Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
January 2012

Statistics SS02

Unit Statistics 2

Friday 20 January 2012 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.
- You do not necessarily need to use all the space provided.

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

1 A garage sells batteries, exhausts and tyres.

The number of customers, X, arriving at the garage during a one-hour period to buy a battery may be modelled by a Poisson distribution with mean 2.8.

The number of customers, Y, arriving at the garage during a one-hour period to buy an exhaust may be modelled by a Poisson distribution with mean 3.5.

The number of customers, W, arriving at the garage during a one-hour period to buy tyres may be modelled by a Poisson distribution with mean 5.7.

(a) Find the probability that during a particular hour there are fewer than 2 customers arriving to buy a battery. *(2 marks)*

(b) Find the probability that during a particular **four**-hour period there are exactly 8 customers arriving to buy an exhaust. *(3 marks)*

(c) Find the probability that during a particular hour there is a total of more than 15 customers arriving to buy a battery, an exhaust or tyres. Assume that X, Y and W are independent and that each customer buys only one product. *(3 marks)*

(d) Explain why the Poisson distribution is unlikely to provide a suitable model for the number of tyres sold during an hour. *(2 marks)*

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2 In Blackport, the price of a night's accommodation in a two-star hotel in June 2009 could be modelled by a normal distribution with mean £72.80 and standard deviation £8.70.

To investigate whether there had been a change in the mean price, a random sample of 10 two-star hotels advertising on the 'Visit Blackport' website was taken and the corresponding prices, in £, for June 2010 were

72 65 60 80 71 63 54 82 59 65

(a) Show that this sample provides evidence, at the 5% significance level, to conclude that the mean price of two-star hotel accommodation in Blackport had **changed**. Assume that the distribution of prices in June 2010 was normal with standard deviation £8.70. *(8 marks)*

(b) State whether a Type I error or a Type II error might have been made in reaching the conclusion in part **(a)**. Explain your answer. *(2 marks)*

(c) State, with a reason, whether the conclusion in part **(a)** would be valid if you did not know that the prices in June 2010 were normally distributed. *(2 marks)*

(d) In addition to the possible errors already considered, state one reason why the conclusion reached in part **(a)** may not be valid. *(1 mark)*

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3 A restaurant offers fresh lobster on its menu. On each lobster sold, the restaurant makes a profit of £24. On each lobster unsold at the end of the day, it makes a loss of £16. At present, the manager buys **four** lobsters each day. Past experience has shown that the number of lobsters, X, requested daily by customers follows the distribution shown in **Table 1**.

Table 1

x	0	1	2	3	4
$\mathbf{P}(X = x)$	0.1	0.15	0.25	0.35	0.15

(a) (i) Show that the mean value of X is 2.3, and calculate the standard deviation of X. *(4 marks)*

(ii) Use this mean value of X and the corresponding mean value of lobsters unsold to show that the restaurant's mean daily profit on lobsters is £28. *(2 marks)*

(b) The manager considers reducing the number of lobsters that she buys each day to three. Assuming that the distribution of the number of lobsters requested daily by customers stays the same, **Table 2** shows the distribution of the number of lobsters, Y, **sold** daily under this new arrangement.

Table 2

y	0	1	2	3
$\mathbf{P}(Y = y)$	0.1	0.15	0.25	k

(i) State the value of k. *(1 mark)*

(ii) Calculate the mean daily profit from the lobsters when the manager buys only three each day. *(3 marks)*

(iii) Give one advantage of the manager reducing the number of lobsters that she buys to three each day. *(1 mark)*

(iv) Give one disadvantage of the manager reducing the number of lobsters that she buys to three each day. *(1 mark)*

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4 **Figure 1** shows data relating to the marital status of the adult population of England and Wales during the period 1971 to 2006.

Figure 1

Population aged 16 and over: sex and legal marital status

England and Wales numbers (thousands)

		Males					Females				
Mid-year	Total population	Single	Married	Divorced	Widowed	Total	Single	Married	Divorced	Widowed	Total
1971	36 818	4173	12 522	187	682	17 563	3583	12 566	296	2810	19 255
1976	37 486	4369	12 511	376	686	17 941	3597	12 538		2877	19 545
1981	38 724	5013	12 238	611	698	18 559	4114	12 284	828	2939	20 165
1986	39 837	5625	11 867	917	695	19 103	4617	12 000	1165	2953	20 734
1991	40 501	5891	11 636	1187	727	19 441	4817	11 833	1459	2951	21 060
1996	40 827	6225	11 310	1346	733	19 614	5168	11 433	1730	2881	21 212
2001	41 865	6894	11 090	1482	733	20 198	5798	11 150	1975	2745	21 667
2006	43 494	7833	10 881	1696	716	21 126	6683	10 893	2244	2548	22 367

Source: *Population Trends*, Office for National Statistics, 2009

(a) (i) How many single males were there in England and Wales in 1981? *(2 marks)*

(ii) The number of divorced females for 1976 has been omitted. Calculate the number which should be inserted in that space. *(2 marks)*

(iii) The total population shown in the table for 1996 is **not** the sum of the total number of males and the total number of females. Assuming that the figures are correct, explain how this has happened. *(1 mark)*

(b) (i) Describe the trend shown by the **number** of females who are widowed. *(2 marks)*

(ii) Showing necessary calculations, describe the trend shown by the **proportion** of males who are widowed. *(3 marks)*

(c) A statistician plans to draw a pie chart for 2006 to illustrate how the total population is divided between the four categories single, married, divorced and widowed.

Calculate the angles, to the nearest degree, which should be used for the four sectors. You are **not** required to draw the pie chart. *(3 marks)*

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5 During an outbreak of flu, a telephone helpline is set up for people to call for advice. The helpline is staffed in three shifts: **M**orning (midnight to 8 am), **D**ay (8 am to 4 pm) and **E**vening (4 pm to midnight).

The number of calls received each shift is recorded. The table shows the data for the Monday, Tuesday and Wednesday of the first week of the outbreak.

Day	**Monday**			**Tuesday**			**Wednesday**		
Shift	**M**	**D**	**E**	**M**	**D**	**E**	**M**	**D**	**E**
Number of calls	2568	5307	5046	3398	6374	6015	4184	7342	7050

(a) Complete, on **Figure 2** opposite, a graph of the data. *(1 mark)*

(b) Calculate values of a suitable moving average and plot these values on **Figure 2**. *(5 marks)*

(c) Draw a trend line by eye. *(1 mark)*

(d) Calculate the seasonal effect for the Day shift. *(3 marks)*

(e) Use your trend line and your seasonal effect for the Day shift to forecast the number of calls which will be received during the Day shift on Thursday. *(2 marks)*

(f) In fact, the numbers of calls received on Thursday are:

Morning: 5281;
Day: 8995;
Evening: 9462.

(i) Plot these values on **Figure 2**. *(1 mark)*

(ii) Comment on the accuracy of your forecast in part **(e)** and on the pattern of Thursday calls. *(2 marks)*

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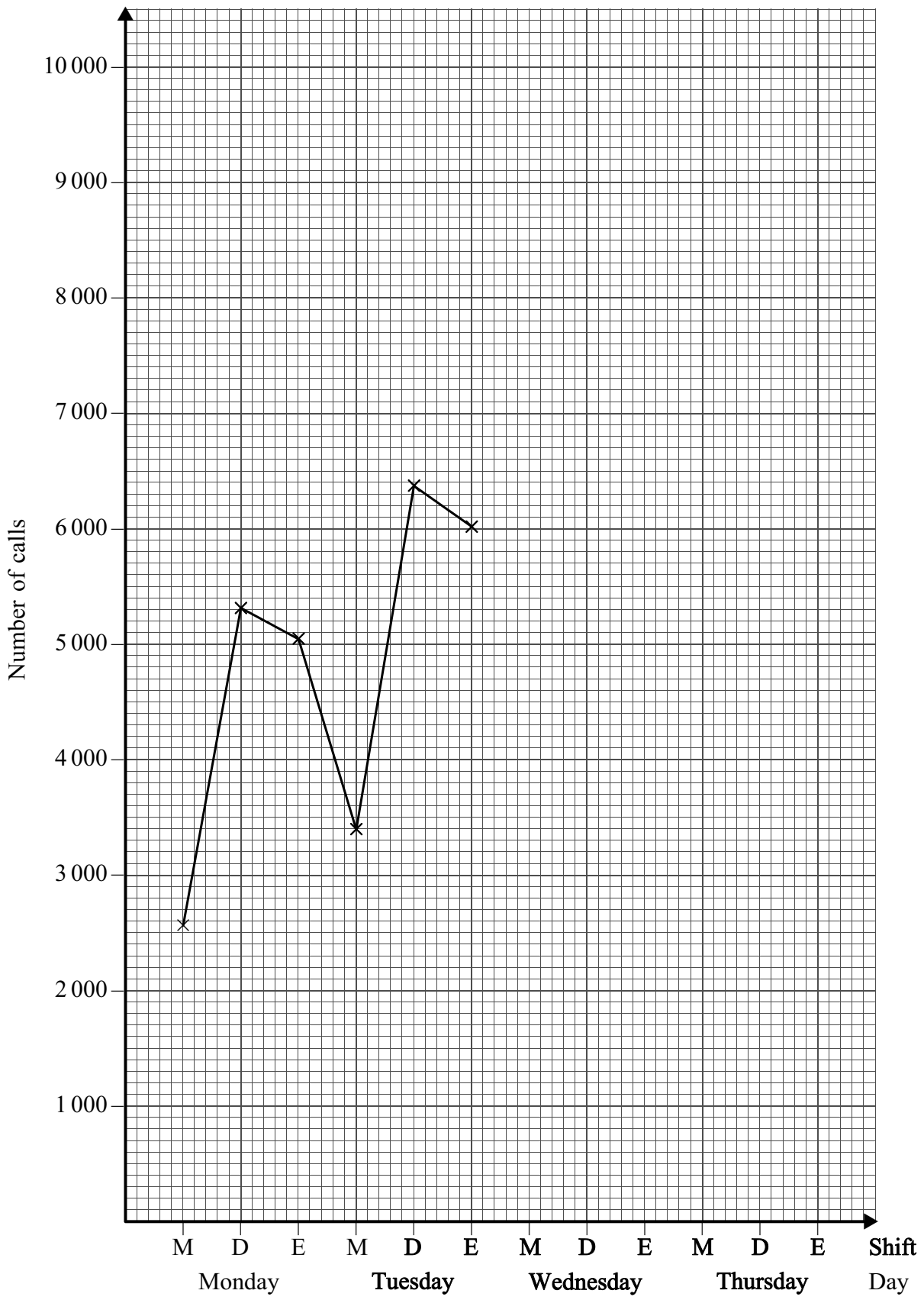
Figure 2


10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
Number of calls
M D E M D E M D E M D E
Shift
Monday
Tuesday
Wednesday
Thursday
Day

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6 Adam owns a farm. On the farm, there are 330 sheep, 160 cattle and 10 goats. The animals are each tagged with a number which is recorded in a stock book. The sheep are numbered from 001 to 330, the cattle are numbered from 331 to 490 and the goats are numbered from 491 to 500.

Adam wants to carry out a blood test to check the health of his animals but can only afford to carry out the test on 50 animals.

(a) (i) Describe how Adam could use random numbers to select a simple random sample of 50 animals for the test. *(4 marks)*

(ii) Explain why the small number of goats might cause a problem when using a random sample. *(1 mark)*

(b) Adam's farm manager, Ellie, suggests a different sampling method. She suggests randomly choosing a number from 1 to 10, testing the animal corresponding to that number in the stock book, and then testing every tenth animal after that. For example, if 7 were the randomly chosen number, then animals 007, 017, 027 and so on would be tested.

(i) Name the sampling method suggested by Ellie. *(1 mark)*

(ii) State, with a reason, whether a sample chosen in this way is a random sample. *(2 marks)*

(c) The animals are kept in many different fields. Adam decides to carry out a quota sample.

(i) Describe how Adam might carry out a quota sample of size 50. *(2 marks)*

(ii) State **one** advantage to Adam of carrying out a quota sample. *(1 mark)*

(iii) State **one** disadvantage of carrying out a quota sample. *(1 mark)*

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END OF QUESTIONS

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