

IB Maths AI HL Unit 4 Statistics and Probability Practice Exam

IB Mathematics: Applications and Interpretation HL · 12 questions · 60 marks

Name _____

Date _____

Score / 60

- Answer every question. Show your working: most marks are for method.
- Calculator allowed.
- Topics: Data Collection Principles; One-sample Mean Inference; CI and Test Fundamentals.
- The mark scheme is a separate free PDF: ibmathrevision.com/downloads/practice-exams/hlai/ib-maths-ai-hl-unit-4-statistics-probability-practice-exam-mark-scheme.pdf

1. A school wants to find out how much time its students spend on homework each week. The head of mathematics suggests the survey question: *'You do at least 10 hours of homework a week, don't you?'* [3]
 - a. Explain why this is a poor survey question. [1]
 - b. Suggest an improved question. [1]
 - c. State one other variable, apart from hours of homework, that it would be relevant to record, and give a reason. [1]
2. The lengths of a species of fish are normally distributed with standard deviation 6 cm. A random sample of 25 fish has mean length 48.2 cm. Find a 95% confidence interval for the population mean length. [3]
3. A 95% confidence interval for the mean time, in minutes, that customers spend in a shop is (12.4, 15.8) [3]
 - a. Write down the sample mean. [1]
 - b. Write down the margin of error. [1]
 - c. A student says 'there is a 95% probability that the population mean lies between 12.4 and 15.8'. Explain what the 95% actually refers to. [1]



4. To test the reliability of a new 20-mark reading test, eight students sat the same test twice, two weeks apart. Their scores are shown in the table. [4]

Student	1	2	3	4	5	6	7	8
First sitting	12	15	9	18	14	11	16	13
Second sitting	13	14	10	17	15	10	17	12

- State the name of this type of reliability test. [1]
- Calculate Pearson's product-moment correlation coefficient r for the two sets of scores. [2]
- Hence comment on the reliability of the test. [1]

5. The masses, in grams, of a random sample of 10 apples from an orchard are [5]
152, 148, 160, 155, 149, 158, 151, 147, 163, 154.

The masses are assumed to be normally distributed.

- Find the sample mean and the unbiased estimate of the population standard deviation. [2]
- Find a 95% confidence interval for the mean mass of apples from the orchard. [3]

6. A battery manufacturer tests a random sample of batteries. A 95% confidence interval for the mean lifetime, in hours, is (9.62, 10.18). [4]

- The manufacturer advertises a mean lifetime of 10.5 hours. Comment on this claim. [2]
- State, with a reason, whether a 99% confidence interval from the same data would be wider or narrower. [2]

7. For a random sample of 20 students, the mean reaction time is 72.4 ms and $s_{n-1} = 8.5$ ms. Reaction times are normally distributed. [4]

- Find a 90% confidence interval for the population mean. [2]
- Find a 99% confidence interval for the population mean. [1]
- Explain why the 99% interval is wider. [1]



8. A coach designs a quick field test of fitness. To check whether it measures fitness, eight athletes take the field test and also have their VO_2 max measured in a laboratory, which is the accepted measure. The results are shown in the table. [6]

Athlete	A	B	C	D	E	F	G	H
Field test score	32	45	28	50	38	41	30	47
Laboratory VO_2 max	35	48	30	55	40	44	29	50

- State whether this is a test of reliability or of validity, and name the type of test. [2]
- Calculate the Pearson product-moment correlation coefficient and Spearman's rank correlation coefficient for these data. [2]
- Hence comment on whether the field test is a valid measure of fitness. [1]
- Explain why a high correlation between two sittings of the field test would not, on its own, show that the test is valid. [1]

9. The volume of juice in cartons is normally distributed with standard deviation 7.5 ml. A 95% confidence interval for the mean volume is to be found from a random sample of n cartons. [4]
- Write down an expression, in terms of n , for the width of the interval. [1]
 - Find the smallest value of n for which the width of the interval is less than 2 ml. [3]



- 10.** Bags of rice are labelled '500 g'. A consumer group weighs a random sample of 12 bags and records these masses, in grams: [9]
 498, 502, 495, 490, 505, 497, 493, 499, 496, 501, 494, 492.
 The masses are normally distributed.

- Find the sample mean and s_{n-1} . [2]
- Explain why a t -distribution is used to find a confidence interval for the mean. [1]
- Find a 95% confidence interval for the mean mass. [3]
- Find a 99% confidence interval for the mean mass. [1]
- Comment on the label, referring to both intervals. [2]

- 11.** A factory records the number of defects on each of 100 randomly chosen panels. No panel had more than 4 defects. [10]

Defects	0	1	2	3	4
Frequency	30	36	20	10	4

A quality engineer wants to test, at the 5% significance level, whether the number of defects per panel follows a Poisson distribution.

- Estimate the mean number of defects per panel. [2]
- Using a Poisson distribution with this mean, the expected frequency for 0 defects is 29.52. Find the expected frequencies for 1, 2 and '3 or more' defects. [2]
- Explain why the categories '3' and '4' have been combined into '3 or more'. [1]
- Write down the number of degrees of freedom for the test, justifying your answer. [2]
- Find the p -value and state the conclusion of the test. [3]



- 12.** A random sample of 40 observations is taken from a normal population with known standard deviation σ . A 95% confidence interval for the population mean is (71.2, 76.8). [5]
- a. Find the sample mean. [1]
 - b. Find the value of σ . [2]
 - c. Find a 90% confidence interval for the population mean from the same sample. [2]

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