UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/71**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2011**

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.

JC11 06_9709_71/RP
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1 On average, 2 people in every 10 000 in the UK have a particular gene. A random sample of 6000 people in the UK is chosen. The random variable X denotes the number of people in the sample who have the gene. Use an approximating distribution to calculate the probability that there will be more than 2 people in the sample who have the gene. [4]

2 **(a)** The time taken by a worker to complete a task was recorded for a random sample of 50 workers. The sample mean was 41.2 minutes and an unbiased estimate of the population variance was 32.6 minutes^2. Find a 95% confidence interval for the mean time taken to complete the task. [3]

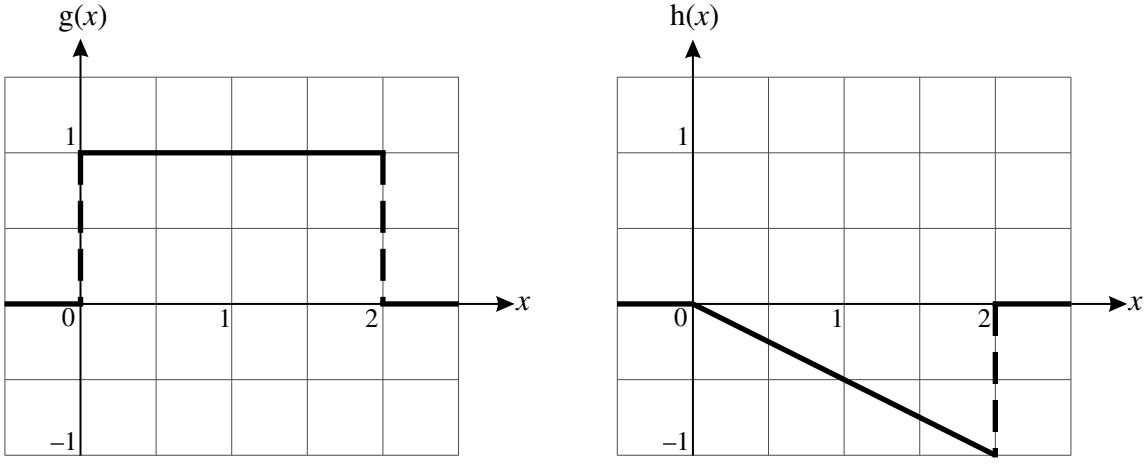
(b) The probability that an α% confidence interval includes only values that are lower than the population mean is $\frac{1}{16}$. Find the value of α. [2]

3 Past experience has shown that the heights of a certain variety of rose bush have been normally distributed with mean 85.0 cm. A new fertiliser is used and it is hoped that this will increase the heights. In order to test whether this is the case, a botanist records the heights, x cm, of a large random sample of n rose bushes and calculates that $\bar{x} = 85.7$ and $s = 4.8$, where $\bar{x}$ is the sample mean and s^2 is an unbiased estimate of the population variance. The botanist then carries out an appropriate hypothesis test.

(i) The test statistic, z, has a value of 1.786 correct to 3 decimal places. Calculate the value of n. [3]

(ii) Using this value of the test statistic, carry out the test at the 5% significance level. [3]

4 **(a)**



The diagrams show the graphs of two functions, g and h. For each of the functions g and h, give a reason why it cannot be a probability density function. [2]

(b) The distance, in kilometres, travelled in a given time by a cyclist is represented by the continuous random variable X with probability density function given by

$$f(x) = \begin{cases} \dfrac{30}{x^2} & 10 \leqslant x \leqslant 15, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Show that $E(X) = 30 \ln 1.5$. [3]

(ii) Find the median of X. Find also the probability that X lies between the median and the mean. [5]

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5 Cans of drink are packed in boxes, each containing 4 cans. The weights of these cans are normally distributed with mean 510 g and standard deviation 14 g. The weights of the boxes, when empty, are independently normally distributed with mean 200 g and standard deviation 8 g.

(i) Find the probability that the total weight of a full box of cans is between 2200 g and 2300 g. [6]

(ii) Two cans of drink are chosen at random. Find the probability that they differ in weight by more than 20 g. [5]

6 The number of injuries per month at a certain factory has a Poisson distribution. In the past the mean was 2.1 injuries per month. New safety procedures are put in place and the management wishes to use the next 3 months to test, at the 2% significance level, whether there are now fewer injuries than before, on average.

(i) Find the critical region for the test. [5]

(ii) Find the probability of a Type I error. [1]

(iii) During the next 3 months there are a total of 3 injuries. Carry out the test. [3]

(iv) Assuming that the mean remains 2.1, calculate an estimate of the probability that there will be fewer than 20 injuries during the next 12 months. [5]

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