FREE SAMPLE: THE FIRST QUESTION

Question One (14 marks)

(a) A fictional poll of 400 randomly selected voters asked about a four-day school week. In the sample, 55% said they favour a four-day week and 43% said they oppose it. The report concludes: ‘Those who favour a four-day week are clearly in the lead.’

(i) Calculate the margin of error (using $1/\sqrt{n}$) and give an approximate 95% confidence interval for each of the two percentages.

(ii) Evaluate the report's conclusion using the intervals.

(iii) The pollster wants a margin of error of at most 2.00%. Calculate the sample size needed, and explain why a sample that is bigger but not random would still not give a reliable result.

[8 marks]

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(b) Two fictional surveys have the following designs.

Survey 1: A survey of school pupils measures their ‘height’ by asking them to estimate it themselves.

Survey 2: A question asks: ‘How much do you like our excellent new service?’

(i) For each survey, name the main source of bias.

(ii) Explain how the bias in each survey could affect the results, and in which direction.

(iii) Describe how each survey could be redone to avoid this bias, and explain why a larger sample size would not remove it.

[6 marks]

THE WORKED ANSWER TO THAT QUESTION

Question 1 (14 marks) [Surveys and polls]

(a) A fictional poll of 400 randomly selected voters asked about a four-day school week. In the sample, 55% said they favour a four-day week and 43% said they oppose it. The report concludes: 'Those who favour a four-day week are clearly in the lead.' (i) Calculate the margin of error (using $1/\sqrt{n}$) and give an approximate 95% confidence interval for each of the two percentages. (ii) Evaluate the report's conclusion using the intervals. (iii) The pollster wants a margin of error of at most 2.00%. Calculate the sample size needed, and explain why a sample that is bigger but not random would still not give a reliable result.

(a) Answer: (i) MOE 5.00%; (ii) intervals do not overlap; (iii) n = 2500

- Evidence level: Merit (margin of error ≈ $1 \div \sqrt{n}$; confidence interval = estimate ± margin of error).
- (i) Margin of error = $1 \div \sqrt{400} = 0.0500$, i.e. about ±5.00%. First group: 55% ± 5.00% = 50.0% to 60.0%; second group: 43% ± 5.00% = 38.0% to 48.0%.
- (ii) The intervals do not overlap, so the difference is greater than the sampling variation, and the conclusion that the first group leads is supported by the data (for these intervals).
- Achievement: (iii) Calculates the sample size.
- Merit: Links to the formula: $n = (1 \div \text{margin of error})^2$.
- Excellence: Full answer: margin of error = $1 \div \sqrt{n} \le 2.00\% = 0.0200$, so $n \ge (1 \div 0.0200)^2 = 2500$; the margin of error covers only sampling variation (random error), not bias; a larger voluntary or non-random sample (for example a call-in poll) can be biased because the people who respond differ from the population, so the estimate is still unreliable however large the sample.

> **KEY TAKEAWAY**
> Polls: margin of error ≈ $1/\sqrt{n}$ (as a proportion); an interval is estimate ± margin of error; overlapping intervals mean no clear difference; the margin of error does not account for bias; $n = (1/\text{MOE})^2$.

(b) Two fictional surveys have the following designs. Survey 1: A survey of school pupils measures their 'height' by asking them to estimate it themselves. Survey 2: A question asks: 'How much do you like our excellent new service?' (i) For each survey, name the main source of bias. (ii) Explain how the bias in each survey could affect the results, and in which direction. (iii) Describe how each survey could be redone to avoid this bias, and explain why a larger sample size would not remove it.

(b) Answer: (i) measurement bias; leading (biased) question

- Evidence level: Merit (name the bias, then link it to the way people were selected or asked).
- (i) Survey 1: measurement bias; Survey 2: leading (biased) question.
- (ii) Survey 1: the measuring method gives readings that are systematically wrong, so the sample is not representative and the estimate is shifted from the population value (an over- or under-estimate depending on how the group differs). Survey 2: the word 'excellent' suggests the answer wanted, so the estimate is shifted from the population value in the same way.
- Achievement: (iii) States that a random sample or neutral wording is needed.
- Merit: Gives a design for each survey.
- Excellence: Full answer: choose a random sample from a complete list (sampling frame) of the population (for example by random number selection), use neutral, balanced wording, follow up non-respondents, and use trained interviewers who do not influence answers; a larger sample reduces

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only the random sampling error (the margin of error), but a biased method produces a result that is wrong by the same systematic amount however many people are surveyed.

KEY TAKEAWAY

Survey bias: voluntary response, selection, non-response, leading questions, response and measurement bias; a bigger sample does not remove bias, only random selection and good design do.

LOS: Surveys and polls (91584)

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