

S1 Estimation Challenge

Challenge 1

The weights of the contents of packets of table salt are known to be normally distributed with standard deviation 6 g. The mean weight of the contents of a random sample of 4 packets was found to be 748 g. Calculate a 99% confidence interval for the mean weight of the contents of all packets. *(4 marks)*

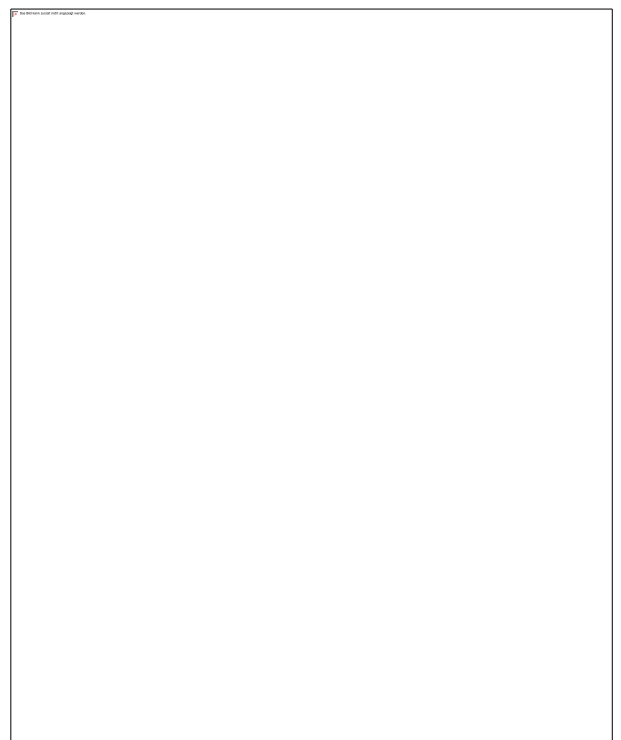


Challenge 2

A manufacturer makes batteries for use in bicycle lights. The working lives, in hours, of the batteries are known to be normally distributed with a standard deviation of 1.8. A random sample of batteries was tested and their working lives were as follows:

48.2 49.6 47.1 50.0 46.8 47.2 47.9

- (a) Calculate a 95% confidence interval for the mean working life of the batteries. *(6 marks)*
- (b) State the width of the confidence interval you have calculated. *(1 mark)*
- (c) What percentage would be associated with a confidence interval of width 2 hours calculated from the given data? *(5 marks)*
- (d) A further random sample of size seven is to be taken and used to calculate a confidence interval of width 2 hours. State the probability that this confidence interval will **not** contain the mean working life. *(1 mark)*



Challenge 3

A health food co-operative imports a large quantity of dates and packs them into plastic bags labelled 500 grams. Georgina, a Consumer Protection Officer, checked a random sample of 95 bags and found the contents had a mean weight of 498.6 grams, and a standard deviation of 9.3 grams.

- (a) Assuming that weights follow a normal distribution, calculate, for the mean weight of contents of all the bags:
- (i) a 95% confidence interval; *(4 marks)*
 - (ii) an 80% confidence interval. *(2 marks)*
- (b) The health food co-operative also imports raisins. Georgina intends to take a random sample of 500 gram packets of raisins, weigh the contents and use the results to calculate an 80% and a 95% confidence interval for the mean weight, μ , of the contents of all the co-operative's packets of raisins.
- (i) Find the probability that:
 - (A) the 80% confidence interval contains μ ; *(1 mark)*
 - (B) the 95% confidence interval contains μ but the 80% confidence interval does not. *(2 marks)*
 - (ii) Instead of calculating both confidence intervals from the same sample, Georgina now decides to calculate the 95% confidence interval from one sample and the 80% confidence interval from a second independent random sample. Find the probability that the 95% confidence interval contains μ but the 80% confidence interval does not. *(2 marks)*



Final Challenge

Applicants to join a police force are tested for physical fitness. Based on their performance, a physical fitness score is calculated for each applicant. Assume that the distribution of scores is normal.

- (a) The scores for a random sample of ten applicants were

55 23 44 69 22 45 54 72 34 66

Experience suggests that the standard deviation of scores is 14.8.

Calculate a 99% confidence interval for the mean score of all applicants. (5 marks)

- (b) The scores of a further random sample of 110 applicants had a mean of 49.5 and a standard deviation of 16.5.

Use the data from this second sample to calculate:

- (i) a 95% confidence interval for the mean score of all applicants; (3 marks)
- (ii) an interval within which the score of approximately 95% of applicants will lie. (2 marks)
- (c) By interpreting your results in parts (b)(i) and (b)(ii), comment on the ability of the applicants to achieve a score of 25. (3 marks)
- (d) Give **two** reasons why a confidence interval based on a sample of size 110 would be preferable to one based on a sample of size 10. (2 marks)
- (e) It is suggested that a much better estimate of the mean physical fitness of all recruits could be made by combining the two samples before calculating a confidence interval. Comment on this suggestion. (3 marks)

