_i \Sigma y_i}{n\Sigma x_i^2 - (\Sigma x_i)^2}$$

x on y :

$$r_2 = b_{xy} = \frac{\sigma_x}{r\sigma_y} = \frac{Cov(x,y)}{\sigma_y^2} = \frac{n\Sigma x_i y_i - \Sigma x_i \Sigma y_i}{n\Sigma y_i^2 - (\Sigma y_i)^2}$$

PROPERTIES OF REGRESSION COEFFICIENTS

Both regression coefficients have the same sign i.e. either both are positive or both are negative.

The sign of correlation coefficient is same as that of regression coefficient i.e.

$r > 0$, if $b_{xy} > 0$ and $b_{yx} > 0$ and $r < 0$, if $b_{xy} < 0$ and $b_{yx} < 0$.

The coefficients of correlation is the geometric mean between the two regression coefficients

$$r = \pm\sqrt{b_{yx} \times b_{xy}}$$

The sign to be taken outside the square root is that of the regression coefficients.

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PROPERTIES OF REGRESSION COEFFICIENTS

Both the regression coefficients cannot be numerically greater than one.

$$b_{yx} \le 1 \; ; \; b_{xy} \le 1$$

Regression coefficients are independent of change of origin but not scale.

origin → adding constant to all observations,

Scale → multiplying constant to all observations,

AM of the regression coefficients is greater than the correlation coefficient.

$$|r| < \left| \frac{b_{xy} + b_{yx}}{2} \right|$$

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PROPERTIES OF REGRESSION LINES

The two lines of regression pass through the point

$(\bar{x}, \bar{y})$.

mean of $x_1, x_2 \ldots x_n$ and $y_1, y_2 \ldots y_n$

Slope of the line of regression of y on $x = b_{yx}$.

Slope of the line of regression of x on $y = \left(\frac{1}{b_{xy}}\right)$

$y = mx + c$

$m = b_{yx}$

$x = my + c$

$m = \frac{1}{b_{xy}} \Rightarrow b_{xy} = \frac{1}{m}$

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ANGLE BETWEEN LINES OF REGRESSION

$$\tan\theta = \left(\frac{1-r^2}{|r|}\right)\frac{\sigma_x\sigma_y}{\sigma_x^2\sigma_y^2} = \left|\frac{b_{yx}b_{xy}-1}{b_{yx}+b_{xy}}\right| = \left|\frac{m_1-m_2}{1+m_1m_2}\right|$$

$m_1 = b_{yx}$

$m_2 = \frac{1}{b_{xy}}$

If $r = 0$, then $\tan\theta = \infty \Rightarrow \theta = \frac{\pi}{2}$ i.e. if two variables are not correlated, the lines of regression are perpendicular to each other.

If $r = \pm 1$, then $\tan\theta = 0 \Rightarrow \theta = 0$ or π i.e. in the case of perfect correlation ($r = \pm 1$) the two lines of regression coincide.

MEAN AND VARIANCE IN BINOMIAL DISTRIBUTION

probability of success $= p$; probability of failure $= q$

$p + q = 1$

$P(X = r) = {}^nC_r \, p^{n-r} \, q^r$

Mean $= np$

Variance $= npq$

QUESTION

In a binomial distribution, if the mean is 6 and the standard deviation is $\sqrt{2}$, then what are the values of the parameters n and p respectively?

(a) 18 and 1/3

(b) 9 and 1/3

(c) 18 and 2/3

(d) 9 and 2/3

$np = 6$ —— (1)

$npq = 2$ —— (2)

Variance = (stand. deviation)^2

(2) ÷ (1)

$q = \frac{2}{6} = \frac{1}{3}$

$p = 1 - \frac{1}{3} = \frac{2}{3}$

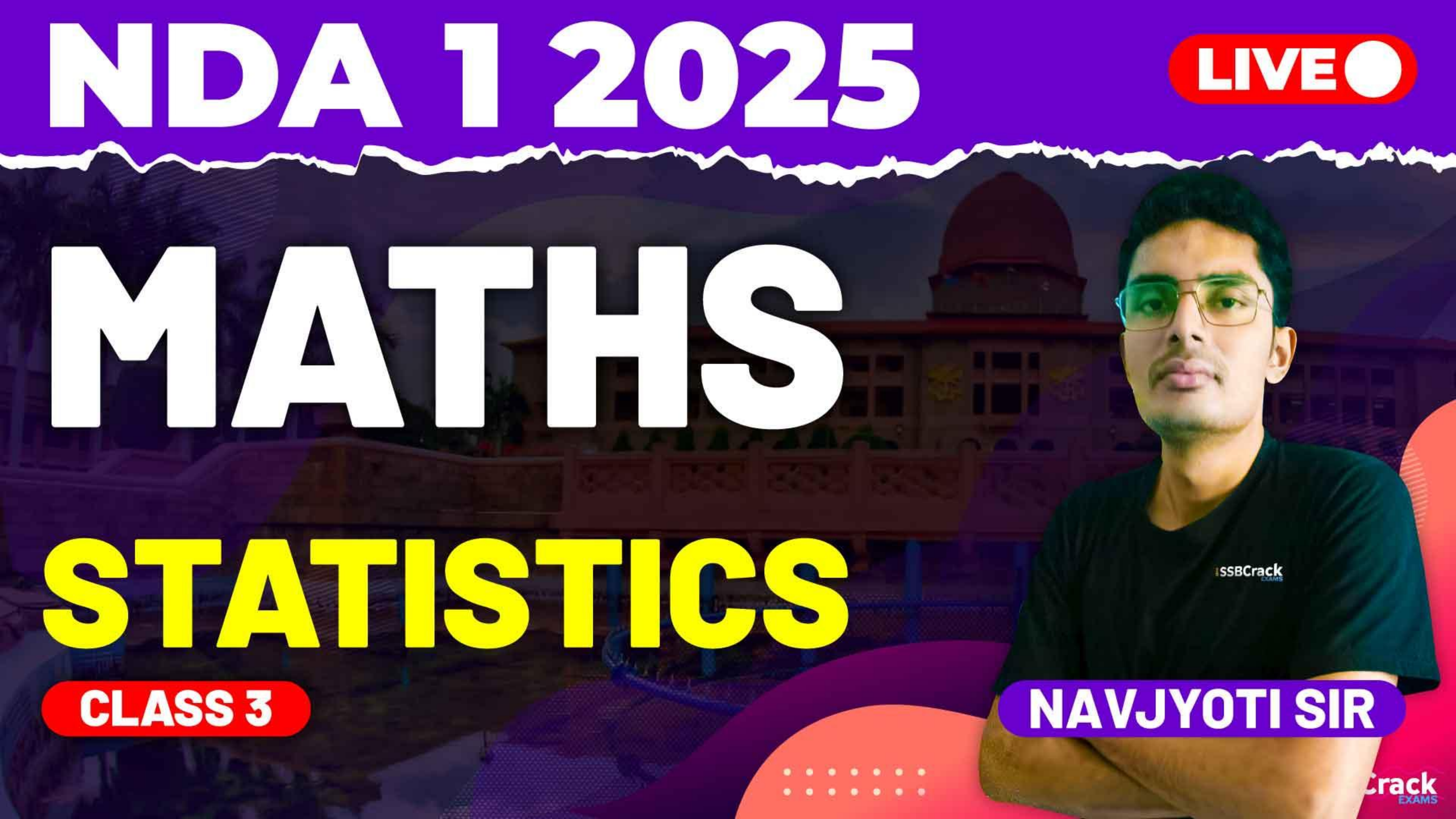
$p = \frac{2}{3}$

$np = 6$

$n = \frac{6}{p} = 6 \times \frac{3}{2}$

$n = 9$

Ans. (d)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