

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
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2	
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6	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2013

Statistics

SS04

Unit Statistics 4

Monday 10 June 2013 9.00 am to 10.30 am

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.



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3 Teleza, a psychologist, conducted a series of experiments to investigate the effects of two potential distractors, flashing lights and loud noises, on the time taken by students to perform a simple task. In an initial experiment, a large number of students performed the task without distraction and the mean time was found to be 92 seconds.

Assume that all the task times in this question have normal distributions.

(a) In the next experiment, a random sample of 8 students was subjected to flashing lights, and the times taken to perform the task were recorded by Teleza. These times, in seconds, were as follows.

85 100 105 92 92 89 112 90

(i) Construct a 95% confidence interval for the mean time taken by students to perform the task when subjected to flashing lights, giving the limits to one decimal place. *(6 marks)*

(ii) Use this confidence interval to decide whether there is significant evidence that the mean task time has changed from 92 seconds when students are subjected to flashing lights. Justify your decision. *(2 marks)*

(b) In a further experiment, the times taken, x seconds, by the same group of 8 students to perform the task when subjected to loud noises were found by Teleza to have mean $\bar{x} = 94.5$ seconds and standard deviation $s = 4.2$ seconds.

(i) Investigate, at the 5% level of significance, whether the population mean time has changed from 92 seconds when students are subjected to loud noises. *(7 marks)*

(ii) If previous research had shown that the population standard deviation of task times when students are subjected to loud noises is 4 seconds, what type of test should you have carried out in part **(b)(i)**? You are **not** required to carry out the test. *(1 mark)*

(c) Identify, with a reason, the most notable difference between the task times for the two different types of distraction. *(2 marks)*

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- 5** Conrad, a popular author, is signing copies of his latest book in a high street bookshop.
- (a)** The number of people joining the queue for his signature during a one-minute interval can be modelled by a Poisson distribution with mean 2.5 .
- (i)** Find the probability that, during a **three**-minute interval, at most 6 people join the queue. *(2 marks)*
- (ii)** Use an approximate distribution to find the probability that, during a **fifteen**-minute interval, at most 42 people join the queue. *(4 marks)*
- (b)** For each person in the queue, Conrad will either just sign a copy of his book or write a personal dedication. The time he takes to **sign** a copy of his book can be modelled by a normal distribution with mean 40 seconds and standard deviation 10 seconds. The time he takes to **write a personal dedication** can be modelled by a normal distribution with mean 100 seconds and standard deviation 15 seconds. All these times are independent from person to person.
- The random variable T represents the **total** time taken to sign 4 copies of his book.
- (i)** Find the mean and the standard deviation of T . *(3 marks)*
- (ii)** Evaluate the probability that T is between 2 minutes and 3 minutes. *(3 marks)*
- (iii)** Evaluate the probability that Conrad can write 2 personal dedications in less time than he can sign 4 copies of his book. *(5 marks)*
- (c)** Give a reason, in context, why a Poisson distribution would probably not be a valid model for the number of people joining an airport check-in queue during a time interval of several hours. *(2 marks)*

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- 6** James is a guitarist in a rock band which is about to start a 14-night tour. James usually uses Britepick guitar strings, which he changes before each performance. The thinnest string on a guitar, the top-E string, is the one most likely to break and, for James, the probability that this happens during a 1-hour performance is 0.02.
- (a)** James is thinking of using Pluckwell strings rather than Britepick strings in the future and has bought some Pluckwell top-E strings to use each night of the 14-night tour. He finds that he breaks a top-E string during the band’s 1-hour performance on 2 of these 14 nights.
- (i)** Use a binomial distribution to investigate, at the 5% level of significance, whether Pluckwell top-E strings are more likely to break than Britepick top-E strings. *(5 marks)*
- (ii)** Name one other factor besides reliability that James should consider when deciding whether to change his brand of strings. *(1 mark)*
- (iii)** Irrespective of the data collected during the tour, explain why it would not have been possible to investigate, at the 5% level of significance, whether Pluckwell top-E strings are **less** likely to break than Britepick top-E strings. You should support your explanation with an appropriate binomial probability. *(2 marks)*
- (b)** James plays a standard six-string electric guitar. The other five strings are thicker than the top-E string and are less likely to break. James wishes to estimate the probability that he will complete a 1-hour performance without breaking any of the six strings.
- Assuming that the six strings break independently of each other, show that, if he uses Britepick strings, this probability will be greater than 0.88. *(3 marks)*

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