



Random and systematic sampling

About 50 minutes Calculator allowed 45 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] **A2** Maths skill [2 marks]

There are 4350 houses in a town. In a random sample of 80 of them, 21 have solar panels. Estimate how many of the 4350 houses have solar panels. Give your answer as a whole number.

Work out $\sqrt{24^2 + 7^2}$.

Answer

Answer

A3 Maths skill [2 marks] **A4** Maths skill [2 marks]

Find the gradient of the line through $(-4, -1)$ and $(5, -5)$.

$a = 12$ and $b = 16$, both correct to the nearest whole number. Work out the upper bound of $a + b$.

Answer

Answer

B Examples, then your turn

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

EXAMPLE 1

A hospital has 640 patients on its list. Describe how to use random numbers to take a simple random sample of 40 patients.

Hint Say what you number, how you match, and what you do with numbers you cannot use.

B1 A library has 1400 members. [3 marks]

Describe how Nadia can use a calculator's random number generator to choose a simple random sample of 35 members.

EXAMPLE 2

A club's 300 members are numbered 001 to 300. Use these random numbers, reading three digits at a time from the left, to choose a sample of 4 members.

27194 80562 71133 08249

Hint Write the numbers in threes first: 271, 948, 056, ...

B2 A sports club's 450 members [2 marks]

are numbered 001 to 450. Use these random numbers, reading three digits at a time from the left, to choose a sample of 4 members.

50311 71172 86000 44206
98361

Answer

EXAMPLE 3

A cinema sold 840 tickets for a film. The manager wants a systematic sample of 30 ticket holders from the list of ticket numbers. Describe how to take the sample, and write down the first three ticket numbers if the random start is 11.

Hint Divide the list size by the sample size to find the gap.

B3 A dentist has 1250 patient [3 marks]

records, numbered 1 to 1250. She takes a systematic sample of 50 records with a random start of 17. Work out the interval, then write down the first three record numbers and the last record number in her sample.

Answer

EXAMPLE 4

A head teacher wants a random sample of 20 students. She chooses the first 20 students who arrive at school one morning. Explain why this is not a random sample of the students.

Hint Could every student be chosen? Say "equal chance", not "even chance".

B4 Ollie wants a random sample [2 marks]

of 25 students from his year group. He chooses the students whose surnames begin with A, B or C. Explain why this is not a random sample.

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EXAMPLE 5

A machine fills tins with 10 filling heads used in turn. To check the tins, every 10th tin is taken from the line. Explain why this systematic sample may be biased.

Hint Which filling head does every 10th tin come from?

- B5** A theatre has 400 seats in rows of 20, numbered along each row. A survey of comfort takes every 20th seat on the seat list. Explain why this sample may be biased, and suggest a better method.
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c Practice

- C1** Kit chooses from members numbered 1 to 750. She multiplies each random number from her calculator by 750 and rounds up. Her calculator gives 0.137, 0.902 and 0.489. Which members does she choose? [2 marks]
- C2** The 80 runners in a race are numbered 01 to 80. Use these random numbers, reading two digits at a time from the left, to choose 4 runners. [2 marks]
41920 74163 00882 51734

Answer

- C3** Ben uses his calculator to give random three-digit numbers. He uses them to choose 30 of the 640 students in his school, numbered 001 to 640. Give two problems Ben may have with the numbers his calculator gives. [2 marks]
- C4** Ella wants a systematic sample of 40 students from a list of 730 students. Work out $730 \div 40$, and explain why she should take every 18th student rather than every 19th. [2 marks]
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- C5** Mia says, "A random sample always represents the population exactly." [2 marks]
Explain why Mia is wrong.
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- C6** A gym has 900 members. Ravi chooses every 5th member who comes in on a Monday morning until he has 40 members. Is this a random sample of the members? Give a reason. [2 marks]
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D Exam-style questions

D1 Explain what is meant by a simple random sample. [2 marks]

D2 A garden centre has 960 customers on its loyalty list, numbered 001 to 960.

(a) Use these random numbers, reading three digits at a time from the left, to choose a sample of 6 customers. [2 marks]

58310 49600 27583 99141 27650 18374

Answer

(b) The manager wants a systematic sample of 48 customers instead. Describe how to take it. [2 marks]

(c) Give one reason why a random sample of the customers may still not represent all the customers. [1 mark]

Total for D2: 5 marks

D3 A factory makes kettles on a production line. Jo checks for faults by taking every 50th kettle from the line, starting from a random kettle among the first 50. Assess whether systematic sampling is appropriate for Jo's check. You must give a conclusion. [3 marks]

E Extension

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

E1 A firm has 600 workers, numbered 1 to 600. It takes a systematic sample of 30: a random start from 1 to 20, then every 20th worker. Show that worker 137 has a probability of $\frac{1}{20}$ of being chosen, and explain why this is still not a simple random sample. [3 marks]

Extension hints

Cover these with paper. Uncover one at a time.

- E1**
- Hint 1** Which random starts would choose worker 137?
- Hint 2** Only the start 17 works, because $137 = 17 + 6 \times 20$, and the start is one of 20 equally likely numbers.
- Hint 3** Now think of workers 1 and 2. Can one start choose both of them?

How did it go?

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

I can choose a simple random sample from random numbers, ignoring repeats and numbers out of range. ☐ ☐ ☐

I can take a systematic sample with a random start. ☐ ☐ ☐

I can explain why a method does not give every member an equal chance. ☐ ☐ ☐