UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/73**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 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 At the 2009 election, $\frac{1}{3}$ of the voters in Chington voted for the Citizens Party. One year later, a researcher questioned 20 randomly selected voters in Chington. Exactly 3 of these 20 voters said that if there were an election next week they would vote for the Citizens Party. Test at the 2.5% significance level whether there is evidence of a decrease in support for the Citizens Party in Chington, since the 2009 election. [5]

2 Dipak carries out a test, at the 10% significance level, using a normal distribution. The null hypothesis is $\mu = 35$ and the alternative hypothesis is $\mu \neq 35$.

(i) Is this a one-tail or a two-tail test? State briefly how you can tell. [1]

Dipak finds that the value of the test statistic is $z = -1.750$.

(ii) Explain what conclusion he should draw. [2]

(iii) This result is significant at the α% level. Find the smallest possible value of α, correct to the nearest whole number. [2]

3 The weight, in grams, of a certain type of apple is modelled by the random variable X with mean 62 and standard deviation 8.2. A random sample of 50 apples is selected, and the mean weight in grams, $\overline{X}$, is found.

(i) Describe fully the distribution of $\overline{X}$. [3]

(ii) Find $\mathrm{P}(\overline{X} > 64)$. [3]

4 At a power plant, the number of breakdowns per year has a Poisson distribution. In the past the mean number of breakdowns per year has been 4.8. Following some repairs, the management carry out a hypothesis test at the 5% significance level to determine whether this mean has decreased. If there is at most 1 breakdown in the following year, they will conclude that the mean has decreased.

(i) State what is meant by a Type I error in this context. [1]

(ii) Find the probability of a Type I error. [2]

(iii) Find the probability of a Type II error if the mean is now 0.9 breakdowns per year. [3]

5 The time, in minutes, taken by volunteers to complete a task is modelled by the random variable X with probability density function given by

$$\mathrm{f}(x) = \begin{cases} \dfrac{k}{x^4} & x \geqslant 1, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Show that $k = 3$. [2]

(ii) Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. [6]

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6 Yu Ming travels to work and returns home once each day. The times, in minutes, that he takes to travel to work and to return home are represented by the independent random variables W and H with distributions $N(22.4, 4.8^2)$ and $N(20.3, 5.2^2)$ respectively.

(i) Find the probability that Yu Ming's total travelling time during a 5-day period is greater than 180 minutes. [4]

(ii) Find the probability that, on a particular day, Yu Ming takes longer to return home than he takes to travel to work. [5]

7 A clinic deals only with flu vaccinations. The number of patients arriving every 15 minutes is modelled by the random variable X with distribution $Po(4.2)$.

(i) State two assumptions required for the Poisson model to be valid. [2]

(ii) Find the probability that

(a) at least 1 patient will arrive in a 15-minute period, [2]

(b) fewer than 4 patients will arrive in a 10-minute period. [3]

(iii) The clinic is open for 20 hours each week. At the beginning of one week the clinic has enough vaccine for 370 patients. Use a suitable approximation to find the probability that this will not be enough vaccine for that week. [4]

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