oliveboard

CAIIB 2025

ABM - Module A

Giveaway

Class Length or Class Width

The difference between the class' upper and lower class limit is called the length or the width of class.

Class Length = Class Width = Upper Class Interval – Lower Class Interval

Mid-Value or Class Mark

The mid-point of the class is called mid-value or class mark.

Class Mark = (Lower class-limit + Upper Class limit)/2

Relative Frequency $= \dfrac{\textit{frequency}}{\textit{Total frequency}}$

Example 5: Relative frequency of the class interval = 20–30 in Example 2 is 12/32 = 0.375

Percentage Frequency

Percentage Frequency = (Class frequency/Total Frequency) × 100

Example 6: Percentage frequency of the class interval = 20–30 in Example 2 is (12/32) 100 = 37.5.

Frequency Density

Frequency density of a class interval = Class frequency/Width of Class

CHAPTER 2 : SAMPLING

Equations Introduced in the Unit

Equation 1 $$\sigma_{\bar{x}} = \sigma / \sqrt{n}$$

Use this formula to derive the standard error of the mean when the population is infinite, that is, when the elements of the population cannot be enumerated in a reasonable period, or when we sample with replacement. This equation states that the sampling distribution has a standard deviation, which we also call a standard error, equal to the population standard deviation divided by the square root of the sample size.

Equation 2 $$z = (\bar{x} - \mu) / \sigma_{\bar{x}}$$

A modified version of the equation allows us to determine the distance of the sample mean x from the population mean μ, when we divide the difference by the standard error of the mean s_x. Once we have derived a z value, we can use the Standard Normal Probability Distribution Table and compute the probability that the sample mean will be that distance from the population mean. Because of the central limit theorem, we can use this formula for non-normal distributions if the sample size is at least 30.

Equation 3 $$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}\left(\sqrt{\frac{N-n}{N-1}}\right)$$

where N = size of the population; n = size of the sample

This is the formula for finding the standard error of the mean when the population is finite, that is, of stated or limited size, and the sampling is done without replacement.

Equation 4 $$\text{Finite population multiplier} = \sqrt{\frac{N-n}{N-1}}$$

In Equation 3, the term $= \sqrt{\frac{N-n}{N-1}}$, which we multiply by the standard error from Equation (1), is called the finite population multiplier. When the population is small in relation to the size of the sample, the finite population multiplier reduces the size of the standard error. Any decrease in the standard error increases the precision with which the sample mean can be used to estimate the population mean.

CHAPTER 3: CENTRAL TENDENCY AND DISPERSION

1. Arithmetic Mean

a. Ungrouped Data: $\bar{X} = \frac{\sum_{i=1}^{n} x_i}{n}$, where $x_1, x_2, \ldots, x_n$ are n observations of x.

b. Grouped Data : If a variate X take values $x_1, x_2, \ldots, x_n$ with corresponding frequencies $f_1, f_2, \ldots, f_n$ respectively, then the arithmetic mean of these values is given by $\bar{X} = \frac{\sum_{i=1}^{n} f_i x_i}{\sum f_i}$, x_i are the class marks of the class intervals for grouped continuous data.

In case of grouped data of continuous series, take mid value of class range as 'x'.

Combined Mean: $$\bar{X} = \frac{n_1 \overline{X_1} + n_2 \overline{X_2}}{n_1 + n_2}$$

$$\text{Corrected mean} = \frac{\textit{Corrected sum}}{\text{No. } \textit{of observation}}$$

2. Geometric Mean:

Geometric Mean of Ungrouped or Raw Data

G.M. $= \sqrt[n]{x_1 x_2 \ldots x_n} = (x_1 x_2 \ldots x_n)^{\frac{1}{n}}$ where $x_1, x_2, \ldots, x_n$ are n observations of x.

Geometric Mean of Grouped or Raw Data

$$\text{G.M.} = \sqrt[n]{x_1^{f_1} x_2^{f_2} \ldots . x_n^{f_n}} = \left(x_1^{f_1} x_2^{f_2} \ldots . x_n^{f_n}\right)^{\frac{1}{n}}$$

where $x_1, x_2 \ldots, x_n$ are n observations of x with frequencies $f_1, f_2 \ldots, f_n$ respectively and $n = f_1 + f_2 + \ldots + f_n$

3. Harmonic Mean

Harmonic Mean of Ungrouped or Raw data:

$$\text{H.M.} = \frac{n}{\sum_{i=1}^{n} \frac{1}{x_i}}$$ where $x_1, x_2, \ldots\ldots x$ are n observations of x.

Harmonic Mean of Grouped or Raw data:

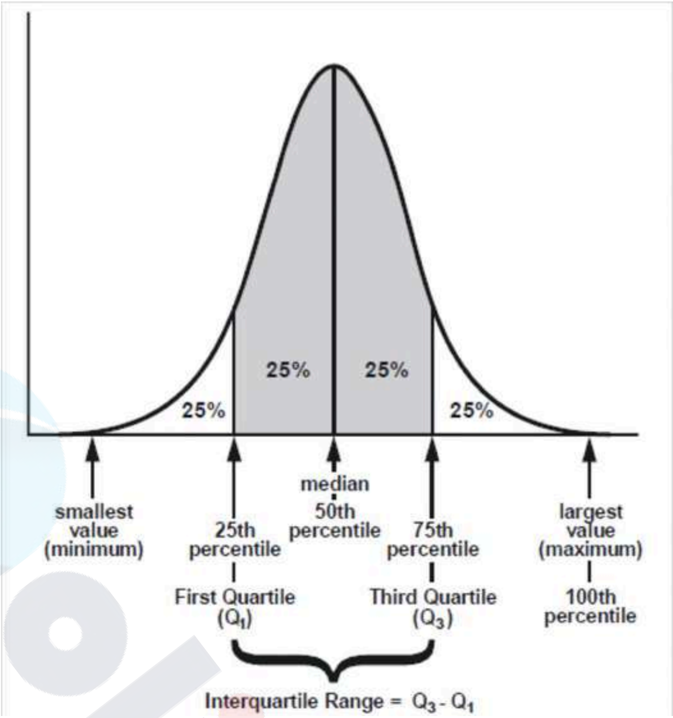
$$\text{H.M.} = \; = \frac{n}{\sum_{i=1}^{n} \frac{f_i}{x_i}}$$

where $x_1, x_2, \ldots\ldots x_n$ are n observations of x with frequencies $f_1, f_2, \ldots . f_n$ respectively and $n = f_1 + f_2 + \ldots . + f_n$

RELATION BETWEEN AM, GM, HM (V.IMP): AM>GM>HM

$$\text{A.M.} \times \text{H.M.} = (\text{G.M.})^2$$

4. Median



Median of Ungrouped or Raw data

The formula to calculate the median of the data is different for odd and even number of observations.

Median of odd Number of Observations

If the total number of given observations is odd, then the formula to calculate the median for a number of n observations is:

Median = $\frac{n+1}{2}$ th observation

Median of even Number of Observations

If the total number of given observations is even, then the median formula to calculate the median for n number of observations is:

$$\text{Median} = \{(\frac{n}{2})^{\text{th}} \text{observation} + (\frac{n+1}{2})^{\text{th}} \text{observation})\} / 2$$

Median of Grouped data:

If a variate X take values $x_1, x_2 \ldots, x_n$ with corresponding frequencies $f_1, f_2 \ldots, f_n$ respectively, then the median of these values is given by

$$Median = l_1 + \frac{(l_2 - l_1)\left(\frac{N}{2} - cf\right)}{f}$$

Median class is the class in which the corresponding value of less than cumulative frequency just exceeds the value of $N/2$.

Where,

l_1 = lower limit of the median class,
l_2 = upper limit of the median class
f = frequency of the median class,
cf = cumulative frequency of the class preceding the median class,
N = total frequency.

$$Q1 = l1 + \frac{(l2 - l1)\left(\frac{N}{4} - CF\right)}{f}$$

Q2 = Median hi hota h

$$Q3 = l1 + \frac{(l2 - l1)\left(\frac{3N}{4} - CF\right)}{f}$$

5. MODE

a. Ungrouped Data: Jo number sabse jyada baar aaye.

b.

Mode of Grouped data

If a variate X take values $x_1, x_2, \dots x_n$ with corresponding frequencies $f_1, f_2, \dots f_n$ respectively, then the mode is

$$Mode = l_1 + \frac{(l_2 - l_1)(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

where, l_1= lower limit of the modal class

$l_2 = up$per limit of the modal class

f_1= frequency of the modal class

f_0= frequency of the class preceding the modal class

f_2= frequency of the class succeeding the modal class

Relation b/w Mean, Median and Mode (V Imp)

Mode = 3 Median – 2 Mean

6. Range and it's coefficient

Range: It is the simplest absolute measure of dispersion. Range (R) = Maximum – Minimum

Coefficient of Range = (Max – Min)/(Max + Min)

7. Quartile Deviation and it's coefficient

It is the mid-point of the range between two quartiles. Quartile Deviation is defined as

$QD = (Q_3 - Q_1)/2$

Where $Q_1 = 1^{st}$ quartile and $Q_3 = 3^{rd}$ quartile.

Co-efficient of QD = $(Q_3 - Q_1)/(Q_3 + Q_1)$

8. Mean Deviation and its coefficient

Mean Deviation (MD) ungrouped data

$$\text{MD (Mean)} = \left(\sum_{i=1}^{n} |x_i - \bar{x}|\right)/\text{n}$$

$$\text{Coefficient of Mean Deviation (Mean)} = \frac{\text{MD}(\text{Mean})}{\text{Mean}}$$

Mean Deviation (MD) grouped data

$$\text{MD (Mean)} = \left(\sum_{i=1}^{n} f_i |x_i - \bar{x}|\right)/\left(\sum_{i=1}^{n} f_i\right)$$

$$\text{Coefficient of Mean Deviation (Mean)} = \frac{\text{MD}(\text{Mean})}{\text{Mean}}$$

9. Standard Deviation & it's coefficient

Standard Deviation (SD) ungrouped data:

$$\text{SD} = \sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n}} = \sqrt{\frac{\Sigma x^2}{n} - (\bar{x})^2} \quad \text{where } \bar{x} \text{ is the mean of these observations}$$

Standard Deviation (SD) grouped data:

$$\text{SD} = \sigma = \sqrt{\frac{\Sigma f (x-\bar{x})^2}{\Sigma f}} = \sqrt{\frac{\Sigma f x^2}{N} - \left(\frac{\Sigma f x}{N}\right)^2} \quad \text{where N} = \Sigma f$$

$$\textbf{Coefficient of Variation} = \textbf{CV} = \frac{\sigma}{\bar{x}} \times 100\%$$

CHAPTER 4: CORRELATION AND REGRESSION

1. Co-relation

$$r = \frac{\operatorname{cov}(X,Y)}{\sigma_x \sigma_y}$$

where $\operatorname{cov} X,Y = \frac{1}{N}\sum(x-\bar{x})(y-\bar{y})$

cov (X, Y) is called the covariance between X and Y.

N is the total number of observations.

$\bar{x}$, $\bar{y}$ are the means and σ_x, σ_y are the standard deviations of the variables X and Y.

Correlation Coefficient can also be calculated using the formula:

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

(not recommended – use only if you have solved multiple times using this formula on calculator)

2. Regression

The equation of the line used to predict values of y, if values of x are known, is y = a + bx, where b is called the slope of the line. Its sign (plus or minus) tells us whether the line slopes from left to right, or from right to left. a is called the y-intercept. It is the point where the line crosses the y-axis.

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

$$b = \frac{\operatorname{cov}(X,Y)}{\sigma_x^2}$$

CHAPTER 5: TIME SERIES

Equation for Straight Line

Equation for estimating a straight line, ŷ = a + bx

Slope $b = \frac{\Sigma xy}{\Sigma x^2}$ (since the coded mean of $x = 0$, the second part of the equation becomes 0).
Then $a = \overline{y}$.

CHAPTER 6: PROBABILITY

Basic Formula of Probability	$P(A) = \frac{n_A}{n} = \frac{\text{No. of equally likely events favourable to A}}{\text{Total no. of equally likely events}}$

Permutation

$$P(n, r) = {}^nP_r = \frac{n!}{(n-r)!}$$

Combination

$${}^nC_r = \frac{n!}{r!(n-r)!}$$

It may be noted that : $0! = 1, \quad 1! = 1$

Value at Risk (VAR)

VaR at 95% confidence level =
[Return of the portfolio –1.65 * σ][Value of the portfolio]

VaR at 99% confidence level =
[Return of the portfolio –2.33 * σ][Value of the portfolio]

Correct value of z at 90% is 1.645, 95% is 1.96 and 99% is 2.58

Expected loss = PD * EAD * (1 – LGD)

Additional Rule

(1) Probability of Event A or B = $P(A \cup B)$ =

$$\boxed{P(A) + P(B) - P(A \text{ and } B)}$$

(2) For Mutually exclusive Events

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

$$\boxed{P(A \text{ and } B) = 0}$$

Multiplication Rule

⇒ Conditional Probability ⇒

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

multiply both sides P(B)

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

$$P\left(\frac{B}{A}\right) = \frac{P(A \text{ and } B)}{P(A)}$$

Multiply both side by P(A)

$$\boxed{P(A \text{ and } B) = P\left(\frac{B}{A}\right) \times P(A)}$$

$\Rightarrow$ Independent Events

$P\left(\frac{A}{B}\right) = P(A)$ [because A does not depend on B]

$P\left(\frac{B}{A}\right) = P(B)$ [" " A.]

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

$\Rightarrow$ Independent Events

$P\left(\frac{A}{B}\right) = P(A)$ [because A does not depend on B]

$P\left(\frac{B}{A}\right) = P(B)$ [" " A.]

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

Addition Theorem

Let A and B are two events (subsets of sample space S) and are not disjoint, then the probability of the occurrence of A or B or A and B both, in other words probability of occurrence of at least one of them is given by,

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

Corollary 1: If the events A and B are mutually exclusive, then

$$A \cap B = \varphi \subset P(A \cap B) = 0 \Rightarrow P(A \cap B) = P(A) + P(B)$$

Corollary 2: For three non-mutually exclusive events A, B, C

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

Corollary 3: If A and B are any two events, then

$$P(A) = P(A \cap B) + P(A \cap B^c)$$

Corollary 4: If A^c is complementary event of A then

$$P(A^c) = 1 - P(A)$$

Multiplication Theorem

If A and B are two events of a sample space S associated with an experiment, then the probability of simultaneous occurrence of events A and B is given by

$$P(A \cap B) = P(A)\,P(B/A) = P(B)\,P(A/B)$$

Independent Events

Two events A and B are independent of each other if the occurrence or non-occurrence of one does not affect the occurrence of the other.

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

Binomial Distribution - Mode

Mode

Let $M = (n+1)\,p$

If M is not an integer, mode is the integral part lying between $M - 2$ and M.

If M is an integer, there are two modes and thus the distribution is bimodal, and two modes are $M - 1$ and M.

CHAPTER 7:

POINT ESTIMATE – Calculation

1. **Point estimate of Population Mean:** The sample mean x is the best estimator of the population mean u. It is unbiased, consistent, and the most efficient estimator, and as long as the sample is sufficiently large, using Central Limit Theorem, its sampling distribution can be approximated by the normal distribution.

2. **Point Estimate of Population Variance & Standard Deviation**

$$s^2 = \frac{\Sigma(x - \bar{x})^2}{n-1}$$ as the estimate of the population variance.

Interval Estimates and Confidence Intervals

will often express confidence intervals like this: $x \pm 1.64 * \sigma_{\bar{x}}$ where

$$x + 1.64 * \sigma_{\bar{x}} = \text{upper limit of the confidence interval}$$

$$x - 1.64 * \sigma_{\bar{x}} = \text{lower limit of the confidence interval}$$

Thus *confidence limits* are the upper and lower limits of the confidence interval. In this case, $(x + 1.64 * \sigma x)$ is called the *upper confidence limit (UCL)* and $(x - 1.64 * \sigma_{\bar{x}})$ is called the *lower confidence limit (LCL)*.

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