General Certificate of Education
June 2006
Advanced Subsidiary Examination

STATISTICS　　　　　　　　　　　　　　　　**SS02**
Unit Statistics 2

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Wednesday 24 May 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
- an insert for use in Question 1 (enclosed)

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

The table shows the expenditure, in £ million, of households in the United Kingdom on clothes and footwear. It also shows values of an appropriate moving average.

Year	2002				2003				2004		
Quarter	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**
Expenditure	8559	9497	10 097	13 163	9113	10 198	10 748	13 877	9826	11 116	11 481
Moving average			10 329	10 468	10 643	10 805		11 162	11 392	11 575	

Source: *Consumer Trends*, Office for National Statistics, 2004

(a) Calculate the value of the missing moving average. *(2 marks)*

(b) Plot the moving averages on **Figure 1** and draw a trend line by eye. *(3 marks)*

(c) Estimate the fourth quarter seasonal effect. *(3 marks)*

(d) Use the trend line and your estimated seasonal effect to forecast the expenditure in quarter 4 of 2004. Give your answer to an appropriate degree of accuracy. *(3 marks)*

(e) Given that the actual expenditure on clothes and footwear in quarter 4 of 2004 was £14 813 million, comment on the effectiveness of your method of forecasting. *(2 marks)*

2 During the summer, the number of bicycles sold by Cycologic, a small cycle shop, may be modelled by a Poisson distribution with mean 12 per week.

(a) Find the probability that the number of bicycles sold during a particular week in summer is:

  (i) 10 or fewer;

  (ii) exactly 10. *(3 marks)*

(b) Cycologic also sells tricycles. The number of tricycles sold is independent of the number of bicycles sold and, during the summer, may be modelled by a Poisson distribution with mean 2 per week. Find the probability that during a particular week in summer Cycologic sells:

  (i) more than 3 tricycles; *(2 marks)*

  (ii) a **total** of 18 or more bicycles and tricycles. *(3 marks)*

(c) An analysis of sales throughout the year suggests that the probability distribution tabulated below would form an adequate model for X, the number of tricycles sold during a randomly selected week.

x	0	1	2	3	4	5	6
$P(X = x)$	0.39	0.25	0.08	0.09	0.06	0.05	0.08

  (i) Find the mean of X.

  (ii) Show that $E(X^2) = 6.47$.

 (iii) Find the variance of X.

  (iv) Find the standard deviation of X. *(6 marks)*

(d) (i) Give **one** reason, based on your calculations in part (c), why the Poisson distribution might not provide a suitable model for the number of tricycles sold throughout the year. *(1 mark)*

  (ii) Give **one** reason, **not** based on your calculations in part (c), why the Poisson distribution might not provide a suitable model for the number of tricycles sold throughout the year. *(1 mark)*

3 The time series shown in **Figure 2** exhibits random variation about an upward linear trend.

Figure 2
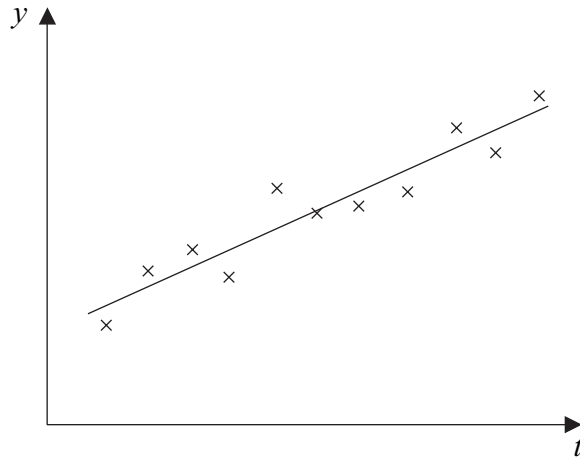
Describe the type of variation and trend in each of the following time series.

(a)

(b)

(c)

(d)

(8 marks)
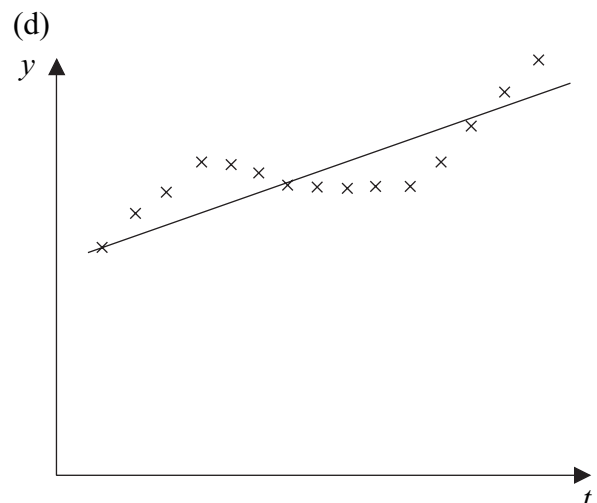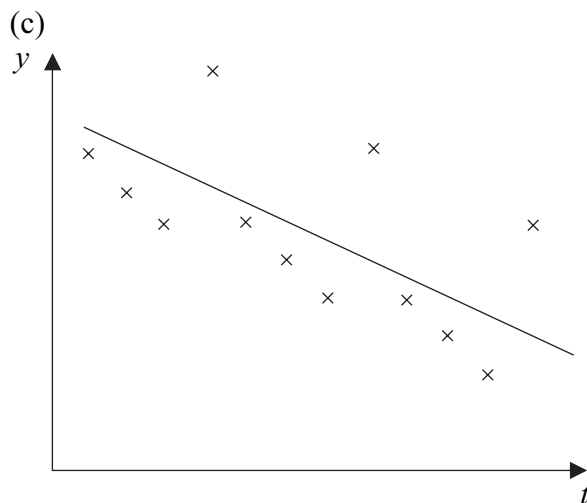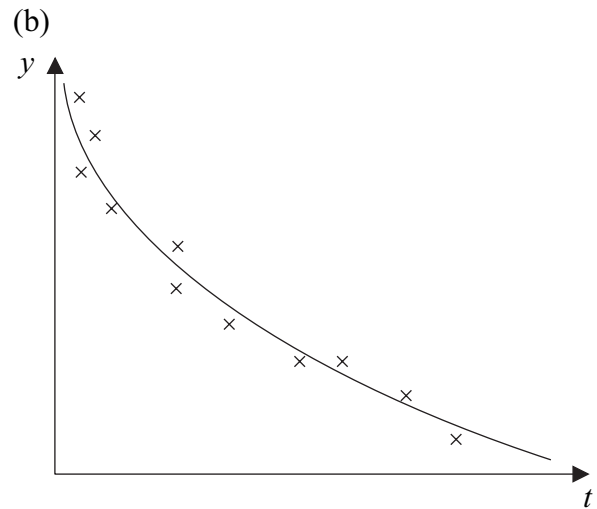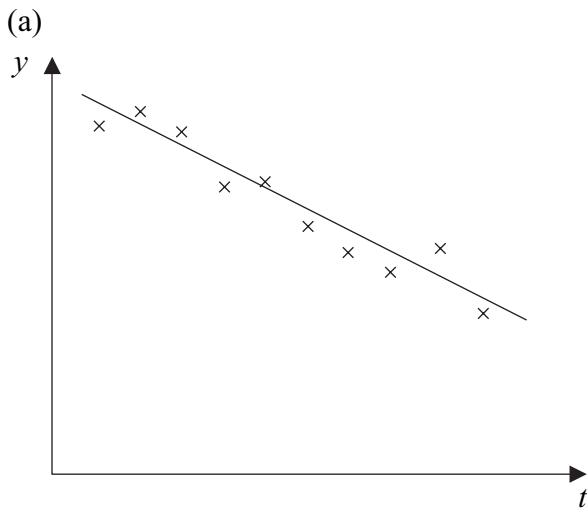
4 New pupils entering a large secondary school take a general knowledge test during their first week. The mean score achieved on this test is 46.7 with a standard deviation of 14.3.

At the beginning of a second term, pupils were asked if they would like to be considered for a team to represent the school in a general knowledge quiz. The test scores of a random sample of the pupils who did wish to be considered for the quiz team were

$$38 \qquad 63 \qquad 79 \qquad 91 \qquad 42 \qquad 53 \qquad 84$$

(a) Test, using the 5% significance level, whether the mean test score of those pupils who wished to be considered for the quiz team exceeded 46.7. Assume that the sample of scores is from a normal distribution with standard deviation 14.3. Interpret your conclusion in context. *(8 marks)*

(b) A further random sample of those pupils who wished to be considered for the quiz team is to be taken and the test in part (a) repeated.

State, with an explanation, the probability of making a Type I error in this test if the mean test score for all pupils who wished to be considered for the quiz team is:

 (i)   46.7;

 (ii) 56.7. *(4 marks)*

Turn over for the next question

5 The table relates to water usage in England and Wales during the period 1993 to 2001.
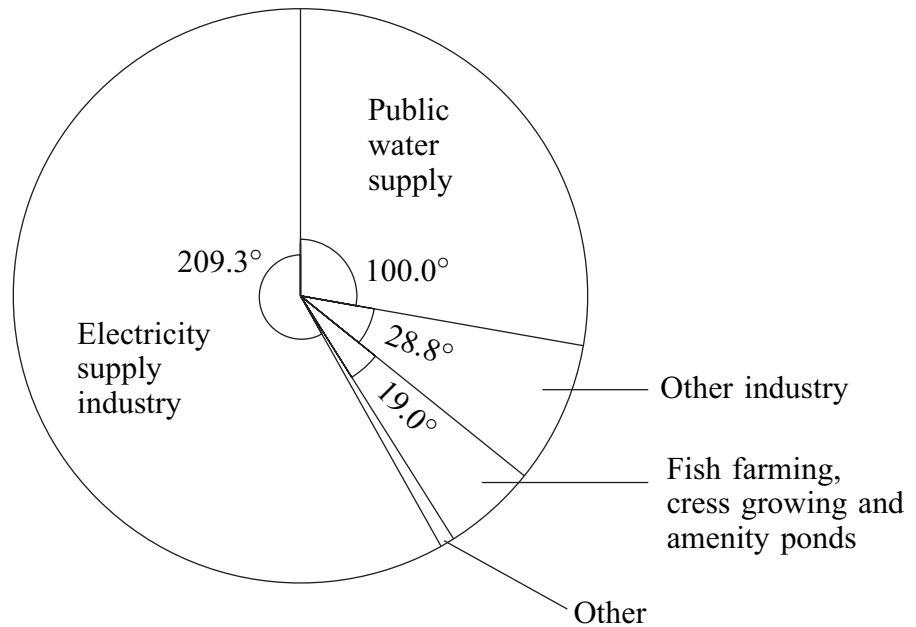
Estimated water usage by purpose

								Megalitres per day	
	1993	1994	1995	1996	1997	1998	1999	2000	2001
Public water supply	16 651	16 735	17 346	17 435	16 820	16 765		16 990	16 231
Electricity supply industry	26 581	27 732	29 510	31 294	33 307	34 587	26 515	31 546	32 263
Other industry	6 017	4 292	3 808	4 960	4 352	4 964	5 428	5 433	4 772
Fish farming, cress growing and amenity ponds	3 818	3 985	4 268	4 338	4 211	5 495	4 867	4 709	4 657
Other	675	896	1 038	1 476	1 267	1 080	1 083	1 104	566
Total	53 742	53 640	55 970	59 503	59 957	62 891	54 148	59 782	58 489

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

(a) How much water per day was used in the electricity supply industry in 1999? *(2 marks)*

(b) The amount of water used for public water supply in 1999 is missing from the table. Evaluate this missing number. *(2 marks)*

(c) The table shows the estimated water usage divided into five categories: Public water supply; Electricity supply industry; Other industry; Fish farming, cress growing and amenity ponds; Other. Comparing 2001 with 1993, state which of these categories has:

　(i) the largest increase in water usage; *(1 mark)*

　(ii) the largest percentage increase in water usage. Justify your answer. *(3 marks)*

(d) The pie chart illustrates the estimated water usage for 2002. The total estimated water usage for 2002 was 60 981 megalitres per day.

Copy and complete the following table.

Estimated water usage by purpose in 2002

Megalitres per day

Public water supply	
Electricity supply industry	
Other industry	
Fish farming, cress growing and amenity ponds	
Other	
Total	60 981

(5 marks)

Turn over for the next question

6 A fan club has 2076 members who are divided geographically into 8 branches. The club's committee wishes to seek members' views on where to hold the next annual meeting. A sample of 100 members is to be obtained and their views sought.

The following suggestions are made as to how to choose the sample.

Suggestion A Members are selected from all 8 branches. The number of members from each branch is proportional to the size of the branch. The branch secretaries are asked to choose the appropriate number of members from their branches in any convenient way.

Suggestion B Two of the branches are selected at random. Fifty members from each of these branches are selected at random.

Suggestion C Members are selected by a random process from each branch. The number of members from each branch is proportional to the size of the branch.

Suggestion D The names of all members are to be listed and numbered from 0000 to 2075. One hundred different four-digit random numbers between 0000 and 2075 are taken from random number tables and the corresponding members are included in the sample.

(a) For **each** of the four suggestions:

   (i) name the method of sampling; *(4 marks)*

   (ii) either state that each member is equally likely to be included in the sample, or explain why this is not the case. *(6 marks)*

(b) (i) State, giving a reason, which of the four methods is preferable from a statistical point of view. *(2 marks)*

   (ii) Give a reason why Suggestion A might be preferred to Suggestion C. *(1 mark)*

END OF QUESTIONS

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Insert

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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

Figure 1 (for use in Question 1)