

SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai



Department of Computer Science and Engineering

Course Code & Title : 23AD0201 - Data Science Fundamentals

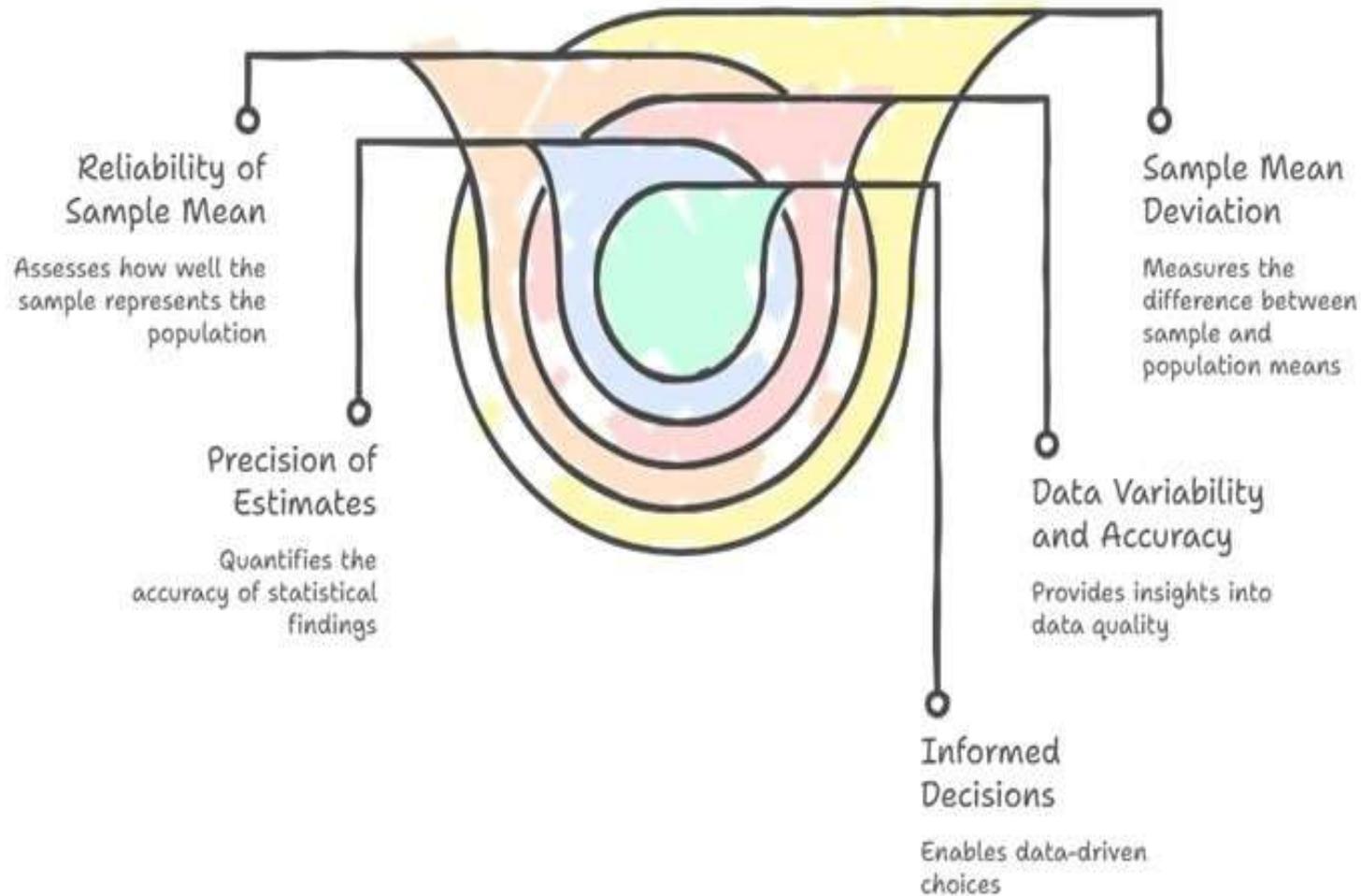
III YEAR / VI SEMESTER - ECE

Unit 3 - INFERENTIAL STATISTICS

Topic : Standard Error of the Mean

K.KARTHIKEYAN AP /CSE

Sample Mean Deviation in Statistics



Understanding Standard Error of the Mean



$$E=MC^2$$

Formula

The mathematical equation for calculating SEM

$$S_e$$

Interpretation

What a smaller SEM signifies



Sample Size Impact

How increasing sample size affects SEM

$$S_m$$

SEM vs. SD

The difference between SEM and Standard Deviation



Usage

Applications of SEM in statistics

Standard Deviation Formula

Formula for calculating standard deviation is:

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}}$$

where:

- σ is Standard Deviation
- x_i is Each Data Point
- μ is Mean of Data Set
- N is Number of Data Points

Example: Find the standard error of mean of given observations,

x= 10, 20,30,40,50

Solution: Given,

x= 10, 20,30,40,50

Number of observations, n = 5

Hence, Mean = Total of observations/Number of Observations

Mean = (10+20+30+40+50)/5

Mean = 150/5 = 30

By the formula of standard error, we know;

SEM = SD/√N

Now, we need to find the standard deviation here.

By the formula of standard deviation, we get;

$$SD = \sqrt{(1/N - 1) \times ((x_1 - x_m)^2) + (x_2 - x_m)^2 + \dots + (x_n - x_m)^2)}$$

$$SD = \sqrt{(1/5 - 1) \times ((10 - 30)^2) + (20 - 30)^2 + (30 - 30)^2 + (40 - 30)^2 + (50 - 30)^2}$$

$$SD = \sqrt{1/4((-20)^2 + (-10)^2 + (0)^2 + (10)^2 + (20)^2}$$

$$SD = \sqrt{1/4(400 + 100 + 0 + 100 + 400)}$$

$$SD = \sqrt{250}$$

$$SD = 15.811$$

Therefore, putting the values of standard deviation and root of number of observations, we get;

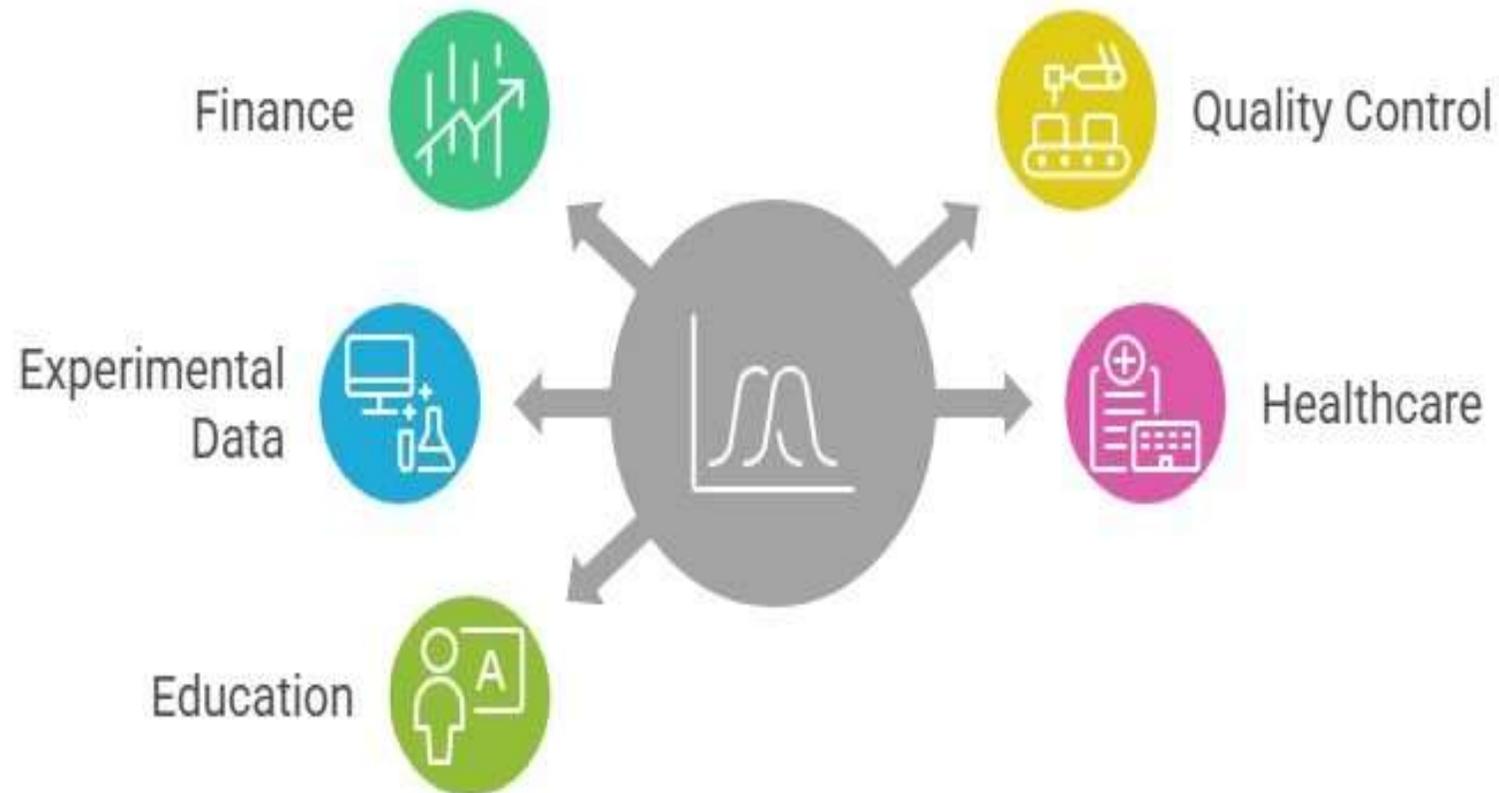
Standard error of mean, SEM = SD/√N

$$SEM = 15.811/\sqrt{5}$$

$$SEM = 15.8114/2.2361$$

$$SEM = 7.0711$$

Applications of Standard Deviation



What is Standard Error of Mean (SEM)?

Standard Error of the Mean (SEM) is a statistical metric that quantifies the precision of the sample mean as an estimate of the population mean. It essentially measures how much the sample mean is expected to vary from the true population mean. Standard Error of the Mean is therefore constitutes the extent to which one would expect the sampled mean of a data set deviate from the true population mean.

Standard Error of Mean Formula

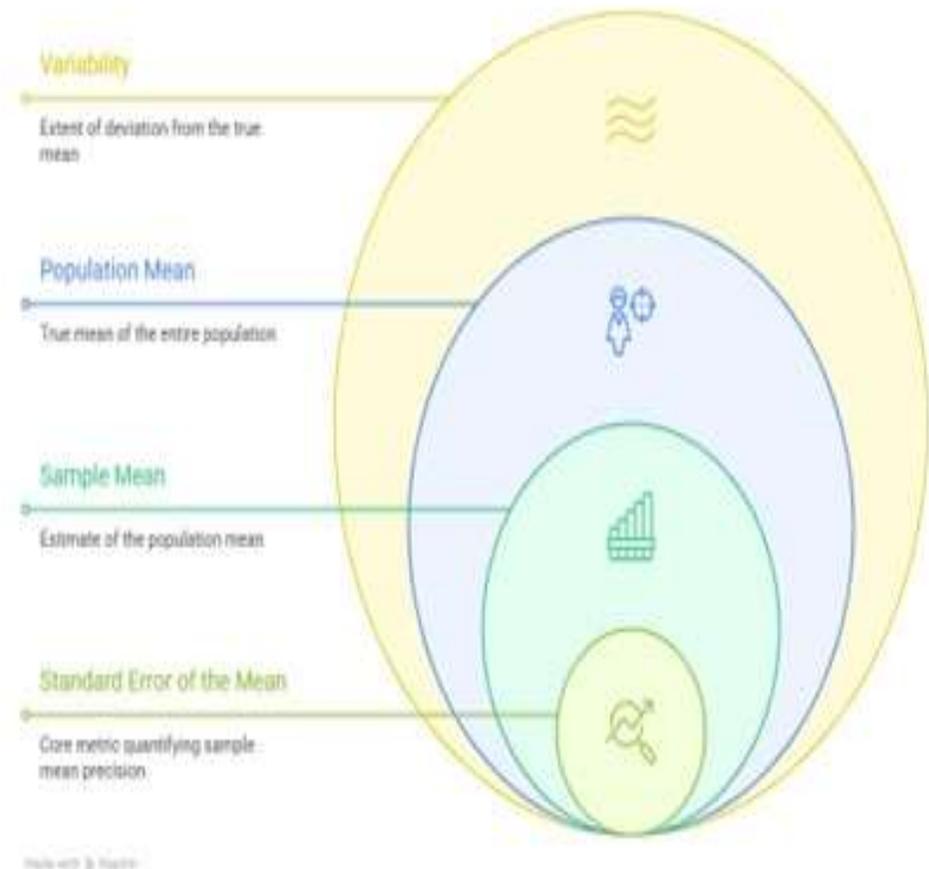
Formula for calculating the Standard Error of the Mean is:

$$SEM = \frac{\sigma}{\sqrt{n}}$$

where:

- σ is Standard Deviation of Sample
- n is Number of observations in Sample

Standard Error of the Mean



Problem -1

Standard error of the mean

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{N(n)}}$$

$\sigma_{\bar{x}}$ = The standard error of the mean

σ = The standard deviation of the population

n = The sample size

Example: Standard error calculation procedure

Name	Height of student
X	150
Y	170
Z	165
A	155
B	158
n=5 total = 798	
5	

Step 1) mean $\bar{x} = 159.5$

Step 2) Deviation

(m-i)	(m-i) ²
9.6	92.16
-10.4	108.16
-5.4	29.16
4.6	21.16

Step 3) Squared Deviations

Step 4

$$S.D = \frac{S.D}{n}$$

$$= \frac{1.9809}{5} = 0.9$$

$$\boxed{1.6 \quad 2.56}$$

Step 5) $\sum (m-i)^2 = 253.2$

$$\text{Step 6) } \frac{\sum (m-i)^2}{n-1}$$

$$= \frac{253.2}{5-1}$$

$$= \frac{253.2}{4}$$

$$\boxed{S.D. = 63.3}$$

Step 6)

$$S.D = \sqrt{\frac{\sum (m-i)^2}{n-1}}$$

$$= \sqrt{\frac{63.3}{4}}$$

$$= \frac{7.956}{4}$$

$$= 1.9809$$

$$\boxed{S.D = 1.9809}$$

$$\boxed{S.E = 0.9}$$



Scanned with CamScanner

Step ②

$$M \pm 1SE = 159.6 \pm 0.99$$

$$\begin{array}{|l} = 159.6 + 0.99 \\ \text{Step ②} = 160.59 \\ \text{1 answer} \end{array}$$

$$\begin{array}{l} (01) = 159.6 - 0.99 \\ = 158.60. \end{array}$$

Activity

Activity: Standard Error of the Mean (SEM)

Objective:

To help students understand how the Standard Error of the Mean (SEM) measures the variability of the sample mean from the population mean.

Activity Scenario

A teacher wants to study the average marks of students in a class. A random sample of 36 students is selected. The sample standard deviation is 12 marks. Calculate the Standard

Error of the Mean.

Formula Used

$$SE = \frac{\sigma}{\sqrt{n}}$$

Where:

- SE = Standard Error of the Mean
- σ = Standard deviation
- n = Sample size

Step	Student Task	Answer
1	Identify the sample size (n)	36
2	Identify the standard deviation (σ)	12
3	Substitute values in the formula	$SE = 12 / \sqrt{36}$
4	Calculate $\sqrt{36}$	6
5	Compute the Standard Error	$SE = 12 / 6$
6	Final Result	$SE = 2$

MCQ

MCQ questions on Standard Error of the Mean (SEM).

1. What does the Standard Error of the Mean (SEM) measure?

- A) Variability of individual data values
- B) Variability of the sample mean from the population mean
- C) Difference between mean and median
- D) Total number of samples

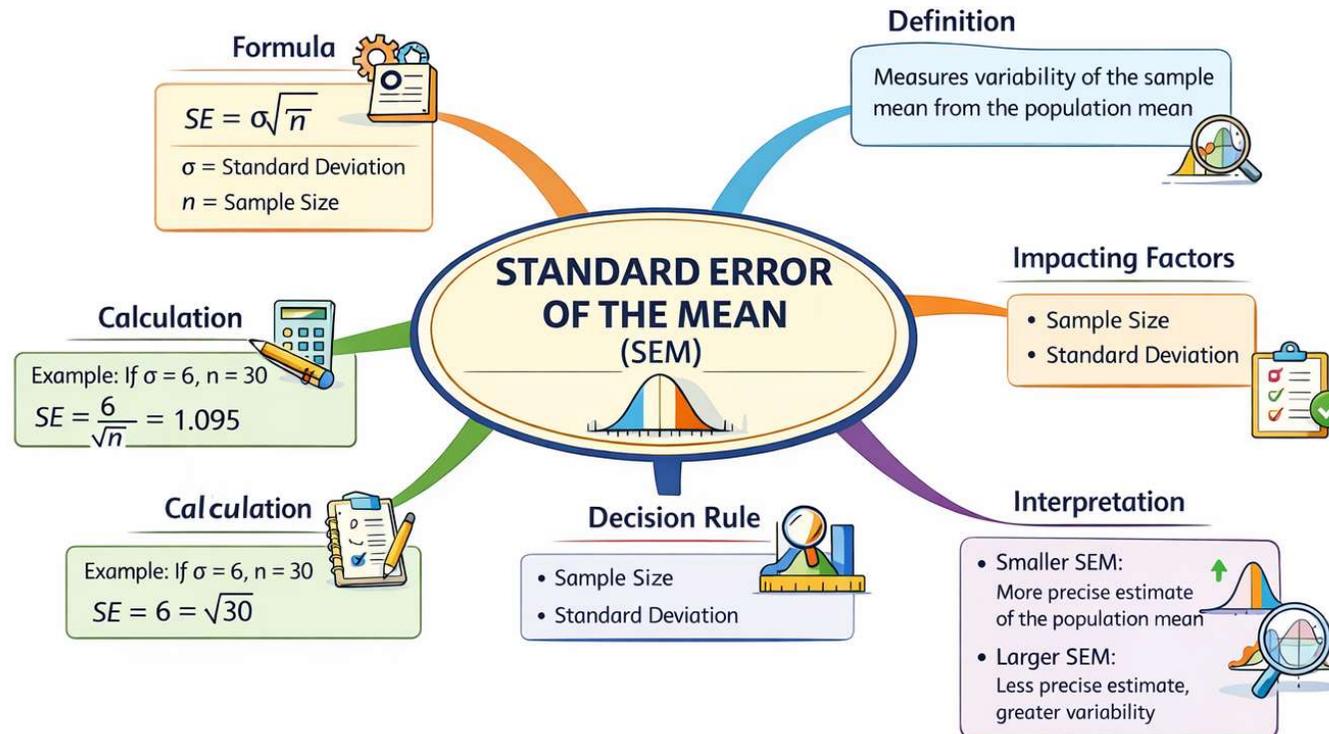
Answer: B

2. The Standard Error of the Mean is calculated using which formula?

- A) σ^2 / n
- B) σ / n
- C) σ / \sqrt{n}
- D) $\sqrt{\sigma} / n$

Answer: C

MIND MAP



REFERENCE BOOKS

1.Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

2.Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, “Fundamentals of Data Science”, CRC Press, 2022.

3.Chirag Shah, “A Hands-On Introduction to Data Science”, Cambridge University Press, 2020.

4.Vineet Raina, Srinath Krishnamurthy, “Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice”, A press, 2021.

