Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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6	
7	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2010

Statistics SS02

Unit Statistics 2

Wednesday 9 June 2010 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.

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

1 The table shows the different possible fares, X pence, and the probability that they apply to a fare-paying passenger boarding a bus.

Fare, x pence	**P($X = x$)**
40	0.37
70	0.18
100	0.14
140	0.12
190	0.19

(a) (i) Find the mean value of X.

(ii) Show that $\mathrm{E}(X^2) = 12\,085$.

(iii) Find the standard deviation of X. *(5 marks)*

(b) Find the probability that a fare-paying passenger boarding the bus pays:

(i) more than £1.20;

(ii) exactly £1.20. *(2 marks)*

(c) The table only includes passengers who pay fares. Children under 5 and holders of a senior citizen bus pass travel free.

State, giving a reason, whether, if the zero fares of these passengers were included, the mean would be larger, smaller or the same as that calculated in part **(a)**.

(2 marks)

QUESTION PART REFERENCE

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2 *Hopeforthebest* is a travel company which organises package holidays that are sold through a number of travel agents. It decides to offer the travel agents a bonus if they can increase the number of holidays sold by 10% or more.

The number of *Hopeforthebest* holidays sold by Ajay, a travel agent, is shown in the table.

2007			2008			2009		
January–April	**May–August**	**September–December**	**January–April**	**May–August**	**September–December**	**January–April**	**May–August**	**September–December**
145	98	121	123	85	101	118	76	74

(a) Calculate values of a suitable moving average. *(3 marks)*

(b) Plot the moving averages on the graph **on page 6** and draw a trend line. *(3 marks)*

(c) (i) Estimate the seasonal effect for January–April, and hence forecast the number of holidays Ajay will sell during January–April 2010 if current trends continue. *(5 marks)*

(ii) Hence calculate how many holidays Ajay needs to sell during January–April 2010 to exceed current trends by at least 10%. *(2 marks)*

(d) Ajay argues that, if he sells 82 or more holidays during January–April 2010, he will have exceeded the September–December 2009 sales by more than 10% and so should qualify for a bonus.

Hopeforthebest argues that, in order to qualify for a bonus, he will need to sell 130 or more holidays, as he sold 118 during January–April 2009.

Suggest a suitable value for the number of holidays Ajay will need to sell during January–April 2010 in order to qualify for a bonus. Explain why your value is fairer than either of the values suggested by Ajay and *Hopeforthebest*. *(3 marks)*

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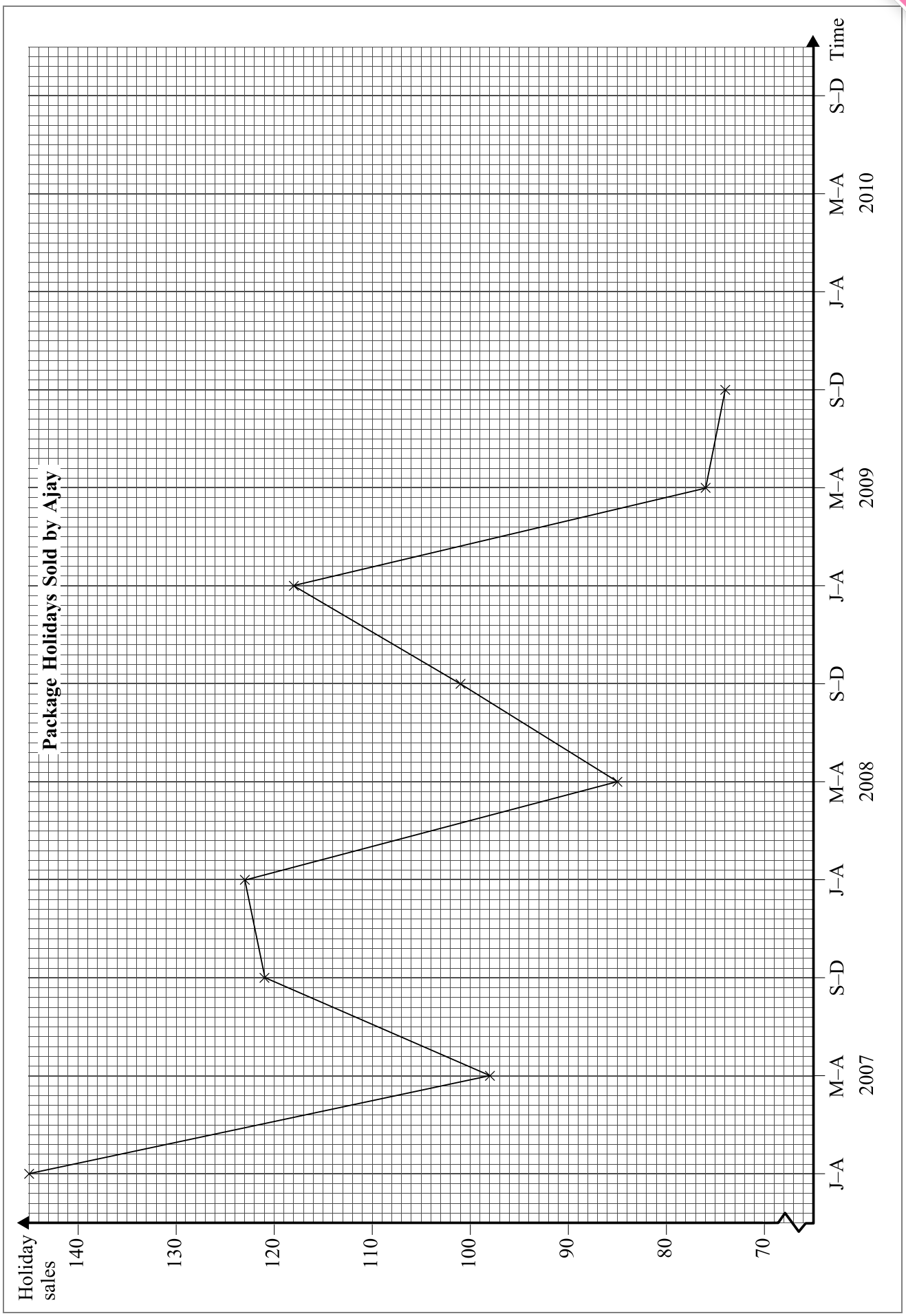

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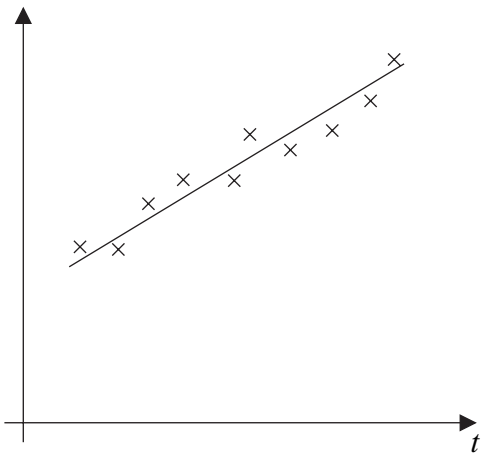
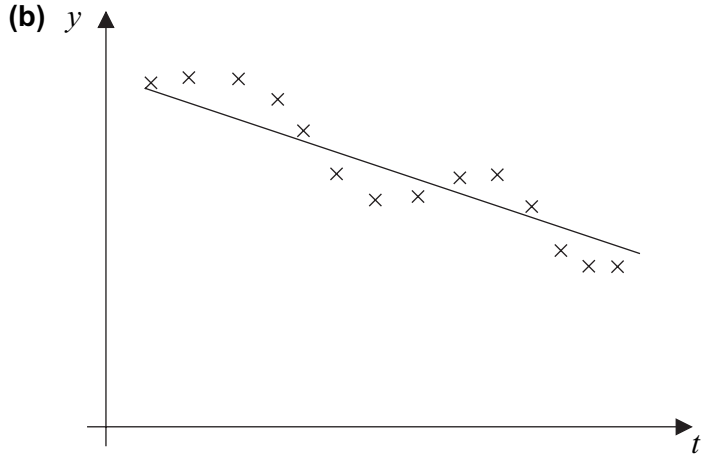
3 Describe the variation and trend exhibited by the following diagrams.

(a)



(b)



(4 marks)

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4 A company manufactures components for fridge motors. The components are designed to have a length of 135.0 millimetres.

The lengths, in millimetres, of a random sample of components manufactured on a given Monday were

135.2 135.7 134.8 135.1 136.2 135.7 136.0 135.8 135.5

(a) Examine whether the mean length of components manufactured on that Monday was 135.0 mm. Use the 5% significance level and assume that the lengths of components are normally distributed with a standard deviation of 0.45 mm. *(9 marks)*

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

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5 The table shows estimates of the remaining recoverable oil reserves for the United Kingdom.

	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006
Oil (million tonnes)										
Reserves										
Proven	605	685	665	630	605	593	571	533	516	479
Probable	765	575	455	380	350	327	286	283	300	298
Proven plus Probable	1370	1260	1120	1010	955	920	857	816	816	776
Possible	520	540	545	480	475	425	410	512	451	
Maximum	1890	1800	1665	1490	1430	1344	1267	1328	1267	1254
Expected level of reserves										
Opening stocks	1975	1675	1535	1370	1235	1160	1192	1180	1212	1162
Extraction	−130	−132	−137	−126	−117	−117	−106	−95	−85	−77
Other volume changes	−95	−8	−28	−9	42	149	94	127	35	130
Closing stocks	1750	1535	1370	1235	1160	1192	1180	1212	1162	1215
Life expectancy (years)	13	12	10	10	10	10	11	13	14	

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

(a) (i) State the estimate of probable oil reserves in 2002. *(2 marks)*

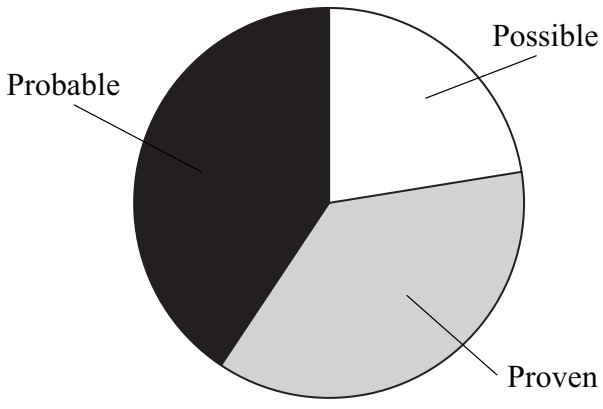
(ii) Find the estimate of possible oil reserves in 2006. *(2 marks)*

(iii) The life expectancy is calculated from the expected closing stocks and current extraction. Find the life expectancy for 2006. Give your answer to an appropriate level of accuracy. *(3 marks)*

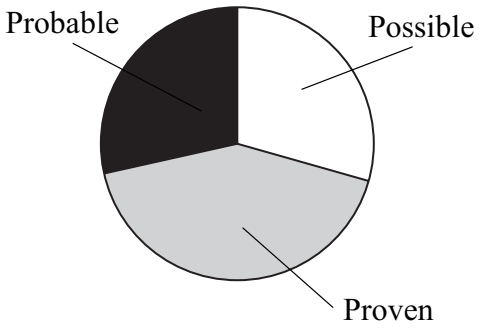
(b) The pie charts show estimates of the remaining **gas** reserves for the United Kingdom in 1995 and 2006. The area of each chart is proportional to the estimated maximum reserve.

Make **three** statements that can be deduced from these pie charts. *(3 marks)*

Gas Reserves 1995



Gas Reserves 2006



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

QUESTION PART REFERENCE

6 During the football season, an amateur football club holds training sessions for its first team squad on Tuesdays and Thursdays. The number of squad members who do **not** attend the Tuesday training session may be modelled by a Poisson distribution with mean 3.2 .

(a) Find the probability that, for a particular Tuesday training session:

(i) 6 or more squad members do not attend; *(2 marks)*

(ii) the entire first team squad **does** attend. *(2 marks)*

(b) The number of squad members who do not attend the Thursday training session may be modelled by a Poisson distribution with mean 3.8 .

(i) Find the probability that, for a particular Thursday training session, the number of squad members who do not attend is 2 or fewer. *(1 mark)*

(ii) Find the probability that, in a particular week, the number of squad members who do not attend the Tuesday training session plus the number of squad members who do not attend the Thursday training session is less than 2. Assume that the number who do not attend on Thursday is independent of the number who do not attend on Tuesday. *(3 marks)*

(iii) In an attempt to improve attendance, the club decided to introduce a rule that any squad member who does not attend both training sessions in any week will not be selected for the match on the following Saturday. In the first week that this rule was introduced, the entire first team squad attended on Tuesday and only one squad member did not attend on Thursday.

Do you think the new rule was effective? Explain your answer. *(3 marks)*

(c) (i) Give a reason why, although the Poisson distribution may provide an adequate model, it cannot provide an exact model for the number of squad members who do not attend training.

(ii) Give one possible reason why the number of squad members who attend on Thursday may not be independent of the number who attend on Tuesday. *(2 marks)*

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7 A cooperative society owns 420 shops. The society decides to employ a team of energy efficiency experts to carry out audits of the electricity consumed by these shops and to recommend ways in which this could be reduced. The team will be able to audit about 40 shops during the next three months.

(a) Describe how random numbers could be used to select a simple random sample of 40 shops to be audited. *(4 marks)*

(b) The energy efficiency experts arrange the shops in order of electricity consumption and number them from 000 to 419. The shop numbered 000 consumes the least electricity and the shop numbered 419 consumes the most.

The following three suggestions are made for selecting the shops for audit.

Suggestion P
The sample is made up of random samples of
10 shops from those numbered 000 to 099,
10 shops from those numbered 100 to 199,
10 shops from those numbered 200 to 299 and
12 shops from those numbered 300 to 419.

Suggestion Q
Select a single digit at random and choose this shop and every tenth shop thereafter. For example, if 002 is selected, shops numbered 002, 012, 022,… and 412 would constitute the sample.

Suggestion R
Shops numbered 378 to 419 are selected.

(i) For **Suggestion P**:

(A) name the method of sampling; *(1 mark)*

(B) state whether or not each shop is equally likely to be selected; *(1 mark)*

(C) give a reason why the sample is not a random sample. *(1 mark)*

(ii) For **Suggestion Q**:

(A) name the method of sampling; *(1 mark)*

(B) state whether or not each shop is equally likely to be selected; *(1 mark)*

(C) give a reason why the sample is not a random sample. *(1 mark)*

(iii) Give a reason why **Suggestion R** might be preferred to both **Suggestion P** and **Suggestion Q**. *(2 marks)*

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END OF QUESTIONS