OCR
Oxford Cambridge and RSA

Friday 5 June 2015 – Morning

A2 GCE MATHEMATICS

4733/01 Probability & Statistics 2

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4733/01
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

* 4 8 2 6 4 5 1 3 7 4 *

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Turn over

1 The random variable Y is normally distributed with mean μ and variance σ^2. It is found that $\mathrm{P}(Y > 150.0) = 0.0228$ and $\mathrm{P}(Y > 143.0) = 0.9332$. Find the values of μ and σ. **[6]**

2 A class investigated the number of dead rabbits found along a particular stretch of road.

(i) The class agrees that dead rabbits occur randomly along the road. Explain what this statement means. **[1]**

(ii) State, in this context, an assumption needed for the number of dead rabbits in a fixed length of road to be modelled by a Poisson distribution, and explain what your statement means. **[2]**

Assume now that the number of dead rabbits in a fixed length of road can be well modelled by a Poisson distribution with mean 1 per 600 m of road.

(iii) Use an appropriate formula, showing your working, to find the probability that in a road of length 1650 m there are exactly 3 dead rabbits. **[3]**

3 A continuous random variable X has probability density function

$$\mathrm{f}(x) = \begin{cases} \dfrac{3}{2a^3}x^2 & -a \leqslant x \leqslant a, \\ 0 & \text{otherwise,} \end{cases}$$

where a is a constant.

(i) It is given that $\mathrm{P}(-3 \leqslant X \leqslant 3) = 0.125$. Find the value of a in this case. **[4]**

(ii) It is given instead that $\mathrm{Var}(X) = 1.35$. Find the value of a in this case. **[5]**

(iii) Explain the relationship between x and X in this question. **[1]**

4 A continuous random variable is normally distributed with mean μ. A significance test for μ is carried out, at the 5% significance level, on 90 independent occasions.

(i) Given that the null hypothesis is correct on all 90 occasions, use a suitable approximation to find the probability that on 6 or fewer occasions the test results in a Type I error. Justify your approximation. **[5]**

(ii) Given instead that on all 90 occasions the probability of a Type II error is 0.35, use a suitable approximation to find the probability that on fewer than 29 occasions the test results in a Type II error. **[5]**

5 **(i)** State an advantage of using random numbers in selecting samples. **[1]**

(ii) It is known that in analysing the digits in large sets of financial records, the probability that the leading digit is 1 is 0.25. A random sample of 18 leading digits from a certain large set of financial records is obtained and it is found that 8 of the leading digits are 1s. Test, at the 5% significance level, whether the probability that the leading digit is 1 in this set of records is greater than 0.25. **[7]**

6 Records for a doctors' surgery over a long period suggest that the time taken for a consultation, T minutes, has a mean of 11.0. Following the introduction of new regulations, a doctor believes that the average time has changed. She finds that, with new regulations, the consultation times for a random sample of 120 patients can be summarised as

$$n = 120,\ \sum t = 1411.20,\ \sum t^2 = 18\,737.712.$$

(i) Test, at the 10% significance level, whether the doctor's belief is correct. **[11]**

(ii) Explain whether, in answering part **(i)**, it was necessary to assume that the consultation times were normally distributed. **[1]**

7 A large railway network suffers points failures at an average rate of 1 every 3 days. Assume that the number of points failures can be modelled by a Poisson distribution. The network employs a new firm of engineers. After the new engineers have become established, it is found that in a randomly chosen period of 15 days there are 2 instances of points failures.

(i) Test, at the 5% significance level, whether there is evidence that the mean number of points failures has been reduced. **[7]**

(ii) A new test is carried out over a period of 150 days. Use a suitable approximation to find the greatest number of points failures there could be in 150 days that would lead to a 5% significance test concluding that the average number of points failures had been reduced. **[6]**

8 The random variable S has the distribution $B(14, p)$. A significance test is carried out of the null hypothesis H_0: $p = 0.3$ against the alternative hypothesis H_1: $p > 0.3$. The critical region for the test is $S \geqslant 8$.

(i) Find the significance level of the test, correct to 3 significant figures. **[2]**

(ii) It is given that, on each occasion that the test is carried out, the true value of p is equally likely to be 0.3, 0.5 or 0.7, independently of any other test. Four independent tests are carried out. Find the probability that at least one of the tests results in a Type II error. **[5]**

END OF QUESTION PAPER

