Date: 14.01.2023

MATH - 281

Cls: 01

Engineering Statistics and Complex variable → U. K. Deb Sir

→ Statistics for Engineers and scientists (Walpole)

→ Advanad Engineering M. H.K. Das

Statistics কী?

Statistics Data নিয়ে কাজ করে.

↓

যা collect করি (number বা information)

Qualitative → number ছাড়া যার নাম

Quantitative → পরিমাণ বা number দিয়ে express করা যায়

Statistics

→ Data

→ Collection

→ Summarize/Organize

↓

(proper way তে present করা)

→ Analyze

↓

Data analyze

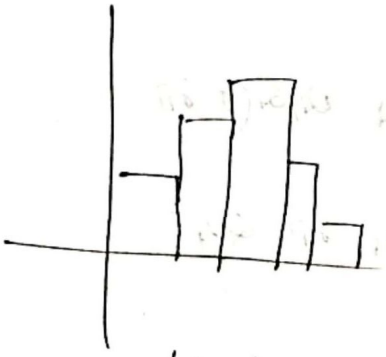
→ Decision (সিদ্ধান্ত নেয়া)

→ Valid Conclusion → (সঠিকভাবে বলা যায়)

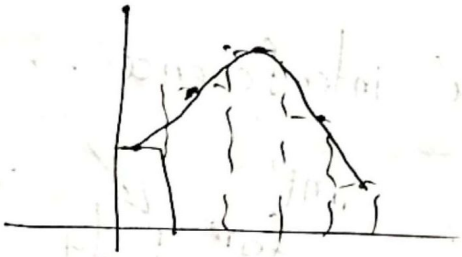
S is a branch of science dealing with the collection of data, organising, summarising, presenting and analysing data and drawing valid conclusions and thereafte

Graphical Representation

1) Histogram → দুটো ক্লাসের মধ্যে gap নেই
continuous data value



Histogram



Freq polygon

3) Cumulative freq. curve or the ogive

x_i	f_i	cf
0-10	12	12
	20	32
	35	67
	20	82

Avg or Measures of central tendency:

1) Arithmetic avg of mean ii) Median (মধ্যক) iii) Mode (প্রচলক)

iv) Geometric Mean v) Harmonic Mean

Mean ব্যবহার use করতে না → extreme value থাকলে না

Median ↳ ↳ ↳ ↳ → ↳ ↳ ↳ ,

Mode → qualitative data থাকলে

Walpoles

1.1 Statistical interference → কম ও বেশি তথ্য

imp for higher study

কী হয় না হয়

* Step deviation Method → example 3 → HW Pass

example: 4

Mean:

- Direct method
- Short-cut memory : Data বড় হলে, ছোট করে use হয়.

Date: 21.03.2
Cls: 02

handle করতে

$d = x - a$

$$\therefore AM = a + \frac{\Sigma fd}{\Sigma f}$$

- Updated method : Step deviation method

$$\rightarrow D = \frac{x-a}{i} \quad A.M. = a + \frac{\Sigma fD}{\Sigma f} \times i$$

i = interval বা difference

MEDIAN : ⟶ extreme value সরিয়ে

the mean of the values of $\frac{1}{2}$ nth and $\left(\frac{1}{2}n+1\right)$th items is the median.

Grouped data, median $= l + \frac{\frac{1}{2}N - F}{f} \cdot i$

l : median class এর lower value

F : আগের ধাপ এর cumulative freq

N : total frequency

i : class interval

f : freq for the median ধাপ

MODE :

↓

$$MODE = l + \frac{f - f_{-1}}{2f - f_{-1} - f_1} \cdot i$$

Expenical formula:

$$Mean - Mode = 3[Mean - Median]$$

modal ধাপ → সবচেয়ে বেশি value

f = modal ধাপ এর freq

f_{-1} : " " " আগের freq

f_1 : " " " পরের " "

- Geometric mean
- Harmonic mean: ~~~~ signal এ লাগে

Avg Deviation or mean deviation:

It is the mean of the absolute values of the deviations of a given set of numbers from their arithmetic mean.

absolute value মানে +ve করে দেয়?

$$|a| = \begin{cases} a; & a>0 \\ 0; & a=0 \\ -a; & a<0 \end{cases}$$

$$|-3| = -(-3) = 3$$

Mean deviation: $\frac{\sum f_i |x_i - \bar{x}|}{\sum f_i}$

↓

CT & Final এ আসতে পারে

Standard Deviation:

Standard deviation is defined as the square root of the mean of the square of the deviation from the arithmetic mean:

$$S.D = \sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

→ important

Note: i) The square of the standard deviation σ^2 is called variance

ii) σ^2 is called the 2nd moment about the mean and is denoted by μ_2

$(x - \bar{x})^2 \rightarrow$ deviation এর square

mean $\rightarrow \dfrac{(x-\bar{x})^2}{n}$

S.D $= \sigma = \sqrt{\quad}$

$$S.D = \sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{\Sigma f}}$$

$$SD = \sigma = \sqrt{\frac{\Sigma f d^2}{N} - \left(\frac{\Sigma f d}{N}\right)^2}$$

Note: Coefficient of variation $= \dfrac{\sigma}{\bar{x}} \times 100$

Problem - 12 freq সহকার group data.

$a = \frac{9+9}{2} = 9$

x	f	$d = x - a$	$f.d$	$f.d^2$
6	3	-3	-9	27
7	6	-2	-12	24
8	9	-1	-9	9
9	13	0	0	0
10	8	1	8	8
11	5	2	10	20
12	4	3	12	36
	$\Sigma f = 48$		$\Sigma fd = 0$	$\Sigma fd^2 = 124$

$$S.D = \sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2}$$

$$= \sqrt{\frac{124}{48} - \left(\frac{0}{N}\right)^2} = 1.6$$

$$\text{Mean} = a + \frac{\Sigma fd}{\Sigma f} = 9 + 0 = 9$$

$$S.D = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{\Sigma f}} = \sqrt{\frac{\Sigma fd^2}{\Sigma f}}$$

$\therefore$ Coefficient of variation $= \frac{\sigma}{\bar{x}} \times 100$

$= \frac{1.6}{9} \times 100 = 17.78$

※ grouped data এর ক্ষেত্রে: x = mid value

60-62 → $x = 61$

Sunday CT → Grouped data থেকে হবে Mean, Median, Mode, Coefficient of variation → cls time

---

※ **Moment**: The rth moment of a variable x about the mean $\bar{x}$ is usually denoted by μ_r, is given by

$$\mu_r = \frac{1}{N} \sum f_i (x_i - \bar{x})^r \; ; \; \sum f_i = N$$

The rth moment of a variable x about any point a is defined by

$$\mu_r' = \frac{1}{N} f_i (x_i - a)^r \; ;$$

In particular: $\mu_0 = \frac{1}{N} \sum f_i (x - \bar{x})^0 = \frac{1}{N} \sum f_i$

$$= \frac{N}{N} = 1$$

[Moment → Data গুলো অ্যাভারেজ থেকে কত কাছাকাছি আছে, বলে]

$$\mu_1 = \frac{1}{N}\sum f_1(x-\bar{x}) = 0, \quad \mu_1' = \frac{1}{N}\sum f_1(x-a)$$
$$= \bar{x} - a$$

$$\mu_2 = \frac{1}{N}$$

Relⁿ b/w moments about mean and moment about any point.

mean কে respect এ → μ_2

কোনো point কে respect এ ← μ_2'

$$\mu_2 = \mu_2' - \mu_1'^2$$

$$\mu_3 = \mu_3' - 3\mu_2'\mu_1' + 2\mu_1'^3$$

$$\mu_4 = \mu_4' - 4\mu_3'\mu_1' + 6\mu_2'\mu_1'^2 - 3\mu_1'^4$$

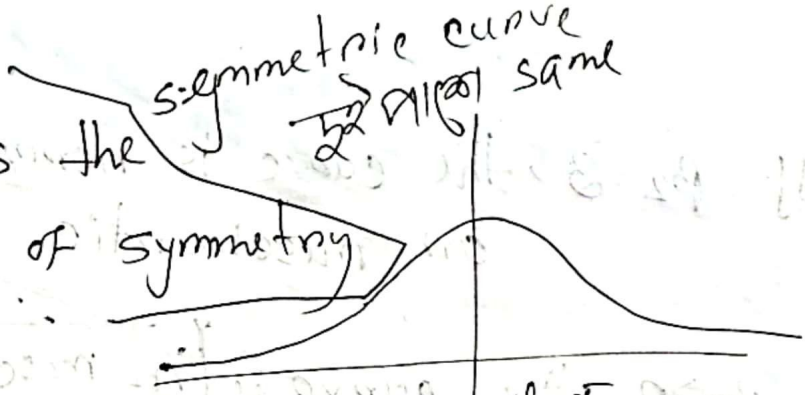
Note:

1) The sum of the coefficients of the variens

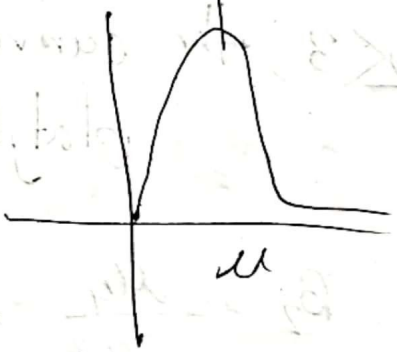
γ

Skewness:

1) • Skewness → denotes the opposite of symmetry



• Mean, median, mode same → in case of symmetrical. এক point এ থাকবে এক value



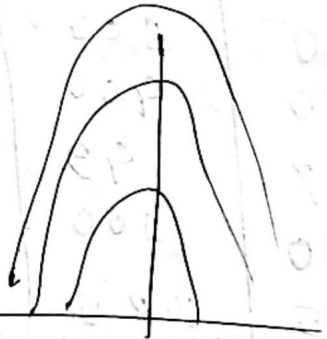
Coefficient of skewness: $\frac{\text{Mean} - \text{Mode}}{\text{Standard deviation}}$

+ve হলে +ve skew

-ve " -ve "

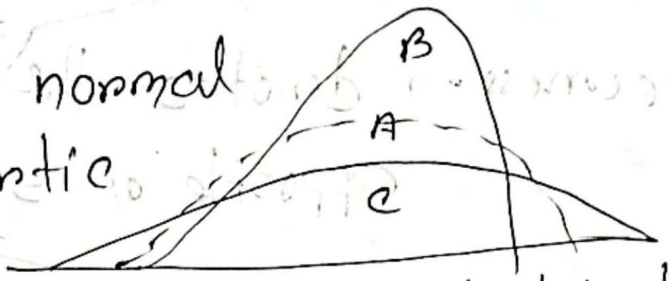
Q. Define momentum skewness, kurtosis. imp

KURTOSIS:



বক্রের চূড়া ভিত্তিক → kurtosis

If $\beta_2 = 3$, the curve is normal or mesokurtic



If $\beta_2 > 3$, the curve is peaked or leptokurtic

A = mesokutic B = leptokutic C = platykutic

If $\beta_2 < 3$, the curve is flat topped or platykurtic

$$\beta_2 = \frac{\mu_4}{\mu_2^2}, \quad \mu_2 = \frac{\Sigma(x-\bar{x})^2}{N}, \quad \mu_4 = \frac{\Sigma(x-\bar{x})^4}{N}$$

Page - 745

Σd^4

Σd^3

1	x_i	$d = x_i - \bar{x}$	$d^2 = (x_i - \bar{x})^2$	$d^3 = (x_i - \bar{x})^3$	$d^4 = (x_i - \bar{x})^4$
	52	2	4	8	16
	57	7	49	343	2401
	40	-10	100	-1000	10000
	70	20	400	8000	160000
	43	-7	49	-343	2401
	40	-10	100	-1000	10000
	65	15	225	3375	50625
	35	-15	225	-3375	50625
	48	-2	4	-8	16
		$\Sigma d = 0$	$\Sigma d^2 = 1156$	$\Sigma d^3 = 6000$	$\Sigma d^4 = 286084$

$N = 9$

$\mu_2 = \frac{1156}{9}$; $\mu_4 = \frac{286084}{9}$

$= 128.44$ $= 31787.111$

$\therefore \beta_2 = \frac{\mu_4}{\mu_2^2}$

$= \frac{31787.11}{(128.44)^2} = 1.927 < 3$

↓

platykurtic

Date: 28.01.24
Cls: 03

Complete the first four moments about mean

Class interval:	0-10	10-20	20-30	30-40
Frequency:	1	3	4	2

⇒ Raw moment, $A = 25$

Determination of β_1 and β_2 and comment on that

Mean এর আশেপাশে –
বলতে μ_1, μ_2 বোঝায় না
এর চেয়ে বেশি বোঝায়

Class	f	Mid x	$u = \frac{x-25}{10}$	fu	fu^2	fu^3	fu^4
0-10	1	5	-2	-2	4	-8	16
10-20	3	15	-1	-3	3	-3	3
20-30	4	25	0	0	0	0	0
30-40	2	35	1	2	2	2	2
				-3	9	-9	21

$$\mu_r' = \frac{1}{N} \sum f_i (x_i - a)^r$$

$\mu_1' = \frac{-3}{10} \times 10$ → সমস্যা 10 দিয়ে ভাগ করায় তখন তুল্য দিতে হবে

fu^2 → 10^2 গুণ

fu^3 → 10^3 গুণ

$= -3/10 \times 10$

$= -3$

$\mu_2' = \frac{9 \times 10^2}{10} = 90$

$\mu_3' = \frac{-9 \times 10^3}{10} = -900$

$\mu_4' = \frac{21 \times 10^4}{10} = 2100$

Moments about $A = 25$

Moments about the mean

$\mu_1 = 0$ $\quad \mu_2 = 90 - 9$

$\mu_3 = -900 - 3 \times 90 \times (-3) + 2 \times (-3)^3 = -189$

$\mu_4 = 14817$

β_1, β_2 = ?

β_1 → Skewness

β_2 → kurtosis

$$\beta_1 = \frac{\mu_3^2}{\mu_2^3} = \frac{(-144)^2}{(81)^3} = 0.03902$$

$$\beta_2 = \frac{\mu_4}{\mu_2^2} = \frac{14817}{(81)^2} = 2.2583$$

□ The 1st four central moments of a distributions are (mean এর আশেপাশের)

0, 2.5, 0.7 and 18.75

Find Beta co-efficients.

⇒ $\mu_1 = 0$, $\mu_2 = 2.5$, $\mu_3 = 0.7$, $\mu_4 = 18.75$ → +ve skewness → mean এর ডানে ঘুরে থাকা

$$\beta_1 = \frac{\mu_3^2}{\mu_2^3} = \frac{(0.7)^2}{(2.5)^3} = 0.03136$$

$$\beta_2 = \frac{\mu_4}{\mu_2^2} = \frac{18.75}{(2.5)^2} = 3$$

↓ mesokurtic

Coefficient of co-relation :

0-1 → +ve

0--1 → -ve

1 → perfect

0 means there's no relation b/w two variables.

Date: 04.02.24

Cls: 04

. variable: variable গুলো একটা আরেকটাকে প্রভাবিত-
করে।

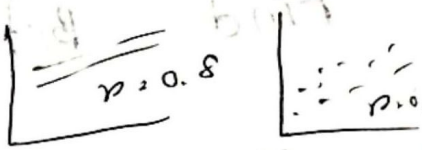
walpole-এর বই: বর্ণনাগুলো এখান থেকে।

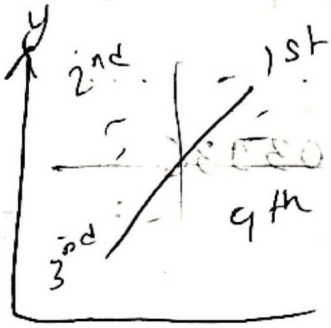
. Correlation: দুটির বৃদ্ধিতে আরেকটি বাড়ে অথবা কমে।

একটি বাড়লে আরেকটিও বাড়লে → +ve

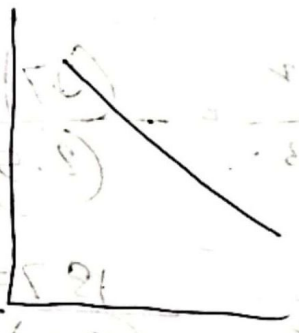
" " কমলে → -ve

Perfect correlation: দুটি variable এর ratio always same থাকে।

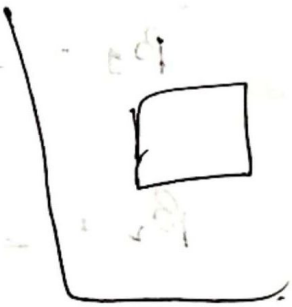




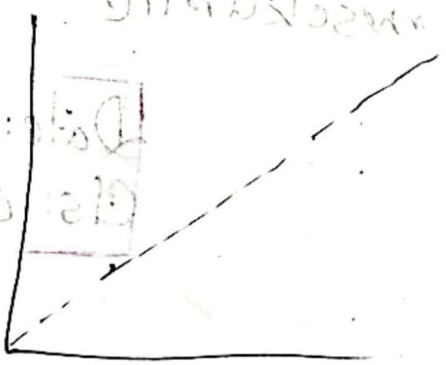
+ve



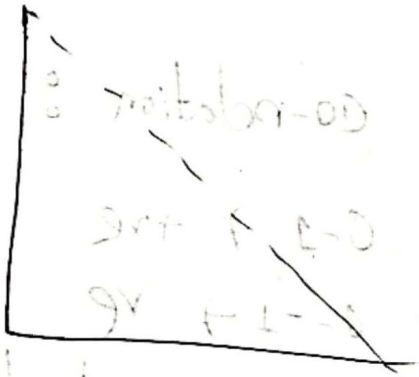
-ve



~~Perfect~~
No correlation



Coefficient of correlation = +1



Coefficient of correlation = -1

Methods of Determining Simple Correlation:

⇒ KARL Pearson's coefficient of correlation.

r between two variables x and y is defined by the relation:

$$r = \frac{\Sigma XY}{\sqrt{(\Sigma X^2)(\Sigma Y^2)}} = \frac{\rho}{\sigma_x \sigma_y} = \frac{\text{Covariance}(x,y)}{\sqrt{\text{variance}\,x}\sqrt{\text{variance}\,y}}$$

Where, $X = x - \bar{x}$, $Y = y - \bar{y}$

i.e X, Y are the deviations measured from their respective means.

$$\rho = \left(\frac{\Sigma XY}{n}\right) = \text{Co-variance}$$

and σ_x, σ_y being the standard deviations of these series.

2.

$x = 70$ $\quad \bar{x} = 68.5$

$y = 67$ $\quad \bar{y} = 68.25$

x	y	$x-\bar{x}$	$y-\bar{y}$	X^2	Y^2	XY
67	65	-3	-2	9	4	6
68	66	-2	-1	4	1	2
64	67	-6	0	36	0	0
68	67	-2	0	4	0	0
72	68	2	1	4	1	2
70	69	0	2	0	4	0
69	71	-1	4	1	16	-4
70	73	0	6	0	36	0
				$\Sigma X^2 = 58$	$\Sigma Y^2 = 62$	$\Sigma XY = 6$

$$\therefore r = \frac{\Sigma XY}{\sqrt{(\Sigma X^2)(\Sigma Y^2)}} = \frac{6}{\sqrt{58 \times 62}} = 0.1000556$$

x	y	$X = x-\bar{x}$	$Y = y-\bar{y}$	X^2	Y^2	XY
67	65	-1.5				
68	66	-0.5				
64	67	-4.5				
68	67	-0.5				
72	68	3.5				
70	69	1.5				
69	71	0.5				
70	73	1.5				

Spearman's Rank correlation coefficient

$$r = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

where r = rank coefficient of correlation and

d = the difference of ranks b/w paired items in 2 series.

- Example 18:

- Theory না জানলে এ হবে।

Line of Regression

interpolation → data-র ভিতরে

extrapolation → data-র বাইরে কিছু value বের করা।

When the curve is a straight line, it is called a line of Regression

What do u understand be regression and what it the purpose of it in engg-field

$y = a + bx$

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

$\bar{y} = a + b\bar{x}$

$a = \bar{y} - b\bar{x}$

$$\bar{x} = \frac{\Sigma x}{n}$$

$$\bar{y} = \frac{\Sigma y}{n}$$

x	y	$X = x - \bar{x}$	$Y = y - \bar{y}$	XY

↳ table থেকে b, a

Example 29: let, $y = a + bx$.

summation নিয়ে ↙ $\Sigma y = na + b\Sigma x$

↙ $\Sigma xy = a\Sigma x + b\Sigma x^2$

Σx দিয়ে multiply Σ

Example 30: $n = 100$

$\Sigma y = na + b\Sigma x$ ... (i)

$\Rightarrow 6800 = 100a + 15000b$ ... (i)

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

$\Rightarrow 1022250 = a.15000 + 2272500b$ ... (ii)

Solving (i) & (ii) $\Rightarrow$ $a = 53$, $b = 0.1$

$\therefore$ Equation of the line regression is $y = 53 + 0.1x$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \text{---} \qquad b = \frac{\Sigma xy}{\Sigma x^2} = 68.15$$

$$\bar{x} = \frac{\Sigma x}{n} = \frac{15000}{100} = 150$$

$$\bar{y} = \frac{\Sigma y}{n} = \frac{6800}{100} = 68$$

Q. What do u understand be error of prediction?

Table for error of Prediction: $y_p = a + bx$

x	y	$X = x - \bar{x}$	$Y = y - \bar{y}$	X^2	Y^2	XY	y_p	$y - y_p$	$(y - y_p)^2$

$\Sigma y_x =$

Practice

Number: 6 → 0.007 } এটা check
Ans: $y = 0.55 + 0.0583$ } করা যাবে

Date: 11.02.2024
Cls: 05

$2x+3y+5=0$ — (i)

$x+4y+8=0$ — (ii)

$y = a+bx$

$x = a+by$

b_{xy} ও x এর গুণ y এর মান

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

$y = a+bx$
$x = a+by$

$\cdot\ b_{yx} = r\dfrac{\sigma_y}{\sigma_x}$ → standard deviation of y

$\cdot\ b_{xy} = r\dfrac{\sigma_x}{\sigma_y}$

$y-\bar{y} = r\dfrac{\sigma_y}{\sigma_x}(x-\bar{x})$ $\quad \bar{x}, \bar{y}$ → line এর

$x-\bar{x} = r\dfrac{\sigma_x}{\sigma_y}(y-\bar{y})$

Q Find the correlation co-efficient b/w x and y when the lines of regression are $2x-9y+6=0$ and $x-2y+1=0$

→ y of x :

$2x-9y+6=0$

$9y = 2x+6$

$y = \frac{2}{9}x + \frac{2}{3}$

$\therefore b_{yx} = \frac{2}{9}$

x of y:

$x - 2y + 1 = 0$

$x = 2y - 1$

$b_{xy} = 2$

$\therefore r = \sqrt{b_{yx} \times b_{xy}} = \sqrt{2/9 \times 2} = \sqrt{4/9} = \frac{2}{3} < 1$

তারমানে r এর মান এটাই

2X-140

Q. In a partially destroyed laboratory record of an analyses of correlation data the following results only are ligible:

* Variance of $x = 9 \rightarrow \sigma_x^2 = 9$, $\sigma_x = 3$

Regression eqns: $8x - 10y + 66 = 0$

$40x - 18y - 214 = 0$

i) $\bar{x}$, $\bar{y}$ ii) σ_y iii) r

⇒ y of x:

$8x - 10y + 66 = 0$

$10y = 8x + 66$

$y = 8/10\, x + 6.6$

$\therefore b_{yx} = 8/10$

x of y:

$40x - 18y - 214 = 0$

$40x = 18y - 214$

$x = 18/40\, y - 214/40$

$\therefore b_{xy} = 18/40$

$\therefore r = \sqrt{b_{yx} \times b_{xy}} = \sqrt{8/10 \times 18/40} = \frac{3}{5}$

$\therefore b_{yx} = r \frac{\sigma_y}{\sigma_x}$

$\Rightarrow \frac{8}{10} = \frac{3}{5} \times \frac{\sigma_y}{3}$

$\Rightarrow \frac{5 \times 8}{10} = \sigma_y$

$\Rightarrow \sigma_y = 4$

Solving the 2 eqn $\Rightarrow$ $x = 13 = \bar{x}$, $y = 17 = \bar{y}$

$\therefore y - \bar{y} = r \frac{\sigma_y}{\sigma_x} (x - \bar{x})$

$\Rightarrow 17 - \bar{y} = b_{yx} (x - \bar{x})$

$\Rightarrow 17 - \bar{y} = \frac{8}{10} \times (13 - \bar{x})$

$\Rightarrow 170 - 10\bar{y} = 104 - 8\bar{x}$

$\Rightarrow 8\bar{x} - 10\bar{y} + 66 = 0$ ——— (iii)

$\therefore x - \bar{x} = b_{xy} (y - \bar{y})$ $\Rightarrow$ ~~$13 - x = 2(17 - y)$~~

$\Rightarrow 13 - x = 34 - 2y \Rightarrow x - 2y + 21$

$\therefore x - \bar{x} = b_{xy}(y - \bar{y})$

$\Rightarrow 13 - \bar{x} = \frac{18}{40}(17 - \bar{y})$

$\Rightarrow 520 - 40\bar{x} = 306 - 18\bar{y}$

$\Rightarrow 40\bar{x} - 18\bar{y} - 214 = 0$ — (iv)

Solving (iii) & (iv)

$\bar{x} = 13$

$\bar{y} = 17$

Correlation থেকে এর প্রশ্ন আসতে

Probability

→ {1, 2, 3, 4, 5, 6}

↓ Sample space

→ Experiment

→ Event → একটা ঘটনা. $P(\text{even num}) = \frac{3}{6} = \frac{1}{2}$

Sample space → exp থেকে সব possible outcome থাকতে

Exawtive event → সব event বিবেচনা

Mutually exclusive event (uncommon) → দুটি ঘটনা যার থাকবেই ঘটনার মধ্যে কোনো মিল থাকবে না, যেমন even, odd

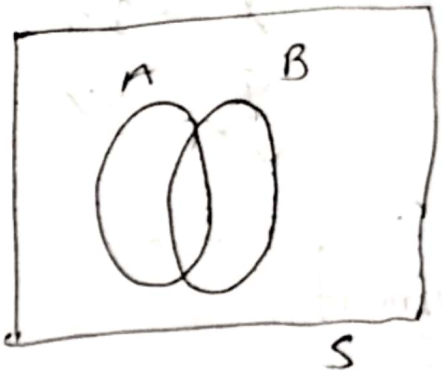
Conditional probability: defn থাকতে • $P(A|B)$ Probability of the event A, event given that the B is already happened

→ Baye's Thm

Probability = $\frac{\text{Possible outcomes}}{\text{Total outcomes}}$

$P(A|B)$ → Probability of the event A Given that the event B is already happened.

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



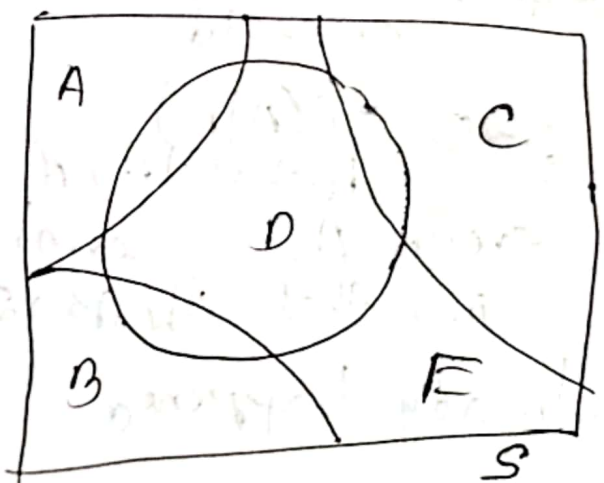
$A \cap B$

$A \cup B$

⊛ Independent event: 2 ते event independent असतात

$$P(A \cap B) = P(A) \times P(B)$$

Exclusive $P(A \cap B) = 0$



defective

20% → 2%

25% → 5%

33% → 2~~0~~.4%

4% → 4%

20% → 5%

$$P(B_i|A) = \frac{P(B_i)\,P(A|B_i)}{\sum_{i=1}^{n} P(B_i)\,P(A|B_i)}$$

$$P(B_2|A) = \frac{P(B_2)P(A|B_2)}{P(B_1)P(A|B_1)+P(B_2)P(A|B_2)+P(B_3)P(A|B_3)}$$

$B_1, B_2, B_3 \rightarrow$ 3 টি বাক্সের আছে

$P(A) = 0.2$ $\quad P(A|D) = 0.002$

$P(B) = 0.25$ $\quad P(B|D) = 0.03$

$P(C) = 0.35$ $\quad P(C|D) = 0.04$

$P(E) = 0.2$ $\quad P(E|D) = 0.05$

$P(D|B) = ?$

$$\therefore P(D|B) = \frac{P(D)\,P(B|D)}{P(A)P(A|D)+P(B)P(B|D)+P(C)P(C|D)+P(E)P(E|D)}$$

$=$

(*) বইয়ের অংক:
↓
780 page
Example- C

{ bayes' thm এর অংক xm-এ আসবে }

A → 25%, B → 35%, C → 40%

if there output 5% 4% 2% are found to be defected

A → 25%	5%	$P(A) = 0.25$
B → 35%	4%	$P(B) = 0.35$
C → 40%	2%	$P(C) = 0.4$

$P(D|A) = 0.05$

$P(D|B) = 0.04$

$P(D|C) = 0.02$

$$\therefore P(B|D) = \frac{P(B)P(D|B)}{P(A)P(D|A) + P(B)P(D|B) + P(C)P(D|C)}$$

$$= \frac{0.35 \times 0.04}{0.25 \times 0.05 + 0.35 \times 0.04 + 0.4 \times 0.02}$$

$$= 0.4058$$

Date: 25.02.24
Cls: 7

BINOMIAL DISTRIBUTION

p → probability of success
q → " " failure ~~→ 1 হয়ে হয়ে~~

→ $P(r) = {}^nC_r p^r q^{n-r}$ → Probability fn

toss করা → no of trials

no of trials should be fixed in Binom. Dist

su

$n = 10, r = 3$

$P(r) = {}^{10}C_3 \cdot (1/2)^3 \cdot (1/2)^7$ $F(n) = \begin{cases} 1/2 ; \\ ; \end{cases}$

→ n fixed, success failure দুটো optn
↓
Condtn fill up → Binomial Distribution

- fair coin → p & q = 1/2

Advanced Eng

Example 27

at best → সর্বোচ্চ ২ → at most → 0, 1, 2
at least → সর্বনিম্ন 2 → 0, 1 হবে না

Exam: 34 99% → 100 নয় কারণ full success হবে কম কাঠিন্য

Exercise: 11.3

1) $p = 0.2 \quad q = 0.8 \quad n = 4$

a)

$$P(1) = {}^4C_1 \cdot (0.2) \cdot (0.8)^3$$

$$= 0.4096$$

b)

$$P(0) = {}^4C_0 \cdot (0.2)^0 \cdot (0.8)^4$$

$$= 0.4096$$

c) At most 2 (0 or 1 or 2)

$$= P(0) + P(1) + P(2)$$

$$\therefore P(2) = {}^4C_2 \cdot (0.2)^2 \cdot (0.8)^2$$

$$= 0.1536$$

$$\therefore P(0) + P(1) + P(2) = 0.4096 + 0.4096 + 0.1536$$

$$= 0.9728$$

2) Six dice are thrown 729 times

Binomial থেকে slightly differ করলে → Poisson Distribution

Poisson Distribution: P (or q) very small, $n \to$ large

- n এর মান যখন 35 এর উপরে → Bino. D. → Poisson
  ↳ নিম্নে 20

$$P(r) = \frac{m^r e^{-m}}{r!}$$

mean $= m = np$.

$p = \frac{m}{n}$

Example: 39