Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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4	
5	
6	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
January 2011

Statistics SS02

Unit Statistics 2

Wednesday 19 January 2011 1.30 pm to 3.00 pm

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer the questions in the spaces provided. Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

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Answer **all** questions in the spaces provided.

1 A convenience store stocks three brands of teabags which are sold in boxes of 40.

The price, X pence, of a box and the probability that a customer buying teabags will choose that brand is shown in **Table 1**.

Table 1

	x	$P(X = x)$
Own brand	99	0.50
Fairtrade	125	0.30
Supertea	144	0.20

(a) Find the mean and the standard deviation of X. *(4 marks)*

(b) Alec, the store owner, is considering stocking a cheaper brand of teabags, *Sweepings*, which would sell for 79p per box of 40. He estimates that, if he did this, there would be a 20 per cent increase in the number of boxes of teabags sold.

The new distribution of prices, Y pence, would be as shown in **Table 2**.

Table 2

	y	$P(Y = y)$
Sweepings	79	0.250
Own brand	99	0.375
Fairtrade	125	0.225
Supertea	144	0.150

(i) Show that the mean value of Y is 107, correct to the nearest penny. *(2 marks)*

(ii) Assume that Alec's estimates are correct.

Determine whether, if Alec stocks *Sweepings*, the increased sales would, despite the reduced average price, lead to an increase in the total amount of money taken on teabags. *(3 marks)*

(c) Apart from a possible increase in the total amount of money taken on teabags, suggest one advantage of stocking *Sweepings*. *(1 mark)*

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2 Mohammed is offered a week's trial with a view to being permanently employed to service bicycles in Robyn's bicycle shop.

The number of bicycles brought in to be serviced may be modelled by a Poisson distribution with mean 2.6 per day.

(a) Find the probability that, on Mohammed's first day, the number of bicycles brought in to be serviced is:

(i) 2 or fewer; *(1 mark)*

(ii) more than 3; *(2 marks)*

(iii) exactly 4. *(2 marks)*

(b) Before starting work, Mohammed told his mother that he hoped that, during his first week (5 days), the number of bicycles brought in to be serviced would be:

- at least 10, otherwise Robyn might decide that there was not enough work to justify permanently employing him;
- not more than 15, so that he would not have to work too hard.

Find the probability that Mohammed's hopes will be met. *(4 marks)*

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3 The table shows the quarterly household expenditure, £ million, on shoes and other footwear in the United Kingdom during 2006, 2007 and 2008.

Year	**2006**				**2007**				**2008**			
Quarter	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Expenditure	1289	1544	1542	1922	1306	1603	1618	1879	1374	1637	1716	1998

Source: *Consumer Trends*, Office for National Statistics, Quarter 1, 2009

(a) Calculate the first two values of a suitable moving average. Add these to **Figure 1** opposite, which shows further values of a suitable moving average. *(3 marks)*

(b) Draw a trend line. *(1 mark)*

(c) Plot the data given in the table on **Figure 1**. *(2 marks)*

(d) Estimate the seasonal effect of expenditure in quarter 1. *(3 marks)*

(e) Estimate the expenditure in quarter 1 of 2009. Indicate the method that you have used. *(3 marks)*

(f) The actual expenditure on shoes and other footwear in quarter 1 of 2009 was £1420 million.

Comment on the effectiveness of your method of forecasting. *(1 mark)*

(g) The owner of a shoe shop uses the data above to forecast the expenditure on shoes and other footwear for quarter 1 of 2010.

Make two comments on the likely accuracy of this forecast. **No calculations are required**. *(2 marks)*

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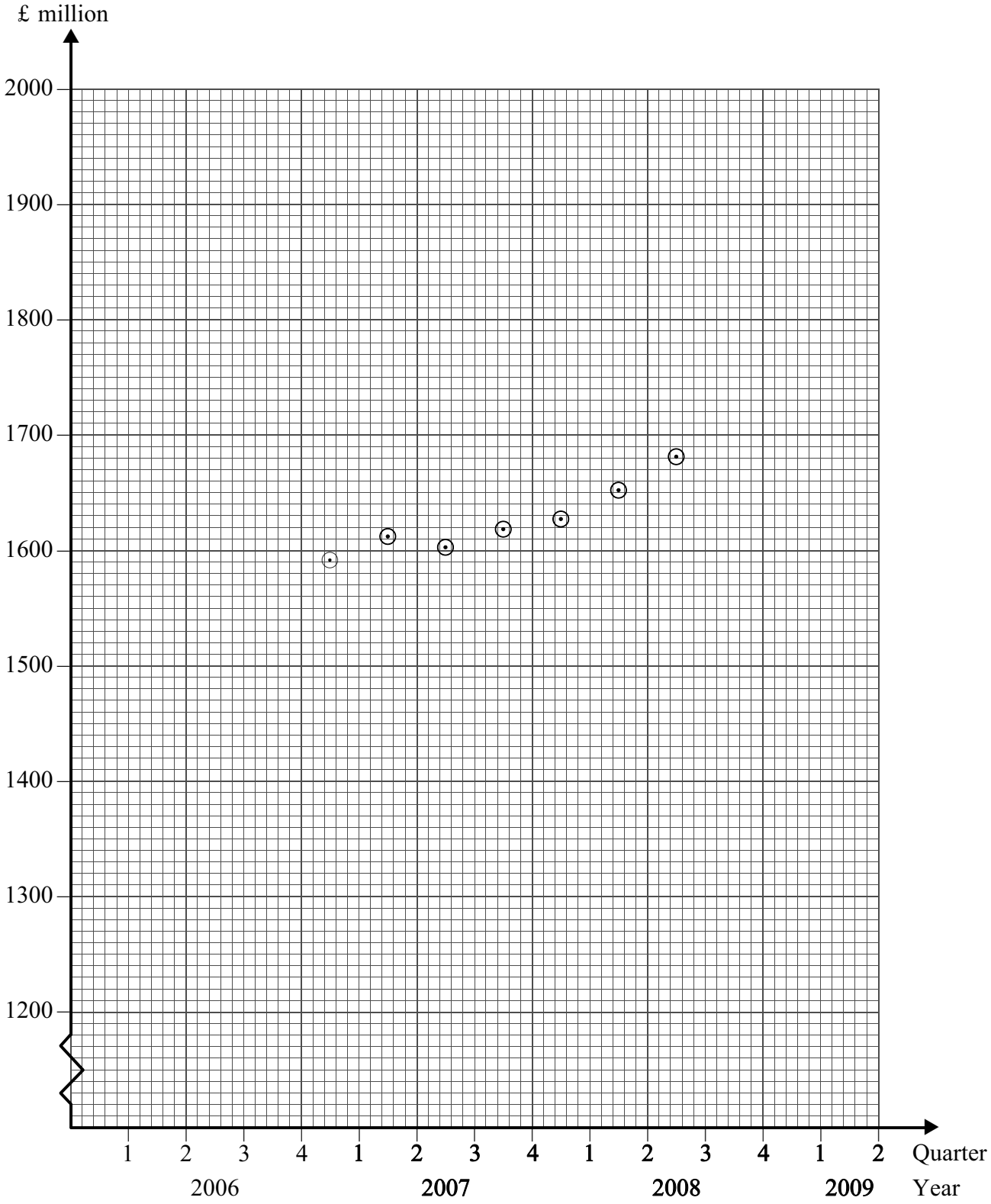
Figure 1

UK household expenditure on shoes and other footwear



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4 As a special promotion, a supermarket offers cartons of orange juice containing '25% extra' with no increase in price.

A random sample of cartons of orange juice was checked. The percentages by which the contents exceeded the nominal quantity were recorded, with the following results.

23.3 27.5 25.7 20.9 24.3 22.6 21.5 22.1

(a) Examine whether the mean percentage by which the contents exceed the nominal quantity is less than 25. Use the 5% significance level. Assume that the data are from a normal distribution with standard deviation 2.3. *(9 marks)*

(b) Define a Type I error in the context of this question. *(2 marks)*

(c) The supermarket manager claims that, if a larger sample were taken, the risk of making a Type I error would be reduced.

Comment on this claim. *(2 marks)*

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5 A hospital has 820 employees in 4 categories. The table shows the number of employees in each category.

Category	Number of employees
Medical	390
Ancillary	220
Administrative	140
Managerial	70

For each category, a list of employees is available. The hospital is seeking to improve its standard of hygiene and, as a first step, it plans to ask a sample of employees to answer a questionnaire.

(a) Describe how random numbers could be used to select a stratified sample of size 82 in such a way that all employees have an equal chance of being selected. *(6 marks)*

(b) (i) Describe how a systematic sample of size 100 could be selected.

(ii) Explain whether or not all employees have an equal chance of being selected in the systematic sample that you described in part **(b)(i)**. *(5 marks)*

(c) Data from a similar questionnaire, used at a nearby hospital, found that there was little difference in the opinions of the different categories but there was a difference between the opinions of males and females.

The hospital is to decide whether to select a stratified sample using the categories in the table, a differently stratified sample or a systematic sample.

Make **three** points which may help the hospital in making this decision. *(3 marks)*

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6 The table shows the numbers of students in further education in England and in Scotland during 2005/6 by age and by mode of study.

Thousands

	England		Scotland	
	Full-time	**Part-time**	**Full-time**	**Part-time**
Age under 16	2.0	10.2	1.5	32.8
16	274.7	46.4	8.7	12.1
17	235.3	54.4	9.7	14.9
18	103.3	65.4	6.9	11.4
19	41.1	61.6	3.3	9.0
20	23.3	61.9	2.1	7.2
21	16.8	63.6	1.4	5.9
22	14.7	67.4	1.1	5.4
23	13.2	69.3	1.0	5.4
24	12.0	72.5	0.9	5.4
25	11.7	75.1	0.7	5.2
26	10.6	71.2	0.6	4.9
27	9.5	65.6	0.6	4.7
28	8.6	62.1	0.4	4.3
29	8.3	62.6	0.5	4.3
30+	151.8	1884.9	5.8	153.4
Unknown	0.7	12.2	–	–
	937.5	2806.5	45.1	286.2

Source: *Annual Abstract of Statistics*, Office for National Statistics, 2008

(a) How many part-time students aged 19 were there in Scotland in 2005/6? *(2 marks)*

(b) In 2005/6, the population of England was 53 700 000 and the population of Scotland was 5 117 000.

Using this information, comment on the number of full-time students and the number of part-time students in further education in the two countries. *(3 marks)*

(c) The box and whisker plot, on **Figure 2** on page 21, illustrates the ages of full-time students in further education in England in 2005/6. For these students:

- the lower quartile is estimated to be 16.8 years;
- the median is estimated to be 17.8 years;
- the upper quartile is estimated to be 22.5 years.

(i) The usual convention is to class any age greater than

$$\text{upper quartile} + 1.5 \times (\text{interquartile range})$$

as an outlier. How old would a student have to be for their age to be classed as an outlier? *(1 mark)*

(ii) The usual convention is to illustrate outliers with a *. Explain why this has not been possible in this case. *(1 mark)*

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(d) (i) Explain why the median age of full-time students in Scotland is between 18.0 and 19.0 years. *(3 marks)*

(ii) For the ages of full-time students in Scotland:

- the lower quartile is estimated to be 17.1 years;
- the median is estimated to be 18.4 years;
- the upper quartile is estimated to be 22.2 years.

Add a box and whisker plot for full-time students in Scotland to **Figure 2**. Assume that the youngest student is 15 and that the oldest is 55. *(2 marks)*

(iii) Compare, briefly, the age distributions of full-time students in Scotland and in England. *(2 marks)*

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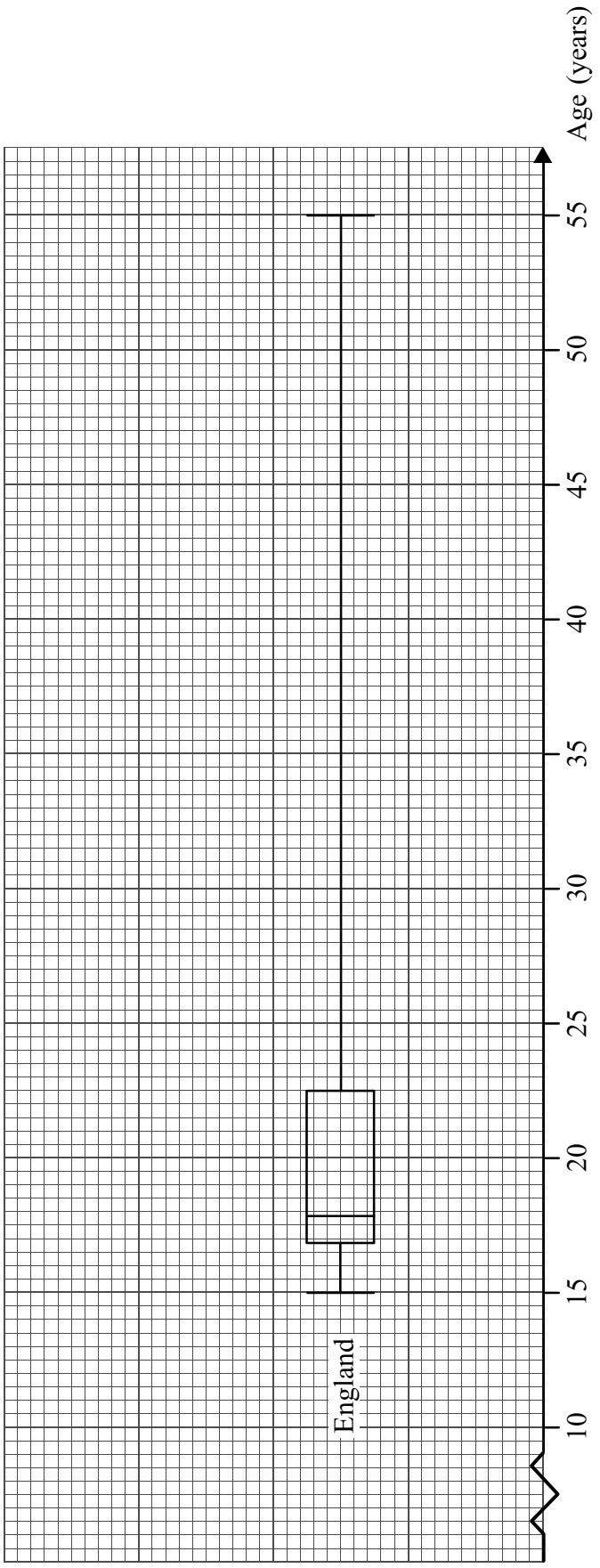
Figure 2

Age of full-time students in further education 2005/6



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