UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

MATHEMATICS **9709/71**

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

1 hour 15 minutes

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

4198359015

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.

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1 Marie wants to choose one student at random from Anthea, Bill and Charlie. She throws two fair coins. If both coins show tails she will choose Anthea. If both coins show heads she will choose Bill. If the coins show one of each she will choose Charlie.

(i) Explain why this is not a fair method for choosing the student. [2]

(ii) Describe how Marie could use the two coins to give a fair method for choosing the student. [2]

2 The times taken by students to complete a task are normally distributed with standard deviation 2.4 minutes. A lecturer claims that the mean time is 17.0 minutes. The times taken by a random sample of 5 students were 17.8, 22.4, 16.3, 23.1 and 11.4 minutes. Carry out a hypothesis test at the 5% significance level to determine whether the lecturer's claim should be accepted. [5]

3 Weights of cups have a normal distribution with mean 91 g and standard deviation 3.2 g. Weights of saucers have an independent normal distribution with mean 72 g and standard deviation 2.6 g. Cups and saucers are chosen at random to be packed in boxes, with 6 cups and 6 saucers in each box. Given that each empty box weighs 550 g, find the probability that the total weight of a box containing 6 cups and 6 saucers exceeds 1550 g. [5]

4 The lengths, x m, of a random sample of 200 balls of string are found and the results are summarised by $\Sigma x = 2005$ and $\Sigma x^2 = 20\,175$.

(i) Calculate unbiased estimates of the population mean and variance of the lengths. [3]

(ii) Use the values from part **(i)** to estimate the probability that the mean length of a random sample of 50 balls of string is less than 10 m. [3]

(iii) Explain whether or not it was necessary to use the Central Limit theorem in your calculation in part **(ii)**. [2]

5 The probability that a new car of a certain type has faulty brakes is 0.008. A random sample of 520 new cars of this type is chosen, and the number, X, having faulty brakes is noted.

(i) Describe fully the distribution of X and describe also a suitable approximating distribution. Justify this approximating distribution. [4]

(ii) Use your approximating distribution to find

(a) $P(X > 3)$, [2]

(b) the smallest value of n such that $P(X = n) > P(X = n + 1)$. [3]

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6 The time in minutes taken by people to read a certain booklet is modelled by the random variable T with probability density function given by

$$\mathrm{f}(t) = \begin{cases} \dfrac{1}{2\sqrt{t}} & 4 \leqslant t \leqslant 9, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Find the time within which 90% of people finish reading the booklet. [3]

(ii) Find $\mathrm{E}(T)$ and $\mathrm{Var}(T)$. [6]

7 Leila suspects that a particular six-sided die is biased so that the probability, p, that it will show a six is greater than $\frac{1}{6}$. She tests the die by throwing it 5 times. If it shows a six on 3 or more throws she will conclude that it is biased.

(i) State what is meant by a Type I error in this situation and calculate the probability of a Type I error. [3]

(ii) Assuming that the value of p is actually $\frac{2}{3}$, calculate the probability of a Type II error. [3]

Leila now throws the die 80 times and it shows a six on 50 throws.

(iii) Calculate an approximate 96% confidence interval for p. [4]

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