

1. A random sample is to be taken from the A-level results obtained by the final-year students in a Sixth Form College. Suggest
- (a) suitable sampling units, (1 mark)
 - (b) a suitable sampling frame. (1 mark)
 - (c) Would it be advisable simply to use the results of all those doing A-level Maths?
Explain your answer. (2 marks)
2. The random variable X , which can take any value in the interval $1 \leq X \leq n$, is modelled by the continuous uniform distribution with mean 12.
- (a) Show that $n = 23$ and find the variance of X . (3 marks)
 - (b) Find $P(10 < X < 14)$. (2 marks)
3. The Driving Theory Test includes 30 questions which require one answer to be selected from four options.
- (a) Phil ticks answers at random. Find how many of the 30 he should expect to get right. (2 marks)
 - (b) If he gets 15 correct, decide whether this is evidence that he has actually done some revision. Use a 5% significance level. (5 marks)
- Another candidate, Sarah, has revised and has a 0.9 probability of getting each question right.
- (c) Determine the expected number of answers that Sarah will get right. (1 mark)
 - (d) Find the probability that Sarah gets more than 25 correct answers out of 30. (2 marks)
4. A continuous random variable X has probability density function
- $$\begin{aligned} f(x) &= 0 & x < 1, \\ f(x) &= kx & 1 \leq x \leq 4, \\ f(x) &= 0 & x > 4. \end{aligned}$$
- (a) Sketch a graph of $f(x)$, and hence find the value of k . (4 marks)
 - (b) Calculate the mean and the variance of X . (6 marks)

5. In World War II, the number of V2 missiles that landed on each square mile of London was, on average, 3.5. Assuming that the hits were randomly distributed throughout London,
- (a) suggest a suitable model for the number of hits on each square mile, giving a suitable value for any parameters. (1 mark)
 - (b) calculate the probability that a particular square mile received
 - (i) no hits, (1 mark)
 - (ii) more than 7 hits. (2 marks)
 - (c) State, with a reason, whether the model is likely to be accurate. (1 mark)
- In contrast, the number of bombs weighing more than 1 ton landing on each square mile was 45.
- (d) Use a suitable approximation to find the probability that a randomly selected square mile received more than 60 such bombs. Explain what adjustment must be made when using this approximation. (9 marks)

6. In a fruit packing plant, apples are packed on to trays of 10, and then checked for blemishes. The chance of any particular apple having a blemish is 5%. If a tray is selected at random, find
- (a) the probability that at least two of the apples in it are blemished, (3 marks)
 - (b) the probability that exactly two are blemished. (3 marks)

Trays are now packed in boxes of 50 trays each. In one such box, find

- (c) the probability that at most one tray contains at least two blemished apples, (5 marks)
- (d) the expected number of trays containing at least two blemished apples. (2 marks)
- (e) Use a suitable approximation to find the probability that in a random selection of 20 trays there are more than 10 blemished apples. (3 marks)

7. The time, in hours, taken to run the London marathon is modelled by a continuous random variable T with the probability density function

$$f(t) = \begin{cases} c(t-2) & 2 \leq t < 4, \\ \frac{2c(7-t)}{3} & 4 \leq t \leq 7, \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Sketch the function $f(t)$, and show that $c = \frac{1}{5}$. (5 marks)
- (b) Calculate the median value of T . (9 marks)
- (c) Make two critical comments about the model. (2 marks)