UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/73**

Paper 7 Probability & Statistics **(S2)** **October/November 2011**

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 Test scores, X, have mean 54 and variance 144. The scores are scaled using the formula $Y = a + bX$, where a and b are constants and $b > 0$. The scaled scores, Y, have mean 50 and variance 100. Find the values of a and b. [4]

2 35% of a random sample of n students walk to college. This result is used to construct an approximate 98% confidence interval for the population proportion of students who walk to college. Given that the width of this confidence interval is 0.157, correct to 3 significant figures, find n. [5]

3 Jack has to choose a random sample of 8 people from the 750 members of a sports club.

(i) Explain fully how he can use random numbers to choose the sample. [3]

Jack asks each person in the sample how much they spent last week in the club café. The results, in dollars, were as follows.

15 25 30 8 12 18 27 25

(ii) Find unbiased estimates of the population mean and variance. [3]

(iii) Explain briefly what is meant by 'population' in this question. [1]

4 The random variable X has probability density function given by

$$f(x) = \begin{cases} ke^{-x} & 0 \leqslant x \leqslant 1, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Show that $k = \dfrac{e}{e-1}$. [3]

(ii) Find $E(X)$ in terms of e. [4]

5 Records show that the distance driven by a bus driver in a week is normally distributed with mean 1150 km and standard deviation 105 km. New driving regulations are introduced and in the next 20 weeks he drives a total of 21 800 km.

(i) Stating any assumption(s), test, at the 1% significance level, whether his mean weekly driving distance has decreased. [6]

(ii) A similar test at the 1% significance level was carried out using the data from another 20 weeks. State the probability of a Type I error and describe what is meant by a Type I error in this context. [2]

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6 Ranjit goes to mathematics lectures and physics lectures. The length, in minutes, of a mathematics lecture is modelled by the variable X with distribution $N(36, 3.5^2)$. The length, in minutes, of a physics lecture is modelled by the independent variable Y with distribution $N(55, 5.2^2)$.

(i) Find the probability that the total length of two mathematics lectures and one physics lecture is less than 140 minutes. [4]

(ii) Ranjit calculates how long he will need to spend revising the content of each lecture as follows. Each minute of a mathematics lecture requires 1 minute of revision and each minute of a physics lecture requires $1\frac{1}{2}$ minutes of revision. Find the probability that the total revision time required for one mathematics lecture and one physics lecture is more than 100 minutes. [4]

7 The numbers of men and women who visit a clinic each hour are independent Poisson variables with means 2.4 and 2.8 respectively.

(i) Find the probability that, in a half-hour period,

(a) 2 or more men and 1 or more women will visit the clinic, [4]

(b) a total of 3 or more people will visit the clinic. [3]

(ii) Find the probability that, in a 10-hour period, a total of more than 60 people will visit the clinic. [4]

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