Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

MATHEMATICS **9709/72**

Paper 7 Probability & Statistics 2 **(S2)** **October/November 2014**

1 hour 15 minutes

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

* 2 3 7 4 3 9 5 3 3 1 *

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 masses, in grams, of potatoes of types A and B have the distributions $N(175, 60^2)$ and $N(105, 28^2)$ respectively. Find the probability that a randomly chosen potato of type A has a mass that is at least twice the mass of a randomly chosen potato of type B. [5]

2 The probability that a randomly chosen plant of a certain kind has a particular defect is 0.01. A random sample of 150 plants is taken.

(i) Use an appropriate approximating distribution to find the probability that at least 1 plant has the defect. Justify your approximating distribution. [4]

The probability that a randomly chosen plant of another kind has the defect is 0.02. A random sample of 100 of these plants is taken.

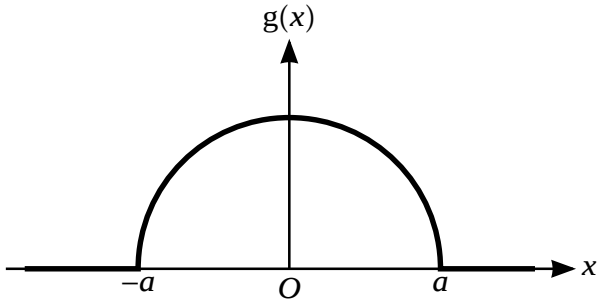
(ii) Use an appropriate approximating distribution to find the probability that the total number of plants with the defect in the two samples together is more than 3 and less than 7. [3]

3 **(a)** The time for which Lucy has to wait at a certain traffic light each day is T minutes, where T has probability density function given by

$$\mathrm{f}(t) = \begin{cases} \frac{3}{2}t - \frac{3}{4}t^2 & 0 \leqslant t \leqslant 2, \\ 0 & \text{otherwise.} \end{cases}$$

Find the probability that, on a randomly chosen day, Lucy has to wait for less than half a minute at the traffic light. [3]

(b)



The diagram shows the graph of the probability density function, g, of a random variable X. The graph of g is a semicircle with centre (0, 0) and radius a. Elsewhere $\mathrm{g}(x) = 0$.

(i) Find the value of a. [2]

(ii) State the value of $\mathrm{E}(X)$. [1]

(iii) Given that $\mathrm{P}(X < -c) = 0.2$, find $\mathrm{P}(X < c)$. [2]

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4 In a survey a random sample of 150 households in Nantville were asked to fill in a questionnaire about household budgeting.

(i) The results showed that 33 households owned more than one car. Find an approximate 99% confidence interval for the proportion of all households in Nantville with more than one car. [4]

(ii) The results also included the weekly expenditure on food, x dollars, of the households. These were summarised as follows.

$$n = 150 \qquad \Sigma x = 19\,035 \qquad \Sigma x^2 = 4\,054\,716$$

Find unbiased estimates of the mean and variance of the weekly expenditure on food of all households in Nantville. [3]

(iii) The government has a list of all the households in Nantville numbered from 1 to 9526. Describe briefly how to use random numbers to select a sample of 150 households from this list. [3]

5 The number of hours that Mrs Hughes spends on her business in a week is normally distributed with mean μ and standard deviation 4.8. In the past the value of μ has been 49.5.

(i) Assuming that μ is still equal to 49.5, find the probability that in a random sample of 40 weeks the mean time spent on her business in a week is more than 50.3 hours. [4]

Following a change in her arrangements, Mrs Hughes wishes to test whether μ has decreased. She chooses a random sample of 40 weeks and notes that the total number of hours she spent on her business during these weeks is 1920.

(ii) (a) Explain why a one-tail test is appropriate. [1]

(b) Carry out the test at the 6% significance level. [4]

(c) Explain whether it was necessary to use the Central Limit theorem in part **(ii) (b)**. [1]

6 The number of accidents on a certain road has a Poisson distribution with mean 3.1 per 12-week period.

(i) Find the probability that there will be exactly 4 accidents during an 18-week period. [3]

Following the building of a new junction on this road, an officer wishes to determine whether the number of accidents per week has decreased. He chooses 15 weeks at random and notes the number of accidents. If there are fewer than 3 accidents altogether he will conclude that the number of accidents per week has decreased. He assumes that a Poisson distribution still applies.

(ii) Find the probability of a Type I error. [3]

(iii) Given that the mean number of accidents per week is now 0.1, find the probability of a Type II error. [3]

(iv) Given that there were 2 accidents during the 15 weeks, explain why it is impossible for the officer to make a Type II error. [1]

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