

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education  
Advanced Subsidiary Level and Advanced Level

**HIGHER MATHEMATICS**  
**MATHEMATICS**

**8719/07**  
**9709/07**

Paper 7 Probability & Statistics 2 **(S2)**

October/November 2004

**1 hour 15 minutes**

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

**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 on both sides of the paper.  
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.  
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.  
The use of an electronic calculator is expected, where appropriate.  
You are reminded of the need for clear presentation in your answers.

This document consists of **3** printed pages and **1** blank page.



- 1 The number of radioactive particles emitted per second by a certain metal is random and has mean 1.7. The radioactive metal is placed next to an object which independently emits particles at random such that the mean number of particles emitted per second is 0.6. Find the probability that the total number of particles emitted in the next 3 seconds is 6, 7 or 8. [4]
- 2 Over a long period of time it is found that the amount of sunshine on any day in a particular town in Spain has mean 6.7 hours and standard deviation 3.1 hours.
- (i) Find the probability that the mean amount of sunshine over a random sample of 300 days is between 6.5 and 6.8 hours. [4]
- (ii) Give a reason why it is not necessary to assume that the daily amount of sunshine is normally distributed in order to carry out the calculation in part (i). [1]
- 3 A random sample of 150 students attending a college is taken, and their travel times,  $t$  minutes, are measured. The data are summarised by  $\Sigma t = 4080$  and  $\Sigma t^2 = 159\,252$ .
- (i) Calculate unbiased estimates of the population mean and variance. [3]
- (ii) Calculate a 94% confidence interval for the population mean travel time. [4]
- 4 The weights of men follow a normal distribution with mean 71 kg and standard deviation 7 kg. The weights of women follow a normal distribution with mean 57 kg and standard deviation 5 kg. The total weight of 5 men and 2 women chosen randomly is denoted by  $X$  kg.
- (i) Show that  $E(X) = 469$  and  $\text{Var}(X) = 295$ . [2]
- (ii) The total weight of 4 men and 3 women chosen randomly is denoted by  $Y$  kg. Find the mean and standard deviation of  $X - Y$  and hence find  $P(X - Y > 22)$ . [5]
- 5 Of people who wear contact lenses, 1 in 1500 on average have laser treatment for short sight.
- (i) Use a suitable approximation to find the probability that, of a random sample of 2700 contact lens wearers, more than 2 people have laser treatment. [4]
- (ii) In a random sample of  $n$  contact lens wearers the probability that no one has laser treatment is less than 0.01. Find the least possible value of  $n$ . [3]
- 6 A continuous random variable  $X$  has probability density function given by

$$f(x) = \begin{cases} 3(1-x)^2 & 0 \leq x \leq 1, \\ 0 & \text{otherwise.} \end{cases}$$

Find

- (i)  $P(X > 0.5)$ , [3]
- (ii) the mean and variance of  $X$ . [6]

- 7 In a research laboratory where plants are studied, the probability of a certain type of plant surviving was 0.35. The laboratory manager changed the growing conditions and wished to test whether the probability of a plant surviving had increased.
- (i) The plants were grown in rows, and when the manager requested a random sample of 8 plants to be taken, the technician took all 8 plants from the front row. Explain what was wrong with the technician's sample. [1]
  - (ii) A suitable sample of 8 plants was taken and 4 of these 8 plants survived. State whether the manager's test is one-tailed or two-tailed and also state the null and alternative hypotheses. Using a 5% significance level, find the critical region and carry out the test. [7]
  - (iii) State the meaning of a Type II error in the context of the test in part (ii). [1]
  - (iv) Find the probability of a Type II error for the test in part (ii) if the probability of a plant surviving is now 0.4. [2]

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