6684/01

Edexcel GCE

Statistics

Unit S2 Mock paper

Advanced Subsidiary / Advanced

Time: 1 hour 30 minutes

Materials required for the examination	Items included with these question papers
Answer Book (AB04) Graph Paper (GP02) Mathematical Formulae	Nil

Candidates may use any calculator EXCEPT **those with a facility for symbolic algebra, differentiation and/or integration. Thus candidates may** NOT **use calculators such as Texas TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.**

Instructions to Candidates

In the boxes on the Answer Book provided, write the name of the Examining Body (Edexcel), your Centre Number, Candidate Number, the Unit Title (Statistics S2), the Paper Reference (6684), your surname, other names and signature.

Values from the Statistical tables should be quoted in full. When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae including Statistical Formulae and Tables' is provided.

Full marks may be obtained for answers to ALL questions.

This paper has 6 questions. There are no blank pages.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.

You must show sufficient working to make your methods clear to the Examiner. Answers without working will gain no credit.

1. The lifetime, in tens of hours, of a certain delicate electrical component can be modelled by the random variable X with probability density function

$$f(x) = \begin{cases} \frac{1}{42}x, & 0 \le x < 6, \\ \frac{1}{7} & 6 \le x \le 10, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Sketch f(x) for all values of x. **(4 marks)**

(b) Find the probability that a component lasts at least 50 hours. **(3 marks)**

A particular device requires two of these components and it will not operate if one or more of the components fail. The device has just been fitted with two new components and the lifetimes of these two components are independent.

(c) Find the probability that the device breaks down within the next 50 hours. **(2 marks)**

---

2. The continuous random variable X represents the error, in mm, made when a machine cuts piping to a target length. The distribution of X is rectangular over the interval [–5.0, 5.0].

Find

(a) P($X < -4.2$), **(1 mark)**

(b) P($|X| < 1.5$). **(2 marks)**

A supervisor checks a random sample of 10 lengths of piping cut by the machine.

(c) Find the probability that more than half of them are within 1.5 cm of the target length. **(3 marks)**

If $X < -4.2$, the length of piping cannot be used. At the end of each day the supervisor checks a random sample of 60 lengths of piping.

(d) Use a suitable approximation to estimate the probability that no more than 2 of these lengths of piping cannot be used. **(5 marks)**

---

3. An athletics teacher has kept careful records over the past 20 years of results from school sports days. There are always 10 competitors in the javelin competition. Each competitor is allowed 3 attempts and the teacher has a record of the distances thrown by each competitor at each attempt. The random variable D represents the greatest distance thrown by each competitor and the random variable A represents the number of the attempt in which the competitor achieved their greatest distance.

(a) State which of the two random variables D or A is continuous. **(1 mark)**

A new athletics coach wishes to take a random sample of the records of 36 javelin competitors.

(b) Specify a suitable sampling frame and explain how such a sample could be taken. **(2 marks)**

The coach assumes that $P(A = 2) = \frac{1}{3}$, and is therefore surprised to find that 20 of the 36 competitors in the sample achieved their greatest distance on their second attempt.

Using a suitable approximation, and assuming that $P(A = 2) = \frac{1}{3}$,

(c) find the probability that at least 20 of the competitors achieved their greatest distance on their second attempt. **(6 marks)**

(d) Comment on the assumption that $P(A = 2) = \frac{1}{3}$. **(2 marks)**

---

4. From past records a manufacturer of glass vases knows that 15% of the production have slight defects. To monitor the production, a random sample of 20 vases is checked each day and the number of vases with slight defects is recorded.

(a) Using a 5% significance level, find the critical regions for a two-tailed test of the hypothesis that the probability of a vase with slight defects is 0.15. The probability of rejecting, in either tail, should be as close as possible to 2.5%. **(5 marks)**

(b) State the actual significance level of the test described in part (a). **(1 mark)**

A shop sells these vases at a rate of 2.5 per week. In the 4 weeks of December the shop sold 15 vases.

(c) Stating your hypotheses clearly test, at the 5% level of significance, whether or not there is evidence that the rate of sales per week had increased in December. **(6 marks)**

---

5. The continuous random variable T represents the time in hours that students spend on homework. The cumulative distribution function of T is

$$\mathrm{F}(t) = \begin{cases} 0, & t < 0, \\ k(2t^3 - t^4) & 0 \le t \le 1.5, \\ 1, & t > 1.5. \end{cases}$$

where k is a positive constant.

(a) Show that $k = \frac{16}{27}$. **(2 marks)**

(b) Find the proportion of students who spend more than 1 hour on homework. **(2 marks)**

(c) Find the probability density function f(t) of T. **(3 marks)**

(d) Show that E(T) = 0.9. **(3 marks)**

(e) Show that F(E(T)) = 0.4752. **(1 mark)**

A student is selected at random. Given that the student spent more than the mean amount of time on homework,

(f) find the probability that this student spent more than 1 hour on homework. **(3 marks)**

---

6. On a typical weekday morning customers arrive at a village post office independently and at a rate of 3 per 10 minute period.

Find the probability that

(a) at least 4 customers arrive in the next 10 minutes, **(2 marks)**

(b) no more than 7 customers arrive between 11.00 a.m. and 11.30 a.m. **(3 marks)**

The period from 11.00 a.m. to 11.30 a.m. next Tuesday morning will be divided into 6 periods of 5 minutes each.

(c) Find the probability that no customers arrive in at most one of these periods. **(6 marks)**

The post office is open for $3\frac{1}{2}$ hours on Wednesday mornings.

(d) Using a suitable approximation, estimate the probability that more than 49 customers arrive at the post office next Wednesday morning. **(7 marks)**

END