

General Certificate of Education
January 2007
Advanced Level Examination



STATISTICS
Unit Statistics 4

SS04

Tuesday 23 January 2007 1.30 pm to 3.00 pm

For this paper you must have:

- an 8-page answer book
 - the **blue** AQA booklet of formulae and statistical tables.
- You may use a graphics calculator.

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is SS04.
- Answer **all** questions.
- Show all necessary working; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information

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

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

1 Marzena buys Simsons matches. Of a random sample of 85 such matches, 27 broke when he struck them.

(a) Calculate an approximate 95% confidence interval for the proportion of Simsons matches which will break when Marzena strikes them. *(6 marks)*

(b) Marzena used to buy Wilkins matches. However, he changed to Simsons matches as he was unhappy that 17 per cent of Wilkins matches broke when he struck them. Comment on Marzena's decision to change to Simsons matches. *(2 marks)*

2 Fiona works for a large manufacturing company and each working day she eats in the company's canteen. The times, in seconds, that Fiona spent between entering the canteen and completing the purchase of her meal on eight days were as follows:

248 317 197 233 255 262 321 249

(a) Calculate a 90% confidence interval for the mean time that Fiona spends between entering the canteen and completing the purchase of her meal. *(7 marks)*

(b) State **two** assumptions that are necessary in order for the calculation in part (a) to be valid. *(2 marks)*

3 The Birmingham branch of a charity for the homeless is investigating ways of raising money. Past experience suggests that, nationally, in a house-to-house collection, 40 per cent of householders approached will make a donation.

- (a) The Birmingham branch organised a house-to-house collection in which, out of 1240 householders approached, 476 made a donation. Assume that the 1240 householders approached may be regarded as a random sample of all householders in Birmingham and that all householders act independently.

Using a suitable approximation and the 5% significance level, test the hypothesis that in Birmingham the proportion of householders who will make a donation when approached is equal to 40 per cent. *(10 marks)*

- (b) A branch member suggests that, instead of asking for a single donation, householders should be asked to commit themselves to making a regular monthly donation. It is estimated that, in the long term, one of these commitments would be worth, on average, as much to the charity as 80 single donations.

Out of 440 householders approached, 7 agreed to make a regular monthly donation. Assume that the 440 householders approached may be regarded as a random sample of all householders in Birmingham and that all householders act independently.

Using a suitable approximation, examine whether, in Birmingham, more than 0.5 per cent of householders approached would commit themselves to making a regular monthly donation. Use the 5% significance level. *(7 marks)*

- (c) Summarise your findings in parts (a) and (b). Include in your answer an explanation of why the figure of 0.5 per cent was used in the hypothesis test in part (b). *(3 marks)*

Turn over for the next question

4 Gwyneth is a resident in a student hostel. The hostel has a snooker table for use by residents. The time, in minutes, taken by residents to play a game of snooker may be modelled by a normal distribution with mean 11.4 and standard deviation 2.4.

- (a) Find the probability that the time taken to play a game exceeds 15 minutes. (3 marks)
- (b) Gwyneth arrives at the snooker table as a game is about to start and other people are waiting to play. She will have to wait for three games to be completed before she is able to play.

Assuming that the times taken to play games are independent and that no time is wasted between games, find the probability that Gwyneth will have to wait less than 30 minutes before she is able to play. (5 marks)

- (c) Gwyneth also wishes to return a book to the library because, if she keeps it until the next day, she will have to pay a fine. The time, in minutes, that she would take to go from the hostel to the library, return the book and then return to the hostel may be modelled by a normal distribution with mean 45.0 and standard deviation 4.1.

Find the probability that, if Gwyneth immediately sets off to return the library book, she will be back at the hostel before the three games are completed. (5 marks)

- (d) If Gwyneth is not at the hostel when the three games are completed, she will miss her turn to play. If she plays her game and then goes to the library, she will almost certainly arrive after it has closed and so be unable to return her book until the next day.

Advise Gwyneth as to her options. (2 marks)

- 5 Sybil, a farmer, employed Maxwell, a statistics student, to pack potatoes into bags. She intended to sell the bags of potatoes at a farmers' market. Each bag should contain approximately 5 kg of potatoes. Sybil weighed the potatoes packed in 11 randomly selected bags, with the following results, in kg:

4.52 5.68 4.02 4.96 5.47 5.98 6.20 3.96 5.10 4.26 6.30

- (a) Maxwell claimed that the mean weight of potatoes in the bags was 5.00 kg.

By carrying out a hypothesis test, using the t -distribution and the 5% significance level, verify that Maxwell's claim was plausible. Regard the data as a sample from a normal distribution. (9 marks)

- (b) Sybil required not only the mean weight of the potatoes in the bags to be 5 kg, but also the weight of the potatoes in **each** bag to be close to 5 kg. Suggest a reason for Sybil's second requirement. (1 mark)

- (c) Sybil checked the weight of potatoes in each of a further random sample of 60 bags packed by Maxwell. She recorded the **magnitudes**, in kg, of the differences of these weights from 5 kg (ie if the potatoes in a bag weighed 4.60 kg she recorded 0.40 and if the potatoes in a bag weighed 5.40 kg she also recorded 0.40). The values that she recorded had a mean of 0.88 and a standard deviation of 0.52.

Use the data from this further sample and the 1% significance level to examine whether the mean of the magnitudes of the differences from 5 kg of the weights of potatoes in all bags packed by Maxwell was more than 0.7 kg. (4 marks)

- (d) Sybil then packed some bags herself.

- (i) The weights of potatoes in a random sample of 50 bags packed by Sybil had a mean of 5.08 kg and a standard deviation of 0.12 kg.

Test, using the 5% significance level, the hypothesis that the mean weight of potatoes in all bags packed by Sybil was 5 kg. (4 marks)

- (ii) The **magnitudes**, in kg, of the differences from 5 kg of the weights of potatoes in another random sample of bags packed by Sybil had a mean of 0.23 and a standard deviation of 0.07.

Explain why it is possible, without further calculation, to conclude that there is no significant evidence that the mean of the magnitudes of the differences from 5 kg of the weights of potatoes in bags packed by Sybil was more than 0.7 kg. (2 marks)

- (e) Compare the weights of potatoes in bags packed by Sybil with those in bags packed by Maxwell and advise Sybil as to whether or not Maxwell's packing is satisfactory. (3 marks)

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