ANSWER KEY & MARKING SCHEME · CBSE CLASS 12

Inferential Statistics

Applied Mathematics · Chapter 5 · Use this with the Board Paper · Companion to Quick Drill

HOW TO USE

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

MODEL ANSWERS · BOARD PAPER

Section A — Short Answer (2 marks)

Q1. Distinguish between a parameter and a statistic with one example each. **[2 marks]**

Ans: A parameter is a numerical summary of the entire population (fixed but usually unknown), e.g. population mean μ. A statistic is a numerical summary computed from a sample (varies sample to sample), e.g. sample mean $\bar{x}$.

Q2. State the Central Limit Theorem. **[2 marks]**

Ans: If random samples of size n are drawn from any population with mean μ and finite variance σ^2, then for sufficiently large n (n > 30), the sampling distribution of the sample mean $\bar{x}$ is approximately normal with mean μ and standard deviation $\sigma/\sqrt{n}$ — regardless of the population's distribution.

Q3. Define Type I and Type II errors in hypothesis testing. **[2 marks]**

Ans: Type I error: rejecting the null hypothesis H_0 when it is actually true (probability α). Type II error: failing to reject H_0 when it is actually false (probability β).

Q4. A factory's quality manager picks 5 chips from each batch every hour off the assembly line. Identify the sampling method and give one limitation. **[2 marks]**

Ans: This is systematic sampling (fixed period). Limitation: if the assembly process has any hidden periodicity that aligns with the sampling interval, the sample becomes biased and unrepresentative.

Section B — Medium Answer (3 marks)

Q5. A sample of 64 bolts produced by a machine has σ = 4 mm. Find the standard error of the sample mean and explain what it measures. **[3 marks]**

Ans: SE = $\sigma/\sqrt{n} = 4/\sqrt{64} = 4/8 = 0.5$ mm. The standard error measures the typical amount by which the sample mean $\bar{x}$ varies from the true population mean μ across repeated samples of size 64 — i.e. the precision of $\bar{x}$ as an estimate of μ.

Q6. A random sample of 100 students has mean exam score $\bar{x}$ = 50 and the population SD is σ = 10. Construct the 95% confidence interval for the population mean μ. **[3 marks]**

Ans: Given n = 100, $\bar{x}$ = 50, σ = 10. For 95% confidence, z = 1.96. SE = $\sigma/\sqrt{n}$ = 10/10 = 1.0. Margin of error E = 1.96 × 1.0 = 1.96. CI = (50 − 1.96, 50 + 1.96) = (48.04, 51.96). We are 95% confident that the true mean exam score lies between 48.04 and 51.96.

Q7. Briefly describe stratified random sampling and state one situation where it is preferable to simple random sampling. **[3 marks]**

Ans: In stratified sampling, the population is divided into non-overlapping subgroups (strata) — such as boys and girls, or different income brackets — and a random sample is drawn from EACH stratum, often in proportion to its size. It is preferable when the strata differ markedly on the variable being studied (e.g. comparing study habits across science / commerce / humanities streams), because it guarantees representation of every subgroup and reduces sampling variance compared to SRS.

Section C — Long Answer (5 marks)

Q8. A company claims that its light bulbs last 1000 hours on average with population SD σ = 100 hours. A random sample of n = 64 bulbs yields $\bar{x}$ = 980 hours. Test the claim at α = 0.05 (two-tailed). Show all five steps. [5 marks]

> **Ans:** Step 1 — Hypotheses: H_0: μ = 1000 (claim holds); H_1: $\mu \neq$ 1000 (two-tailed). Step 2 — Significance level α = 0.05, so z-critical = ±1.96. Step 3 — Standard error: SE = $\sigma/\sqrt{n}$ = $100/\sqrt{64}$ = 100/8 = 12.5. Step 4 — Test statistic: z_calc = $(\bar{x} - \mu_0)$/SE = (980 − 1000)/12.5 = −20/12.5 = −1.6. Step 5 — Decision: |z_calc| = 1.6 < 1.96 = z_critical, so we FAIL to reject H_0. Conclusion: at the 5% level of significance, the data do not provide sufficient evidence that the mean life differs from 1000 hours — the company's claim is supported.

Q9. A sample of 400 households in a city has average monthly spending $\bar{x}$ = ₹6500 with population SD σ = ₹800. (a) Construct a 99% confidence interval for the true mean spending μ. (b) Interpret the interval in context. (c) State what happens to the interval width if the confidence level is reduced to 95%. [6 marks]

> **Ans:** (a) Given: n = 400, $\bar{x}$ = 6500, σ = 800. For 99% confidence, z = 2.58. SE = $800/\sqrt{400}$ = 800/20 = 40. Margin of error E = 2.58 × 40 = 103.2. CI = (6500 − 103.2, 6500 + 103.2) = (₹6396.80, ₹6603.20). (b) Interpretation: we are 99% confident that the true mean monthly household spending in this city lies between ₹6396.80 and ₹6603.20. (c) At 95% confidence, z drops from 2.58 to 1.96, so E = 1.96 × 40 = 78.4, giving CI = (6421.60, 6578.40). The interval is NARROWER (width drops from ₹206.40 to ₹156.80) — lower confidence buys sharper precision.

★ TOPPER ANSWER TEMPLATES

2 TEMPLATES · MEMORISE THE FORMAT

★ TOPPER TEMPLATE — Topper template 1

Common

Step 1 **[1 mark]**	**Step 1**	State the given data: n, $\bar{x}$, σ (or s).
Step 2 **[1 mark]**	**Step 2**	Identify confidence level → z-critical (1.96 for 95%, 2.58 for 99%).
Step 3 **[1 mark]**	**Step 3**	Compute standard error SE = $\sigma/\sqrt{n}$ (substitute s if σ unknown and n is large).
Step 4 **[1 mark]**	**Step 4**	Compute margin of error E = z × SE.
Step 5 **[1 mark]**	**Step 5**	Write CI as $(\bar{x} - E, \bar{x} + E)$ with units and one-line interpretation.

COMMON LOSS OF MARKS:

- Skipping definitions or terminology mid-answer
- No clear paragraph/point structure
- Conclusion absent or one-line

★ TOPPER TEMPLATE — Topper template 2

Common

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

COMMON LOSS OF MARKS:

- Skipping definitions or terminology mid-answer
- No clear paragraph/point structure
- Conclusion absent or one-line

MARKING SCHEME — GENERAL NOTES

- Award 1 mark for stating H_0 and H_1 correctly, 1 mark for quoting α and z-critical, 1 mark for SE, 1 mark for z_calc, 1 mark for decision + contextual conclusion (in 5-mark hypothesis-test questions).
- Deduct 1 mark if 'accept H_0' is written instead of 'fail to reject H_0'.

- Deduct 0.5 mark for missing units (mm, hours, ₹) in numerical answers.
- In CI questions, the interval AND a one-line interpretation in context are both required for full credit.
- Mathematical arithmetic must be shown step-by-step; final numerical answer alone earns at most half the available marks.
- Accept z = 1.96 / 2.58 / 1.645 as quoted critical values without table reproduction.
- Statement of CLT must include both 'large n' AND 'regardless of population distribution' for full 2 marks.