

General Certificate of Education
June 2006
Advanced Level Examination



STATISTICS
Unit Statistics 6

SS06

Friday 23 June 2006 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 2 and 4 (enclosed)

You may use a graphics calculator.

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or 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 SS06.
- 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** Trials of a new ointment for treating eczema are undertaken. Volunteers are allocated to two groups by a random process. One group is treated with the new ointment and the other with a well-established ointment.
- (a) Identify:
- (i) the experimental group; *(1 mark)*
 - (ii) the control group. *(1 mark)*
- (b) Double blind trials are used. Explain, in context, the meaning and purpose of such trials. *(3 marks)*

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

A food factory produces packets of ginger biscuits. After every hour of production, 5 packets are sampled and their weights, in grams, are measured. These weights may be assumed to come from a normal distribution. The target weight for each packet is 210 grams and a standard deviation of 4 grams is considered satisfactory.

(a) Set up charts on **Figure 1** showing upper and lower warning (95%) and action (99.8%) limits for:

(i) means; *(5 marks)*

(ii) ranges. *(4 marks)*

(b) The means and ranges of the last eight samples are shown in the table.

Sample number	1	2	3	4	5	6	7	8
Mean (grams)	222.2	206.8	209.6	208.8	212.0	211.6	213.4	212.8
Range (grams)	28	8	12	6	11	9	15	7

(i) Plot these means and ranges on the appropriate charts. *(2 marks)*

(ii) Comment on the performance of the process over the last eight hours. *(3 marks)*

(c) The weights, in grams, of packets of ginger biscuits in the next sample are

211 212 211 212 212

(i) Add a point for this sample to each of your charts. *(3 marks)*

(ii) State what action, if any, you would advise as a result of this sample. Explain your answer. *(2 marks)*

Turn over for the next question

Turn over ►

- 3 As part of an investigation into the effect of age on sporting ability, the 12 girls in a class were divided by age into two groups. Group A contained the youngest 6 girls and group B the remainder. The youngest girl in group A was then paired with the youngest girl in group B, the second youngest girl in group A with the second youngest girl in group B and so on. The two girls in each pair then played each other at a racket game for fifteen minutes and were asked to remember the number of points that they each won. The results reported were as follows.

Pair	1	2	3	4	5	6
Group A	12	4	14	23	15	9
Group B	19	39	23	11	27	31

- (a) Using a paired t -test and the 10% significance level, examine whether older girls score more points, on average, than younger girls. *(9 marks)*
- (b) State **two** assumptions that it was necessary to make for the test in part (a) to be valid. *(2 marks)*
- (c) Give a statistical reason for not including all the children in the class, which also contained 10 boys, in the experiment. *(1 mark)*
- (d) On reviewing the method of data collection, it was considered that the results were unreliable. However, it was almost certain that the winners (ie the girls scoring more points than their opponents) had been correctly identified.

Without undertaking any calculation, comment on the suggestion that, instead of using a paired t -test, the results should be analysed using:

- (i) a Wilcoxon signed-rank test;
- (ii) a sign test. *(3 marks)*

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

A car manufacturer buys large batches of a particular component. Components which fail to satisfy a test are classified as non-conforming. A sampling plan requires that a random sample of 25 components is taken from each batch and the batch is accepted if the sample includes two or fewer non-conforming components. If the sample includes three or more non-conforming components the batch is rejected.

- (a) (i) Find the probabilities of accepting batches containing 1%, 3%, 5%, 7%, 10% and 15% non-conforming components. *(3 marks)*
- (ii) Draw the operating characteristic on **Figure 2**. *(2 marks)*
- (iii) Also draw, on **Figure 2**, the ideal shape of the operating characteristic if the manufacturer would like to accept all batches containing 5% or fewer non-conforming components and to reject all other batches. *(2 marks)*
- (b) An alternative plan requires a random sample of 50 components to be taken from the batch and the batch to be accepted if four or fewer non-conforming components are found.

Find the probabilities of this plan accepting batches containing 3% and 15% non-conforming components. *(1 mark)*

- (c) (i) By considering your results in parts (a) and (b), or otherwise, give **two** advantages of the plan in part (b) compared with the plan in part (a). *(2 marks)*
- (ii) Give **one** disadvantage of the plan in part (b) compared with the plan in part (a). *(1 mark)*

Turn over for the next question

Turn over ►

- 5 Fairhorizons is a travel firm which specialises in activity holidays in remote areas. It wishes to buy a substantial number of small tents for use on trekking holidays.
- (a) Three inexperienced campers, who intend to go on a trekking holiday with Fairhorizons, agreed to spend a morning helping the firm decide which model of tent to buy.

Each camper was first asked to pitch a tent of model A, which they received packed in a bag. The time from receiving the tent to completing the pitching of the tent was noted for each person. This was then repeated with a tent of model B, then with a tent of model C and finally with a tent of model D. The times, in minutes, are shown in the table.

		Camper		
		Olan	Majda	Raphael
Model	A	42	29	19
	B	37	33	24
	C	24	29	18
	D	25	22	13

- (i) Carry out a two-way analysis of variance and test, at the 5% significance level, for differences between models and between campers. *(13 marks)*
- (ii) State which model appears to take the least time to pitch and explain why this conclusion could be misleading. *(2 marks)*

- (b) Because of doubts about the validity of the conclusions in part (a), Fairhorizons asked five inexperienced campers to take part in a further trial of the four models and invited a statistician to attend.

The statistician selected one of the campers at random to help with the timing and produced the following Latin square design.

		Camper			
		Rhona	Kapil	Sunil	Glenn
Order of pitching	1	A, 46	B, 27	C, 36	D, 53
	2	C, 40	D, 42	A, 25	B, 32
	3	D, 37	A, 35	B, 16	C, 35
	4	B, 18	C, 26	D, 30	A, 22

(Rhona pitched model A first which took 46 minutes, then model C which took 40 minutes, then model D which took 37 minutes, etc.)

- (i) Copy and complete the following table, which arises from the analysis of the Latin square.

Source of variation	Sum of squares	Degrees of freedom
Order	577.5	
Camper	198.5	
Model	611.5	
Error		
Total	1522.0	

(2 marks)

- (ii) Test, at the 5% significance level, for a difference between models. (4 marks)
- (iii) Which model appears to take the least time to pitch? Justify your answer. (2 marks)
- (iv) Explain why the statistician used only four campers to pitch tents although five campers were available. (2 marks)

END OF QUESTIONS

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Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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Unit Statistics 6

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Insert

Friday 23 June 2006 9.00 am to 10.30 am

Insert for use in **Questions 2 and 4**.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

Turn over for Figure 1

Turn over ►

Figure 1 (for use in Question 2)

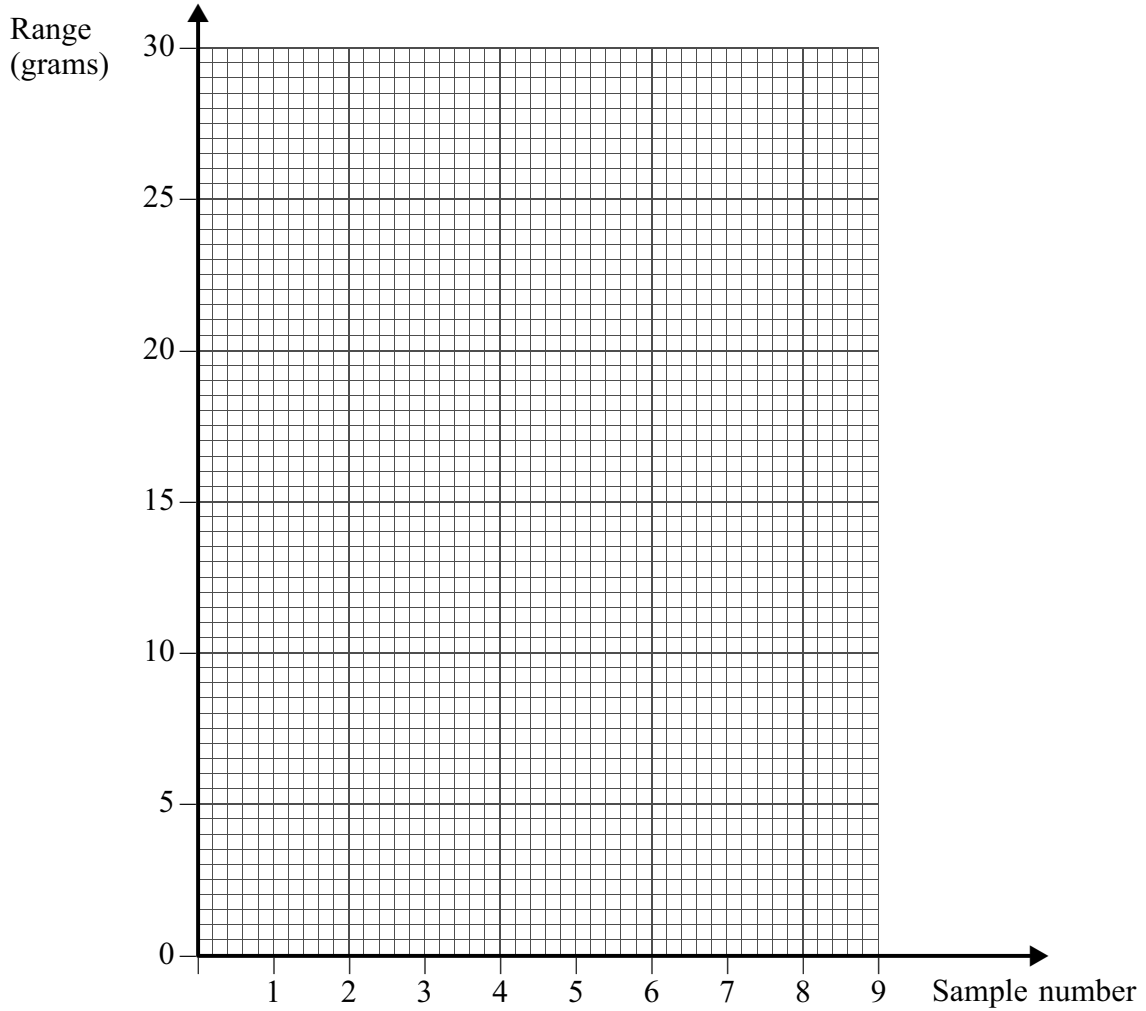
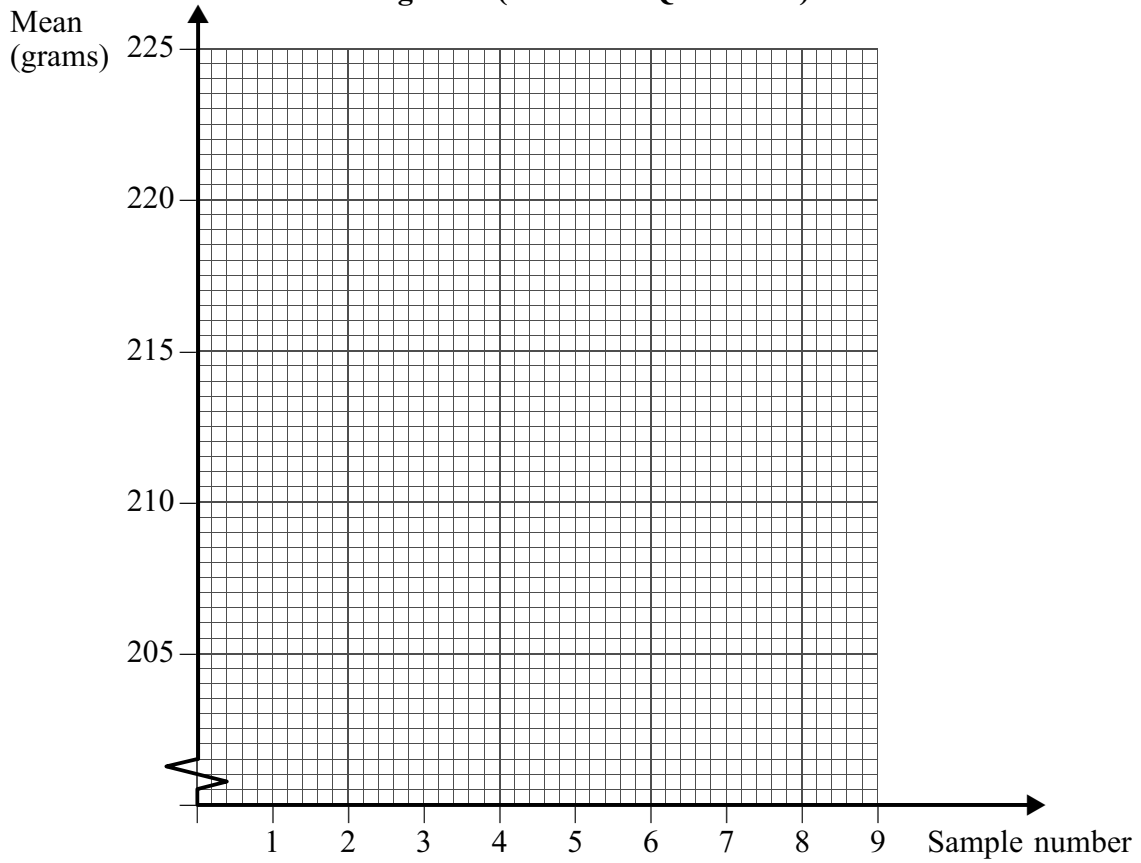
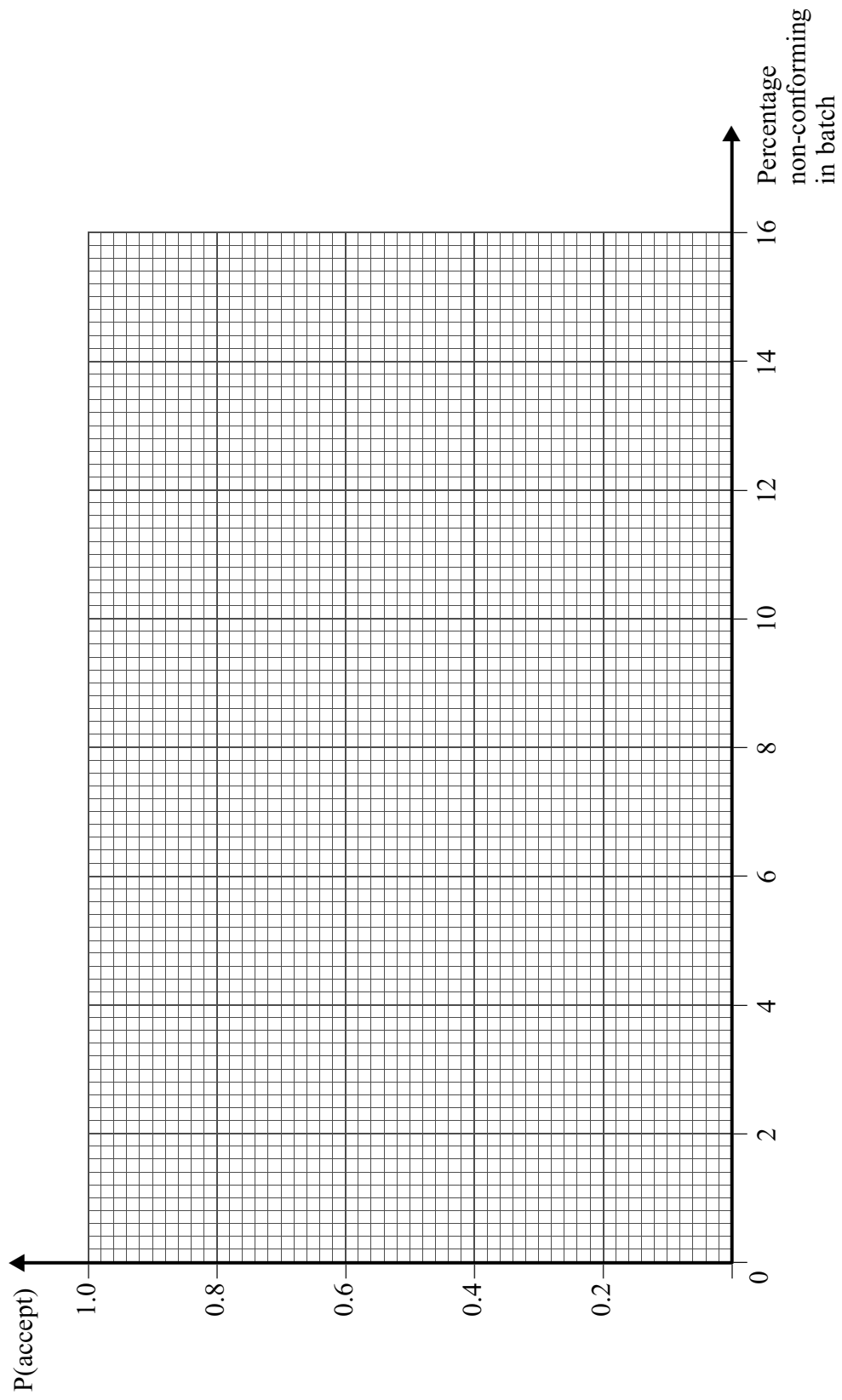


Figure 2 (for use in Question 4)



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