

Friday 22 June 2012 – Afternoon

A2 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

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

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- 1** In one day's production, a machine produces 1000 CDs. Explain how to take a random sample of 15 CDs chosen from one day's production. [2]
- 2** (i) For the continuous random variable V , it is known that $E(V) = 72.0$. The mean of a random sample of 40 observations of V is denoted by \bar{V} . Given that $P(\bar{V} < 71.2) = 0.35$, estimate the value of $\text{Var}(V)$. [4]
- (ii) Explain why you need to use the Central Limit Theorem in part (i), and why its use is justified. [2]
- 3** It is known that on average one person in three prefers the colour of a certain object to be blue. In a psychological test, 12 randomly chosen people were seated in a room with blue walls, and asked to state independently which colour they preferred for the object. Seven of the 12 people said that they preferred blue. Carry out a significance test, at the 5% level, of whether the statement "on average one person in three prefers the colour of the object to be blue" is true for people who are seated in a room with blue walls. [7]
- 4** In a rock, small crystal formations occur at a constant average rate of 3.2 per cubic metre.
- (i) State a further assumption needed to model the number of crystal formations in a fixed volume of rock by a Poisson distribution. [1]
- In the remainder of the question, you should assume that a Poisson model is appropriate.
- (ii) Calculate the probability that in one cubic metre of rock there are exactly 5 crystal formations. [2]
- (iii) Calculate the probability that in 0.74 cubic metres of rock there are at least 3 crystal formations. [3]
- (iv) Use a suitable approximation to calculate the probability that in 10 cubic metres of rock there are at least 36 crystal formations. [5]
- 5** The acidity A (measured in pH) of soil of a particular type has a normal distribution. The pH values of a random sample of 80 soil samples from a certain region can be summarised as
- $$\Sigma a = 496, \quad \Sigma a^2 = 3126.$$
- Test, at the 10% significance level, whether in this region the mean pH of soil is 6.1. [11]
- 6** At a tourist car park, a survey is made of the regions from which cars come.
- (i) It is given that 40% of cars come from the London region. Use a suitable approximation to find the probability that, in a random sample of 32 cars, more than 17 come from the London region. Justify your approximation. [7]
- (ii) It is given that 1% of cars come from France. Use a suitable approximation to find the probability that, in a random sample of 90 cars, exactly 3 come from France. [4]

- 7 The continuous random variable X has probability density function

$$f(x) = \begin{cases} kx^2 & 0 \leq x \leq a, \\ 0 & \text{otherwise,} \end{cases}$$

where a and k are constants.

- (i) Sketch the graph of $y = f(x)$ and explain in non-technical language what this tells you about X . [3]
- (ii) Given that $E(X) = 4.5$, find
- (a) the value of a , [6]
- (b) $\text{Var}(X)$. [3]

- 8 The random variable X has the distribution $N(\mu, 8^2)$. A test is carried out, at the 5% significance level, of $H_0: \mu = 30$ against $H_1: \mu > 30$, based on a random sample of size 18.

- (i) Find the critical region for the test. [4]
- (ii) If $\mu = 30$ and the outcome of the test is that H_0 is rejected, state the type of error that is made. [1]

On a particular day this test is carried out independently a total of 20 times, and for 4 of these tests the outcome is that H_0 is rejected. It is known that the value of μ remains the same throughout these 20 tests.

- (iii) Find the probability that H_0 is rejected at least 4 times if $\mu = 30$. Hence state whether you think that $\mu = 30$, giving a reason. [3]
- (iv) Given that the probability of making an error of the type different from that stated in part (ii) is 0.4, calculate the actual value of μ , giving your answer correct to 4 significant figures. [4]

THERE ARE NO QUESTIONS WRITTEN ON THIS PAGE



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