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| For Examiner's Use | |
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| Examiner's Initials | |
| Question | Mark |
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| TOTAL | |

General Certificate of Education
Advanced Level Examination
June 2011

# Statistics SS04

## Unit Statistics 4

## Thursday 16 June 2011 1.30 pm to 3.00 pm

**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 the questions in the spaces provided. 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.

Answer **all** questions in the spaces provided.

**1** Twelve pears, selected at random from Aaron's market stall, are weighed. For this sample of pears, the mean weight, $\bar{x}$, is 137.24 grams and the standard deviation, $s$, is 22.79 grams.

Test Aaron's claim that the mean weight of his pears is 140 grams. Use the 5% significance level and assume that the distribution is normal. *(8 marks)*

QUESTION PART REFERENCE

*QUESTION PART REFERENCE*

**2 (a)** A large store sells electrical appliances. The number of appliances sold may be modelled by a Poisson distribution with mean 187 per week. Use a distributional approximation to find the probability that, during a particular week, fewer than 176 appliances are sold. *(5 marks)*

**(b)** For each appliance delivered to a customer, there is, independently, a probability of 0.008 that it will have a serious fault and so need to be replaced immediately. Use a distributional approximation to find the probability that, during a week when 175 appliances are delivered to customers, 2 or more will have a serious fault and so need to be replaced immediately. *(5 marks)*

**(c)** The store manager retired and Elani was appointed as the new manager. Peter, an employee, was disappointed as he had hoped to become the new manager. During Elani's first week as manager, 175 appliances were sold, of which 2 had a serious fault and so needed to be replaced immediately. Peter claimed that this proved that Elani was incapable of managing effectively.

Comment on Peter's claim. *(3 marks)*

QUESTION PART REFERENCE

*QUESTION PART REFERENCE*

**3** Each year, a secondary school decides to give a mathematics test to all pupils in Year 7 so that it can monitor any changes over time in their mathematical abilities.

Hina, a mathematics teacher, is asked to design a test on which pupils currently in Year 7 would score, on average, 50 per cent of the available marks. In order to differentiate between pupils, the standard deviation should be at least 10 per cent of the available marks.

Hina designs a test and, as a trial, gives it to a random sample of 10 pupils currently in Year 7.

The scores, out of the 80 available marks for the test, were as follows.

21 35 9 17 22 4 26 29 19 25

**(a)** Calculate a 95% confidence interval for the mean score on this test of pupils currently in Year 7. Assume that the distribution of scores is normal. *(5 marks)*

**(b)** Bearing in mind the targets given to Hina, comment on the appropriateness of this test. *(3 marks)*

QUESTION PART REFERENCE

*QUESTION PART REFERENCE*

**4** The number of complaints of anti-social behaviour made to the police by residents of the Goytbank Estate averaged 9 per week during 2010.

**(a)** Following the opening of a youth club on the estate, the total number of complaints made during the first four weeks of 2011 was 23.

Assume that the number of complaints made during 2011 follows a Poisson distribution. Using a distributional approximation, examine, using the 10% significance level, whether the mean number of complaints made during 2011 is likely to be less than 9 per week. *(8 marks)*

**(b)** Suggest one reason why the Poisson distribution may **not** be a suitable model for the number of complaints of anti-social behaviour made during 2011. *(1 mark)*

QUESTION PART REFERENCE

*QUESTION PART REFERENCE*

**5** A family-owned brewery launches an appeal to raise money to buy a particular piece of medical equipment for a local hospital. Ten pubs agree to take part in the appeal and to stage fund-raising events. The brewery states that, for each pound the pubs raise, it will donate two pounds. For example, if the pubs raise a total of £1000, the brewery will donate an additional £2000.

Past experience of similar fund-raising events suggests that the amount of money raised by each pub may be modelled by a normal distribution with mean £900 and standard deviation £185.

**(a) (i)** State the mean of the distribution of the total amount of money raised by the 10 pubs. Show that the standard deviation of the total amount of money raised by the 10 pubs is £585, correct to the nearest £. Assume that the money raised by each pub is independent of the amount raised by any other pub. *(2 marks)*

**(ii)** Find the probability that the total amount of money raised by the 10 pubs exceeds £10 000. *(2 marks)*

**(b) (i)** State the distribution of the **total** amount of money raised, including the contribution by the brewery. *(3 marks)*

**(ii)** The final cost of the piece of medical equipment is not yet known because the exact specification has not yet been agreed. However, an expert states that the final cost may be modelled by a normal distribution with mean £29 000 and standard deviation £500 and can be assumed to be independent of the amount of money raised.

Find the probability that the total amount of money raised will be sufficient to meet the final cost of the medical equipment. *(5 marks)*

**(c)** Give one possible reason why:

**(i)** the amount of money raised by each pub may not be independent;

**(ii)** the final cost of the medical equipment may not be independent of the amount of money raised. *(2 marks)*

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**6** Steve, the manager of a convenience store, wished to persuade customers to increase the amount that they spend when visiting the store. An analysis of the takings showed that only 3 per cent of receipts were for £30 or more. Steve decided to issue, with each receipt, a voucher offering £3 off the bill the next time that the customer spent £30 or more in the store.

**(a) (i)** A week later, Steve observed that a random sample of 30 customers included 2 who spent £30 or more. Use an exact binomial distribution and the 5% significance level to examine whether the vouchers had been effective. *(6 marks)*

**(ii)** Steve later examined the takings for the whole day and found that 28 out of 583 customers spent £30 or more. Use an approximation to the binomial distribution and the 5% significance level to examine whether the vouchers had been effective. *(8 marks)*

**(iii)** Steve carried out the tests in parts **(a)(i)** and **(a)(ii)**. He reached a different conclusion in part **(a)(i)** from that in part **(a)(ii)**. Advise Steve, giving a reason, which conclusion he should choose. *(1 mark)*

**(b)** Jarrald, the assistant manager, pointed out that 10 of the 583 customers spent £30 or more but did not use a voucher.

Calculate an approximate 95% confidence interval for the proportion of customers who spent £30 or more but did not use a voucher. *(5 marks)*

**(c)** Jarrald argued that some of the customers who used a voucher would have spent £30 or more even if no vouchers had been issued. The store was therefore losing £3 on each of these transactions and so the vouchers should be discontinued.

Using your results in parts **(a)** and **(b)**, comment on Jarrald's argument. *(3 marks)*

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**END OF QUESTIONS**