Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

AS
STATISTICS

Unit Statistics 3

SS03

Friday 17 June 2016 Afternoon

Time allowed: 1 hour 30 minutes

For this paper you must have:
- **the blue AQA booklet of formulae and statistical tables.**

You may use a graphics calculator.

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **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 on blank pages.**
- **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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions.

Answer each question in the space provided for that question.

1 An investigation into the effects of caffeine consumption on coordination and processing skills was carried out by a drinks company.

Ten university students, who normally consumed fewer than three caffeinated drinks per week, agreed to participate in this investigation.

The students agreed to perform several tasks involving hand-eye coordination on two separate occasions.

Students were randomly assigned to have either a caffeinated drink or an uncaffeinated drink thirty minutes before they performed the tasks on the first occasion.

One week later they returned to perform the tasks again. Thirty minutes before the students performed the tasks on the second occasion, those who were given a caffeinated drink on the first occasion were given an uncaffeinated drink and those who were given an uncaffeinated drink on the first occasion were given a caffeinated drink.

The scores gained by each student for the hand-eye coordination tasks were on a scale of 0 to 50, where 50 indicates the highest level of hand-eye coordination.

The scores for each student on each occasion are given in the table.

Student	A	B	C	D	E	F	G	H	I	J
Caffeinated drink	28	39	38	40	41	26	36	37	22	33
Uncaffeinated drink	32	30	34	37	42	21	34	29	21	27

(a) Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate whether the consumption of a caffeinated drink has any effect on the median score gained in the hand-eye coordination tasks. [9 marks]

(b) (i) Write down TWO assumptions that must be made in order for the test in part (a) to be valid.

(ii) Explain, in the context of this question, the meaning of a Type I error. [4 marks]

Answer space for question 1
Write the question part reference in the left margin.

[Turn over]

[Turn over]

[Turn over]

BLANK PAGE

[Turn over]

2 Twelve adults, all of whom suffered from moderate lower back pain, agreed to take part in an investigation into the effectiveness of a commonly recommended painkiller used for the relief of back pain.

They were each given tablets and instructed to take one tablet four times a day. They were also instructed to keep moving as much as possible and asked to record how many days it took for the pain to go away completely.

The adults were randomly assigned to take either tablets containing the recommended painkiller or placebo tablets that contained no active ingredient.

The numbers of days taken by each patient for the back pain to go away completely are given in the table.

Recommended painkiller tablets	13	20	18	16	15	21
Placebo tablets	16	19	17	14	23	22

(a) Carry out a distribution-free test, using the $2\frac{1}{2}\%$ level of significance, to investigate whether the patients taking the recommended painkiller had, on average, fewer days to wait for their back pain to go away completely. [9 marks]

(b) Give a reason why all the adults were given tablets and the same instructions. [1 mark]

Answer space for question 2
Write the question part reference in the left margin.

[Turn over]

BLANK PAGE

[Turn over]

3 **A university psychology department decided to investigate whether background music improves concentration.**

Sixteen final-year university students participated in this investigation.

Each student was allocated to one of three rooms. One room had background music with lyrics, one room had background music without lyrics, and one room had no background music.

The students were all given the same reading task and, on completion, were asked questions about its content.

The numbers of correct answers given by the students are shown in the table.

Type of background music		
With lyrics	Without lyrics	None
21	27	31
19	32	28
30	34	38
25	26	36
22	24	29
27		

You may assume that the 16 students form a random sample.

Carry out a Kruskal-Wallis test, using the 5% level of significance, to determine whether there is evidence of a difference, on average, between the numbers of correct answers given for the three types of background music.

Interpret your conclusion in the context of this question including a suggestion to final-year university students about reading with background music.
[12 marks]

Answer space for question 3
Write the question part reference in the left margin.

[Turn over]

[Turn over]

[Turn over]

[Turn over]

BLANK PAGE

[Turn over]

4 A UK national newspaper conducted a survey on the eating preferences of its readers.

A sample of 300 readers, aged between 40 years and 50 years and supporters of one of five political parties, were asked to state which of the following food types they preferred: British, French or Italian.

They were also asked to state the political party that they supported. Readers could select the political party that they supported from five political parties labelled A, B, C, D and E.

The results are summarised in the table.

		Food type preferred			
		British	French	Italian	Total
Political party supported	A	29	21	25	75
	B	29	39	22	90
	C	13	11	26	50
	D	20	8	7	35
	E	15	18	17	50
Total		106	97	97	300

These 300 readers may be regarded as a random sample.

(a) Investigate, at the 5% significance level, whether food type preferred is independent of political party supported. [11 marks]

(b) By comparing observed and expected frequencies, identify, in context, THREE deductions concerning food type preferred and political party supported. [4 marks]

(c) Give TWO reasons why conclusions from this survey may not necessarily apply to all UK residents. [2 marks]

Answer space for question 4
Write the question part reference in the left margin.

[Turn over]

[Turn over]

[Turn over]

5 **Fatima, a film reviewer, was asked to investigate the level of gender bias in films.**

A random sample of 12 films, released during 2010, was obtained.

Fatima watched the 12 films and then assigned to each of them a gender bias score based on the importance of the female characters in the film and on how well-rounded their roles were.

The score assigned was measured on a scale of 0 to 20, where 20 indicated the LEAST gender bias.

For each film, the gender bias score assigned and the RANK of the gross box office takings, where rank 1 indicates the highest takings, are given in Table 1.

TABLE 1

		Gender bias score	Rank of gross box office takings
Film	A	15	2
	B	18	$10\frac{1}{2}$
	C	19	9
	D	8	7
	E	10	$10\frac{1}{2}$
	F	17	3
	G	13	4
	H	20	12
	I	13	1
	J	16	8
	K	12	6
	L	14	5

Fatima decided to quantify the correlation between gender bias score and gross box office takings.

(a) (i) Calculate an appropriate measure of correlation. [5 marks]

(ii) Carry out a hypothesis test, using the 10% level of significance, to investigate whether the correlation coefficient calculated in part (a)(i) indicates an association between gender bias score and gross box office takings. [4 marks]

[Turn over]

Answer space for question 5(a)
Write the question part reference in the left margin.

[Turn over]

5 (b) **Information was also available about the running time, in minutes, and the budget, in $ million, for making the film for each of the 12 films in Fatima's sample.**

This information is given in Table 2.

TABLE 2

		Running time	Budget
Film	A	135	125
	B	118	110
	C	91	5
	D	120	40
	E	117	110
	F	95	15
	G	108	13
	H	101	20
	I	95	69
	J	100	60
	K	113	80
	L	140	155

Arthur, Fatima's assistant, believed that films that had a longer running time also had a larger budget.

(i) Find the value of the product moment correlation coefficient between running time and budget. [3 marks]

(ii) Hence carry out a hypothesis test, using the 1% level of significance, to investigate Arthur's belief. [4 marks]

(iii) State, in context, the distributional assumption necessary for the test in part (b)(ii) to be valid. [2 marks]

(iv) Arthur also suspected that films released during 2010 had a longer average running time than those released during 2015. The median running time in 2015 was 106 minutes.

Carry out a sign test, at the 10% level of significance, to investigate Arthur's suspicion. [5 marks]

Answer space for question 5(b)
Write the question part reference in the left margin.

[Turn over]

[Turn over]

[Turn over]

END OF QUESTIONS

Copyright information

For confidentiality purposes, from the November 2015 examination series, acknowledgements of third party copyright material will be published in a separate booklet rather than including them on the examination paper or support materials. This booklet is published after each examination series and is available for free download from www.aqa.org.uk after the live examination series.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team, AQA, Stag Hill House, Guildford, GU2 7XJ.

Copyright © 2016 AQA and its licensors. All rights reserved.