Formulas

Measures of Central Tendency

1 Simple Arithmetic Mean

Individual series :-

Direct Method :-

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{N}$$

$$= \frac{\Sigma x}{N}$$

Shortcut Method :-

$$\bar{x} = A + \frac{\Sigma d}{N}, \text{ where } d = x - A$$

Step Deviation Method :-

$$\bar{x} = A + \frac{\Sigma d'}{N} \times c, \text{ where } d' = x - A/c$$

Discrete Series :-

Direct Method :-

$$\bar{x} = \frac{\Sigma f x}{N}$$

Short cut Method :-

$$\bar{x} = A + \frac{\Sigma f d}{N}$$

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Step deviation Method :-

$$\bar{X} = A + \frac{\Sigma f d'}{N} \times C$$

Continuous Series :-

Direct Method :-

$$\bar{X} = \frac{\Sigma f m}{N}$$

Short cut Method :-

$$\bar{X} = A + \frac{\Sigma f d}{N}, \text{ where } d = m - A$$

Step Deviation Method :-

$$\bar{X} = A + \frac{\Sigma f d'}{N} \times C, \text{ where } d' = \frac{m - A}{C}$$

Inclusive Series

E.g. 20 - 29, 30 - 39, 40 - 49

Note : Solve it in same manner as simple continuous

Cumulative frequency Distribution

(More than - Below) or (Less than ~~or~~ - Above)

Unequal Class Intervals

E.g. 20 - 60, 60 - 100, 100 - 150

Note : Solve it in same manner as simple continuous

Missing frequency

Open - End Classes

Correcting Incorrect Values

$\because \bar{X} = \frac{\Sigma X}{N}$

$\therefore \Sigma X = N\bar{X}$

This ΣX is incorrect

Now correct ΣX = Incorrect ΣX - wrong items + correct items

$\therefore$ Correct $\bar{x} = \frac{\text{Correct } \Sigma X}{N}$

2 Geometric Mean

$$G.M. = \sqrt[n]{x_1 . x_2 . x_3}$$

3 Harmonic Mean

Individual Series

$$H.M. = \frac{N}{\Sigma\left(\frac{1}{x}\right)}$$

Discrete Series

$$H.M. = \frac{N}{\Sigma\left(f . \frac{1}{x}\right)}$$

Continuous Series

$$H.M. = \frac{N}{\Sigma\left(f . \frac{1}{m}\right)}$$

Combined Arithmetic Mean

$$\bar{X}_{12} = \frac{N_1 \bar{X}_1 + N_2 \bar{X}_2}{N_1 + N_2}$$

Weighted Arithmetic Mean

$$\bar{X}_w = \frac{\Sigma WX}{\Sigma W}$$

4 Median

Individual Series

Odd number series

Median = Size of $\left(\frac{N+1}{2}\right)$th item

Even number series

Median = Size of $\left(\frac{N+1}{2}\right)$th item

Discrete series

Median = Size of $\left(\frac{N+1}{2}\right)$th item

Continuous Series

Median = Size of $\left(\frac{N}{2}\right)$th item

$$\text{Median} = L + \frac{N/2 - cf}{f} \times C$$

5 Partition Values :

$Q = 4,\ D = 10,\ P = 100$

Individual and Discrete Series:-

Q_1 = Size of $\left(\frac{N+1}{4}\right)$th item

Q_3 = Size of $3\left(\frac{N+1}{4}\right)$ th item

\# Continuous Series :-

→ Q_1 = Size of $\left(\frac{N}{4}\right)$ th item

$$Q_1 = L + \frac{N/4 - cf}{f} \times c$$

→ Q_3 = Size of $3\left(\frac{N}{4}\right)^{th}$ item

$$Q_3 = L + \frac{3(N/4) - cf}{f} \times C$$

6 Mode

Individual Series :-

\# Formula kya dekh raha, ~~tu~~ khud hi series dekh le pata lag jayega

Discrete Series :-

\# Grouping Table = Sar dard

Continuous Series :-

$$Z = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times C$$

\# Mode = 3 Median - 2Mean

Correlation

$r = \frac{\mathrm{Cov}(x,y)}{\sigma_x \sigma_y}$ [Actual Mean Method]

where,

$$\mathrm{Cov}(x,y) = \frac{1}{N}\Sigma(X-\bar{X})(Y-\bar{Y}) = \frac{\Sigma xy}{N}$$

$$\sigma_x = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}} = \sqrt{\frac{\Sigma x^2}{N}}$$

$$\sigma_y = \sqrt{\frac{\Sigma(Y-\bar{Y})^2}{N}} = \sqrt{\frac{\Sigma y^2}{N}}$$

$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \cdot \Sigma y^2}}$

$r = \frac{\Sigma(X-\bar{X})(Y-\bar{Y})}{N\sigma_x\sigma_y}$ or $\frac{\Sigma xy}{N\sigma_x\sigma_y}$

$\sigma = \sqrt{\text{variance}}$

Direct Method:-

$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{N\Sigma X^2 - (\Sigma X)^2}\sqrt{N\Sigma Y^2 - (\Sigma Y)^2}}$

or $r = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{N}}{\sqrt{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}\sqrt{\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}}}$

Assumed Mean Method :-

$$r = \frac{N\Sigma dx\,dy - \Sigma dx\,\Sigma dy}{\sqrt{N\Sigma dx^2 - (\Sigma dx)^2}\,\sqrt{N\Sigma dy^2 - (\Sigma dy)^2}}$$

$$r = \frac{\Sigma dx\,dy - \frac{(\Sigma dx)(\Sigma dy)}{N}}{\sqrt{\Sigma dx^2 - \frac{(\Sigma dx)^2}{N}}\,\sqrt{\Sigma dy^2 - \frac{(\Sigma dy)^2}{N}}}$$

$$r = \frac{\Sigma dx\,dy - N(\bar{X} - A_x)(\bar{Y} - A_y)}{N\,\sigma_x\,\sigma_y}$$

Sum of products of deviations $= \Sigma xy$

Sum of Squared Deviations mean $\sqrt{\Sigma x^2}$ or $\sqrt{\Sigma y^2}$

$\bar{X} = \frac{\Sigma X}{N}$

$\Sigma X = \bar{X}.N$

$\sigma_x = \sqrt{\frac{\Sigma X^2}{N} - (\bar{X})^2}$ (Square both sides)

$\therefore \Sigma X^2 = N[\sigma_x^2 + \bar{X}]$

Correct ΣX = Incorrect ΣX − wrong item + correct item

Correct ΣX^2 = Incorrect ΣX^2 − (wrong item)^2 + (correct item)^2

Correct ΣXY = Incorrect ΣXY − (wrong item of X. wrong item of Y) + (correct item of X. correct item of Y).

Spearman's Rank Correlation

1. When Ranks are given :-

$$r_K = 1 - \frac{6 \Sigma D^2}{N(N^2-1)}$$

Note : Sum of squares of differences means ΣD^2
When 3 ranks are given, use 12 23 13

2. When Ranks are not given :-

First give ranks from highest to low.

Now, use the same formula

3. When Ranks are Equal :-

$$r_K = 1 - \frac{6\left[\Sigma D^2 + \frac{1}{12}(M^3-M) + \frac{1}{12}(M^3-M) + \cdots\right]}{N^3 - N}$$

Measures of Dispersion

Range

$$\text{Range} = L - S$$

where, L = Largest Item
S = Smallest Item

$$\text{Coefficient of Range} = \frac{L - S}{L + S}$$

Semi-Interquartile Range

OR

Quartile Deviation (Q.D.)

$$QD = \frac{Q_3 - Q_1}{2}$$

$$\text{Coefficient of Quartile Deviation} = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

Mean Deviation (MD)

$$MD = \frac{\Sigma |d|}{N} \quad \text{or} \quad \frac{\Sigma f|d|}{N}$$

Coefficient of Mean Deviation :-

$$MD_{\bar{x}} = \frac{MD}{\bar{x}} \quad \text{(from Mean)}$$

$$MD_M = \frac{MD}{M} \quad \text{(from Median)}$$

$$MD_Z = \frac{MD}{Z} \quad \text{(from Mode)}$$

Standard Deviation (S.D.)

1. Actual Mean Method :-

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}}$$

2. Direct Method :-

$$\sigma = \sqrt{\frac{\Sigma X^2}{N} - (\bar{X})^2}$$

3. Assumed Mean Method :-

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

Note : for Discrete series, just use "f" with ΣX and Σd.

Variance (V)

Variance $= \sigma^2$

$\Rightarrow \sigma = \sqrt{\text{Variance}}$

Coefficient of Standard Deviation :- $\frac{\sigma}{\bar{X}}$

Coefficient of Variation $= \frac{\sigma}{\bar{X}} \times 100$

Mathematical Expectation

Probability Density function :-

$f(x)$ is a P.D.F., if it satisfies :

(i) $f(x) \geq 0$ for all x

(ii) $\int_{-\infty}^{\infty} f(x)\, dx = 1$

Properties of Mathematical Expectation :-

1 Addition Theorem

$E(X+Y) = E(X) + E(Y)$

2 Multiplication Theorem

$E(XY) = E(X)E(Y)$

3 $E(aX) = aE(X)$ [where "a" is constant]

4 $E(aX+b) = aE(X) + b$

5 $E(a_i X_i) = \sum a_i E(X_i)$, where $(i = 1, 2, \ldots n)$

Imp :- $\sum P(x) = 1$

$E(x) = \sum x P(x)$

Mathematical Expectation

Discrete Random Variable :-

Mean or Expected Value [E(x)]

$\Rightarrow E(X) = \Sigma xp$ or ΣxP

$Var(x) = E(X^2) - [E(X)]^2$

where, $E(X) = \Sigma xP$

$E(X^2) = \Sigma x^2 P$

Standard Deviation $(\sigma) = \sqrt{Var(x)}$

Continuous Random Variable :-

Mean or Expected Value [E(x)]

$$\Rightarrow E(X) = \int_{LL}^{UL} x \cdot f(x)\, dx$$

where, UL = Upper Limit

LL = Lower Limit

$Var(x) = E(x^2) - [E(X)]^2$

where, $E(X^2) = \int_{LL}^{UL} x^2 f(x)\, dx$

Standard Results :-

(1) $\Sigma P = 1$

(2) $\int_{-\infty}^{\infty} f(x)\, dx = 1$

Covariance of Random Variables :-

$Cov(X, Y) = E(XY) - E(X)E(Y)$

Properties of Variance of a Random Variable :-

1. If a is a constant, then $Var(a) = 0$
2. If a is a constant, then
   $Var(ax) = a^2 Var(x)$
3. If a is a constant, then
   $Var(x + a) = Var(x)$
4. $Var(ax + b) = a^2 Var(x)$
5. If X_1 and X_2 are two independent random variables, then
   (i) $Var(x + y) = Var(x) + Var(y)$
   (ii) $Var(x - y) = Var(x) - Var(y)$

Properties of Covariance of a Random Variable :-

1. $Cov(X, Y) = 0$
2. $Cov(X, Y) = Cov(Y, X)$
3. $Cov(X, X) = Var(X)$
4. $Cov(aX, Y) = a\,Cov(X, Y)$

Probability

Simple Probability :- When everything is fixed

Permutations and Combinations - When their uncertainty

Addition Theorem = either-or

- Mutual Exclusive Events

$P(A+B) = P(A) + P(B)$

Note: $P(A \text{ or } B \text{ or } C) = P(A) + P(B) + P(C) = 1$

- Not Mutual Exclusive Events

$P(A \text{ or } B) = P(A+B) = P(A) + P(B) - P(A \cap B)$

$P(A \text{ or } B \text{ or } C) = P(A) + P(B) + P(C) - P(AB) - P(BC) - P(CA) + P(ABC)$

Multiplication Theorem

- Independent Events = "replacement word" and "both" word

$P(A \text{ and } B) = P(A) \times P(B)$

$P(ABC) = P(A) \times P(B) \times P(C)$

- Happening of atleast one event = Complement of an event
- If "only one" word used in above case, then if three events are given so uses:-

$P(A) \times B(\bar{B}) \times P(\bar{C}) + P(\bar{A}) \times P(B) \times P(\bar{C}) + P(\bar{A}) \times P(\bar{B}) \times P(C)$

- Dependent Events = Condinitional Probability = "without replacement"

- Combined Use of Additional and Multiplication Theorem