OCR
RECOGNISING ACHIEVEMENT

Friday 20 January 2012 – Afternoon

A2 GCE MATHEMATICS

4734 Probability & Statistics 3

QUESTION PAPER

4733001121

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4734
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

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

- The Question Paper will be found in the centre of 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.

1 In a test of association of two factors, A and B, a 2×2 contingency table yielded 5.63 for the value of χ^2 with Yates' correction.

(i) State the null hypothesis and alternative hypothesis for the test. **[1]**

(ii) State how Yates' correction is applied, and whether it increases or decreases the value of χ^2. **[2]**

(iii) Carry out the test at the $2\frac{1}{2}\%$ significance level. **[3]**

2 An investigation in 2007 into the incidence of tuberculosis (TB) in badgers in a certain area found that 42 out of a random sample of 190 badgers tested positive for TB.
In 2010, 48 out of a random sample of 150 badgers tested positive for TB.

(i) Assuming that the population proportions of badgers with TB are the same in 2007 and 2010, obtain the best estimate of this proportion. **[1]**

(ii) Carry out a test at the $2\frac{1}{2}\%$ significance level of whether the population proportion of badgers with TB increased from 2007 to 2010. **[6]**

3 The continuous random variable U has a normal distribution with unknown mean μ and known variance 1. A random sample of four observations of U gave the values

3.9, 2.1, 4.6 and 1.4.

(i) Calculate a 90% confidence interval for μ. **[3]**

(ii) The probability that the sum of four random observations of U is less than 11 is denoted by p. For each of the end points of the confidence interval in part **(i)** calculate the corresponding value of p. **[5]**

4 X is a continuous random variable with the distribution $N(48.5, 12.5^2)$. The values of X are transformed to standardised values of Y, using the equation $Y = aX + b$, where a and b are constants with $a > 0$.

(i) Find values of a and b for which the mean and standard deviation of Y are 40 and 10 respectively. **[4]**

(ii) State the distribution of Y. **[1]**

Two randomly chosen standardised values are denoted by Y_1 and Y_2.

(iii) Calculate the probability that Y_2 is at least 10 greater than Y_1. **[5]**

5 A statistician suggested that the weekly sales X thousand litres at a petrol station could be modelled by the following probability density function.

$$f(x) = \begin{cases} \frac{1}{40}(2x + 3) & 0 \leqslant x < 5, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Show that, using this model, $P(a \leqslant X < a + 1) = \frac{a + 2}{20}$ for $0 \leqslant a \leqslant 4$. **[3]**

Sales in 100 randomly chosen weeks gave the following grouped frequency table.

x	$0 \leqslant x < 1$	$1 \leqslant x < 2$	$2 \leqslant x < 3$	$3 \leqslant x < 4$	$4 \leqslant x < 5$
Frequency	16	12	18	30	24

(ii) Carry out a goodness of fit test at the 10% significance level of whether $f(x)$ fits the data. **[7]**

6 The continuous random variable Y has probability density function given by

$$f(y) = \begin{cases} -\frac{1}{4}y & -2 \leqslant y < 0, \\ \frac{1}{4}y & 0 \leqslant y \leqslant 2, \\ 0 & \text{otherwise.} \end{cases}$$

Find

(i) the interquartile range of Y, **[4]**

(ii) Var (Y), **[5]**

(iii) E $(|Y|)$. **[4]**

7 The manufacturer's specification for batteries used in a certain electronic game is that the mean lifetime should be 32 hours. The manufacturer tests a random sample of 10 batteries made in Factory A, and the lifetimes (x hours) are summarised by

$$n = 10, \sum x = 289.0 \text{ and } \sum x^2 = 8586.19.$$

It may be assumed that the population of lifetimes has a normal distribution.

(i) Carry out a one-tail test at the 5% significance level of whether the specification is being met. **[7]**

(ii) Justify the use of a one-tail test in this context. **[1]**

Batteries made with the same specification are also made in Factory B. The lifetimes of these batteries are also normally distributed. A random sample of 12 batteries from this factory was tested. The lifetimes are summarised by

$$n = 12, \sum x = 363.0 \text{ and } \sum x^2 = 11\,290.95.$$

(iii) (a) State what further assumption must be made in order to test whether there is any difference in the mean lifetimes of batteries made at the two factories.
Use the data to comment on whether this assumption is reasonable. **[3]**

(b) Carry out the test at the 10% significance level. **[7]**

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE.