



Reliability, validity and simulation

About 50 minutes Calculator allowed 41 marks

Date _____

A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

- A1** Needed today [2 marks]

Owen investigates whether the amount of fertiliser affects how tall tomato plants grow. Write down the explanatory variable and the response variable.

A2 From chapter 3 [2 marks]

Isla writes this question for a survey: "Don't you agree that the bus fares are too high?" The response boxes are Yes and No. Give one problem with the question or its boxes, and say how to improve it.

- A3** Maths skill [2 marks]

Given that $\frac{25}{30} = \frac{40}{x}$, find x .

Answer

A4 Maths skill [2 marks]

50% of 6 is equal to 20% of B . Find B .

Answer

B Example, then your turn

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

To compare the fitness of Year 9 and Year 11, a teacher asks students to rate their own fitness from 1 to 10. Explain why the data may not be valid, and suggest a better way.

Hint Does a rating measure fitness?

- B1** A school uses the number of library books a student borrows to measure how well the student reads. Explain why this may not be valid. [2 marks]
- _____
- _____

EXAMPLE 2

Kai times one drop of a paper helicopter from 2 m with a stopwatch. Explain why his result may not be reliable, and how to make it more reliable.

Hint What happens if he does it again?

- B2** A café owner asks 8 customers one Monday how they rate the coffee. Give two ways to make the results more reliable. [2 marks]
- _____
- _____

EXAMPLE 3

A bus is early with probability 0.1, on time with probability 0.6 and late with probability 0.3. Assign the two-digit random numbers 00 to 99 to the outcomes.

Hint There are 100 numbers. Each outcome gets its share of them.

EXAMPLE 4

Using the numbers in Example 3 (late = 70 to 99), simulate 10 journeys with these random numbers and estimate the probability that the bus is late.

37 82 05 91 64 78 73 50 02 46

Hint Count the numbers from 70 to 99.

EXAMPLE 5

A cereal box holds one of 4 cards, each equally likely. Describe how to use random digits to estimate how many boxes are needed to collect all 4 cards.

Hint Which digits stand for the cards, and when does one trial stop?

B3 A café sells tea to 45% of customers, coffee to 40% and juice to 15%. Assign the two-digit random numbers 00 to 99 to the three drinks. [2 marks]

B4 A player scores a free throw with probability 0.65, so 00 to 64 means a score. Use these random numbers to simulate 12 throws. How many score? Estimate the probability of scoring. [2 marks]

12 71 58 93 40 66 05 87 33 49
21 76

Answer

B5 In a game a coin is thrown until it lands the same way 4 times in a row. Describe a simulation to estimate the mean number of throws in a game. [3 marks]

c Practice

C1 The probability of rain on a day is 0.3. Pip simulates days with the random digits 1 to 9: 1, 2 or 3 means rain; 4 to 9 means dry. Explain what is wrong, and correct it. [2 marks]

C2 Rosa simulates 20 days of a bus journey and estimates that the bus is late with probability 0.25. Explain why she should repeat the simulation. [1 mark]

C3 A dice is simulated with random digits: 1 to 6 are the scores; 0, 7, 8 and 9 are ignored. Use these digits to simulate rolling until a 6, twice. Work out the mean number of rolls.

3 8 1 5 9 6 0 2 4 7 6

C4 To decide whether more weekday buses are needed, a council counts the passengers on one Saturday. Explain why the data may not be valid.

Answer

D Exam-style questions

D1 Mia is asking people whether they would use a new cycle path. She says, "If I ask 500 people instead of 50, my results will be more valid."

Is Mia correct? Give a reason for your answer.

D2 At a café, 65% of customers buy a hot drink, 25% a cold drink and 10% no drink.

(a) Assign the two-digit random numbers 00 to 99 to the three outcomes.

(b) Use these random numbers to simulate 15 customers. How many buy a hot drink?

07 66 93 41 28 85 50 72 99 13 64 38 81 02 47

Answer

(c) Use your simulation to estimate the number of hot drinks sold to 300 customers.

Answer

(d) How could the café make the estimate more reliable?

Total for D2: 6 marks

D3 A team wins with probability 0.5, draws with 0.2 and loses with 0.3. Alfie's plan to simulate 10 matches: roll a fair dice, with 1, 2 or 3 a win, 4 a draw and 5 or 6 a loss; roll it 10 times; the number of wins is how many the team will win. Assess Alfie's plan. [4 marks]

E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

E1

Each box of tea holds one card: A with probability 0.5, B with 0.3, C with 0.2. The random digits 0 to 4 stand for A, 5 to 7 for B, and 8 and 9 for C. Use these digits to carry out three trials of buying boxes until all three cards are collected, and estimate the mean number of boxes.

3 6 1 8 0 2 5 4 1 7 9 6 8 2

Answer

Extension hints

Cover these with paper. Uncover one at a time.

- E1**

Hint 1

Read digits until A, B and C have all appeared; that is one trial. Then start again.

Hint 2

The trials are 3 6 1 8 (4 boxes), 0 2 5 4 1 7 9 (7 boxes) and 6 8 2 (3 boxes).

Hint 3

The mean is $\frac{4+7+3}{3} = \frac{14}{3} = 4.67$ boxes.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

- I can explain whether data are valid and whether a result is reliable, and improve each.
- I can assign random numbers to outcomes and carry out a simulation.
- I can describe and judge a simulation plan.