Cambridge International A Level

**Cambridge International Examinations**
Cambridge International Advanced Level

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| CANDIDATE NAME | |
| CENTRE NUMBER | CANDIDATE NUMBER |

*4433263648*

**MATHEMATICS** **9709/72**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2017**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name in the spaces at the top of this page.
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.

This document consists of **11** printed pages and **1** blank page.


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**1** In a survey of 2000 randomly chosen adults, 1602 said that they owned a smartphone. Calculate an approximate 95% confidence interval for the proportion of adults in the whole population who own a smartphone. [4]

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**2** Javier writes an article containing 52 460 words. He plans to upload the article to his website, but he knows that this process sometimes introduces errors. He assumes that for each word in the uploaded version of his article, the probability that it contains an error is 0.000 08. The number of words containing an error is denoted by $X$.

**(i)** Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$, giving your answers correct to three decimal places. [2]

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Javier wants to use the Poisson distribution as an approximating distribution to calculate the probability that there will be fewer than 5 words containing an error in his uploaded article.

**(ii)** Explain how your answers to part **(i)** are consistent with the use of the Poisson distribution as an approximating distribution. [1]

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**(iii)** Use the Poisson distribution to calculate $\mathrm{P}(X < 5)$. [2]

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**[Turn over**

**3** Household incomes, in thousands of dollars, in a certain country are represented by the random variable $X$ with mean $\mu$ and standard deviation $\sigma$. The incomes of a random sample of 400 households are found and the results are summarised below.

$$n = 400 \qquad \Sigma x = 923 \qquad \Sigma x^2 = 3170$$

**(i)** Calculate unbiased estimates of $\mu$ and $\sigma^2$. [3]

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**(ii)** A random sample of 50 households in one particular region of the country is taken and the sample mean income, in thousands of dollars, is found to be 2.6. Using your values from part **(i)**, test at the 5% significance level whether household incomes in this region are greater, on average, than in the country as a whole. [5]

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**4** It is claimed that 1 in every 4 packets of certain biscuits contains a free gift. Marisa and André both suspect that the true proportion is less than 1 in 4.

**(i)** Marisa chooses 20 packets at random. She decides that if fewer than 3 contain free gifts, she will conclude that the claim is not justified. Use a binomial distribution to find the probability of a Type I error. [2]

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**(ii)** André chooses 25 packets at random. He decides to carry out a significance test at the 1% level, using a binomial distribution. Given that only 1 of the 25 packets contains a free gift, carry out the test. [5]

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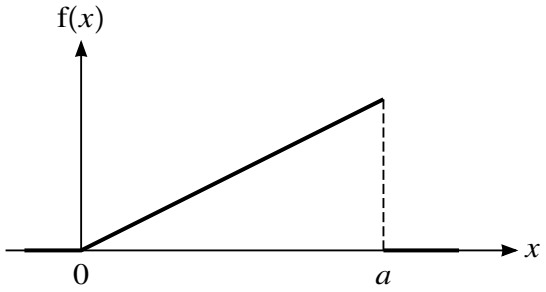
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**5**




The diagram shows the graph of the probability density function, f, of a random variable $X$ which takes values between 0 and $a$ only. It is given that $P(X < 1) = 0.25$.

**(i)** Find, in any order,

**(a)** $P(X < 2)$,

**(b)** the value of $a$,

**(c)** $f(x)$.

[5]

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

**6** Old televisions arrive randomly and independently at a recycling centre at an average rate of 1.2 per day.

**(i)** Find the probability that exactly 2 televisions arrive in a 2-day period. [2]

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**(ii)** Use an appropriate approximating distribution to find the probability that at least 55 televisions arrive in a 50-day period. [4]

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Independently of televisions, old computers arrive randomly and independently at the same recycling centre at an average rate of 4 per 7-day week.

**(iii)** Find the probability that the total number of televisions and computers that arrive at the recycling centre in a 3-day period is less than 4. [3]

**7** **(a)** A random variable $X$ is normally distributed with mean 4.2 and standard deviation 1.1. Find the probability that the sum of two randomly chosen values of $X$ is greater than 10. [4]

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**(b)** Each candidate's overall score for an essay is calculated as follows. The mark for creativity is denoted by $C$, the penalty mark for spelling errors is denoted by $S$ and the overall score is defined by $C - \frac{1}{2}S$. The variables $C$ and $S$ are independent and have distributions N(29, 105) and N(17, 15) respectively. Find the proportion of candidates receiving a negative overall score. [5]

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