

General Certificate of Education
June 2005
Advanced Subsidiary Examination



STATISTICS
Unit Statistics 2

SS02

Thursday 9 June 2005 Morning Session

In addition to this paper you will require:

- an 8-page answer book;
- the **blue** AQA booklet of formulae and statistical tables;
- an insert for use in Questions 1 and 5 (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.
- All necessary working should be shown; 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.
- Mark allocations are shown in brackets.

Advice

- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

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

The following table shows the number of new bicycles sold, quarterly, by Sid's Bicycle Shop from the first quarter of 2002 to the third quarter of 2004.

Year	2002				2003				2004		
Quarter	1	2	3	4	1	2	3	4	1	2	3
Sales	134	146	201	255	147	162	221	273	162	183	228

- (a) Plot a graph of the data on **Figure 1**. *(2 marks)*
- (b) (i) Calculate suitable moving averages and add them to your graph. *(5 marks)*
- (ii) Draw a trend line by eye. *(1 mark)*
- (c) Jenny was appointed to manage the shop at the end of the third quarter of 2004. Sid agreed to pay her a bonus if more bicycles were sold during the fourth quarter of 2004 than would be predicted from current trends.

Jenny calculated that the mean number of bicycles sold for the 11 quarters shown was 192. She claimed that she should be paid a bonus if 193 or more bicycles were sold during the fourth quarter of 2004.

- (i) Give a reason, based on the trend, why selling 193 bicycles is not sufficient to justify a bonus. *(1 mark)*
- (ii) Give a reason, based on the seasonal effects, why selling 193 bicycles is not sufficient to justify a bonus. *(1 mark)*
- (iii) Calculate how many bicycles needed to be sold during the fourth quarter of 2004, in order to justify a bonus. Indicate your method of calculation. *(6 marks)*

2 Albany guest house is situated in a seaside town. It has 7 bedrooms available to guests requesting overnight accommodation. The number of these bedrooms requested on a summer's night may be modelled by a Poisson distribution with mean 5.5.

(a) Find the probability that the number of bedrooms requested by guests on a particular summer's night is:

(i) 7 or fewer;

(ii) exactly 7. (3 marks)

(b) Barlow guest house is next door to Albany guest house. It has 5 bedrooms available to guests. The number of these bedrooms requested on a summer's night may be modelled by a Poisson distribution with mean 4.5.

(i) Find the probability that on a particular summer's night the number of bedrooms requested at Barlow guest house exceeds the number of bedrooms available. (2 marks)

(ii) Albany and Barlow guest houses have the same owner who decides to employ a receptionist to deal with all requests for bedrooms.

Assuming the requests for bedrooms at the guest houses are independent, find the probability that on a summer's night the **total** number of bedrooms requested exceeds the total number of bedrooms available. (4 marks)

3 A fire station has four fire-engines available. The number of fire-engines, which leave the station in response to emergency calls on a typical night shift, may be modelled by the random variable, X , with the following probability distribution.

x	$P(X = x)$
0	0.45
1	0.24
2	0.14
3	0.12
4	0.05

(a) Find the mean and standard deviation of X . (5 marks)

(b) Find the probability that X :

(i) is less than the mean;

(ii) is less than the median. (4 marks)

(c) It is proposed that the number of fire-engines at this fire station be reduced to three. Comment on this proposal. (2 marks)

4 A sixth form college needs to upgrade the software on all its computers. The Head of Computer Services estimates that a technician would require a mean time of 145 minutes per computer to carry out the upgrade. In a pilot scheme technicians upgraded the software on 95 computers. The mean time to carry out these upgrades was 143.5 minutes and the standard deviation was 13.0 minutes.

(a) Using the 5% significance level, test the hypothesis that the mean time to carry out the upgrades on all the college's computers is 145 minutes. Assume that the times to carry out the upgrades during the pilot scheme may be regarded as a random sample of the times for all computers. (7 marks)

(b) A firm of computer consultants claimed that they could carry out the upgrades more quickly and efficiently than the college's own technicians. They were asked to demonstrate on nine of the college's computers. The times, in minutes, recorded for upgrading these nine computers were:

135 104 118 140 141 150 112 165 157

Using the 5% significance level, examine whether there is sufficient evidence to support the claim that the mean time taken by the computer consultants to upgrade the college's computers is less than 145 minutes. Assume the data may be regarded as a random sample from a normal distribution with standard deviation 13.0 minutes. Interpret your conclusion in context. (7 marks)

5 [Figures 2 and 3, printed on the insert, are provided for use in this question.]

The table in **Figure 2** is extracted from *The Annual Abstract of Statistics 2003*. Use the data in **Figure 2** to answer the following questions.

(a) How many births occurred in 1991 in the United Kingdom:

(i) outside marriage to mothers aged over 30;

(ii) in total? (3 marks)

(b) Over the period 1991 to 2001 the number of births, inside marriage, to mothers under 20 has halved while the number of births, outside marriage, to mothers under 20 has also declined but at a much slower rate.

Make similar comparisons in the trend, over the same period, for mothers aged:

(i) 20–24;

(ii) over 30. (4 marks)

(c) For births outside marriage in 2001:

(i) draw, on **Figure 3**, the part of the cumulative frequency curve which lies within the scales shown; (3 marks)

(ii) estimate the median age of mothers. (2 marks)

6 An insurance company received 510 claims during a particular week. All claims are subjected to routine checks. The company has eight investigators who, between them, can carry out a detailed investigation of about 50 of these claims.

- (a) Describe how random numbers could be used to select a simple random sample of 50 claims for detailed investigation. *(4 marks)*

The claims, all of which are for different amounts, are arranged in order of magnitude and numbered from 000 to 509. The number 000 is assigned to the smallest claim and the number 509 to the largest. The following three suggestions are made for selecting the claims for detailed investigation.

Suggestion A Select a single digit at random and choose this claim and every tenth claim thereafter. For example, if 7 is selected, claims numbered 007, 017, 027 and 507 would constitute the sample.

Suggestion B The sample is made up from a random sample of 20 claims from those numbered 000 to 199, a random sample of 20 claims from those numbered 200 to 399 and a random sample of 11 claims from those numbered 400 to 509.

Suggestion C Claims numbered 460 to 509 are selected.

- (b) Name the method of sampling described in:

(i) **Suggestion A**;

(ii) **Suggestion B**. *(2 marks)*

- (c) State whether or not each claim is equally likely to be included in the sample if the method used is:

(i) **Suggestion A**;

(ii) **Suggestion B**. *(2 marks)*

- (d) Explain why **Suggestion A** would not yield a random sample. *(2 marks)*

- (e) Give **one** reason why:

(i) **Suggestion C** might be preferred to **Suggestion A**;

(ii) **Suggestion A** might be preferred to **Suggestion B**;

(iii) **Suggestion B** might be preferred to a simple random sample. *(3 marks)*

END OF QUESTIONS

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STATISTICS
Unit Statistics 2

SS02

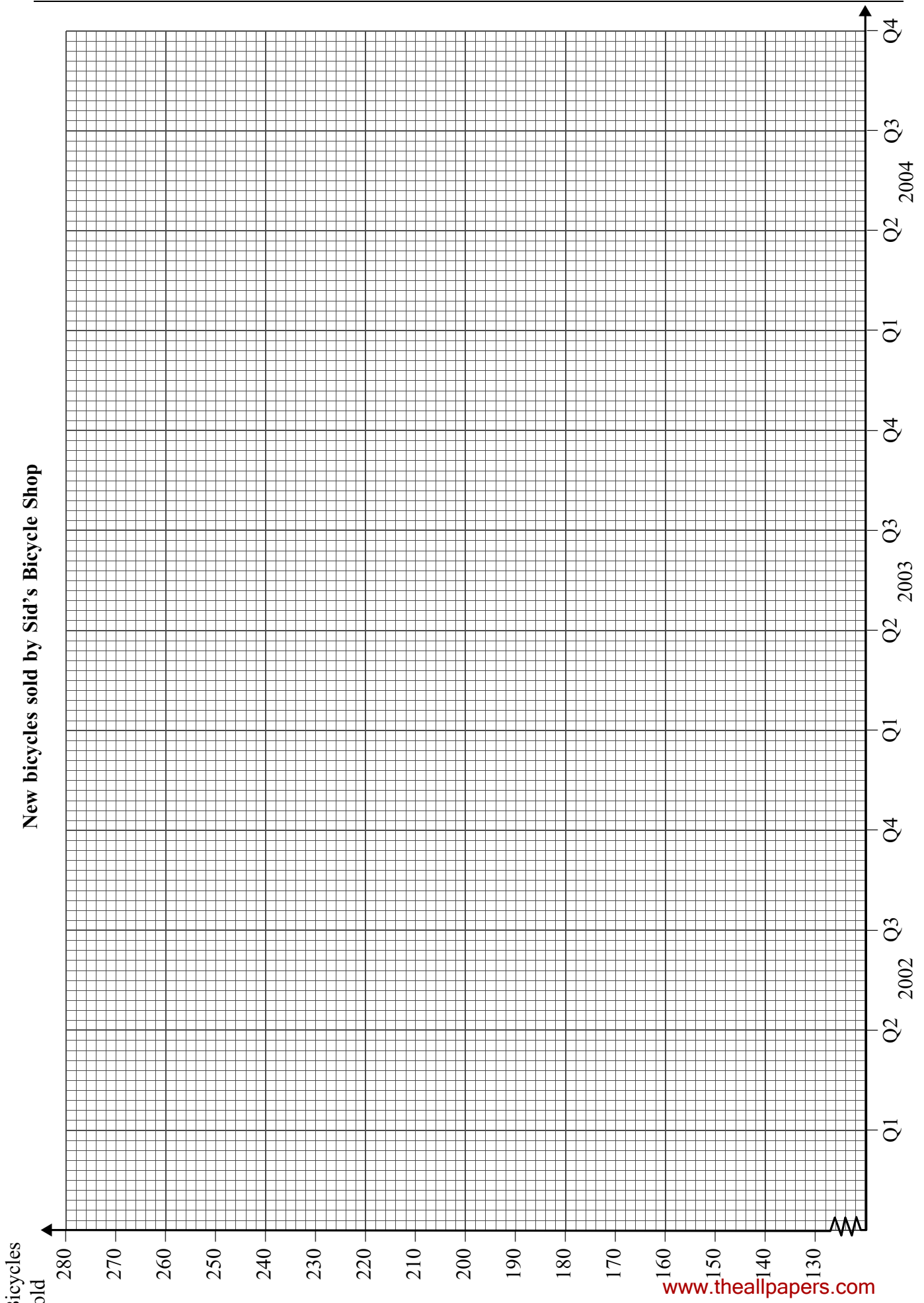
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Insert for use in Questions 1 and 5.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

TURN OVER FOR FIGURE 1



New bicycles sold by Sid's Bicycle Shop

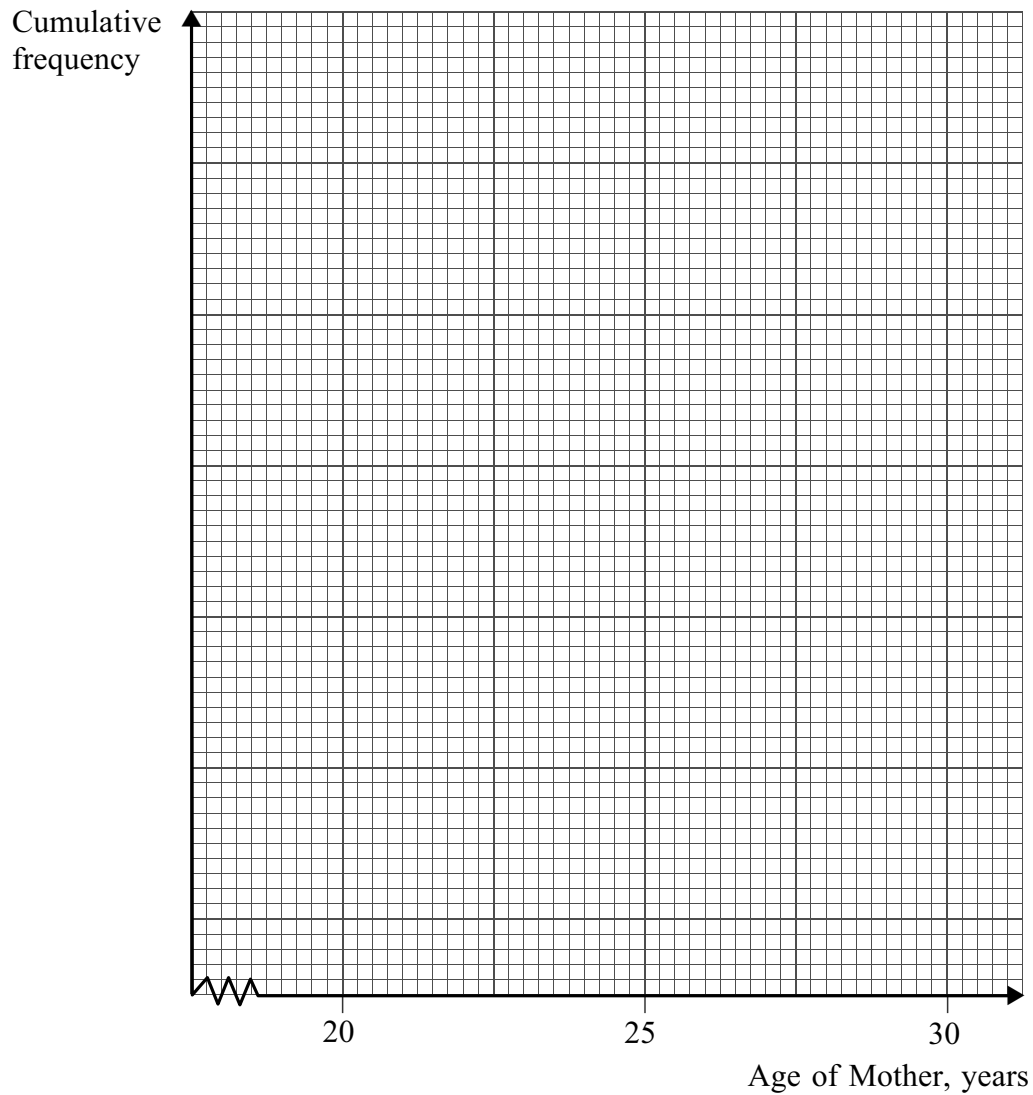
Figure 1 (for Question 1)

Birth occurrence inside and outside marriage by age of mother

	Thousands											
	Inside marriage					Outside marriage					Mean age (Years)	
	All ages	Under 20	20-24	25-29	Over 30	All ages	Under 20	20-24	25-29	Over 30		
United Kingdom												
1961	890	55	273	280	282	27.7	54	13	17	10	13	25.5
1971	828	70	301	271	185	26.4	74	24	25	13	12	23.8
1981	640	36	193	231	180	27.3	91	30	33	16	13	23.4
1986	596	21	159	231	185	27.9	158	45	60	31	22	23.7
1987	598	18	153	235	192	28.1	178	48	68	37	26	23.9
1988	589	16	144	234	195	28.2	198	51	76	42	29	24.1
1989	570	14	130	228	198	28.4	207	49	79	46	32	24.3
1990	576	13	121	233	209	28.6	223	51	83	53	37	24.5
1991	556	10	109	224	213	28.9	236	50	87	58	41	24.8
1992	540	9	98	216	218	29.1	241	46	86	62	46	25.1
1993	520	8	87	204	221	29.3	242	44	84	64	50	25.4
1994	510	7	78	194	231	29.6	240	41	80	65	55	25.7
1995	486	6	69	180	232	29.8	246	42	79	66	60	25.9
1996	473	6	61	170	237	30.1	260	45	80	69	66	26.0
1997	460	6	55	159	240	30.3	267	47	79	71	71	26.1
1998	447	6	51	149	243	30.5	270	49	77	70	74	26.2
1999	428	6	47	136	239	30.7	272	49	77	68	77	26.3
2000	411	5	44	126	237	30.9	268	47	77	66	78	26.4
2001	401	5	44	116	236	30.9	268	45	77	64	82	26.7

Source: Office for National Statistics

Figure 2 (for Question 5)

Births Outside Marriage in UK, 2001

Source: Office for National Statistics

Figure 3 (for Question 5)