

General Certificate of Education
June 2008
Advanced Subsidiary Examination



STATISTICS
Unit Statistics 2

SS02

Monday 2 June 2008 9.00 am to 10.30 am

For this paper you must have:

- an 8-page answer book
- the blue AQA booklet of formulae and statistical tables
- an insert for use in Question 1 (enclosed).

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.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is SS02.
- 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.
- Fill in the boxes at the top of the insert.

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 [Figure 1, printed on the insert, is provided for use in this question.]

A family-owned firm makes ice cream. The following table shows the quantity, in tonnes, sold during each quarter from 2004 to 2006, together with values of a suitable moving average.

| | 2004 | | | | 2005 | | | | 2006 | | | |
|-----------------|------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|------|
| Quarter | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Ice cream sales | 7.2 | 11.3 | 14.2 | 8.9 | 9.1 | 13.6 | 16.8 | 9.4 | 11.5 | 15.7 | 17.5 | 12.2 |
| Moving average | | 10.40 | 10.88 | 11.45 | 12.10 | m | 12.83 | 13.35 | 13.53 | 14.23 | | |

- (a) Calculate the value of m . (2 marks)
- (b) (i) Plot the values of the moving average on **Figure 1**.
(ii) Draw a trend line. (3 marks)
- (c) (i) Estimate the seasonal effects for each of quarters 1 and 4.
(ii) Predict the quantity of ice cream that the firm will sell during quarter 1 of 2007 and during quarter 4 of 2007 if current trends continue. (6 marks)
- (d) The owners planned to hand over the running of the firm to one of their four children at the start of 2008. They decided to allow each of their children to run the firm for one quarter during 2007 and to choose the most successful to run the firm from 2008 onwards.
- Harry ran the firm during quarter 1 and sold 13.5 tonnes of ice cream.
Charlie ran the firm during quarter 2 and sold 14.6 tonnes of ice cream.
Eddie ran the firm during quarter 3 and sold 13.9 tonnes of ice cream.
Annie ran the firm during quarter 4 and sold 15.5 tonnes of ice cream.
- (i) Plot these values on your graph.
(ii) By examining your graph, but without carrying out further calculations, explain why the owners decided **not** to choose either Charlie or Eddie to run the firm.
(iii) Advise the owners, giving a reason, as to which of Harry or Annie should be chosen to run the firm. (5 marks)

- 2 A county cricket club has different categories of membership. The following table shows the categories of membership, the annual subscription for each category of membership and the probability that a new member will join that category.

| Category of membership | Annual subscription, £ | Probability |
|------------------------|------------------------|-------------|
| Full | 120 | 0.22 |
| Senior | 80 | 0.28 |
| Country | 75 | 0.12 |
| Junior | 30 | 0.38 |

- (a) (i) Show that the mean subscription paid by new members is £69.20.
- (ii) Find the standard deviation of the subscription paid by new members. (5 marks)
- (b) As the ground capacity is limited, only 400 new members can be accepted during the coming year. The club is to stage an international match and so expects more than 400 applications for membership.

It is decided that only applications for full membership will be accepted.

How many full members would the club need to accept in order to receive more money in subscriptions than would have been provided by 400 members distributed as in the table above? (2 marks)

- (c) Give one disadvantage of the decision in part (b). (1 mark)

Turn over for the next question

Turn over ►

- 3 The following tables give details of the elections for the Welsh Assembly in 1999 and 2003, for the Scottish Parliament in 1999 and 2003 and for the Northern Ireland Assembly in 1998 and 2003.

Devolved assembly elections

| | 6 May 1999 | 1 May 2003 |
|--------------------------------------|--------------|-------------|
| Welsh Assembly | | |
| Electorate (thousands) | 2205 | 2230 |
| Valid votes counted (thousands) | 1023 | 850 |
| As percentage of electorate | 46.4 | 38.1 |
| Number of members elected (by party) | | |
| Conservative | 9 | 11 |
| Labour | 28 | 30 |
| Liberal Democrat | 6 | 6 |
| Plaid Cymru | 17 | 12 |
| Other | 0 | 1 |
| Scottish Parliament | | |
| Electorate (thousands) | 4024 | 3879 |
| Valid votes counted (thousands) | 2342 | 1916 |
| As percentage of electorate | 58.2 | 49.4 |
| Number of members elected (by party) | | |
| Conservative | 18 | 18 |
| Labour | 56 | 50 |
| Liberal Democrat | 17 | 17 |
| Scottish National Party | 35 | 27 |
| Other | 3 | 17 |
| | 25 June 1998 | 26 Nov 2003 |
| Northern Ireland Assembly | | |
| Electorate (thousands) | 1179 | 1098 |
| Valid votes counted (thousands) | 810 | 702 |
| As percentage of electorate | 68.7 | 64.0 |
| Number of members elected (by party) | | |
| Alliance Party | 6 | 6 |
| SDLP | 24 | 18 |
| Sinn Fein | 18 | 24 |
| Democratic Unionist Party | 20 | 30 |
| UK Unionist Party | 5 | 1 |
| Ulster Unionist Party | 28 | 27 |
| Other | 7 | 2 |

Source: University of Plymouth for the Electoral Commission and *Annual Abstract of Statistics*, Office for National Statistics, 2006

- (a) How many valid votes were counted in the election for the Welsh Assembly in 1999?
(2 marks)
- (b) Compare the percentages of the electorate who cast valid votes in the six elections.
(3 marks)
- (c) In one of the six elections, half of the members elected came from the same party.
Identify:
(i) the election;
(ii) the party. (3 marks)
- (d) For the 2003 elections, calculate the average electorate per member elected for each of the three countries. Comment briefly on your results. (3 marks)

Turn over for the next question

Turn over ►

4 On a map, the symbol **P** indicates a car park. A geography student divided a map into 66 squares, each representing an area of 9 km^2 .

(a) If the number of **P** symbols in a square could be modelled by a Poisson distribution with mean 0.6, find the probability of a square containing:

(i) no **P** symbols;

(ii) 3 or more **P** symbols.

(3 marks)

(b) The student counted the number of **P** symbols in each of the 66 squares. The results are shown in the table.

| Number of P symbols | Number of squares |
|----------------------------|-------------------|
| 0 | 46 |
| 1 | 8 |
| 2 | 4 |
| 3 | 8 |

Calculate the mean and variance of the number of **P** symbols in a square. (2 marks)

(c) Give a reason why the Poisson distribution does **not** provide a good model for the number of **P** symbols in a square based on:

(i) your calculations in part (a);

(ii) your calculations in part (b);

(iii) the likely distribution of car parks.

(4 marks)

- 5 A train travelling between two major cities has ten carriages. Four of the carriages are for first-class passengers only and each contains 48 seats, numbered from 1 to 48. Six of the carriages are for standard-class passengers only and each contains 72 seats, numbered from 1 to 72.

The railway company wishes to survey passengers with a view to making the catering facilities more profitable. Interviews are to be carried out during the middle section of the journey when it can be assumed that **all seats will be occupied**. For practical reasons, only seated passengers will be interviewed.

It is planned that between 25 and 30 interviews in total will be carried out.

Owen suggests that 4 carriages should be selected at random and that 7 passengers selected at random from those seated in each of these carriages should be interviewed.

Xavier suggests that 18 passengers selected at random from the seated standard-class passengers and 8 passengers selected at random from the seated first-class passengers should be interviewed.

Jada suggests that three numbers between 1 and 48 should be selected at random and that the passengers in these seats in each carriage should be interviewed.

- (a) (i) Name the type of sampling suggested by **Owen**.
- (ii) Describe how random numbers could be used to select 7 passengers at random from the 72 passengers seated in a standard-class carriage. *(5 marks)*
- (b) (i) Name the type of sampling suggested by **Xavier**.
- (ii) Suggest reasons why **Xavier** chose the numbers 18 and 8 for his sample sizes. *(4 marks)*
- (c) For **Jada's** method of sampling, state, giving a reason, whether or not:
- (i) all seated passengers have an equal chance of being included in the sample;
- (ii) all seated first-class passengers have an equal chance of being included in the sample. *(3 marks)*
- (d) The railway company requires an estimate of the mean income of all passengers on the train.

State, giving a reason, whether the mean income of a random sample of size 26 from all seated passengers or the mean income of the sample suggested by **Xavier** would be a preferable estimate. *(2 marks)*

Turn over for the next question

Turn over ►

- 6 A large chain of pharmacies introduces a training programme for counter staff to enable them to deal more quickly and effectively with queries from customers.

The managing director believes that the mean time for dealing with queries should be 40 seconds. A larger mean suggests an inefficient use of time while a smaller mean suggests that queries may not have been dealt with adequately.

Before the training programme, the times, in seconds, to deal with 9 queries were recorded as follows:

67 43 19 34 45 62 48 51 59

- (a) Test the hypothesis that the mean time taken to deal with a query was 40 seconds. Use the 5% significance level and assume that the data may be regarded as a random sample from a normal distribution with standard deviation 17 seconds. *(8 marks)*
- (b) (i) After the training programme, the times to deal with 120 queries were recorded and found to have a mean of 35 seconds and a standard deviation of 12 seconds.
- Examine, using the 5% significance level, whether, after the training programme, the mean time to deal with a query was less than 40 seconds. *(5 marks)*
- (ii) State one assumption that it is necessary to make in order for the test in part (b)(i) to be valid. *(1 mark)*
- (c) Summarise the effects of the training programme. *(3 marks)*

END OF QUESTIONS

| | | | | | | | | | |
|---------------------|--|--|--|--|------------------|--|--|--|--|
| Surname | | | | | Other Names | | | | |
| Centre Number | | | | | Candidate Number | | | | |
| Candidate Signature | | | | | | | | | |

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Insert

Insert for use in **Question 1**.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

Turn over for Figure 1

Turn over ►

Figure 1 (for use in Question 1)

