Question 6 (15 marks)

An oyster farm in South Australia produces oysters to sell to restaurants.

The weight of individual oysters produced by the farm varies, and can be modelled by a normal distribution with a mean of $\mu = 82.3$ grams and a standard deviation of $\sigma = 5.3$ grams.



Source: adapted from © julichka | iStockphoto.com

(a) Calculate the probability that a randomly selected oyster from this farm weighs between 80 grams and 90 grams.

(1 mark)

(b) The farm categorises an oyster that weighs 85 grams or more as a luxury-sized oyster.

(i) Calculate the probability that a randomly selected oyster from this farm is a luxury-sized oyster.

(1 mark)

(ii) Exactly half of the luxury-sized oysters from this farm weigh more than k grams. Find the value of k.

(2 marks)

The farm packs oysters by the dozen (12) to be sold to Australian and European restaurants. Each of the 12 oysters in a package is randomly selected.

When sold to European restaurants, a package of 12 oysters has a labelled net weight of 1 kilogram. (1 kilogram = 1000 grams.)

(c) Consider S_{12} , the net weight of a package of 12 oysters.

(i) State the mean and standard deviation of S_{12} .

(2 marks)

(ii) Determine the proportion of packages of 12 oysters that have a net weight of less than 1 kilogram.

(1 mark)

(iii) Hence is it appropriate for this farm to sell its packages of 12 oysters that have a labelled net weight of 1 kilogram to European restaurants? Justify your answer.

(2 marks)

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(d) The mean weight of individual oysters produced by the farm was originally 82.3 grams.

The farm introduces a new farming method to produce oysters that have a greater individual weight. A sample of 100 oysters produced using this new farming method is randomly selected. The mean weight of the oysters in the sample is 89.1 grams.

(i) Using the sample data, calculate a 95% confidence interval for the mean weight of oysters that are produced using the new farming method. Assume that the standard deviation remains at σ = 5.3 grams.

(2 marks)

(ii) Does the confidence interval that you calculated suggest that the new farming method has increased the mean weight of oysters produced by this farm? Justify your answer.

(1 mark)

(iii) After introducing the new farming method, the farm makes the following claim with 95% confidence:

'No more than 0.2% of our packages of 12 oysters will have a net weight that is less than 1 kilogram'.

Using your answer to part (d)(i), provide mathematical calculations to support the farm's claim.



(3 marks)