AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

STATISTICS   **SS04**
Unit Statistics 4

Wednesday 18 January 2006   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.
- All necessary working should be shown; 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, formulae may be quoted, without proof, from the booklet.

SS04

Answer **all** questions.

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1 A large consignment of jars of jam was received by a supermarket. A random sample of nine jars was selected and the contents were weighed. The weights, in grams, were as follows:

507   502   501   501   506   503   499   498   503

(a) Calculate a 90% confidence interval for the mean weight of jam in the jars. Give your answer to an appropriate number of significant figures. *(8 marks)*

(b) State one assumption that it was necessary to make in order to calculate the confidence interval in part (a). *(1 mark)*

(c) On each jar it states that the contents weigh 500 grams. Comment on this statement using the given sample and your answer to part (a). *(3 marks)*

(d) Given that the mean weight of jam in all jars is 503 grams, state the probability that a 90% confidence interval, calculated from the contents of a random sample of jars, will contain 503 grams. *(1 mark)*

2 At a recent general election, Brookdale Junior School was used as a polling station.

(a) The number of voters arriving at the polling station on the morning of election day could be modelled by a Poisson distribution with mean 2.8 per 5-minute interval.

  (i) Find the probability that during a particular 5-minute interval the number of voters arriving was 2 or fewer. *(1 mark)*

  (ii) Use an appropriate distributional approximation to find the probability that the number of voters arriving during a particular **hour** exceeded 50. *(7 marks)*

(b) The number of voters arriving between 6 pm and 9 pm could also be modelled by a Poisson distribution, but the arrival rate could differ from the morning arrival rate. During the hour from 6 pm to 7 pm, 51 voters arrived.

Calculate an approximate 95% confidence interval for the mean number of voters arriving:

  (i) per hour; *(4 marks)*

  (ii) per 5-minute interval. *(2 marks)*

(c) Use your answer to part (b)(ii) to comment on the arrival rate of voters in the morning compared with that between 6 pm and 9 pm. *(2 marks)*

(d) Give **two** reasons why the confidence intervals that you have calculated in part (b) are approximate rather than exact. *(2 marks)*

3 A mill produces cloth in 100-metre lengths. It is common for lengths to contain faults that have to be treated before the cloth is sold. These faults are distributed over the cloth independently, at random and at a constant average rate.

(a) Name a distribution that will provide a suitable model for the number of faults in a 100-metre length of cloth. *(1 mark)*

(b) A new manager states that it is unacceptable for the mean number of faults per 100-metre length of cloth to exceed 2. The next 100-metre length of cloth produced contains 3 faults.

Carry out a hypothesis test, using the 10% significance level, to test the hypothesis that the mean number of faults per 100-metre length of cloth does not exceed 2. *(6 marks)*

(c) The results of the test are presented to the new manager, who states that a significance level of 10% is too high and that a level of 0.1% should be used in order to reduce the possibility of error.

Without carrying out further calculations, comment on the new manager's statement and point out one disadvantage of reducing the significance level. *(2 marks)*

4 The time, in minutes, that a train takes to travel from Carlisle station to Penrith station may be modelled by a normal distribution with mean 20 and standard deviation 2.

The time, in minutes, that Ravinder takes to walk from his home to Penrith station may be modelled by a normal distribution with mean 42 and standard deviation 3.

(a) (i) A train leaves Carlisle station for Penrith at 10.39 am. Find the probability that it arrives at Penrith station after 11.00 am. *(2 marks)*

(ii) Ravinder leaves home to walk to Penrith station at 10.15 am. Find the probability that he arrives at Penrith station before 11.00 am. *(2 marks)*

(iii) Find the probability that the train arrives at Penrith station after 11.00 am and Ravinder arrives before 11.00 am, given that the two events are independent. *(2 marks)*

(b) Every weekday a train leaves Carlisle station at 10.39 am and takes X minutes to travel to Penrith station. Every weekday Ravinder leaves home at 10.15 am and takes Y minutes to walk to Penrith station. X and Y are independent.

(i) Show that Ravinder will arrive at Penrith station before the train provided that

$$X - Y + 24 > 0$$ *(2 marks)*

(ii) Write down the distribution of $X - Y + 24$. *(3 marks)*

(iii) Find the probability that Ravinder will arrive at Penrith station before the train. *(2 marks)*

(c) Explain why it would have been possible to conclude, without undertaking any calculation, that the answer to part (b)(iii) must exceed the answer to part (a)(iii). *(2 marks)*

Turn over ▶

5 A catering company provides prepacked meals for consumption by airline passengers. Gamma Airlines buys large quantities of these meals and finds that 40 per cent of passengers, when surveyed, rate the meals as poor. Passengers also complain about the small quantity of meat in non-vegetarian meals.

The catering company undertakes to improve the meals and to ensure that there will be a mean of more than 140 grams of meat in non-vegetarian meals.

(a) Following this undertaking, a random sample of 20 passengers was asked to rate the meals, and 6 of these passengers rated them as poor.

Carry out a hypothesis test, using the 5% significance level, to examine whether the proportion of passengers rating the meals as poor has been reduced. *(7 marks)*

(b) Following the undertaking, the meat content of 10 non-vegetarian meals was measured. The amounts, in grams, of meat which they contained were:

145   157   139   162   133   156   148   131   164   159

Carry out a hypothesis test, using the 5% significance level, to examine whether the mean meat content of the meals was more than 140 grams. You may treat the data as a random sample from a normal distribution. *(10 marks)*

(c) Summarise the evidence as to whether or not the catering company has complied with its undertakings. *(3 marks)*

END OF QUESTIONS