

## 4.4 Hypothesis testing and contextual conclusions

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Total: 13 marks**

**KEY WORDS** significance level

### Objective

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Hypothesis testing and contextual conclusions. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

### 1 Key knowledge and worked examples

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#### ■ Could chance explain the result?

- A factory claims that only 10% of items are defective. A sample contains more defects, but chance alone may explain some difference.
  - This lesson studies **significance level** : The chosen probability threshold for rejecting a null hypothesis.
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#### ■ Choose the mathematical structure

- State  $H_0$  and  $H_1$  in population parameters before inspecting the outcome. Calculate the appropriate tail probability under  $H_0$ . Reject  $H_0$  when the evidence meets the specified significance rule; otherwise say there is insufficient evidence.
  - State the allowed inputs and units before calculating. An equation should express the relationship, not just record a calculator entry.
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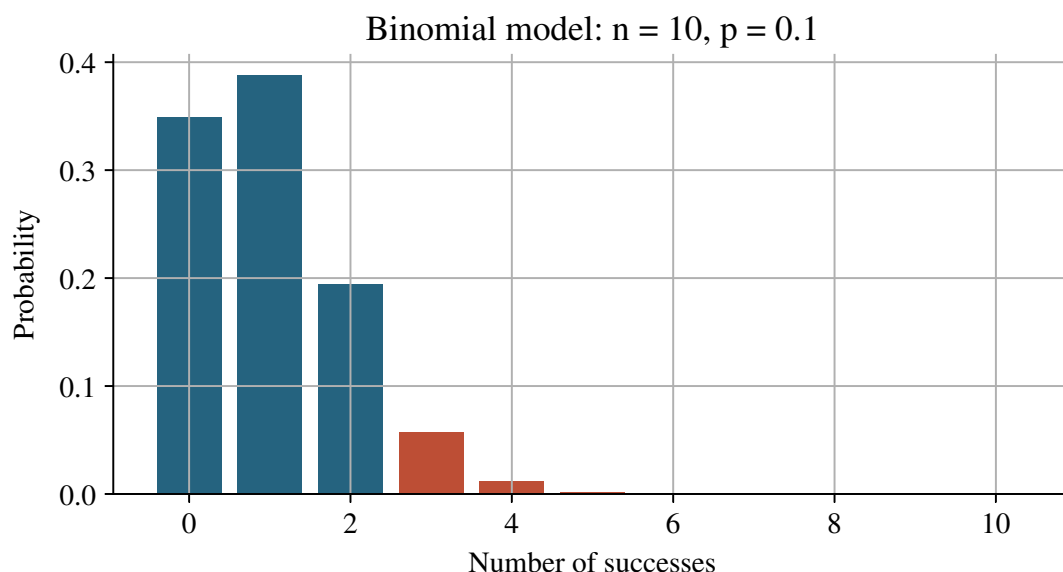
#### ■ Work through a checked case

$$H_0 : p = p_0, \quad H_1 : p > p_0$$

- Check the result against the starting quantities. Substitute into the original relation, or compare the graph and numerical answer where appropriate.

#### Example:

For  $H_0: p=0.1$  and  $H_1: p>0.1$  with  $n=10$ , observing at least 3 defects has probability  $1 - (0.9^{10} + 10 \times 0.1 \times 0.9^9 + 45 \times 0.1^2 \times 0.9^8) \approx 0.070191$ . At 5%, this is insufficient evidence that the defect rate exceeds 10%.



### ■ Test a tempting shortcut

- Failing to reject  $H_0$  is not proof that  $H_0$  is true. Choose the tail from  $H_1$ , not from whichever tail gives a small result. Statistical significance does not measure the practical size of an effect.
- When a shortcut fails, identify the assumption it breaks. Keep an exact value until the requested final rounding.

### Warn:

Failing to reject a null hypothesis proves it is true. This claim is false. Explain which definition or assumption it violates.

### ■ Interpret a new situation

- Finish with a sentence about the population and the original claim. State the model's assumptions and consider whether the sampling procedure supports them.
- A complete solution gives the mathematical result and explains what it means. Check that it is possible in the stated context.

### ■ Use this in your course

- Current first-assessment-2021 Applications and Interpretation HL. This is authored concept support; the full guide is needed to certify every objective.
- Give the method before the final answer, and use the paper's calculator and formula rules. Review a wrong answer by locating the first invalid step.

### Key:

The chosen probability threshold for rejecting a null hypothesis. Choose the relationship, show the method, check its assumptions and interpret the result.

## 2 Practice

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**2.1** Find the significance threshold written as a decimal for 5%. Show the relation, substitution and units. [2]

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**2.2** A correct one-tailed p-value is 0.03 at a 5% threshold. Enter 1 for reject or 0 for do not reject. Show the relation, substitution and units. [2]

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**2.3** Find  $P(X \geq 3)$  for  $X$  binomial(10,0.1). Show the relation, substitution and units. [2]

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**2.4** Decide whether this claim is true and justify: Failing to reject a null hypothesis proves it is true. [2]

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**2.5** Which description correctly defines significance level? Choose one answer.

- **A** The chosen probability threshold for rejecting a null hypothesis.
- **B** A numerical answer that needs no assumptions or interpretation
- **C** A rule that remains valid even when its required conditions fail

[1]

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### 3 Exam-style questions

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**3.1** A correctly designed test gives  $p=0.04$ . State decisions at 5% and 1% significance and explain why  $p$  is not the probability  $H_0$  is true. [4]

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