

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2012

Statistics

SS06

Unit Statistics 6

Friday 22 June 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 each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- 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.



J U N 1 2 S S 0 6 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** An investigation into the effect of a particular chemical on ripening times of fruit in cold storage is carried out by a company that stores apples of three varieties: Red Delicious, Golden Delicious and Pink Lady.
- The chemical is applied to three apples, one of each variety, selected at random from those that are to be kept in cold storage.
- Three further apples, again one of each variety, are selected at random from those that are to be kept in cold storage. These apples are not treated with the chemical.
- In addition to the chemical, it is believed that the variety of an apple might influence its time to ripening.
- The length of time to ripening is measured for the six apples in the investigation.
- (a) Identify those apples that constitute the **control group**. (1 mark)
- (b) Explain the purpose of selecting apples for treatment with the chemical at random from those to be kept in cold storage. (1 mark)
- (c) Name the technique that you would use in order to analyse the data obtained from this investigation. (2 marks)
- (d) Name the **blocking factor**. (1 mark)

QUESTION
PART
REFERENCE

Answer space for question 1



QUESTION
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Answer space for question 1

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2

A manufacturer produces small distress flares for use on boats. The production manager suspects that the quality of the ignition devices used in these flares, obtained from a particular supplier, is not of an acceptable standard.

Two alternative single sampling acceptance plans, Plan A and Plan B, are suggested to the production manager for use in monitoring the quality of batches of ignition devices from the supplier concerned.

Plan A Select a random sample of 30 ignition devices from a batch. Accept the batch if there is at most **one** non-conforming ignition device; otherwise reject the batch.

Plan B Select a random sample of 50 ignition devices from a batch. Accept the batch if there are at most **three** non-conforming ignition devices; otherwise reject the batch.

The production manager requires that the probability of acceptance of a batch that contains 15% non-conforming ignition devices must be below 5%.

- (a) Show that **each plan** meets the requirement of the production manager for batches containing 15% non-conforming ignition devices. (3 marks)

- (b) For **each plan**, find the probability that a batch is accepted when the proportion of non-conforming ignition devices in it is:
 - (i) 1%;

 - (ii) 2%. (3 marks)

QUESTION
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Answer space for questions 2(a) and 2(b)

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QUESTION PART REFERENCE

Answer space for questions 2(a) and 2(b)

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Question 2 continues on the next page

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2 (c) (i) Draw the operating characteristics for Plan A and Plan B on the grid below, using your answers to parts (a) and (b) and the information given in the table.

		Proportion of non-conforming ignition devices	
		4%	10%
Probability batch accepted	Plan A	0.661	0.184
	Plan B	0.861	0.250

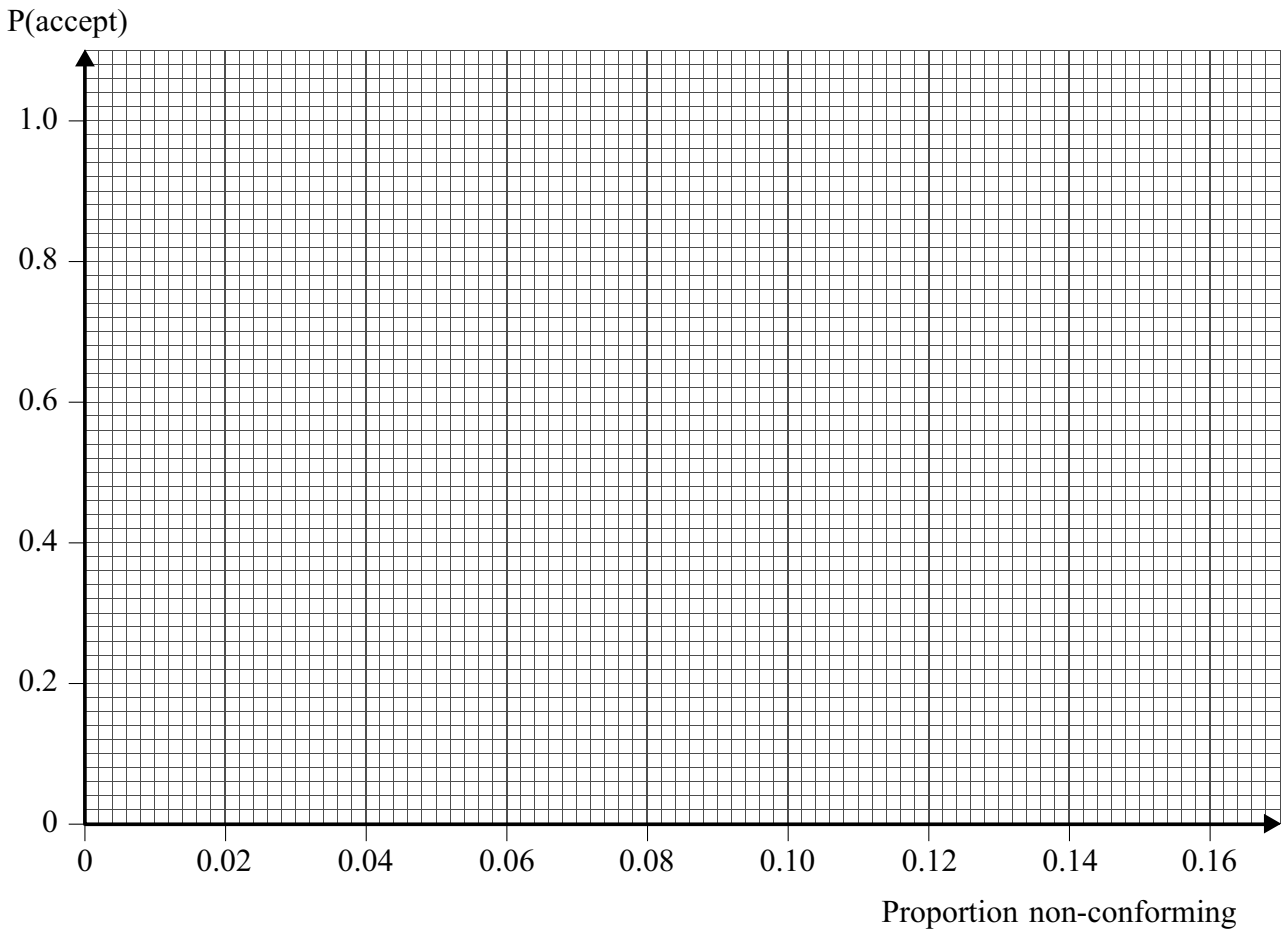
(2 marks)

(ii) Comment on the relative merits of the two plans.

(2 marks)

QUESTION PART REFERENCE

Answer space for question 2(c)



2 (d) The production manager requests that a double sampling plan should also be considered. Hence a new plan, Plan C, is suggested.

Plan C Select a random sample of 20 ignition devices from a batch. Accept the batch if no non-conforming ignition device is found. Reject the batch if two or more non-conforming ignition devices are found. If one non-conforming ignition device is found in the sample, select a further random sample of 20 ignition devices from the batch. Accept the batch if a total of two or fewer non-conforming ignition devices are found in the 40 sampled; otherwise reject the batch.

- (i) For Plan C, find the probability of acceptance of a batch that contains 15% non-conforming ignition devices. *(3 marks)*
- (ii) State **one** advantage and **one** disadvantage of Plan C when compared with either or both of Plans A and B. *(2 marks)*

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Answer space for question 2(d)

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3 An investigation was carried out into the contents of jars of jam. Eight manufacturers, each of which produced both ‘supermarket own’ strawberry jam and ‘branded’ strawberry jam, were asked to provide one jar of each for this investigation.

(a) The jars all had a nominal jam weight of 340 grams.

The contents of each jar were weighed and these weights, in grams, are given in **Table 1**.

Table 1

Manufacturer \ Type	Supermarket own	Branded
	1	351
2	349	362
3	355	354
4	343	349
5	352	348
6	348	364
7	353	354
8	346	351

(i) Carry out a paired *t*-test, using the 10% level of significance, to investigate the claim that, on average, ‘branded’ jars contain strawberry jam that weighs at most 5 grams more than that contained in ‘supermarket own’ jars.

Interpret your conclusion in context.

(9 marks)

(ii) State the **two** assumptions that you have made in order for the test in part **(a)(i)** to be valid.

(2 marks)

QUESTION
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Answer space for question 3(a)

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QUESTION
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Question 3 continues on the next page

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- 3 (b)** It was also decided to investigate the sweetness of ‘supermarket own’ and ‘branded’ jars of strawberry jam. It was claimed that the strawberry jam contained in ‘supermarket own’ jars is sweeter than that contained in ‘branded’ jars. Untrained tasters were each asked to sample the jam from one manufacturer’s ‘branded’ jar and also from its corresponding ‘supermarket own’ jar. Each person was then asked to award each jam a sweetness score, on a scale from 0 to 50, with the sweeter jam given a higher score.

The scores are given in **Table 2**.

Table 2

Type Manufacturer	Supermarket own	Branded
1	44	22
2	35	14
3	36	27
4	17	19
5	41	30
6	29	16
7	42	34
8	31	19

- (i) It is suggested that a sign test is used to investigate the claim regarding the sweetness of the strawberry jam in ‘supermarket own’ and ‘branded’ jars.

Give a reason for this suggestion.

(1 mark)

- (ii) Carry out a sign test to investigate the claim, using the 5% level of significance.

(5 marks)

QUESTION
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Answer space for question 3(b)



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Answer space for question 3(b)

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4 A machine produces steel rods whose target length is 2.00 centimetres. These rods have lengths that can be assumed to be normally distributed with a standard deviation of 0.02 centimetres. A random sample of 4 rods is taken at regular intervals.

- (a)** Calculate upper and lower warning (95%) and action (99.8%) control limits for:
- (i)** sample means;
 - (ii)** sample ranges.

You are **not** required to plot these limits.

(6 marks)

QUESTION
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Answer space for question 4(a)

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4 (b) For the 4 rods in each sample, the deviation from the target length of 2.00 centimetres, in units of 0.01 centimetres, is measured.

The deviation found from the target length for each of the rods in the last 10 samples is given in the table.

Sample	1	2	3	4	5	6	7	8	9	10
	1	-2	-1	-1	-2	3	-2	1	-1	3
	-4	0	0	-2	1	0	-1	-6	-1	1
	2	1	-1	-1	-1	2	-2	1	0	2
	1	1	1	-1	1	-1	1	1	-1	3
Mean	0	0	-0.25	-1.25	-0.25				-0.75	2.25
Range	6	3	2	1	3				1	2

(i) Find the missing means and ranges for the samples given and enter these values into the table. *(2 marks)*

(ii) Comment on the performance of the process over the last 10 samples. *(2 marks)*

(iii) What action, if any, would you recommend on the basis of sample 10?

Justify your answer. *(2 marks)*

QUESTION PART REFERENCE

Answer space for question 4(b)

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Question 4 continues on the next page

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Answer space for question 4(c)

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5 A researcher carries out investigations into various aspects of sport.

(a) She wishes to investigate the job satisfaction of athletics coaches. An extensive questionnaire is given to a random selection of 17 athletics coaches, and a final job satisfaction score is obtained for each coach. A higher score indicates greater job satisfaction.

The scores for the athletics coaches in three age categories, 20–29 years, 30–49 years and 50 years and over, are given in **Table 3**.

Table 3

20–29 years	30–49 years	50 years and over
2.02	2.25	2.28
2.10	2.54	2.55
2.12	2.67	2.65
2.14	2.80	2.90
2.29	2.85	2.96
	2.92	3.05

- (i)** Carry out a one-factor analysis of variance, using the 1% level of significance, to investigate for a difference in the mean satisfaction scores between the three age categories. *(10 marks)*

- (ii)** Interpret your conclusion in context. *(1 mark)*

- (iii)** State **one** assumption that you made about the given data when carrying out the test in part **(a)(i)**. *(1 mark)*

QUESTION
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Answer space for question 5(a)

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QUESTION
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Answer space for question 5(a)

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5 (b) The researcher also wishes to investigate the mean weekly training hours undertaken by male and female athletes in three sports: running, cycling and swimming.

A running club, a cycling club and a swimming club were each asked to estimate the average weekly training hours undertaken by their male athletes and by their female athletes.

These average weekly training hours are given in **Table 4**.

Table 4

	Sport		
	Running	Cycling	Swimming
Male	7.9	9.3	8.8
Female	6.8	8.2	8.6

Carry out a two-factor analysis of variance, using the 5% level of significance, to investigate for a difference in the mean weekly training hours for the three sports.

(10 marks)

QUESTION
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Answer space for question 5(b)



QUESTION
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Answer space for question 5(b)

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Answer space for question 5(b)

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END OF QUESTIONS

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