General Certificate of Education
June 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

STATISTICS **SS02**
Unit Statistics 2

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
$\mathbf{P}(X=x)$	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 $\mathrm{E}(Y) = 2.5$

and $\mathrm{E}[(Y-2.5)^2] = 2.2$:

(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

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 /94	1994 /95	1995 /96	1996 /97	1997 /98	1998 /99	1999 /00	2000 /01	2001 /02	2002 /03	2003 /04
All Services:											
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
Naval Service:											
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
Army:											
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
Royal Air Force:											
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 /94	1994 /95	1995 /96	1996 /97	1997 /98	1998 /99	1999 /00	2000 /01	2001 /02	2002 /03	2003 /04
All Services:											
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
Naval Service:											
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
Army:											
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
Royal Air Force:											
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

(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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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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Unit Statistics 2

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

Figure 1 (for use in Question 2)

Expenditure of Households in the UK on Audio-Visual Equipment