OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

MATHEMATICS **4733**

Probability & Statistics 2

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
* Printed answer book 4733
* List of Formulae (MF1)

Other materials required:
* Scientific or graphical calculator

Friday 14 January 2011
Afternoon

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. Pencil may be used for graphs and diagrams only.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Answer **all** the questions.
* 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

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* 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 **16** 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 destroyed.

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1 A random sample of nine observations of a random variable is obtained. The results are summarised as

$$\Sigma x = 468, \quad \Sigma x^2 = 24\,820.$$

Calculate unbiased estimates of the population mean and variance. **[4]**

2 The random variable H has the distribution $N(\mu, 5^2)$. The mean of a sample of n observations of H is denoted by $\overline{H}$. It is given that $P(\overline{H} > 53.28) = 0.0250$ and $P(\overline{H} < 51.65) = 0.0968$, both correct to 4 decimal places. Find the values of μ and n. **[6]**

3 The probability that a randomly chosen PPhone has a faulty casing is 0.0228. A random sample of 200 PPhones is obtained. Use a suitable approximation to find the probability that the number of PPhones in the sample with a faulty casing is 2 or fewer. Justify your approximation. **[6]**

4 The continuous random variable X has mean μ and standard deviation 45. A significance test is to be carried out of the null hypothesis H_0: $\mu = 230$ against the alternative hypothesis H_1: $\mu \neq 230$, at the 1% significance level. A random sample of size 50 is obtained, and the sample mean is found to be 213.4.

  (i) Carry out the test. **[5]**

  (ii) Explain whether it is necessary to use the Central Limit Theorem in your test. **[2]**

5 A temporary job is advertised annually. The number of applicants for the job is a random variable which is known from many years' experience to have a distribution $Po(12)$. In 2010 there were 19 applicants for the job. Test, at the 10% significance level, whether there is evidence of an increase in the mean number of applicants for the job. **[7]**

6 The number of randomly occurring events in a given time interval is denoted by R. In order that R is well modelled by a Poisson distribution, it is necessary that events occur independently.

  (i) Let R represent the number of customers dining at a restaurant on a randomly chosen weekday lunchtime. Explain what the condition 'events occur independently' means in this context, and give a reason why it would probably not hold in this context. **[2]**

  Let D represent the number of tables booked at the restaurant on a randomly chosen day. Assume that D can be well modelled by the distribution $Po(7)$.

  (ii) Find $P(D < 5)$. **[2]**

  (iii) Use a suitable approximation to find the probability that, in five randomly chosen days, the total number of tables booked is greater than 40. **[6]**

7 Two continuous random variables S and T have probability density functions f_S and f_T given respectively by

$$f_S(x) = \begin{cases} \dfrac{a}{x^2} & 1 \leqslant x \leqslant 3, \\ 0 & \text{otherwise,} \end{cases}$$

$$f_T(x) = \begin{cases} b & 1 \leqslant x \leqslant 3, \\ 0 & \text{otherwise,} \end{cases}$$

where a and b are constants.

   (i) Sketch on the same axes the graphs of $y = f_S(x)$ and $y = f_T(x)$. **[3]**

   (ii) Find the value of a. **[3]**

  (iii) Find E(S). **[3]**

  (iv) A student gave the following description of the distribution of T: "The probability that T occurs is constant". Give an improved description, in everyday terms. **[1]**

8 A company has 3600 employees, of whom 22.5% live more than 30 miles from their workplace. A random sample of 40 employees is obtained.

   (i) Use a suitable approximation, which should be justified, to find the probability that more than 5 of the employees in the sample live more than 30 miles from their workplace. **[8]**

  (ii) Describe how to use random numbers to select a sample of 40 from a population of 3600 employees. **[3]**

9 A pharmaceutical company is developing a new drug to treat a certain disease. The company will continue to develop the drug if the proportion p of those who have the disease and show a substantial improvement after treatment is greater than 0.7. The company carries out a test, at the 5% significance level, on a random sample of 14 patients who suffer from the disease.

   (i) Find the critical region for the test. **[3]**

  (ii) Given that 12 of the 14 patients in the sample show a substantial improvement, carry out the test. **[5]**

  (iii) Find the probability that the test results in a Type II error if in fact $p = 0.8$. **[3]**

4

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE

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Candidate forename		Candidate surname	

Centre number						Candidate number				

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1

2

3

4 (i)

4 (ii)

5

6 (i)

6 (ii)

6 (iii)

Turn over

7 (i)

7 (ii)

7 (iii)

7 (iv)

8 (i)

8 (i) (continued)

8 (ii)

Turn over

9 (i)

9 (ii)

9 (iii)

9 (iii)

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