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WJEC GCSE Mathematics and Numeracy (Double Award) – Question Pack

Estimating probability from experimental data (relative frequency) and predicting the expected number of times an event happens over N trials. Sourced

REVISE

.wales

2.21 – Relative & expected frequency

Spec 3.5.3, 3.5.4 – Unit 2 (no calculator)

Estimating probability from experimental data (relative frequency) and predicting the expected number of times an event happens over N trials. Sourced from legacy WJEC GCSE Mathematics / Mathematics–Numeracy Higher non-calculator papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~34 minutes

Derived from the GCSE Higher pace of ~1.5 min/mark (23 marks across 6 questions).

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification. Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – method marks are awarded for clear setup.

*A calculator is **not** permitted on any question in this pack (Unit 2 is the non-calculator paper).*

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Relative & expected frequency – what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 2: non-calculator.

Relative frequency 3.5.3

- relative frequency = trials in which event happened \div total trials.
- Use as an estimate of probability when outcomes aren't equally likely.
- Accuracy improves with more trials.

Expected frequency 3.5.4

- Expected number of times an event happens = $N \times P$.
- P can be theoretical or experimental.
- Actual count may differ – the expectation is the long-run average.

Large-sample behaviour 3.5.3

- Relative frequency converges to the true probability as N grows.
- Small samples give noisy estimates.
- Combine several experiments to improve reliability.

Frequency tables 3.5.3

- N = sum of the frequency column.
- Relative frequency per row = freq/N .
- All relative frequencies sum to 1.

Relative & expected frequency in one page

Quick-reference notes – revisit before each question. Don't use during the questions.

Relative frequency

$$\text{relative frequency} = \frac{\text{number of times the event happened}}{\text{total trials}}$$

Also called *experimental probability*.
Use when outcomes aren't equally likely (biased die, drawing pin landing).

Expected frequency

$$\text{expected number} = N \times P(\text{event})$$

N is the total number of trials.
 P can be theoretical (fair die) or experimental (relative frequency from past data).

Big- N effect

The more trials, the closer the relative frequency tends to the true probability.
A handful of trials gives a noisy estimate; thousands gives a reliable one.
This is why we trust large samples.

Worked example (relative)

A spinner is spun 200 times. Lands on red 80 times.
Estimated $P(\text{red}) = 80/200 = 0.4$.
Best estimate from this experiment.

Worked example (expected)

$P(\text{red}) = 0.4$ from above. Spin 50 more times.
Expected number of reds = $50 \times 0.4 = 20$.
The actual count may differ – expectation isn't a guarantee.

Fair vs biased

Fair: theoretical probability is reliable.
Use $\frac{1}{6}$ for a fair die.
Biased: theoretical doesn't work – estimate using relative frequency from trials.
If experimental and theoretical disagree on a die, suspect bias.

Reading frequency tables

Sum the frequency column to find N .
Each row's relative frequency = freq/N .
Check the column sums to 1.

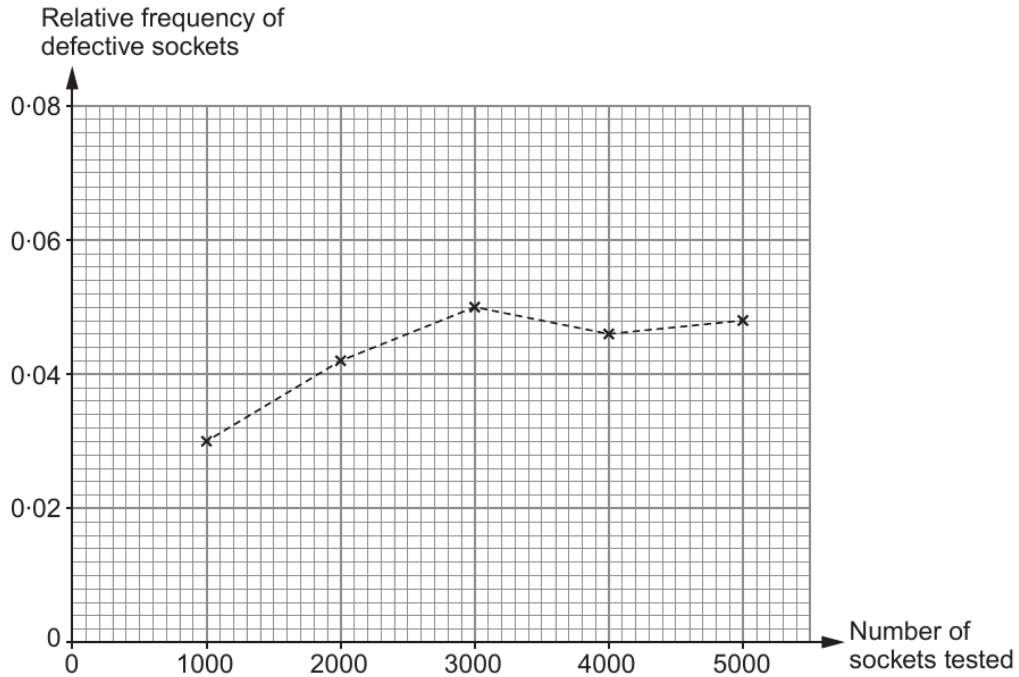
Common traps

- Using N instead of $N \times P$ for expected frequency.
- Treating a small-sample relative frequency as the 'true' probability.
- Confusing the frequency with the relative frequency (one is a count, the other a probability).

Examiner only

7. A factory uses a machine to produce electrical sockets. The manager carries out a survey to investigate the probability of the machine producing a defective socket.

The relative frequency of defective sockets produced was calculated after testing a total of 1000, 2000, 3000, 4000 and 5000 sockets. The results are plotted on the graph below.



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- (a) How many of the first 3000 sockets tested were defective? [2]

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- (b) Write down the best estimate for the probability that one socket, selected at random, will be defective. You must give a reason for your choice. [2]

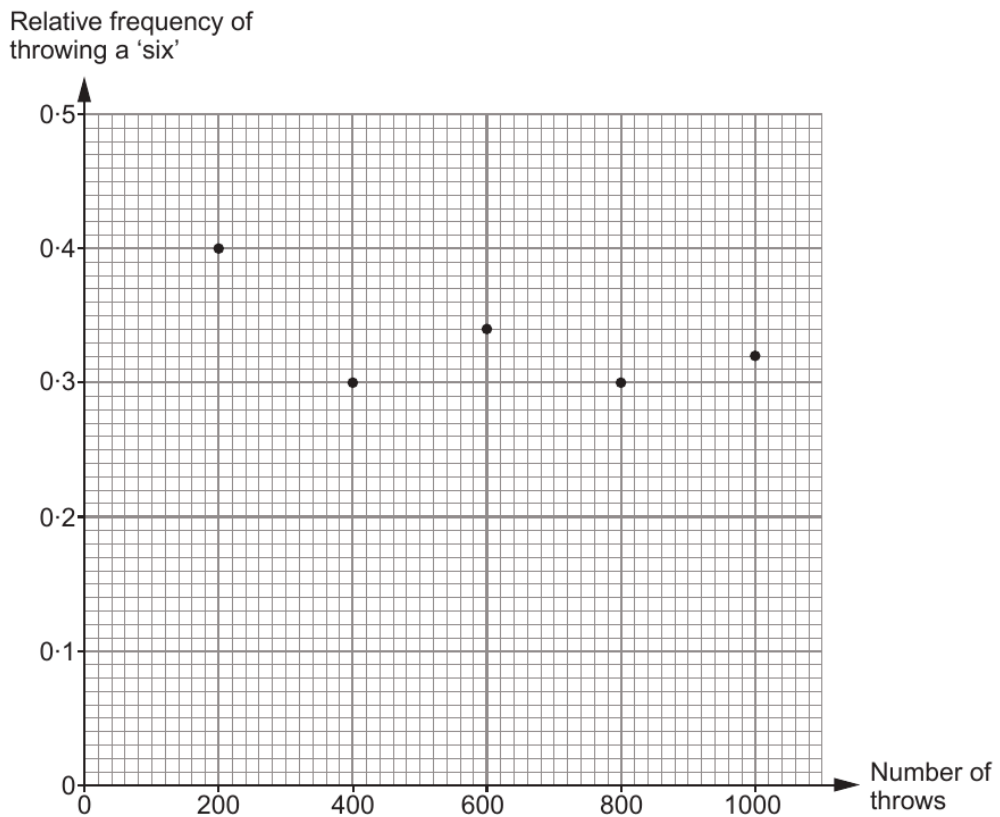
Probability:

Reason:



Examiner only

8. A biased six-sided dice is thrown a total of 1000 times. The graph shows the relative frequency of throwing a 'six' after 200, 400, 600, 800 and 1000 throws.



- (a) Which of the following is the best estimate for the probability of throwing a 'six' with this dice?
Circle your answer. [1]

0.4 0.3 0.5 0.32 0.34

- (b) (i) How many 'sixes' were thrown in the first 600 throws of the dice? [2]

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- (ii) How many **more** 'sixes' were recorded for these 600 throws than you would expect when a **fair** six-sided dice is thrown 600 times? [2]

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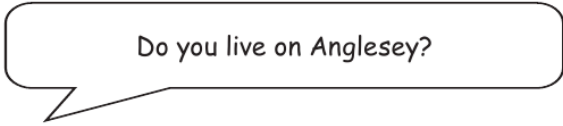
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Examiner
only

6. The Anglesey Show is a two-day event held every August.

(a) On the first day, a random sample of 2000 visitors at the show were asked:



640 of them answered 'Yes'.

What was the relative frequency of those who answered 'Yes'?
Give your answer as a decimal.

[1]

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(b) On the second day a random sample of 3000 visitors at the show were asked the same question.
The relative frequency of those who answered 'Yes' on this day was 0.42.

Calculate the relative frequency of those who said they lived on Anglesey when the samples for **both** days were combined.
Give your answer as a decimal.

[4]

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(c) Which of the following is most likely to give the best estimate for the relative frequency of visitors to the show living on Anglesey?
Circle your answer.

Your answer
to part (a)

0.42

Your answer
to part (b)

You **must** give an explanation for your choice.

[1]

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Examiner
only

2. (a) A biased coin is thrown 100 times.
The number of heads thrown is recorded after 20 throws, 40 throws, 60 throws, 80 throws and 100 throws.

Some of the results are recorded in the relative frequency table below.

Complete the table.

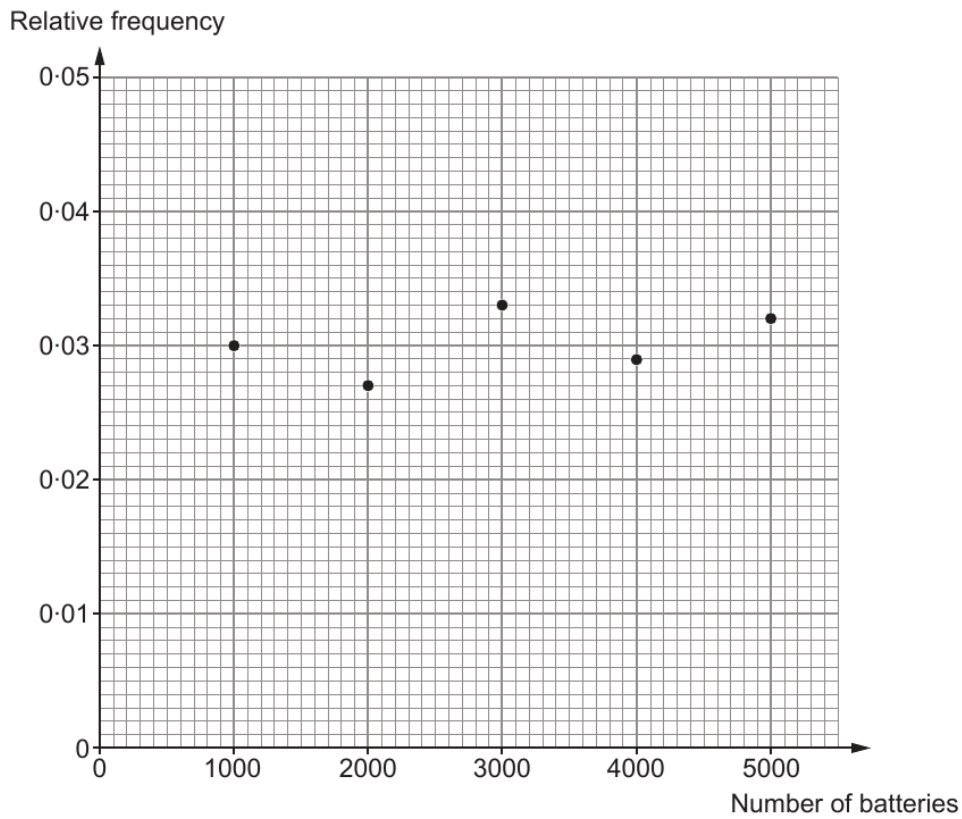
[2]

Number of throws	20	40	60	80	100
Number of heads	11	18	24	30	
Relative frequency	0.55	0.45		0.375	0.37



Examiner only

7. PowrUp is a company that makes batteries. The quality of the batteries is tested regularly. PowrUp calculates the relative frequency of faulty batteries after checking a total of 1000, 2000, 3000, 4000 and 5000 batteries. The results are plotted on the graph below.



- (a) One battery is selected at random. Write down the best estimate for the probability that this battery will be faulty. You must give a reason for your choice. [2]

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Probability =

Reason:

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(b) It costs the company 2·6p to dispose of each of the faulty batteries.
How much will it cost the company to dispose of all the faulty batteries after testing the first 3000 batteries?
You must show all your working. [3]

Examiner
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