

STATISTICS
Unit Statistics 2

SS02

Monday 1 June 2009 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
- a sheet of graph paper for use in Question 4.

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.

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 A charity shop opens for 8 hours each day. The daily number of customers requesting a refund for an earlier purchase may be modelled by a Poisson distribution with mean 0.6.
- (a) Find the probability that on a particular day there are:
- (i) no requests for refunds;
 - (ii) more than 2 requests for refunds. *(3 marks)*
- (b) On a particular day, the shop manager is absent for 4 hours and leaves an assistant in charge of the shop. Find the probability that, during the manager's 4-hour absence, there are:
- (i) one or more requests for refunds;
 - (ii) exactly 2 requests for refunds. *(5 marks)*

- 2 Nazia owns an ice-cream van and sells tubs containing 1, 2, 3 or 4 scoops of ice cream. The prices, X pence, of these tubs together with the distribution of sales are shown in **Table 1**.

Table 1

| | x | $P(X = x)$ |
|-----------------|-----|------------|
| 1 scoop | 50 | 0.40 |
| 2 scoops | 95 | 0.16 |
| 3 scoops | 135 | 0.24 |
| 4 scoops | 170 | 0.20 |

- (a) Find the mean and the standard deviation of X . (4 marks)
- (b) Nazia is considering discontinuing the sale of tubs containing 1 scoop of ice cream. She estimates that if she does this:
- half of those customers who buy such tubs would instead buy tubs containing 2 scoops of ice cream;
 - the other half would not buy any ice cream.

The new distribution of prices, Y pence, would be as shown in **Table 2**.

Table 2

| | y | $P(Y = y)$ |
|-----------------|-----|------------|
| 2 scoops | 95 | 0.45 |
| 3 scoops | 135 | 0.30 |
| 4 scoops | 170 | 0.25 |

- (i) Show that the mean value of Y is 126, correct to three significant figures. (2 marks)
- (ii) By making a suitable calculation, advise Nazia as to whether, if her estimate is correct, she will increase the total amount of money taken if she discontinues selling tubs containing 1 scoop of ice cream. (3 marks)

Turn over ►

3 **Table 3** shows the number of passenger journeys undertaken on local bus services in Great Britain each year from 1994/95 to 2004/05.

Table 3
Local bus services: passenger journeys: by area

| | Millions | | | | | | | | | | |
|-------------------------------|-------------|-------------|-------------|-------------|-------------|---------------|-------------|-------------|-------------|-------------|-------------|
| | 1994/ 95 | 1995/ 96 | 1996/ 97 | 1997/ 98 | 1998/ 99 | 1999/ 2000 | 2000/ 01 | 2001/ 02 | 2002/ 03 | 2003/ 04 | 2004/ 05 |
| Great Britain | 4402 | 4366 | 4333 | 4313 | 4231 | 4278 | 4319 | 4352 | 4444 | 4564 | 4609 |
| London | 1155 | 1193 | 1230 | 1281 | 1266 | 1294 | 1347 | 1422 | 1527 | 1692 | 1782 |
| English Metropolitan Counties | 1331 | 1292 | 1246 | 1232 | 1195 | 1178 | 1166 | 1154 | 1145 | 1114 | 1083 |
| English Shire Counties | 1271 | 1259 | 1260 | 1243 | 1242 | 1250 | 1247 | 1222 | 1210 | 1189 | 1167 |
| All outside London | 3247 | 3173 | 3103 | 3032 | 2965 | 2984 | 2972 | 2930 | 2917 | 2871 | 2828 |
| England | 3757 | 3744 | 3736 | 3755 | 3702 | 3722 | 3761 | 3798 | 3882 | 3995 | 4032 |
| Scotland | 513 | 494 | 467 | 438 | 413 | 442 | 443 | 449 | 452 | 457 | 465 |
| Wales | 132 | 127 | 130 | 120 | 116 | 114 | 116 | 104 | 110 | 111 | 113 |

Source: Department for Transport and *Annual Abstract of Statistics*, Office for National Statistics, 2006

- (a) How many passenger journeys were undertaken on local bus services in Wales during 2004/05? (2 marks)
- (b) (i) Describe the trend over the period 1994/95 to 2004/05 in the number of passenger journeys undertaken on local bus services in London.
- (ii) Compare this trend with that on local bus services outside London over the same period. (3 marks)

- (c) **Table 4** shows indices of fares for local bus services and also values of the Retail Prices Index in Great Britain each year from 1994/95 to 2004/05.

Table 4
Local bus services: fare indices: by area

| | Indices (1995 = 100) | | | | | | | | | | |
|-------------------------------------|----------------------|-------------|-------------|-------------|-------------|---------------|-------------|-------------|-------------|-------------|-------------|
| | 1994/ 95 | 1995/ 96 | 1996/ 97 | 1997/ 98 | 1998/ 99 | 1999/ 2000 | 2000/ 01 | 2001/ 02 | 2002/ 03 | 2003/ 04 | 2004/ 05 |
| Great Britain | 96.7 | 101.2 | 106.3 | 112.0 | 117.1 | 122.0 | 126.4 | 130.6 | 134.5 | 139.1 | 145.7 |
| London | 96.2 | 101.1 | 105.4 | 109.3 | 113.7 | 117.2 | 117.2 | 115.5 | 114.8 | 116.9 | 126.8 |
| English Metropolitan Counties | 96.4 | 101.5 | 106.9 | 113.3 | 118.7 | 124.6 | 129.9 | 137.4 | 142.7 | 148.0 | 154.2 |
| English Shire Counties | 97.0 | 101.1 | 106.0 | 111.5 | 116.7 | 122.0 | 128.6 | 135.1 | 141.7 | 148.5 | 155.7 |
| All outside London | 96.8 | 101.2 | 106.6 | 112.8 | 118.2 | 123.4 | 129.2 | 135.3 | 140.8 | 146.3 | 152.5 |
| England | 96.7 | 101.2 | 106.1 | 111.4 | 116.5 | 121.5 | 125.9 | 130.3 | 134.2 | 139.1 | 146.2 |
| Scotland | 96.9 | 100.8 | 108.0 | 116.5 | 121.8 | 125.3 | 129.9 | 131.8 | 134.5 | 136.8 | 140.4 |
| Wales | 97.4 | 100.7 | 104.4 | 110.1 | 116.3 | 122.2 | 127.5 | 133.5 | 139.5 | 145.5 | 152.4 |
| Retail Prices Index (1995 = 100) | 97.5 | 100.7 | 103.1 | 106.5 | 109.9 | 111.6 | 114.9 | 116.6 | 119.1 | 122.4 | 126.2 |

Source: Department for Transport and *Annual Abstract of Statistics*, Office for National Statistics, 2006

- (i) Give possible reasons for the trends considered in part (b), given the additional information in **Table 4**. (3 marks)
- (ii) An index of motoring costs in Great Britain was 100 for the year 1994 and had risen to 122 by the year 2004. The corresponding figures for an index of rail fares in Great Britain were 100 and 136. Extend your answer to part (c)(i), given this further information. (2 marks)

Turn over for the next question

Turn over ►

4 [A sheet of graph paper is provided for use in this question.]

A professional institution provides a statistics examination in January and June each year. The table shows the number of candidates who have taken the examination between June 2005 and January 2008.

| | June 2005 | Jan 2006 | June 2006 | Jan 2007 | June 2007 | Jan 2008 |
|---------------------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|
| Number of candidates | 1188 | 192 | 1351 | 238 | 1499 | 290 |

- (a) Plot the data. **Your horizontal axis should extend to June 2009.** (3 marks)
- (b) Calculate values of a suitable moving average and add them to your graph. (4 marks)
- (c) Draw a trend line and estimate the seasonal effect for June. (4 marks)
- (d) Estimate the number of candidates taking the examination in June 2009. Explain the method that you use. (3 marks)
- (e) In June 2007, four examiners were used to mark the papers. It is estimated that, for any particular examination, an examiner can mark up to 400 papers.

Estimate how many examiners will be needed to mark the papers in June 2009. Justify your answer. (2 marks)

- (f) Jackie fitted a regression equation to the numbers of candidates taking the examination in June 2005, June 2006 and June 2007. Using this equation, she forecast that about 1800 candidates would take the examination in June 2009.

Comment on:

- (i) whether this is a sensible method of forecasting;
- (ii) the effect, if any, that this forecast would have on your answer to part (e). (3 marks)

- 5 An ambulance service serves a large rural area. A sample of the times taken, in minutes, from receipt of an emergency call to the arrival of an ambulance at the location of the emergency was recorded as follows.

23 14 27 15 12 26 20 18 22

- (a) Assume that these times may be regarded as a random sample from a normal distribution with standard deviation 3.5 minutes. Carry out a hypothesis test, at the 5% significance level, to examine whether the mean time could be equal to 19 minutes. *(8 marks)*
- (b) It is now decided to examine, at the 5% significance level, whether the mean time is less than 19 minutes. State the:
- (i) hypotheses;
 - (ii) critical value(s);
 - (iii) conclusion. *(4 marks)*
- (c) There is a target of at most 19 minutes for the mean time from receipt of an emergency call to the arrival of an ambulance at the location of the emergency. The director of the ambulance service states that the data provide significant evidence that this target has been achieved. Comment on this statement. *(3 marks)*

Turn over for the next question

Turn over ►

- 6 John organises the house-to-house delivery of free newspapers in a small town. He divides the town into areas and employs students to deliver the newspapers to the houses in each area. After a delivery, John calls on eight houses in each area to check that the free newspaper has been delivered.

A particular area consists of:

North Street, which contains 63 houses;
East Street, which contains 77 houses;
South Street, which contains 46 houses;
West Street, which contains 94 houses.

- (a) Describe how John could select a simple random sample of eight houses from this area. *(5 marks)*
- (b) Describe how John could select a systematic sample of eight houses from this area. *(3 marks)*
- (c) John decides to select two of the four streets in this area at random and to call at four houses selected randomly from each of these two streets. Name this type of sampling. *(1 mark)*
- (d) Socrates is a student who is sometimes employed by John to deliver the free newspapers in this area. If Socrates does not have time to deliver to all the houses, he misses out one whole street.
- (i) Explain why John should not use the type of sampling described in part (c) when checking that Socrates has delivered to all houses in this area.
- (ii) State, giving a reason, which, if either, of a simple random sample or a systematic sample would be preferable when checking that Socrates has delivered to all houses in this area. *(3 marks)*
- (e) Mary is another student who is sometimes employed by John to deliver the free newspapers in this area. If Mary does not have time to deliver to all the houses, she misses out houses haphazardly.

State, giving a reason, which, if either, of a simple random sample or a systematic sample would be preferable when checking that Mary has delivered to all houses in this area. *(2 marks)*

END OF QUESTIONS

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