Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 6 8 4 / 0 1	Signature	

Paper Reference(s)

6684/01

Edexcel GCE

Statistics S2

Advanced/Advanced Subsidiary

Monday 1 June 2009 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
Total	

Materials required for examination
Mathematical Formulae (Orange or Green)

Items included with question papers
Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer for each question in the space following the question.
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.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 8 questions in this question paper. The total mark for this paper is 75.
There are 24 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. A bag contains a large number of counters of which 15% are coloured red. A random sample of 30 counters is selected and the number of red counters is recorded.

(a) Find the probability of no more than 6 red counters in this sample.

(2)

A second random sample of 30 counters is selected and the number of red counters is recorded.

(b) Using a Poisson approximation, estimate the probability that the total number of red counters in the combined sample of size 60 is less than 13.

(3)

Leave blank

Question 1 continued

Q1

(Total 5 marks)

Leave blank

2. An effect of a certain disease is that a small number of the red blood cells are deformed. Emily has this disease and the deformed blood cells occur randomly at a rate of 2.5 per ml of her blood. Following a course of treatment, a random sample of 2 ml of Emily's blood is found to contain only 1 deformed red blood cell.

Stating your hypotheses clearly and using a 5% level of significance, test whether or not there has been a decrease in the number of deformed red blood cells in Emily's blood.

(6)

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Question 2 continued

Q2

(Total 6 marks)

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3. A random sample $X_1, X_2, \ldots X_n$ 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) $\sum_{i=1}^{n} \frac{(X_i - \bar{X})^2}{n}$ (ii) $\sum_{i=1}^{n} \left(\frac{X_i - \mu}{\sigma}\right)^2$ (iii) $\sum_{i=1}^{n} X_i^2$

(2)

Leave blank

Question 3 continued

Q3

(Total 5 marks)

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4. Past records suggest that 30% of customers who buy baked beans from a large supermarket buy them in single tins. A new manager questions whether or not there has been a change in the proportion of customers who buy baked beans in single tins. A random sample of 20 customers who had bought baked beans was taken.

(a) Using a 10% level of significance, find the critical region for a two-tailed test to answer the manager's question. You should state the probability of rejection in each tail which should be less than 0.05.
(5)

(b) Write down the actual significance level of a test based on your critical region from part (a).
(1)

The manager found that 11 customers from the sample of 20 had bought baked beans in single tins.

(c) Comment on this finding in the light of your critical region found in part (a).
(2)

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Question 4 continued

Q4

(Total 8 marks)

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5. An administrator makes errors in her typing randomly at a rate of 3 errors every 1000 words.

(a) In a document of 2000 words find the probability that the administrator makes 4 or more errors.

(3)

The administrator is given an 8000 word report to type and she is told that the report will only be accepted if there are 20 or fewer errors.

(b) Use a suitable approximation to calculate the probability that the report is accepted.

(7)

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Question 5 continued

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Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 10 marks)

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6. The three independent random variables A, B and C each has a continuous uniform distribution over the interval [0, 5].

(a) Find $P(A > 3)$.
(1)

(b) Find the probability that A, B and C are all greater than 3.
(2)

The random variable Y represents the maximum value of A, B and C.

The cumulative distribution function of Y is

$$F(y) = \begin{cases} 0 & y < 0 \\ \dfrac{y^3}{125} & 0 \leqslant y \leqslant 5 \\ 1 & y > 5 \end{cases}$$

(c) Find the probability density function of Y.
(2)

(d) Sketch the probability density function of Y.
(2)

(e) Write down the mode of Y.
(1)

(f) Find $E(Y)$.
(3)

(g) Find $P(Y > 3)$.
(2)

Leave blank

Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

(Total 13 marks)

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7.

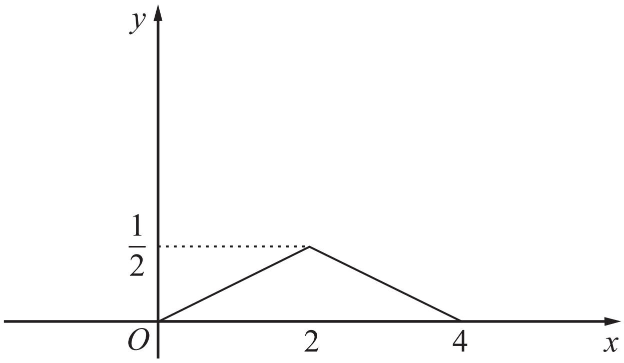

Figure 1

Figure 1 shows a sketch of the probability density function f(x) of the random variable X. The part of the sketch from $x = 0$ to $x = 4$ consists of an isosceles triangle with maximum at (2, 0.5).

(a) Write down E(X).

(1)

The probability density function f(x) can be written in the following form.

$$\mathrm{f}(x) = \begin{cases} ax & 0 \leqslant x < 2 \\ b - ax & 2 \leqslant x \leqslant 4 \\ 0 & \text{otherwise} \end{cases}$$

(b) Find the values of the constants a and b.

(2)

(c) Show that σ, the standard deviation of X, is 0.816 to 3 decimal places.

(7)

(d) Find the lower quartile of X.

(3)

(e) State, giving a reason, whether $\mathrm{P}(2 - \sigma < X < 2 + \sigma)$ is more or less than 0.5

(2)

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Question 7 continued

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Question 7 continued

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Question 7 continued

Q7

(Total 15 marks)

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8. A cloth manufacturer knows that faults occur randomly in the production process at a rate of 2 every 15 metres.

(a) Find the probability of exactly 4 faults in a 15 metre length of cloth.

(2)

(b) Find the probability of more than 10 faults in 60 metres of cloth.

(3)

A retailer buys a large amount of this cloth and sells it in pieces of length x metres. He chooses x so that the probability of no faults in a piece is 0.80

(c) Write down an equation for x and show that $x = 1.7$ to 2 significant figures.

(4)

The retailer sells 1200 of these pieces of cloth. He makes a profit of 60p on each piece of cloth that does not contain a fault but a loss of £1.50 on any pieces that do contain faults.

(d) Find the retailer's expected profit.

(4)

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Question 8 continued

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Question 8 continued

Q8

(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

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