UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/71**

Paper 7 Probability & Statistics 2 **(S2)** **October/November 2010**

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)

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READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 50.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

This document consists of **3** printed pages and **1** blank page.

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1 In a survey of 1000 randomly chosen adults, 605 said that they used email. Calculate a 90% confidence interval for the proportion of adults in the whole population who use email. [3]

2 People arrive randomly and independently at a supermarket checkout at an average rate of 2 people every 3 minutes.

(i) Find the probability that exactly 4 people arrive in a 5-minute period. [2]

At another checkout in the same supermarket, people arrive randomly and independently at an average rate of 1 person each minute.

(ii) Find the probability that a total of fewer than 3 people arrive at the two checkouts in a 3-minute period. [3]

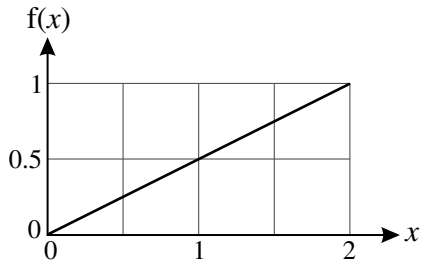
3 A book contains 40 000 words. For each word, the probability that it is printed wrongly is 0.0001 and these errors occur independently. The number of words printed wrongly in the book is represented by the random variable X.

(i) State the exact distribution of X, including the values of any parameters. [1]

(ii) State an approximate distribution for X, including the values of any parameters, and explain why this approximate distribution is appropriate. [3]

(iii) Use this approximate distribution to find the probability that there are more than 3 words printed wrongly in the book. [3]

4



The diagram shows the graph of the probability density function, f, of a random variable X which takes values between 0 and 2 only.

(i) Find $P(1 < X < 1.5)$. [2]

(ii) Find the median of X. [3]

(iii) Find $E(X)$. [2]

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5 The marks of candidates in Mathematics and English in 2009 were represented by the independent random variables X and Y with distributions $N(28, 5.6^2)$ and $N(52, 12.4^2)$ respectively. Each candidate's marks were combined to give a final mark F, where $F = X + \frac{1}{2}Y$.

(i) Find $E(F)$ and $Var(F)$. [3]

(ii) The final marks of a random sample of 10 candidates from Grinford in 2009 had a mean of 49. Test at the 5% significance level whether this result suggests that the mean final mark of all candidates from Grinford in 2009 was lower than elsewhere. [5]

6 It is claimed that a certain 6-sided die is biased so that it is more likely to show a six than if it was fair. In order to test this claim at the 10% significance level, the die is thrown 10 times and the number of sixes is noted.

(i) Given that the die shows a six on 3 of the 10 throws, carry out the test. [5]

On another occasion the same test is carried out again.

(ii) Find the probability of a Type I error. [3]

(iii) Explain what is meant by a Type II error in this context. [1]

7 **(a)** Give a reason why sampling would be required in order to reach a conclusion about

(i) the mean height of adult males in England, [1]

(ii) the mean weight that can be supported by a single cable of a certain type without the cable breaking. [1]

(b) The weights, in kg, of sacks of potatoes are represented by the random variable X with mean μ and standard deviation σ. The weights of a random sample of 500 sacks of potatoes are found and the results are summarised below.

$$n = 500, \qquad \Sigma x = 9850, \qquad \Sigma x^2 = 194\,125.$$

(i) Calculate unbiased estimates of μ and σ^2. [3]

(ii) A further random sample of 60 sacks of potatoes is taken. Using your values from part **(b) (i)**, find the probability that the mean weight of this sample exceeds 19.73 kg. [4]

(iii) Explain whether it was necessary to use the Central Limit Theorem in your calculation in part **(b) (ii)**. [2]

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