

1. Explain what you understand by

(a) a population, (1)

(b) a statistic. (1)

A researcher took a sample of 100 voters from a certain town and asked them who they would vote for in an election. The proportion who said they would vote for Dr Smith was 35%.

(c) State the population and the statistic in this case. (2)

(d) Explain what you understand by the sampling distribution of this statistic. (1)

(Total 5 marks)

2. A bag contains a large number of coins. It contains only 1p and 2p coins in the ratio 1:3

(a) Find the mean μ and the variance σ^2 of the values of this population of coins. (3)

A random sample of size 3 is taken from the bag.

(b) List all the possible samples. (2)

(c) Find the sampling distribution of the mean value of the samples. (6)

(Total 11 marks)

3. A random sample X_1, X_2, \dots, X_n is taken from a population with unknown mean μ and unknown variance σ^2 . A statistic Y is based on this sample.

(a) Explain what you understand by the statistic Y .

(2)

(b) Explain what you understand by the sampling distribution of Y .

(1)

(c) State, giving a reason which of the following is **not** a statistic based on this sample.

$$(i) \sum_{i=1}^n \frac{(X_i - \bar{X})^2}{n} \quad (ii) \sum_{i=1}^n \left(\frac{X_i - \mu}{\sigma} \right)^2 \quad (iii) \sum_{i=1}^n X_i^2$$

(2)

(Total 5 marks)

4. (a) Explain what you understand by a census.

(1)

Each cooker produced at GT Engineering is stamped with a unique serial number. GT Engineering produces cookers in batches of 2000. Before selling them, they test a random sample of 5 to see what electric current overload they will take before breaking down.

(b) Give one reason, other than to save time and cost, why a sample is taken rather than a census.

(1)

(c) Suggest a suitable sampling frame from which to obtain this sample.

(1)

(d) Identify the sampling units.

(1)

(Total 4 marks)

5. Before introducing a new rule the secretary of a golf club decided to find out how members might react to this rule.
- (a) Explain why the secretary decided to take a random sample of club members rather than ask all the members. (1)
 - (b) Suggest a suitable sampling frame. (1)
 - (c) Identify the sampling units. (1)
- (Total 3 marks)**

6. A bag contains a large number of coins. Half of them are 1p coins, one third are 2p coins and the remainder are 5p coins.
- (a) Find the mean and variance of the value of the coins. (4)

A random sample of 2 coins is chosen from the bag.

- (b) List all the possible samples that can be drawn. (3)
 - (c) Find the sampling distribution of the mean value of these samples. (6)
- (Total 13 marks)**

7. Explain what you understand by
- (a) a sampling unit, (1)
 - (b) a sampling frame, (1)

(c) a sampling distribution.

(2)

(Total 4 marks)

8. (a) Explain what you understand by (i) a population and (ii) a sampling frame.

(2)

The population and the sampling frame may not be the same.

(b) Explain why this might be the case.

(1)

(c) Give an example, justifying your choices, to illustrate when you might use

(i) a census,

(ii) a sample.

(4)

(Total 7 marks)

9. Explain briefly what you understand by

(a) a sampling frame,

(1)

(b) a statistic.

(2)

(Total 3 marks)

10. A large dental practice wishes to investigate the level of satisfaction of its patients.

(a) Suggest a suitable sampling frame for the investigation.

(1)

- (b) Identify the sampling units. (1)
- (c) State one advantage and one disadvantage of using a sample survey rather than a census. (2)
- (d) Suggest a problem that might arise with the sampling frame when selecting patients. (1)
- (Total 5 marks)**

11. A magazine has a large number of subscribers who each pay a membership fee that is due on January 1st each year. Not all subscribers pay their fee by the due date. Based on correspondence from the subscribers, the editor of the magazine believes that 40% of subscribers wish to change the name of the magazine. Before making this change the editor decides to carry out a sample survey to obtain the opinions of the subscribers. He uses only those members who have paid their fee on time.

- (a) Define the population associated with the magazine. (1)
- (b) Suggest a suitable sampling frame for the survey. (1)
- (c) Identify the sampling units. (1)
- (d) Give one advantage and one disadvantage that would have resulted from the editor using a census rather than a sample survey. (2)

As a pilot study the editor took a random sample of 25 subscribers.

- (e) Assuming that the editor's belief is correct, find the probability that exactly 10 of these subscribers agreed with changing the name. (3)

In fact only 6 subscribers agreed to the name being changed.

- (f) Stating your hypotheses clearly test, at the 5% level of significance, whether or not the percentage agreeing to the change is less than the editor believes. (5)

The full survey is to be carried out using 200 randomly chosen subscribers.

- (g) Again assuming the editor's belief to be correct and using a suitable approximation, find the probability that in this sample there will be least 71 but fewer than 83 subscribers who agree to the name being changed. (7)
- (Total 20 marks)**

12. An athletics teacher has kept careful records over the past 20 years of results from school sports days. There are always 10 competitors in the javelin competition. Each competitor is allowed 3 attempts and the teacher has a record of the distances thrown by each competitor at each attempt. The random variable D represents the greatest distance thrown by each competitor and the random variable A represents the number of the attempt in which the competitor achieved their greatest distance.

(a) State which of the two random variables D or A is continuous.

(1)

A new athletics coach wishes to take a random sample of the records of 36 javelin competitors.

(b) Specify a suitable sampling frame and explain how such a sample could be taken.

(2)

The coach assumes that $P(A = 2) = \frac{1}{3}$, and is therefore surprised to find that 20 of the 36 competitors in the sample achieved their greatest distance on their second attempt.

Using a suitable approximation, and assuming that $P(A = 2) = \frac{1}{3}$,

(c) find the probability that at least 20 of the competitors achieved their greatest distance on their second attempt.

(6)

(d) Comment on the assumption that $P(A = 2) = \frac{1}{3}$.

(2)

(Total 11 marks)