UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

**MATHEMATICS** **9709/73**

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

**1 hour 15 minutes**

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

*2747805859*

**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.

© UCLES 2010

**1** A random variable has the distribution Po(31). Name an appropriate approximating distribution and state the mean and standard deviation of this approximating distribution. [3]

**2** The editor of a magazine wishes to obtain the views of a random sample of readers about the future of the magazine.

**(i)** A sub-editor proposes that they include in one issue of the magazine a questionnaire for readers to complete and return. Give two reasons why the readers who return the questionnaire would not form a random sample. [2]

The editor decides to use a table of random numbers to select a random sample of 50 readers from the 7302 regular readers. These regular readers are numbered from 1 to 7302. The first few random numbers which the editor obtains from the table are as follows.

49757 80239 52038 60882

**(ii)** Use these random numbers to select the first three members in the sample. [2]

**3** The masses of sweets produced by a machine are normally distributed with mean $\mu$ grams and standard deviation 1.0 grams. A random sample of 65 sweets produced by the machine has a mean mass of 29.6 grams.

**(i)** Find a 99% confidence interval for $\mu$. [3]

The manufacturer claims that the machine produces sweets with a mean mass of 30 grams.

**(ii)** Use the confidence interval found in part **(i)** to draw a conclusion about this claim. [2]

**(iii)** Another random sample of 65 sweets produced by the machine is taken. This sample gives a 99% confidence interval that leads to a different conclusion from that found in part **(ii)**. Assuming that the value of $\mu$ has not changed, explain how this can be possible. [1]

**4** The masses, in milligrams, of three minerals found in 1 tonne of a certain kind of rock are modelled by three independent random variables $P$, $Q$ and $R$, where $P \sim \mathrm{N}(46, 19^2)$, $Q \sim \mathrm{N}(53, 23^2)$ and $R \sim \mathrm{N}(25, 10^2)$. The total value of the minerals found in 1 tonne of rock is modelled by the random variable $V$, where $V = P + Q + 2R$. Use the model to find the probability of finding minerals with a value of at least 93 in a randomly chosen tonne of rock. [7]

**5** A continuous random variable $X$ has probability density function given by

$$\mathrm{f}(x) = \begin{cases} \frac{1}{6}x & 2 \leqslant x \leqslant 4, \\ 0 & \text{otherwise.} \end{cases}$$

**(i)** Find $\mathrm{E}(X)$. [3]

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

**(iii)** Two independent values of $X$ are chosen at random. Find the probability that both these values are greater than 3. [3]

© UCLES 2010

**6** A clinic monitors the amount, $X$ milligrams per litre, of a certain chemical in the blood stream of patients. For patients who are taking drug $A$, it has been found that the mean value of $X$ is 0.336. A random sample of 100 patients taking a new drug, $B$, was selected and the values of $X$ were found. The results are summarised below.

$$n = 100, \qquad \Sigma x = 43.5, \qquad \Sigma x^2 = 31.56.$$

**(i)** Test at the 1% significance level whether the mean amount of the chemical in the blood stream of patients taking drug $B$ is different from that of patients taking drug $A$. [8]

**(ii)** For the test to be valid, is it necessary to assume a normal distribution for the amount of chemical in the blood stream of patients taking drug $B$? Justify your answer. [2]

**7** In the past, the number of house sales completed per week by a building company has been modelled by a random variable which has the distribution Po(0.8). Following a publicity campaign, the builders hope that the mean number of sales per week will increase. In order to test at the 5% significance level whether this is the case, the total number of sales during the first 3 weeks after the campaign is noted. It is assumed that a Poisson model is still appropriate.

**(i)** Given that the total number of sales during the 3 weeks is 5, carry out the test. [6]

**(ii)** During the following 3 weeks the same test is carried out again, using the same significance level. Find the probability of a Type I error. [3]

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

**(iv)** State what further information would be required in order to find the probability of a Type II error. [1]

© UCLES 2010

**BLANK PAGE**

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.