Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

MATHEMATICS **9709/72**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2014**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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 weights, in grams, of a random sample of 8 packets of cereal are as follows.

250 248 255 244 259 250 242 258

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

2 Each day Samuel travels from $\boldsymbol{A}$ to $\boldsymbol{B}$ and from $\boldsymbol{B}$ to $\boldsymbol{C}$. He then returns directly from $\boldsymbol{C}$ to $\boldsymbol{A}$. The times, in minutes, for these three journeys have the independent distributions $N(20, 2^2)$, $N(18, 1.5^2)$ and $N(30, 1.8^2)$, respectively. Find the probability that, on a randomly chosen day, the total time for his two journeys from $\boldsymbol{A}$ to $\boldsymbol{B}$ and $\boldsymbol{B}$ to $\boldsymbol{C}$ is less than the time for his return journey from $\boldsymbol{C}$ to $\boldsymbol{A}$. [5]

3 The number of calls per day to an enquiry desk has a Poisson distribution. In the past the mean has been 5. In order to test whether the mean has changed, the number of calls on a random sample of 10 days was recorded. The total number of calls was found to be 61. Use an approximate distribution to test at the 10% significance level whether the mean has changed. [5]

4 **(i)** The random variable $\boldsymbol{W}$ has the distribution Po(1.5). Find the probability that the sum of 3 independent values of $\boldsymbol{W}$ is greater than 2. [3]

(ii) The random variable $\boldsymbol{X}$ has the distribution Po(λ). Given that $P(\boldsymbol{X} = 0) = 0.523$, find the value of λ correct to 3 significant figures. [2]

(iii) The random variable $\boldsymbol{Y}$ has the distribution Po(μ), where $\mu \neq 0$. Given that

$$P(\boldsymbol{Y} = 3) = 24 \times P(\boldsymbol{Y} = 1),$$

find μ. [3]

5 Mahmoud throws a coin 400 times and finds that it shows heads 184 times. The probability that the coin shows heads on any throw is denoted by $\boldsymbol{p}$.

(i) Calculate an approximate 95% confidence interval for $\boldsymbol{p}$. [4]

(ii) Mahmoud claims that the coin is not fair. Use your answer to part **(i)** to comment on this claim. [1]

(iii) Mahmoud's result of 184 heads in 400 throws gives an α% confidence interval for $\boldsymbol{p}$ with width 0.1. Calculate the value of α. [4]

6 The time, $\boldsymbol{T}$ hours, spent by people on a visit to a museum has probability density function

$$f(\boldsymbol{t}) = \begin{cases} \boldsymbol{kt}(16 - \boldsymbol{t}^2) & 0 \leqslant \boldsymbol{t} \leqslant 4, \\ 0 & \text{otherwise,} \end{cases}$$

where $\boldsymbol{k}$ is a constant.

(i) Show that $\boldsymbol{k} = \frac{1}{64}$. [3]

(ii) Calculate the probability that two randomly chosen people each spend less than 1 hour on a visit to the museum. [4]

(iii) Find the mean time spent on a visit to the museum. [3]

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7 A researcher is investigating the actual lengths of time that patients spend with the doctor at their appointments. He plans to choose a sample of 12 appointments on a particular day.

(i) Which of the following methods is preferable, and why?

- Choose the first 12 appointments of the day.
- Choose 12 appointments evenly spaced throughout the day. [2]

Appointments are scheduled to last 10 minutes. The actual lengths of time, in minutes, that patients spend with the doctor may be assumed to have a normal distribution with mean μ and standard deviation 3.4. The researcher suspects that the actual time spent is more than 10 minutes on average. To test this suspicion, he recorded the actual times spent for a random sample of 12 appointments and carried out a hypothesis test at the 1% significance level.

(ii) State the probability of making a Type I error and explain what is meant by a Type I error in this context. [2]

(iii) Given that the total length of time spent for the 12 appointments was 147 minutes, carry out the test. [5]

(iv) Give a reason why the Central Limit theorem was not needed in part **(iii)**. [1]

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