

Paper Reference(s)

**6684**

**Edexcel GCE**

**Statistics S2**

**Advanced/Advanced Subsidiary**

**Friday 24 January 2003 – Morning**

**Time: 1 hour 30 minutes**

**Materials required for examination**

Answer Book (AB16)  
Graph Paper (ASG2)  
Mathematical Formulae (Lilac)

**Items included with question papers**

Nil

**Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration. Thus candidates may NOT use calculators such as the Texas Instruments TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.**

**Instructions to Candidates**

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In the boxes on the answer book, write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Statistics S2), the paper reference (6684), your surname, other name and signature.

Values from the statistical tables should be quoted in full. When a calculator is used, the answer should be given to an appropriate degree of accuracy.

**Information for Candidates**

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A booklet 'Mathematical Formulae and Statistical Tables' is provided.

Full marks may be obtained for answers to ALL questions.

This paper has seven questions.

**Advice to Candidates**

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You must ensure that your answers to parts of questions are clearly labelled.

You must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

1. An engineer measures, to the nearest cm, the lengths of metal rods.
- (a) Suggest a suitable model to represent the difference between the true lengths and the measured lengths. (2)
- (b) Find the probability that for a randomly chosen rod the measured length will be within 0.2 cm of the true length. (2)

Two rods are chosen at random.

- (c) Find the probability that for both rods the measured lengths will be within 0.2 cm of their true lengths. (2)
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2. A single observation  $x$  is to be taken from a Poisson distribution with parameter  $\lambda$ . This observation is to be used to test  $H_0 : \lambda = 7$  against  $H_1 : \lambda \neq 7$ .
- (a) Using a 5% significance level, find the critical region for this test assuming that the probability of rejection in either tail is as close as possible to 2.5%. (5)
- (b) Write down the significance level of this test. (1)

The actual value of  $x$  obtained was 5.

- (c) State a conclusion that can be drawn based on this value. (2)
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3. A botanist suggests that the number of a particular variety of weed growing in a meadow can be modelled by a Poisson distribution.
- (a) Write down two conditions that must apply for this model to be applicable. (2)

Assuming this model and a mean of 0.7 weeds per  $\text{m}^2$ , find

- (b) the probability that in a randomly chosen plot of size  $4 \text{ m}^2$  there will be fewer than 3 of these weeds. (4)
- (c) Using a suitable approximation, find the probability that in a plot of  $100 \text{ m}^2$  there will be more than 66 of these weeds. (6)
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4. The continuous random variable  $X$  has cumulative distribution function

$$F(x) = \begin{cases} 0, & x < 0, \\ \frac{1}{3}x^2(4 - x^2), & 0 \leq x \leq 1, \\ 1 & x > 1. \end{cases}$$

- (a) Find  $P(X > 0.7)$ . (2)
- (b) Find the probability density function  $f(x)$  of  $X$ . (2)
- (c) Calculate  $E(X)$  and show that, to 3 decimal places,  $\text{Var}(X) = 0.057$ . (6)

One measure of skewness is

$$\frac{\text{Mean} - \text{Mode}}{\text{Standard deviation}}.$$

- (d) Evaluate the skewness of the distribution of  $X$ . (4)

5. A farmer noticed that some of the eggs laid by his hens had double yolks. He estimated the probability of this happening to be 0.05. Eggs are packed in boxes of 12.

Find the probability that in a box, the number of eggs with double yolks will be

- (a) exactly one, (3)
- (b) more than three. (2)

A customer bought three boxes.

- (c) Find the probability that only 2 of the boxes contained exactly 1 egg with a double yolk. (3)

The farmer delivered 10 boxes to a local shop.

- (d) Using a suitable approximation, find the probability that the delivery contained at least 9 eggs with double yolks. (4)

The weight of an individual egg can be modelled by a normal distribution with mean 65 g and standard deviation 2.4 g.

- (e) Find the probability that a randomly chosen egg weighs more than 68 g. (3)

6. 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)

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