CHAPTER 5

Inferential Statistics

CBSE · Applied Mathematics · Class 12

WHAT THIS CHAPTER DOES

Boards prep that builds confidence, not anxiety.

TODAY'S MISSION

Today's Mission

WHY THIS MATTERS

The Inference Pipeline

TOPIC

A

Part A — Population, Sample & Sampling Methods

TOPIC

Population vs Sample — the Vocabulary Locked

POINT 1	POINT 2	POINT 3	POINT 4

TOPIC

Five Sampling Methods — Quick Recognition Table

TOPIC

Self-Check — Have You Locked Part A?

TOPIC

B

Part B — Sampling Distribution & CLT

THEOREM · LOAD-BEARING RESULT

The Central Limit Theorem (CLT)

> "If $X_1, X_2, \cdots, X_n$ is a random sample of size n drawn from ANY population with mean μ and finite variance σ^2, then for sufficiently large n (typically $n > 30$), the sampling distribution of the sample mean $\bar{x}$ is approximately normal with mean μ and standard deviation $\sigma/\sqrt{n}$.

STATEMENT

If $X_1, X_2, \cdots, X_n$ is a random sample of size n drawn from ANY population with mean μ and finite variance σ^2, then for sufficiently large n (typically $n > 30$), the sampling distribution of the

WHY THIS MATTERS

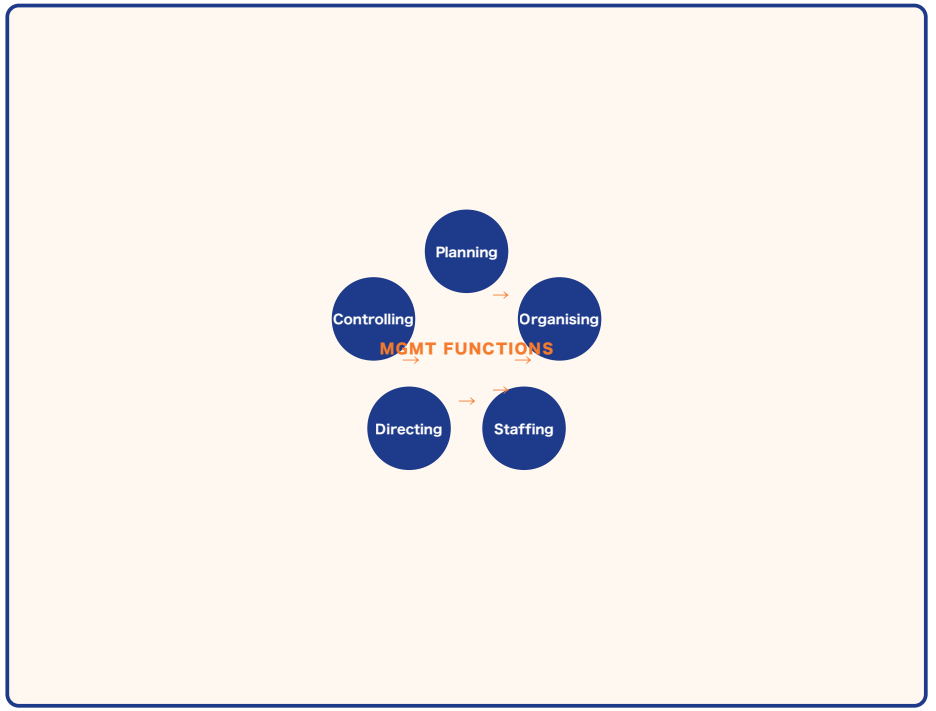
- This is the single most important result in inferential statistics: it lets us use the normal-distribution z-table for problems even when the underlying population is skewed, bimodal, or otherwise non-normal.

WATCH OUT FOR

NOTE CLT does NOT say the population becomes normal. It says the distribution of $\bar{x}$ (the AVERAGES of repeated samples) becomes normal.

WORKED EXAMPLE

Worked Example 1 — SE from CLT (motif-driven)



TRY IT · SOLVE BEFORE YOU PEEK

Quick Test — Can You Apply CLT?

Work it out before you flip the answer.

SOLUTION

TOPIC

C

Part C — Estimation: Confidence Intervals

TOPIC

Point Estimate vs Interval Estimate

POINT 1	POINT 2	POINT 3	POINT 4

WORKED EXAMPLE

Worked Example 2 — Constructing a 95% CI

TOPPER TEMPLATE · MARK-BY-MARK

Topper Template — 5-mark CI Question

TOPIC

D

Part D — Hypothesis Testing

TOPIC

The Five Pillars of a Hypothesis Test

POINT 1	POINT 2	POINT 3	POINT 4

WORKED EXAMPLE

Worked Example 3 — Full One-Sample z-Test

TOPIC

Decision Matrix — Reading Type I vs Type II at a Glance

TOPIC

Pre-Exam Self-Check — Hypothesis Testing

PYQ PATTERNS

PYQ Marks Pattern — Last 5 Years

MARKS DISTRIBUTION

Sub-topic Weight — Where the Marks Live

TOPPER TEMPLATE · MARK-BY-MARK

Topper template 1

1 **STEP 1** — 1 m

State the given data: n, $\bar{x}$, σ (or s).

2 **STEP 2** — 1 m

Identify confidence level → z-critical (1.96 for 95%, 2.58 for 99%).

3 **STEP 3** — 1 m

Compute standard error SE = $\sigma/\sqrt{n}$ (substitute s if σ unknown and n is large).

4 **STEP 4** — 1 m

Compute margin of error E = z × SE.

TOPPER TEMPLATE · MARK-BY-MARK

Topper template 2

1	**STEP 1** 1 m	State H_0: $\mu = \mu_0$ and H_1 (one- or two-tailed as the problem dictates).
2	**STEP 2** 1 m	Note the level of significance α (0.05 or 0.01) and the critical z-value(s).
3	**STEP 3** 1 m	Compute SE = $\sigma/\sqrt{n}$, then z_calc = $(\bar{x} - \mu_0)/SE$ — show arithmetic.
4	**STEP 4** 1 m	Compare |z_calc| with z_critical OR compare p-value with α.
5	**STEP 5** 1 m	State decision (reject / fail to reject H_0) and write the conclusion in the language of the problem.

PYQ PATTERNS

Top PYQ patterns to drill

#1	Construct a CI for μ given n, $\bar{x}$, σ (3 marks)	82%
#2	One-sample z-test on a claimed mean (4 marks)	71%
#3	Identify the sampling technique used in a scenario (2 marks)	57%
#4	State CLT and find SE for a sampling distribution (2 marks)	64%
#5	Distinguish Type I vs Type II error in a real context (2 marks)	39%

RECAP · MEMORISE THESE

Chapter 5 — Lock-In Summary

1 Parameter (μ, σ) describes population (fixed unknown); statistic ($\bar{x}$, s) describes sample (random, computed).

2 CLT: for $n > 30$, $\bar{x}$ is approximately Normal(μ, σ^2/n) regardless of population shape.

3 Standard error of mean: $SE = \sigma/\sqrt{n}$ (use s when σ unknown and n is large).

4 95% CI: $\bar{x} \pm 1.96 \times SE$; 99% CI: $\bar{x} \pm 2.58 \times SE$; 90% CI: $\bar{x} \pm 1.645 \times SE$.

5 Hypothesis test = H_0 + H_1 + α + test statistic + decision + contextual conclusion.

6 Type I = false alarm (probability α); Type II = miss (probability β). Trade-off between them.

WHAT'S NEXT

Next Chapter

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