Paper Reference(s)

6687

Edexcel GCE

Statistics S5

Advanced/Advanced Subsidiary

Friday 14 June 2002 – Morning

Time: 1 hour 30 minutes

Materials required for examination	Items included with question papers
Answer Book (AB16)	Nil
Graph Paper (ASG2)	
Mathematical Formulae (Lilac)	

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

In the boxes on the answer book, write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Statistics S5), the paper reference (6687), 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

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
This paper has seven questions. Pages 6, 7 and 8 are blank.

Advice to Candidates

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.

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1. The continuous random variable X has probability density function

$$f(x) = \begin{cases} 0.5, & 0 \le x \le 2, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Show that the moment generating function is given by $\dfrac{1}{2t}(e^{2t} - 1)$.

(4)

(b) Using this moment generating function, find the mean and the variance of X.

(4)

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2. The police are carrying out a check on car tyres. The percentage of cars with tyre defects is assumed to be 40%. Let X represent the number of cars checked, up to and including the first one with tyre defects.

(a) State the distribution that could be used to model X and write down the mean of X.

(2)

The police decide that they are going to change the place where they are carrying out the check after they have found two cars with tyre defects. Let W represent the number of cars checked, up to and including the second one with tyre defects.

(b) Determine the mean and the variance of W.

(4)

(c) Calculate the probability that $W = 5$.

(2)

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3. There are 3 categories of driving test. The car test accounts for 90% of the tests, the motorbike test for 6% and the other category for 4%. The probabilities of passing each category of test on the first attempt are 0.44, 0.66 and 0.49 respectively.

(a) Calculate the probability of a randomly selected person passing the driving test on the first attempt.

(2)

(b) A person takes a driving test and passes on the first attempt. Calculate the probability that it is a car test.

(2)

Two people selected at random are found to have passed a different category of test at the first attempt.

(c) Find the probability that these 2 tests were the car test and the motorbike test.

(6)

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4. Power cuts occur in the village of Densfield independently and at random, at a rate of 6 per year.

(*a*) Find the probability that exactly one power cut occurs in the next month.

(2)

(*b*) Given that T is the time in months between successive power cuts, show that

$$\mathrm{P}(0 \leq T \leq t) = 1 - \mathrm{e}^{-\frac{1}{2}t}.$$

(3)

(*c*) Calculate the probability that the interval between successive power cuts is

(i) 2 months or less,

(ii) between 2 and 3 months.

(4)

There has just been a power cut.

(d) Calculate the length of time such that there is an 80% chance that there will not be another power cut.

(3)

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5. A large consignment of components is delivered to a factory. A sample of 10 components is selected at random from the consignment and tested for defects. If the sample contains no defective components the consignment is accepted. If more than two components are defective the consignment is rejected, otherwise a second random sample of size 10 is taken and tested for defects. If the total number of defective components in the two samples is less than 3, the consignment is accepted; otherwise it is rejected. The probability of a defective component is 0.04.

(*a*) Calculate the probability that the consignment is accepted after the first sample only has been tested for defects.

(1)

(*b*) Find the probability that a second sample is taken.

(4)

(*c*) Calculate the probability of the consignment being accepted.

(7)

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6. In a game, Joan has to throw a ring onto a peg. The probability of Joan being successful on a throw is 0.4.

(*a*) Find the probability that Joan first succeeds on the 6th throw.
(2)

(*b*) Find the probability that Joan will have at least 3 failures before she succeeds.
(2)

Harry joins Joan for a game. Joan starts and they then take alternate throws of the ring. The winner is the first person to throw the ring onto the peg. The probability of Harry being successful on a throw is 0.3.

(*c*) Calculate the probability that

(i) Harry wins on his 3rd throw,

(ii) Joan wins the game.
(5)

To make the game fairer, they decide to toss a coin. If it lands heads Joan starts the game.

(*d*) Calculate the probability that Joan wins the game on her 3rd throw.
(3)

7. Four torpedoes are fired independently from a ship at a target. Each one has a probability of $\frac{1}{3}$ of hitting the target. The random variable X represents the number of hits and has probability generating function

$$G_X(t) = k(2 + t)^4.$$

(*a*) Show that $k = \dfrac{1}{81}$.

(3)

(*b*) Find the mean and the variance of X.

(2)

A second ship fires at the same target and the random variable Y, representing its number of hits, has probability generating function

$$G_Y(\text{t}) = \frac{1}{243}(2 + t)^5.$$

Given that X and Y are independent,

(*c*) find the probability generating function of $Z = X + Y$.

(2)

(*d*) Calculate the mean and the variance of Z.

(6)

END