General Certificate of Education
June 2007
Advanced Level Examination

STATISTICS   **SS04**
Unit Statistics 4

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Thursday 14 June 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.

SS04

Answer **all** questions.

1 In order to economise on office space, a firm decides to encourage its employees to work from home. It claims that employees working from home will save themselves an average of £1250 a year in travelling and other expenses.

A detailed study of 9 employees suggested that the annual amounts, in £, that they would save by working from home were

    960   320   1480   690   800   1650   1800   1070   440

(a) Calculate a 95% confidence interval for the mean amount saved by working from home. Assume that the data may be regarded as a random sample from a normal distribution. *(6 marks)*

(b) Comment on the firm's claim. *(2 marks)*

2 During 2004, the mean number of hours per week worked by females in full-time employment in the United Kingdom was 37.3.

During the second week of December 2004, the hours worked by a sample of females employed full-time by a large store in the centre of a city were

    36.5   44.5   28.0   54.5   53.5   59.0   44.0   42.0   48.5   40.5

The data may be regarded as a random sample from a normal distribution.

(a) Use a *t*-test and the 5% significance level to examine whether the mean number of hours worked during the second week of December 2004, by females employed full-time by this store, differed from 37.3. *(9 marks)*

(b) Explain why your conclusion in part (a) is plausible in the context of this question. *(2 marks)*

3 A credit card company claims that its credit card will be accepted by at least 80 per cent of hotels in Europe.

A survey, carried out by a travel agent, of a random sample of 150 European hotels found that the credit card was **not** accepted in 36 of these hotels.

  (a) Using a suitable distributional approximation and the 5% significance level, test the validity of the claim made by the credit card company. *(10 marks)*

  (b) Sheila went on holiday in Europe and stayed in 11 different hotels. She found that the credit card was **not** accepted in 7 of these hotels.

  Assuming that these hotels may be regarded as a random sample of all European hotels, test the validity of the claim made by the credit card company, using the 1% significance level. *(6 marks)*

  (c) Discuss the conclusions that you reached in parts (a) and (b). Include in your answer **two** possible reasons why it may be inappropriate to assume that the hotels used by Sheila may be regarded as a random sample of all European hotels. *(4 marks)*

4 Abu shops at a local supermarket. At this supermarket, the time taken to serve a customer at a checkout may be modelled by a normal distribution with mean 63 seconds and standard deviation 18 seconds. The times to serve customers may be assumed to be independent.

  (a) Find the probability that it will take more than 90 seconds to serve a customer.
  (3 marks)

  (b) There is a queue of 3 customers at a checkout. Find:

   (i) the distribution of the total time to serve these customers;

   (ii) the probability that the total time to serve these customers will be less than 135 seconds. *(5 marks)*

  (c) There is one express checkout, which is reserved for customers buying five or fewer items. The time taken to serve a customer at this express checkout may be modelled by a normal distribution with mean 25 seconds and standard deviation 8 seconds.

  Abu has to choose whether to join a queue of 7 customers waiting at the express checkout or a queue of 3 customers waiting at another checkout.

  Find the probability that the total time to serve the 3 customers waiting at the other checkout will exceed the total time to serve the 7 customers waiting at the express checkout. *(7 marks)*

  (d) Suggest **two** factors, other than your calculations, which might influence Abu's decision as to which queue to join. *(2 marks)*

Turn over for the next question

Turn over ▶

4

5 The number of customers entering a bank between 1 pm and 2 pm on a weekday may be modelled by a Poisson distribution. On a particular weekday, Barnabas, the bank manager, observed that 136 customers entered the bank between 1 pm and 2 pm.

(a) Calculate an approximate 95% confidence interval for the mean number of customers entering the bank between 1 pm and 2 pm on a weekday. *(4 marks)*

(b) Most customers who enter the bank have business which can be dealt with by any member of staff. However, 22 of the 136 customers had business which could only be dealt with by a senior member of staff.

Regarding these 136 customers as a random sample of all customers, calculate an approximate 99% confidence interval for the proportion of customers who have business which can only be dealt with by a senior member of staff. *(6 marks)*

(c) Barnabas decides to assume that, on a busy day, 170 customers will enter the bank between 1 pm and 2 pm, and that a proportion of 0.25 of all customers will have business which can only be dealt with by a senior member of staff. He decides to ensure that, between 1 pm and 2 pm, there are sufficient senior members of staff available to deal with 60 customers.

Use Barnabas's assumptions and a suitable approximation to calculate the probability that, on a busy day, more than 60 customers will enter the bank between 1 pm and 2 pm with business which can only be dealt with by a senior member of staff. *(6 marks)*

(d) In the light of your calculations in parts (a), (b) and (c), comment on Barnabas's assumptions and his decision to have sufficient senior members of staff available, between 1 pm and 2 pm, to deal with 60 customers. *(3 marks)*

END OF QUESTIONS