

Sampling and Estimation 3

Q1.

Mahmoud throws a coin 400 times and finds that it shows heads 184 times. The probability that the coin shows heads on any throw is denoted by p .

- (i) Calculate an approximate 95% confidence interval for p . [4]
 - (ii) Mahmoud claims that the coin is not fair. Use your answer to part (i) to comment on this claim. [1]
 - (iii) Mahmoud's result of 184 heads in 400 throws gives an $\alpha\%$ confidence interval for p with width 0.1. Calculate the value of α . [4]
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Q2.

A die is thrown 100 times and shows an odd number on 56 throws. Calculate an approximate 97% confidence interval for the probability that the die shows an odd number on one throw. [4]

Q3.

In a survey a random sample of 150 households in Nantville were asked to fill in a questionnaire about household budgeting.

- (i) The results showed that 33 households owned more than one car. Find an approximate 99% confidence interval for the proportion of all households in Nantville with more than one car. [4]
- (ii) The results also included the weekly expenditure on food, x dollars, of the households. These were summarised as follows.

$$n = 150 \quad \Sigma x = 19\,035 \quad \Sigma x^2 = 4\,054\,716$$

Find unbiased estimates of the mean and variance of the weekly expenditure on food of all households in Nantville. [3]

- (iii) The government has a list of all the households in Nantville numbered from 1 to 9526. Describe briefly how to use random numbers to select a sample of 150 households from this list. [3]
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Q4.

Jagdeesh measured the lengths, x minutes, of 60 randomly chosen lectures. His results are summarised below.

$$n = 60 \quad \Sigma x = 3420 \quad \Sigma x^2 = 195\,200$$

- (i) Calculate unbiased estimates of the population mean and variance. [3]
- (ii) Calculate a 98% confidence interval for the population mean. [3]

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Q5.

It is known that the number, N , of words contained in the leading article each day in a certain newspaper can be modelled by a normal distribution with mean 352 and variance 29. A researcher takes a random sample of 10 leading articles and finds the sample mean, \bar{N} , of N .

- (i) State the distribution of \bar{N} , giving the values of any parameters. [2]
- (ii) Find $P(\bar{N} > 354)$. [3]
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Q6.

From a random sample of 65 people in a certain town, the proportion who own a bicycle was noted. From this result an $\alpha\%$ confidence interval for the proportion, p , of all people in the town who own a bicycle was calculated to be $0.284 < p < 0.516$.

- (i) Find the proportion of people in the sample who own a bicycle. [1]
- (ii) Calculate the value of α correct to 2 significant figures. [4]
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Q7.

A researcher is investigating the lengths, in kilometres, of the journeys to work of the employees at a certain firm. She takes a random sample of 10 employees.

- (i) State what is meant by 'random' in this context. [1]

The results of her sample are as follows.

1.5 2.0 3.6 5.9 4.8 8.7 3.5 2.9 4.1 3.0

- (ii) Find unbiased estimates of the population mean and variance. [3]
- (iii) State what is meant by 'population' in this context. [1]
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Q8.

Based on a random sample of 700 people living in a certain area, a confidence interval for the proportion, p , of all people living in that area who had travelled abroad was found to be $0.5672 < p < 0.6528$.

- (i) Find the proportion of people in the sample who had travelled abroad. [1]
- (ii) Find the confidence level of this confidence interval. Give your answer correct to the nearest integer. [4]
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