Random Response

Key Vocab

Random: Something that happens without method or conscious decision

Sample: A small proportion of the population

interview: a meeting of people face to face, especially for consultation

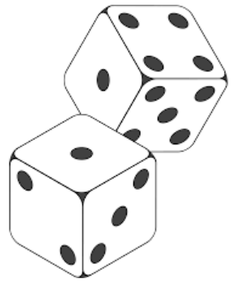
Confidentiality: the state of keeping or being kept secret or private

Probability: the extent to which an event is likely to occur, measured by the ratio of the favourable cases to the whole number of cases possible

Estimate: an approximate calculation or judgement of the value, number, quantity, or extent of something

Proportion: a part, share, or number considered in comparative relation to a whole

Key Knowledge



Randomized response is a research method used in structured survey interview.

It allows respondents to respond to sensitive issues (such as criminal behaviour or sexuality) while maintaining confidentiality.

1. Participants take part in a probability experiment, such as flipping a coin or rolling a dice.
2. Depending on the result, participants answer the question:
   a) yes (embarrassing answer)
   b) honestly
3. Then we estimate the true proportion of results using theoretical probability eliminating the calculated proportion of participants who will have answered yes through random selection

Example - I DO

A school is conducting a survey to estimate the proportion of students who have ever cheated on a test. To encourage honest responses, the school is using the randomized response method. Each student is given the following instructions:

1. Flip a coin in private.
2. If the coin lands on heads, answer the question: "Have you ever cheated on a test?"
3. If the coin lands on tails, answer the question: "Is your birthday in the first half of the year (January to June)?"

Assume that the probability of getting heads or tails is 0.5 and the probability of a birthday falling in the first half of the year is 0.5.

Out of 200 students surveyed, 120 students responded "Yes."

a) Write an equation to represent the relationship between the observed proportion of "Yes" responses and the true proportion of students who have cheated on a test.

b) Solve the equation to estimate the true proportion of students who have cheated on a test.

Example - WE DO

A film company employs Gary to investigate the film-watching habits of people living in the UK. Gary is going to use a questionnaire.

Here is Question 1 on Gary's questionnaire.

Question 1

Spin a fair coin.

If you get **Heads**, tick box A.
If you get **Tails**, answer this question.

Have you downloaded a film illegally during the last month?

If **yes**, tick box A. If **no**, tick box B.

A ❑ B ❑

The method used to decide whether or not to answer a question by spinning a coin is called the random response technique.
(a) Explain why this method is used.
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…… (1 mark)
Gary sends the questionnaire to a sample of people living in a town. He uses a telephone directory as the sample frame.
For Question 1 743 people ticked box A 679 people ticked box B
(b) Calculate an estimate of the proportion of the people in the sample who had downloaded a film illegally during the last month.
..... (3 marks)
Gary is going to write a report on the outcome of Question 1. He is going to use the answer to part (b) as an estimate of the proportion of all the people living in the UK who had downloaded a film illegally during the last month.
(c) Is it appropriate for Gary to use the answer to part (b)? Give two reasons for your answer.
……
…… (3 marks)

YOU DO a

A company is conducting a survey to estimate the proportion of its employees who have ever taken office supplies for personal use. To encourage honest responses, the company is using the randomized response method with a die. Each employee is given the following instructions:

1. Roll a six-sided die in private.
2. If the die shows 1 or 2, answer the question: "Have you ever taken office supplies for personal use?"
3. If the die shows 3, 4, 5, or 6, answer the question: "Do you enjoy watching sports?"

Assume that the probability of rolling a 1 or 2 is $\frac{1}{3}$ and the probability of rolling a 3, 4, 5, or 6 is $\frac{2}{3}$.

Additionally, assume that the probability that an employee enjoys watching sports is 0.5.

Out of 300 employees surveyed, 150 employees responded "Yes."

a) Write an equation to represent the relationship between the observed proportion of "Yes" responses and the true proportion of employees who have taken office supplies for personal use.

b) Solve the equation to estimate the true proportion of employees who have taken office supplies for personal use.

YOU DO b

A company wants to investigate the number of sick days its employees have off work.

The company uses a questionnaire.

Roll a fair dice.

If you get 1, 2, 3 or 4 tick box A.

If you get 5 or 6 answer this question.

Have you ever taken a sick day off work when you weren't really sick?

If yes, tick box A. If no, tick box B. A ☐ B ☐

Here is one of the questions on the questionnaire.

(a) Assess the appropriateness of the method the company uses.

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…… (3 marks)

All the company's employees completed the question. 615 ticked box A. 102 ticked box B.

(b) Show that an estimate of the number of employees who ticked box A because they answered yes to the question is 137

(1 mark)

YOU DO c

A city council is conducting a survey to estimate the proportion of residents who have ever jaywalked. To encourage honest responses, the council is using the randomized response method with a 4-sided spinner. Each resident is given the following instructions:

1. Spin a 4-sided spinner in private.
2. If the spinner lands on 1, answer the question: "Have you ever jaywalked?"
3. If the spinner lands on 2, 3, or 4, answer the question: "Do you enjoy reading books?"

Assume that the probability of landing on 1 is $\frac{1}{4}$ and the probability of landing on 2, 3, or 4 is $\frac{3}{4}$

Additionally, assume that the probability that a resident enjoys reading books is 0.5.

Out of 160 residents surveyed, 70 residents responded "Yes."

a) Write an equation to represent the relationship between the observed proportion of "Yes" responses and the true proportion of residents who have jaywalked.

b) Solve the equation to estimate the true proportion of residents who have jaywalked.

YOU DO d

Remi wants to find out about the number of people that avoid paying tax.
He used a random response question to collect his data. This is a suitable technique to use.
(a) Explain why. .....

…… (1mark)

Here is the random response question that Remi used on a questionnaire. Remi sent the questionnaire to a sample of people.
For this question,
426 people ticked box A
354 people ticked box B

Roll a fair dice.

If you get **1**, **2** or **3**, tick box A.
If you get **4**, **5** or **6**, answer this question.

Have you ever avoided paying tax?

If **yes**, tick box A. If **no**, tick box B.

A ❑ B ❑

A group of researchers also collected data on the number of people that avoid paying tax by directly asking people.
They found that 5.9% of the people they asked said that they had avoided paying tax.
(Source: www.emeraldinsight.com)

(b) Compare the results of Remi's questionnaire with the results obtained by the researchers. You should consider whether the use of the random response technique was effective and you should give a limitation of your conclusion.

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…… (5 marks)