Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

3951791503

MATHEMATICS **9709/72**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2018**

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 in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
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 **12** printed pages.

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1 The numbers of alpha, beta and gamma particles emitted per minute by a certain piece of rock have independent distributions Po(0.2), Po(0.3) and Po(0.6) respectively. Find the probability that the total number of particles emitted during a 4-minute period is less than 4. [3]

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2 The random variable X has the distribution N(3, 1.2). The random variable A is defined by $A = 2X$. The random variable B is defined by $B = X_1 + X_2$, where X_1 and X_2 are independent random values of X. Describe fully the distribution of A and the distribution of B. [3]

Distribution of A: .....

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Distribution of B: .....

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3 The management of a factory wished to find a range within which the time taken to complete a particular task generally lies. It is given that the times, in minutes, have a normal distribution with mean μ and standard deviation 6.5. A random sample of 15 employees was chosen and the mean time taken by these employees was found to be 52 minutes.

(i) Calculate a 95% confidence interval for μ. [3]

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Later another 95% confidence interval for μ was found, based on a random sample of 30 employees.

(ii) State, with a reason, whether the width of this confidence interval was less than, equal to or greater than the width of the previous interval. [1]

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4 The mean mass of packets of sugar is supposed to be 505 g. A random sample of 10 packets filled by a certain machine was taken and the masses, in grams, were found to be as follows.

500 499 496 495 498 490 492 501 494 494

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

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The mean mass of packets produced by this machine was found to be less than 505 g, so the machine was adjusted. Following the adjustment, the masses of a random sample of 150 packets from the machine were measured and the total mass was found to be 75 660 g.

(ii) Given that the population standard deviation is 3.6 g, test at the 2% significance level whether the machine is still producing packets with mean mass less than 505 g. [5]

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(iii) Explain why the use of the normal distribution is justified in carrying out the test in part **(ii)**. [1]

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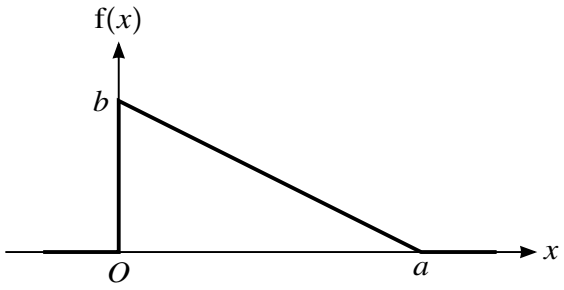
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The diagram shows the probability density function, f, of a random variable X, in terms of the constants a and b.

(i) Find b in terms of a. [2]

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(ii) Show that $f(x) = \frac{2}{a} - \frac{2}{a^2}x$. [3]

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(iii) Given that $E(X) = 0.5$, find a. [4]

6 Accidents on a particular road occur at a constant average rate of 1 every 4.8 weeks.

(i) State, in context, one condition for the number of accidents in a given period to be modelled by a Poisson distribution. [1]

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Assume now that a Poisson distribution is a suitable model.

(ii) Find the probability that exactly 4 accidents will occur during a randomly chosen 12-week period. [2]

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(iii) Find the probability that more than 3 accidents will occur during a randomly chosen 10-week period. [3]

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(iv) Use a suitable approximating distribution to find the probability that fewer than 30 accidents will occur during a randomly chosen 2-year period ($104\frac{2}{7}$ weeks). [4]

7 A ten-sided spinner has edges numbered 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Sanjeev claims that the spinner is biased so that it lands on the 10 more often than it would if it were unbiased. In an experiment, the spinner landed on the 10 in 3 out of 9 spins.

(i) Test at the 1% significance level whether Sanjeev's claim is justified. [5]

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(ii) Explain why a Type I error cannot have been made. [1]

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In fact the spinner is biased so that the probability that it will land on the 10 on any spin is 0.5.

(iii) Another test at the 1% significance level, also based on 9 spins, is carried out. Calculate the probability of a Type II error. [6]

Additional Page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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