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SAMPLE OUTPUT

STUDY GUIDE

Study Guide: Statistics For Decision-Making

A study guide generated from lecture material, with worked definitions, pitfalls and practice sets.

LEVEL

**Introductory
undergraduate**

SECTIONS

7

PRACTICE ITEMS

20

STATUS

Sample output

How To Use This Guide

Each section states the idea in plain language, then in the formal language your exam will use, then shows the mistake that most commonly loses marks. Work the practice items without notes, then check against the pitfalls rather than against the answers.

1. What Statistics Is For

Statistics is the discipline of making defensible statements under uncertainty. Every technique in this course exists to answer one of two questions: what is happening in this data, or how confident can I be that it is not chance?

ORGANISING PRINCIPLE

If you can say which of those two questions a method answers, you will almost never choose the wrong method in an exam.

2. Describing Data

Measure	Use when	Pitfall
Mean	Roughly symmetric data	One outlier moves it a long way
Median	Skewed data or outliers present	Ignores magnitude of extremes
Standard deviation	Spread around a meaningful mean	Meaningless if the mean is
Interquartile range	Skewed data	Discards tail information deliberately

3. Distributions

A distribution is a statement about how likely each value is. Two properties matter for this course: its centre and its spread. The normal distribution is not common because nature prefers it — it is common because averages of many independent things tend towards it, which is the central limit theorem and the single most examined idea here.

4. Sampling And Uncertainty

- A sample statistic is an estimate; it has its own distribution, called the sampling distribution.
- Standard error is the standard deviation of that sampling distribution — not of the data.
- Larger samples reduce standard error by the square root of n , which is why quadrupling the sample halves the error.
- Bias is not reduced by sample size. A badly drawn sample stays wrong, precisely.

5. Hypothesis Testing, Stated Honestly

A p-value is the probability of seeing data at least this extreme if the null hypothesis were true. It is not the probability that the null hypothesis is true, and it is not the probability that you are wrong. Those two misstatements account for most lost marks in this topic.

You conclude	Truth: no effect	Truth: effect exists
Reject null	Type I error (α)	Correct
Do not reject	Correct	Type II error (β)

6. Common Pitfalls

- Reporting significance without effect size. A tiny effect can be significant with enough data.
- Treating a non-significant result as evidence of no effect. It is absence of evidence.
- Multiple comparisons without correction — twenty tests at $\alpha = 0.05$ will hand you a false positive.
- Confusing correlation with causation, especially when a plausible story is available.
- Using a mean on ordinal data such as a five-point satisfaction scale without saying why.

7. Practice Set

- A sample of 400 gives a standard error of 2.5. What sample size halves it?
- State in one sentence what a 95% confidence interval does and does not claim.
- A test returns $p = 0.048$ with $n = 20,000$. What should you report alongside it, and why?
- Data are strongly right-skewed with three extreme values. Which centre and spread measures do you report?
- Explain why bias is unaffected by sample size, using a concrete sampling example.
- You run twelve independent tests at $\alpha = 0.05$. What is the approximate chance of at least one false positive?
- Distinguish standard deviation from standard error in one sentence each.
- Give one situation where the median is the only defensible measure of centre.

Exam Technique

- Name the method and say which of the two organising questions it answers before calculating.
- State assumptions explicitly; marks are available for naming an assumption you then say is doubtful.
- Always report effect size next to significance.
- If you run out of time, write the interpretation sentence — it usually carries more marks than the arithmetic.

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