



General Certificate of Education
January 2009
Advanced Subsidiary Examination

STATISTICS
Unit Statistics 2

SS02

Thursday 15 January 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
- an insert for use in Questions 4 and 6 (enclosed).

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.
- 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 Johann supplies free-range eggs to a health food shop. The eggs are supplied in boxes of six. Simone, the shop owner, checks a sample of these boxes for cracked eggs. She finds that the number, X , of cracked eggs in a box may be modelled by the following probability distribution.

x	$P(X=x)$
0	0.925
1	0.061
2	0.010
3	0.000
4	0.000
5	0.000
6	0.004

- (a) (i) Find the mean number of cracked eggs in a box.
- (ii) Verify that the standard deviation of the number of cracked eggs in a box is 0.484, correct to three significant figures. (5 marks)
- (b) Christos also supplies free-range eggs in boxes of six. The mean number of cracked eggs in his boxes is 0.25 with a standard deviation of 0.21.

Compare the distributions of the numbers of cracked eggs in boxes supplied by Johann and by Christos. (2 marks)

- 2 Peter owns a department store and employs his son Sebastian. Peter introduces a new type of till. He believes that this will not affect the average time to complete a transaction, but that it will provide better stock control information. He asks Sebastian to check that the mean time to complete a transaction with the new type of till remains equal to 24 seconds.

Sebastian records the time taken to complete 130 randomly selected transactions. He calculates that the mean time to complete a transaction is 23.3 seconds and that the standard deviation is 5.2 seconds. He carries out a hypothesis test at the 10% significance level.

- (a) Examine, at the 10% significance level, whether the data are consistent with the mean time to complete a transaction being 24 seconds. (8 marks)
- (b) Peter asks Sebastian to repeat the test using the 3% significance level. Sebastian states that this is not possible as the only possible significance levels are 10%, 5%, 1% and 0.1%.

Comment on Sebastian's statement. (2 marks)

- 3 In each part of this question, use either a binomial distribution or a Poisson distribution if appropriate. If neither distribution is appropriate, **either** find the required probability without using a binomial distribution or a Poisson distribution **or** give an explanation as to why neither distribution can be used.

A mill produces rolls of cloth.

- (a) Flaws in the cloth are distributed independently, at random and at an average rate of 0.3 flaws per metre of cloth.

Find the probability that:

- (i) a metre of cloth will contain exactly one flaw; (3 marks)
- (ii) **ten** metres of cloth will contain 5 or more flaws. (3 marks)
- (b) Each roll of cloth is inspected and those which contain too many flaws are classified as 'seconds' and sold at a lower price. The probability of a roll being classified as a 'second' is 0.08.
- (i) Find the probability that, when 20 rolls are inspected, 2 or fewer will be classified as 'seconds'. (3 marks)
- (ii) Ten rolls of cloth, of which 3 are 'seconds', are left in a store room. Six are selected at random. Find the probability that none of the six rolls selected is a 'second'. (3 marks)

Turn over for the next question

Turn over ►

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

A charity shop is staffed by a manager and unpaid volunteers. It opens on Thursday, Friday and Saturday each week. The table shows the takings, in £s, over a three-week period.

Week	1			2			3		
Day	Thur	Fri	Sat	Thur	Fri	Sat	Thur	Fri	Sat
Takings, £	230	312	456	242	328	467	254	349	468

- (a) (i) Calculate values of a suitable moving average. (2 marks)
- (ii) Plot the given data and the values of your moving average on **Figure 1**. (4 marks)
- (iii) Draw a trend line and hence estimate the value of the moving average for the Saturday of **week 4**. (2 marks)
- (iv) Using your result in part (a)(iii) and an estimate of the 'Saturday effect', forecast the takings on the Saturday of week 4. Show the method that you have used. (4 marks)
- (b) At the end of week 3, the manager left to take up another job. The takings on the Saturday of week 4 were £421. Comment on this value. (2 marks)
- (c) At the beginning of week 5, a new manager started. The **total** takings for week 5 were £1020, for week 6 were £1206 and for week 7 were £1307.

Plot **three** further values of your moving average on **Figure 1** and comment. (5 marks)

- 5 A large number of spectators attend a football match at a ground in England. One of the stands contains 1390 seats, numbered from 1 to 1390.
- (a) (i) Describe how random numbers could be used to select a random sample of 80 of these seats. *(4 marks)*
- (ii) The ground authority wishes to carry out a survey into spectators' opinions of the catering facilities at the ground. It proposes to ask the spectators occupying the 80 seats selected in part (a)(i) to complete a questionnaire. Suggest **two** practical difficulties which might be encountered in carrying out this proposal. *(3 marks)*
- (b) A market research company is employed to investigate the amount of interest taken in sport by the population of the United Kingdom. James, a new employee of the company, suggests that interviewers should be stationed outside each exit from the ground with instructions to interview every 100th person leaving the ground after the match.
- (i) State the name given to this type of sampling. *(1 mark)*
- (ii) Give **one** reason why the results of the investigation suggested by James might be biased. *(1 mark)*
- (iii) Suggest **two** practical difficulties, other than those which you mentioned in part (a)(ii), which might be encountered in carrying out these interviews. *(2 marks)*
- (c) Describe the difference between the type of sampling suggested in part (b) and a quota sample. *(2 marks)*

Turn over for the next question

Turn over ►

6 [Figure 2, printed on the insert, is provided for use in this question.]

The following table shows the numbers of females serving prison sentences in England and Wales at 30 June 1999 and at 30 June 2004, summarised by age and offence.

Female prison population serving sentences: by age and offence

England and Wales

Age									Numbers
	15–17	18–20	21–24	25–29	30–39	40–49	50–59	60 and over	Total
At 30 June 1999									
Offences									
Total	67	224	427	491	798	301	108	20	2436
Violence against the person	17	65	50	77	125	63	25	7	429
Sexual offences	0	2	1	0	5	7	1	1	17
Burglary	7	27	37	38	41	6	2	0	158
Robbery	15	24	36	33	41	6	3	0	158
Theft, handling, fraud and forgery	11	33	113	99	159	58	24	5	502
Drugs offences	2	50	131	184	340	129	35	4	875
Other offences	13	9	45	43	68	26	16	0	220
Offence not known	2	14	14	17	19	6	2	3	77
At 30 June 2004									
Offences									
Total	58	300	632	727	1056	507	152	20	3453
Violence against the person	15	70	98	89	192	95	36		603
Sexual offences	0	0	3	3	8	7	4	2	27
Burglary	6	19	59	83	56	22	3	0	247
Robbery	8	65	93	90	114	20	2	0	392
Theft, handling, fraud and forgery	11	28	100	140	171	67	25	1	543
Drugs offences	6	78	197	245	392	246	65	6	1235
Other offences	11	37	75	72	108	44	13	2	361
Offence not known	2	3	8	7	15	7	4	0	46

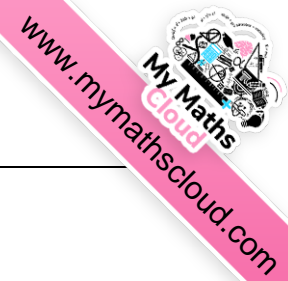
Source: *Annual Abstract of Statistics*, Office for National Statistics, 2006

- (a) How many females aged 60 and over were in prison in England and Wales for the offence of violence against the person at 30 June 1999? (1 mark)
- (b) Find the number of females aged 60 and over who were in prison in England and Wales for the offence of violence against the person at 30 June 2004. (2 marks)
- (c) Compare the female prison population in England and Wales at 30 June 1999 with that at 30 June 2004. Include in your answer a comment on the fact that, in 1999, 49 000 females were found guilty of offences in England and Wales and the equivalent figure for 2004 was 48 400. (3 marks)

- (d) For the ages of females in prison in England and Wales for **robbery** at 30 June **2004**:
- (i) construct a cumulative frequency table;
 - (ii) plot a cumulative frequency curve on **Figure 2**;
 - (iii) estimate the median. *(6 marks)*
- (e) The median age of females in prison in England and Wales for robbery at 30 June 1999 was 25.6 years. Compare the number and the average age of females in prison in England and Wales for robbery at 30 June 1999 with that at 30 June 2004. *(2 marks)*

END OF QUESTIONS

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Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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Insert

Insert for use in **Questions 4 and 6**.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

Turn over for Figure 1

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Figure 1 (for use in Question 4)

Charity Shop Takings

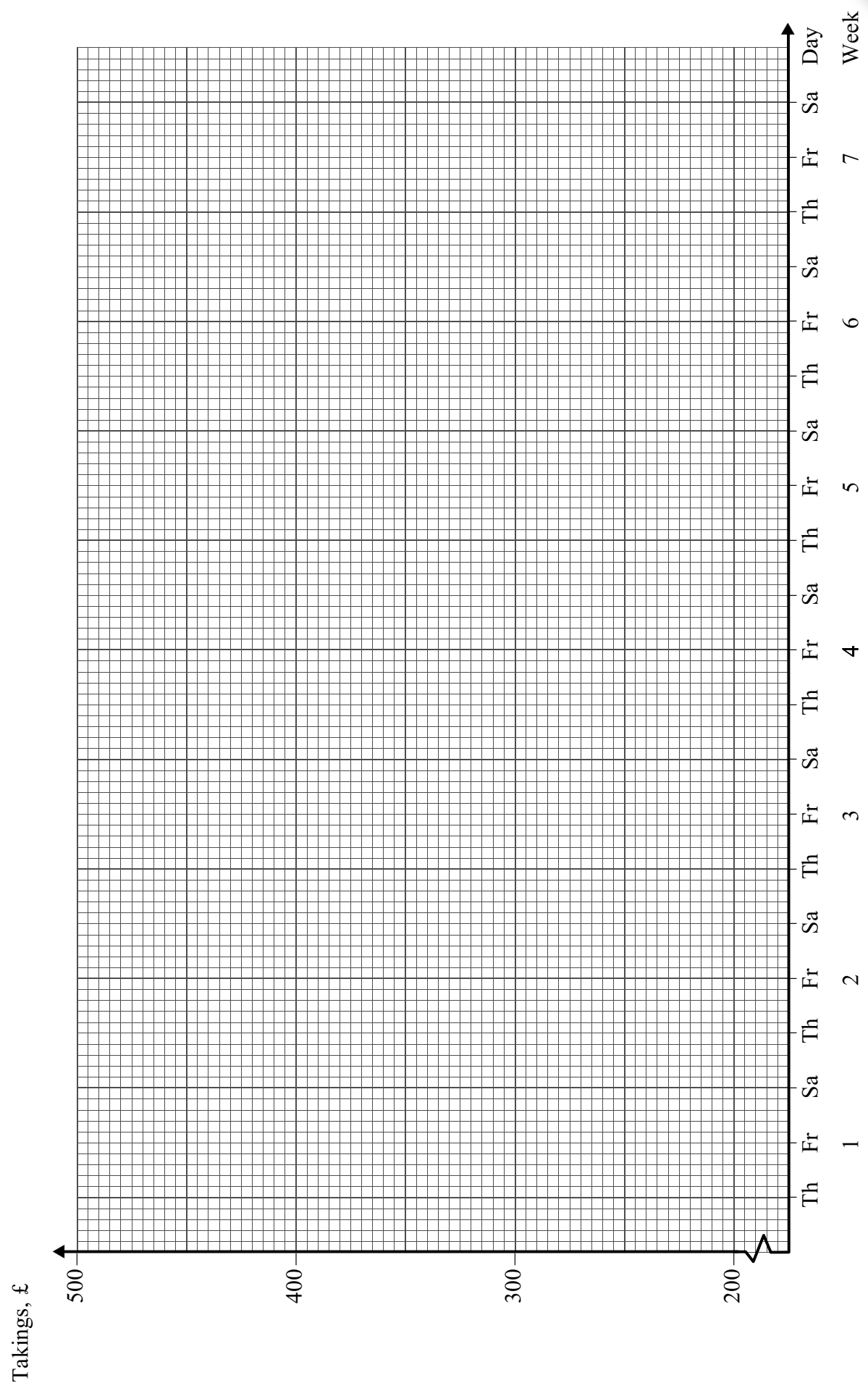
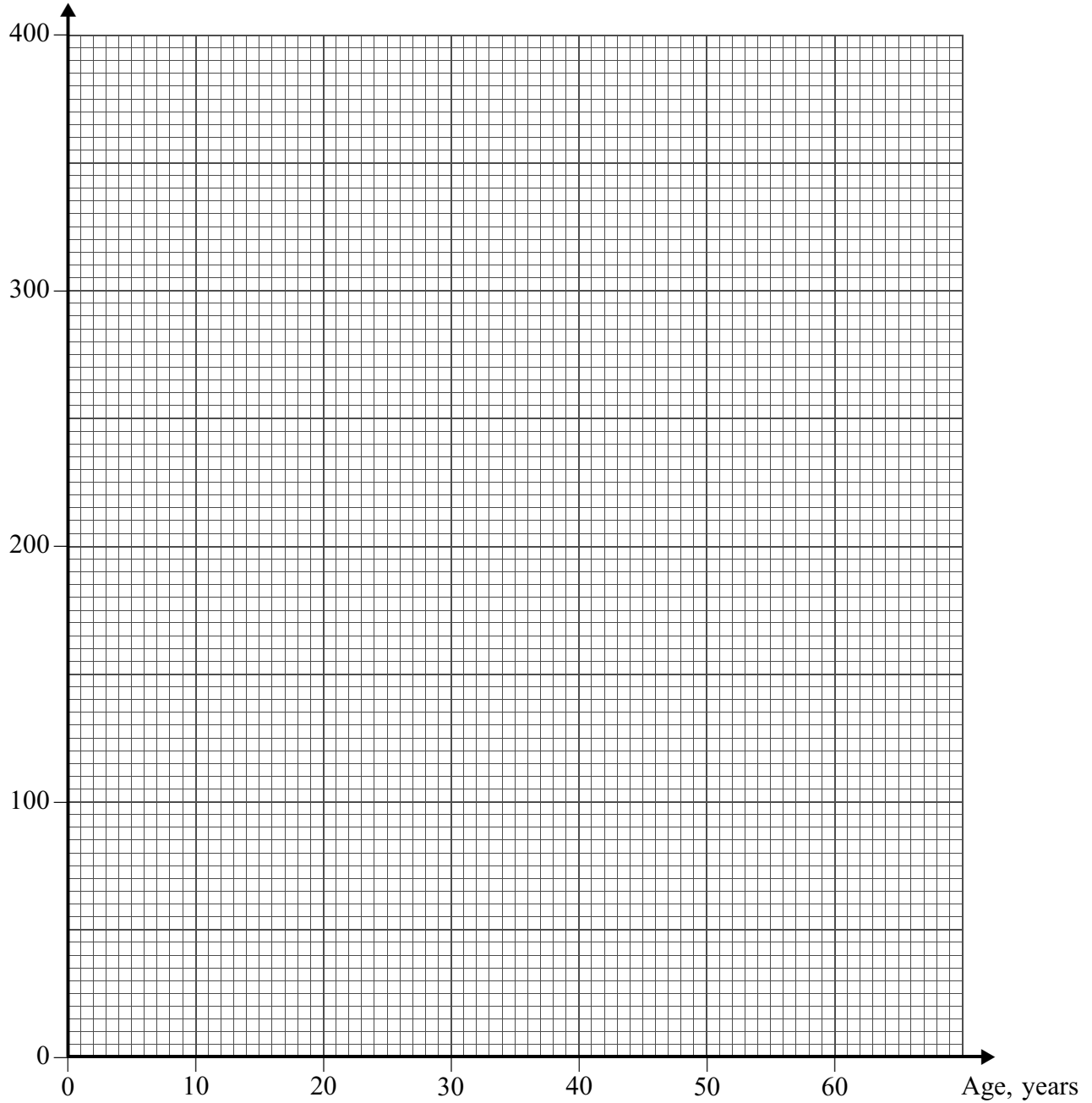


Figure 2 (for use in Question 6)

Females in Prison for Robbery in England and Wales, 30 June 2004

Cumulative
frequency



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