A Level Statistics
AQA Past Exam Questions

TOPIC: Hypothesis Testing
Two Way ANOVA

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.

• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.

• **Fill in the boxes** at the top of this page with your name, centre number and candidate number.

• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.

• Answer the questions **on paper**

• You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

• Unless otherwise stated, statistical tests should be carried out at the 5% significance level.

• When a calculator is used, the answer should be given to three significant figures unless otherwise stated.

Information

• *You may use the* booklet 'Statistical Formulae and Tables'

• There are **8** questions in this question paper. The total mark for this paper is *49*

• The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.

• Try to answer every question.

• Check your answers if you have time at the end.

• If you change your mind about an answer, cross it out and put your new answer and any working underneath.

• Check your answers if you have time at the end.

AQA_JUNE_2014_5
Soneya, the owner of Tipley Cafe´, believes that people cannot tell the difference between the first cup of tea made with a given teabag and the second and third cups made with the same teabag. She chooses seven different brands of teabag and, for each brand in turn, she selects one teabag and makes a first cup, a second cup and a third cup of tea with it.
Soneya then asks one of her regular tea-drinking customers to taste each cup of tea, for each brand in turn, and rate it on a scale of 0 to 20. A higher rating indicates a better tasting tea.
The making order and the brand of tea used are unknown to the customer.
The customer's ratings are given in Table 1.

Table 1

		Making order		
		First	Second	Third
Tea brand	A	8	3	2
	B	15	14	4
	C	16	17	12
	D	7	5	4
	E	9	3	6
	F	8	9	4
	G	10	3	4
	Total	73	54	36

$\sum\sum x_{ij} = 1705$

(a) (i) Making any necessary assumptions, carry out F-tests, using the 5% level of significance, to investigate for a difference between the ratings for the three making orders and for the seven brands.

[12 marks]

(ii) Make recommendations to Soneya based on your conclusions in part (a)(i).

[2 marks]

(b) (i) State the assumption that is necessary regarding the interaction of factors when carrying out the tests in part (a)(i). Interpret this assumption in context.

(ii) State two other necessary assumptions regarding the given data when carrying out the test in part (a)(i).

[4 marks]

AQA_JUNE_2006_5a
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 for model B then with a tern of model C and finally with a tent of model D. The times, in minutes are shown in the table

		Camper		
		Olan	Majda	Raphael
	A	42	29	19
Model	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)

AQA_JUNE_2012_5b
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)

AQA_JUNE_2007_6b
A researcher, investigating the effect of drinking alcohol on mental dexterity, obtained 12 volunteers and divided them randomly into three groups of four. Thirty minutes before solving a simple Sudoku puzzle, the volunteers in Group 2 each drank one measure of whisky and those in Group 3 each drank three measures of whisky. The volunteers in Group 1 had no alcohol. The time, in seconds, that it took each volunteer to solve the puzzle was recorded.

Group 1 (no alcohol)	Group 2 (1 measure)	Group 3 (3 measures)
184	196	262
126	8	168
108	222	240
204	144	190

(b) It was pointed out that the time taken to solve a Sudoku puzzle may also depend on the weight and the sex of the subject. Twelve new female volunteers were obtained. They were ranked by weight and divided into four groups.
Volunteers ranked   1, 2, 3 formed the first group;
                  4, 5, 6 formed the second group;
                  7, 8, 9 formed the third group;
                  10, 11, 12 formed the fourth group.
One member of each group was randomly chosen to drink no alcohol, one to drink one measure of whisky and one to drink three measures of whisky. They were timed to solve the same simple Sudoku puzzle.
Copy and complete the following analysis of variance table which arose from this second experiment. Test for differences between the effects of different weights and of different amounts of alcohol, using the 5% significance level.

Source	Sums of Squares	Degrees of Freedom	Mean Square
Between amounts of alcohol	9 348		
Between Weight	7 80		
Residual			
Total	20 542		

(6 marks)