

1. A telephone directory contains 50 000 names. A researcher wishes to select a systematic sample of 100 names from the directory.

(a) Explain in detail how the researcher should obtain such a sample. (2)

(b) Give one advantage and one disadvantage of

(i) quota sampling,

(ii) systematic sampling. (4)



2. The heights of a random sample of 10 imported orchids are measured. The mean height of the sample is found to be 20.1 cm. The heights of the orchids are normally distributed.

Given that the population standard deviation is 0.5 cm,

(a) estimate limits between which 95% of the heights of the orchids lie, (3)

(b) find a 98% confidence interval for the mean height of the orchids. (4)

A grower claims that the mean height of this type of orchid is 19.5 cm.

(c) Comment on the grower's claim. Give a reason for your answer. (2)



4. A sample of size 8 is to be taken from a population that is normally distributed with mean 55 and standard deviation 3. Find the probability that the sample mean will be greater than 57.

(5)

5. The number of goals scored by a football team is recorded for 100 games. The results are summarised in Table 1 below.

Number of goals	Frequency
0	40
1	33
2	14
3	8
4	5

Table 1

- (a) Calculate the mean number of goals scored per game. (2)

The manager claimed that the number of goals scored per match follows a Poisson distribution. He used the answer in part (a) to calculate the expected frequencies given in Table 2.

Number of goals	Expected Frequency
0	34.994
1	r
2	s
3	6.752
≥ 4	2.221

Table 2

- (b) Find the value of r and the value of s giving your answers to 3 decimal places. (3)
- (c) Stating your hypotheses clearly, use a 5% level of significance to test the manager's claim. (7)



7. A company produces climbing ropes. The lengths of the climbing ropes are normally distributed. A random sample of 5 ropes is taken and the length, in metres, of each rope is measured. The results are given below.

120.3 120.1 120.4 120.2 119.9

- (a) Calculate unbiased estimates for the mean and the variance of the lengths of the climbing ropes produced by the company. (5)

The lengths of climbing rope are known to have a standard deviation of 0.2 m. The company wants to make sure that there is a probability of at least 0.90 that the estimate of the population mean, based on a random sample size of n , lies within 0.05 m of its true value.

- (b) Find the minimum sample size required. (6)





Question 7 continued

Lined writing area for the answer.

(Total 11 marks)

Q7

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8. The random variable A is defined as

$$A = 4X - 3Y$$

where $X \sim N(30, 3^2)$, $Y \sim N(20, 2^2)$ and X and Y are independent.

Find

(a) $E(A)$, (2)

(b) $\text{Var}(A)$. (3)

The random variables Y_1, Y_2, Y_3 and Y_4 are independent and each has the same distribution as Y . The random variable B is defined as

$$B = \sum_{i=1}^4 Y_i$$

(c) Find $P(B > A)$. (6)



