UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/73**

Paper 7 Probability & Statistics 2 **(S2)** **October/November 2012**

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 The lengths of logs are normally distributed with mean 3.5 m and standard deviation 0.12 m. Describe fully the distribution of the total length of 8 randomly chosen logs. [3]

2 **(i)** A random variable X has mean μ and variance σ^2. The mean of a random sample of n values of X is denoted by $\overline{X}$. Give expressions for $\mathrm{E}(\overline{X})$ and $\mathrm{Var}(\overline{X})$. [2]

(ii) The heights, in centimetres, of adult males in Brancot are normally distributed with mean 177.8 and standard deviation 6.1. Find the probability that the mean height of a random sample of 12 adult males from Brancot is less than 176 cm. [3]

(iii) State, with a reason, whether it was necessary to use the Central Limit Theorem in the calculation in part **(ii)**. [1]

3 Joshi suspects that a certain die is biased so that the probability of showing a six is less than $\frac{1}{6}$. He plans to throw the die 25 times and if it shows a six on fewer than 2 throws, he will conclude that the die is biased in this way.

(i) Find the probability of a Type I error and state the significance level of the test. [3]

Joshi now decides to throw the die 100 times. It shows a six on 9 of these throws.

(ii) Calculate an approximate 95% confidence interval for the probability of showing a six on one throw of this die. [4]

4 The masses of a certain variety of potato are normally distributed with mean 180 g and variance 1550 g^2. Two potatoes of this variety are chosen at random. Find the probability that the mass of one of these potatoes is at least twice the mass of the other. [7]

5 It is claimed that, on average, people following the Losefast diet will lose more than 2 kg per month. The weight losses, x kilograms per month, of a random sample of 200 people following the Losefast diet were recorded and summarised as follows.

$$n = 200 \qquad \Sigma x = 460 \qquad \Sigma x^2 = 1636$$

(i) Calculate unbiased estimates of the population mean and variance. [3]

(ii) Test the claim at the 1% significance level. [5]

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6 Darts are thrown at random at a circular board. The darts hit the board at distances X centimetres from the centre, where X is a random variable with probability density function given by

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

where a is a positive constant.

(i) Verify that f is a probability density function whatever the value of a. [3]

It is now given that $\mathrm{E}(X) = 8$.

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

(iii) Find the probability that a dart lands more than 6 cm from the centre of the board. [3]

7 The number of workers, X, absent from a factory on a particular day has the distribution $\mathrm{B}(80, 0.01)$.

(i) Explain why it is appropriate to use a Poisson distribution as an approximating distribution for X. [2]

(ii) Use the Poisson distribution to find the probability that the number of workers absent during 12 randomly chosen days is more than 2 and less than 6. [3]

Following a change in working conditions, the management wishes to test whether the mean number of workers absent per day has decreased.

(iii) During 10 randomly chosen days, there were a total of 2 workers absent. Use the Poisson distribution to carry out the test at the 2% significance level. [5]

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