UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/73**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2013**

1 hour 15 minutes

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

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.

1 The mean and variance of the random variable X are 5.8 and 3.1 respectively. The random variable S is the sum of three independent values of X. The independent random variable T is defined by $T = 3X + 2$.

(i) Find the variance of S. [1]

(ii) Find the variance of T. [1]

(iii) Find the mean and variance of $S - T$. [3]

2 A hockey player found that she scored a goal on 82% of her penalty shots. After attending a coaching course, she scored a goal on 19 out of 20 penalty shots. Making an assumption that should be stated, test at the 10% significance level whether she has improved. [5]

3 Each of a random sample of 15 students was asked how long they spent revising for an exam. The results, in minutes, were as follows.

50 70 80 60 65 110 10 70 75 60 65 45 50 70 50

Assume that the times for all students are normally distributed with mean μ minutes and standard deviation 12 minutes.

(i) Calculate a 92% confidence interval for μ. [4]

(ii) Explain what is meant by a 92% confidence interval for μ. [1]

(iii) Explain what is meant by saying that a sample is 'random'. [1]

4 The independent random variables X and Y have the distributions Po(2) and Po(3) respectively.

(i) Given that $X + Y = 5$, find the probability that $X = 1$ and $Y = 4$. [4]

(ii) Given that $\mathrm{P}(X = r) = \frac{2}{3}\mathrm{P}(X = 0)$, show that $3 \times 2^{r-1} = r!$ and verify that $r = 4$ satisfies this equation. [2]

5 A random variable X has probability density function given by

$$\mathrm{f}(x) = \begin{cases} \dfrac{k}{x^3} & x \geqslant 1, \\ 0 & \text{otherwise,} \end{cases}$$

where k is a constant.

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

(ii) Find $\mathrm{P}(1 \leqslant X \leqslant 2)$. [2]

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

6 Calls arrive at a helpdesk randomly and at a constant average rate of 1.4 calls per hour. Calculate the probability that there will be

(i) more than 3 calls in $2\frac{1}{2}$ hours, [3]

(ii) fewer than 1000 calls in four weeks (672 hours). [4]

7 In the past the weekly profit at a store had mean \$34 600 and standard deviation \$4500. Following a change of ownership, the mean weekly profit for 90 randomly chosen weeks was \$35 400.

(i) Stating a necessary assumption, test at the 5% significance level whether the mean weekly profit has increased. [6]

(ii) State, with a reason, whether it was necessary to use the Central Limit theorem in part **(i)**. [2]

The mean weekly profit for another random sample of 90 weeks is found and the same test is carried out at the 5% significance level.

(iii) State the probability of a Type I error. [1]

(iv) Given that the population mean weekly profit is now \$36 500, calculate the probability of a Type II error. [5]

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