

General Certificate of Education  
June 2007  
Advanced Subsidiary Examination



**STATISTICS**  
**Unit Statistics 2**

**SS02**

Tuesday 5 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
- an insert for use in Question 2 (enclosed)
- a sheet of graph paper for use in Question 4.

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 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 The number of people entering a supermarket may be modelled by a Poisson distribution with mean 2.4 per minute.
- (a) Find the probability that, during a particular minute:
- (i) 3 or fewer people enter the supermarket;
- (ii) exactly 3 people enter the supermarket. (4 marks)
- (b) Find the probability that, during a five-minute interval, more than 10 people enter the supermarket. (3 marks)
- (c) To pay for their goods, customers must join a queue at one of three checkouts. State, giving a reason, whether it is likely that the number of people per minute joining the queue at a particular checkout may be modelled by a Poisson distribution. (2 marks)
- 2 [Figure 1, printed on the insert, is provided for use in this question.]

The table shows the expenditure, £ million, of households in the United Kingdom on audio-visual equipment. It also shows the values,  $y$ , of an appropriate moving average, and of  $t$ , which numbers the values of  $y$  from 1 to 10.

| Year                | 2002 |      |      |      | 2003 |      |      |      | 2004 |      |      |      | 2005 |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Quarter             | 1    | 2    | 3    | 4    | 1    | 2    | 3    | 4    | 1    | 2    | 3    | 4    | 1    |
| Expenditure         | 1041 | 938  | 982  | 1526 | 1065 | 983  | 1059 | 1618 | 1135 | 1070 | 1170 | 1705 | 1231 |
| Moving Average, $y$ |      | 1122 | 1128 | 1139 | 1158 | 1181 |      | 1221 | 1248 | 1270 | 1294 |      |      |
| $t$                 |      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |      |

Source: *Consumer Trends*, Office for National Statistics, Quarter 2, 2005

- (a) Calculate the value of the missing moving average. (2 marks)
- (b) Plot the values of the moving average on **Figure 1**. (2 marks)
- (c) The equation of the regression line of  $y$  on  $t$  is  $y = 1086 + 19.96t$ . Add this line to **Figure 1**. (2 marks)
- (d) Estimate the second quarter seasonal effect. (3 marks)
- (e) Forecast the expenditure for quarter 2 of 2005. Indicate the method used and give your answer to an appropriate degree of accuracy. (4 marks)
- (f) The actual expenditure on audio-visual equipment in quarter 2 of 2005 was £1065 million. Comment on this value and on the effectiveness of your method of forecasting. (2 marks)

- 3 Imran wishes to buy a house in Cheadleville. The number of houses,  $X$ , in Cheadleville advertised for sale in a copy of the *Cheshire Weekly Sentinel* may be modelled by the following probability distribution.

|          |      |      |      |      |      |      |
|----------|------|------|------|------|------|------|
| $x$      | 0    | 1    | 2    | 3    | 4    | 5    |
| $P(X=x)$ | 0.32 | 0.25 | 0.19 | 0.12 | 0.09 | 0.03 |

- (a) Find the mean and the standard deviation of  $X$ . (5 marks)
- (b) The number of houses in Cheadleville advertised for sale in a copy of the *Cheshire Weekly Clarion* may be modelled by the random variable  $Y$ .

Given that  $E(Y) = 2.5$

and  $E[(Y - 2.5)^2] = 2.2$ :

- (i) evaluate the standard deviation of  $Y$ ; (2 marks)
- (ii) compare the number of houses in Cheadleville advertised for sale in the *Cheshire Weekly Sentinel* with that in the *Cheshire Weekly Clarion*. (2 marks)
- (c) Imran intends to subscribe to one of the two papers. Advise him which one to choose, justifying your answer. (2 marks)

**Turn over for the next question**

**Turn over ►**

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

**Table 1** shows details of the numbers joining, and **Table 2** shows details of the numbers leaving, the United Kingdom armed forces between 1993 and 2004.

**Table 1**  
**Intake of UK regular forces from civilian life: by service**

|                         | 1993   | 1994   | 1995   | 1996   | 1997   | 1998   | 1999   | 2000   | 2001   | 2002   | 2003   |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                         | /94    | /95    | /96    | /97    | /98    | /99    | /00    | /01    | /02    | /03    | /04    |
| <b>All Services:</b>    |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 10 620 | 11 150 | 15 500 | 19 230 | 19 740 | 22 560 | 22 390 | 20 410 | 20 950 | 23 040 | 20 760 |
| Female                  | 1 330  | 1 850  | 2 180  | 2 940  | 3 220  | 3 440  | 3 160  | 2 610  | 2 700  | 3 240  | 2 710  |
| Total                   | 11 950 | 13 010 | 17 670 | 22 160 | 22 960 | 26 000 | 25 550 | 23 020 | 23 650 | 26 280 | 23 470 |
| <b>Naval Service:</b>   |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 1 280  | 960    | 2 010  | 3 400  | 3 540  | 4 110  | 4 250  | 3 990  | 4 270  | 4 420  | 3 530  |
| Female                  | 260    | 340    | 350    | 560    | 570    | 660    | 700    | 630    | 740    | 800    | 580    |
| Total                   | 1 540  | 1 300  | 2 360  | 3 960  | 4 110  | 4 770  | 4 950  | 4 620  | 5 010  | 5 220  | 4 120  |
| <b>Army:</b>            |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 8 760  | 9 490  | 11 510 | 13 580 | 13 500 | 15 010 | 14 750 | 13 450 | 13 620 | 15 060 | 13 930 |
| Female                  | 810    | 1 190  | 1 380  | 1 940  | 1 970  | 1 980  | 1 750  | 1 320  | 1 240  | 1 550  | 1 260  |
| Total                   | 9 580  | 10 680 | 12 890 | 15 520 | 15 470 | 16 990 | 16 500 | 14 770 | 14 850 | 16 610 | 15 190 |
| <b>Royal Air Force:</b> |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 580    | 700    | 1 980  | 2 250  | 2 700  | 3 450  | 3 380  | 2 980  | 3 070  | 3 550  | 3 290  |
| Female                  | 260    | 320    | 450    | 430    | 680    | 800    | 710    | 660    | 720    | 890    | 870    |
| Total                   | 840    | 1 020  | 2 420  | 2 680  | 3 380  | 4 250  | 4 100  | 3 630  | 3 780  | 4 450  | 4 160  |

Source: *Annual Abstract of Statistics*, Office for National Statistics, 2005

**Table 2**  
**Outflow of UK regular forces: by service**

|                         | 1993   | 1994   | 1995   | 1996   | 1997   | 1998   | 1999   | 2000   | 2001   | 2002   | 2003   |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                         | /94    | /95    | /96    | /97    | /98    | /99    | /00    | /01    | /02    | /03    | /04    |
| <b>All Services:</b>    |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 29 700 | 31 050 | 25 750 | 29 320 | 21 860 | 24 500 | 23 870 | 22 520 | 22 360 | 21 770 | 21 200 |
| Female                  | 2 430  | 2 990  | 3 120  | 3 680  | 2 490  | 2 970  | 2 750  | 2 430  | 2 350  | 2 340  | 2 200  |
| Total                   | 32 130 | 34 040 | 28 860 | 33 000 | 24 350 | 27 470 | 26 620 | 24 950 | 24 710 | 24 100 | 23 400 |
| <b>Naval Service:</b>   |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 4 610  | 5 500  | 4 310  | 6 190  | 4 650  | 4 920  | 5 160  | 4 480  | 5 110  | 4 680  | 4 230  |
| Female                  | 490    | 680    | 630    | 940    | 620    | 610    | 630    | 550    | 690    | 620    | 540    |
| Total                   | 5 110  | 6 180  | 4 940  | 7 130  | 5 270  | 5 530  | 5 800  | 5 040  | 5 800  | 5 300  | 4 770  |
| <b>Army:</b>            |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 19 630 | 20 230 | 13 940 | 13 760 | 13 190 | 15 320 | 14 620 | 13 900 | 13 290 | 13 420 | 13 500 |
| Female                  | 1 290  | 1 650  | 1 510  | 1 600  | 1 280  | 1 730  | 1 580  | 1 330  | 1 090  | 1 140  | 1 090  |
| Total                   | 20 920 | 21 880 | 15 440 | 15 350 | 14 470 | 17 050 | 16 200 | 15 230 | 14 380 | 14 560 | 14 600 |
| <b>Royal Air Force:</b> |        |        |        |        |        |        |        |        |        |        |        |
| Male                    | 5 450  | 5 310  | 7 500  | 9 380  | 4 020  | 4 250  | 4 080  | 4 140  | 3 960  | 3 670  | 3 470  |
| Female                  | 650    | 660    | 980    | 1 140  | 590    | 640    | 540    | 540    | 570    | 580    | 570    |
| Total                   | 6 100  | 5 970  | 8 480  | 10 520 | 4 610  | 4 890  | 4 620  | 4 680  | 4 530  | 4 250  | 4 040  |

Source: *Annual Abstract of Statistics*, Office for National Statistics, 2005

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- (a) How many males left the Army during 1998/99? *(1 mark)*
- (b) How many more females joined than left the Royal Air Force during 2002/03? *(2 marks)*
- (c) During which of the years shown did the number of females joining the Naval Service exceed the number leaving? *(2 marks)*
- (d) Draw a line diagram to compare the numbers of females leaving the Naval Service, the Army and the Royal Air Force during 2003/04. *(3 marks)*
- (e) For 1993/94:
- (i) calculate, as a percentage, the ratio of the total number joining All Services to the total number leaving All Services;
  - (ii) explain why this ratio could not continue in the long term. *(3 marks)*

**5** A company, with 9320 employees, provides refuse collection services for 47 councils in the United Kingdom. The company asks a market research firm to carry out an opinion poll of its employees concerning union membership.

- (a) Describe how the market research firm could obtain a simple random sample of size 120 from the 9320 employees. *(4 marks)*
- (b) The market research firm selects 4 of the 47 councils at random.
- (i) What further step(s) would be necessary to obtain a cluster sample of size 120 from the 9320 employees? *(2 marks)*
  - (ii) Give a reason why the market research firm might prefer a cluster sample to a random sample. *(2 marks)*
- (c) It is proposed that a stratified sample be used.
- (i) Suggest two factors which could be used to stratify the sample. *(2 marks)*
  - (ii) Suggest a reason why a stratified sample might be preferred to a cluster sample. *(1 mark)*

- 6 A stretch of dual carriageway near a city centre has a speed limit of 30 mph. Before the introduction of speed cameras, the speeds of vehicles using this dual carriageway had a mean of 41 mph and a standard deviation of 8.5 mph.

Following the introduction of speed cameras on this dual carriageway, ten drivers were prosecuted for exceeding the speed limit. Their recorded speeds, in mph, were:

53.7 39.9 46.0 62.8 44.9 55.3 49.6 48.2 53.0 66.9

- (a) Liam, a representative of a motoring organisation, stated that he had examined these data and found significant evidence that the mean speed of vehicles had increased since the introduction of the speed cameras. He therefore claimed that the road would be much safer if the cameras were removed.
- (i) Verify that, if the ten recorded speeds are regarded as a random sample from a normal distribution with standard deviation 8.5, there is evidence, significant at the 1% level, that the mean of this distribution exceeds 41. *(8 marks)*
- (ii) Explain why Liam's claim is not valid. *(2 marks)*
- (b) To investigate whether the mean speed of vehicles has increased since the introduction of speed cameras, the speeds of a random sample of 120 vehicles using the dual carriageway are recorded and are found to have a mean of 31.6 and a standard deviation of 6.9.
- (i) Use this second sample, and the 5% significance level, to examine whether there is evidence that the mean speed of vehicles now exceeds 30 mph. *(5 marks)*
- (ii) Comment on your result in part (b)(i). Include in your answer a comment on whether most cars are now observing the speed limit and a comment on whether the speed cameras have reduced the average speed on this stretch of dual carriageway. **No further calculations are required.** *(3 marks)*

**END OF QUESTIONS**

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P94477/Jun07/SS02



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

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 June 2007  
 Advanced Subsidiary Examination



**STATISTICS**  
**Unit Statistics 2**

**SS02**

# Insert

Insert for use in **Question 2**.

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 2)

## Expenditure of Households in the UK on Audio-Visual Equipment

