Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

AS
STATISTICS

Unit Statistics 3

Friday 16 June 2017 Afternoon Time allowed: 1 hour 30 minutes

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

You may use a graphics calculator.

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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
TOTAL	

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.

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Answer **all** questions.

Answer each question in the space provided for that question.

1 Researchers at a university department of medicine carried out an investigation into the immediate effect of smoking a cigarette on systolic blood pressure.

The researchers selected 10 male regular smokers who were each aged between 20 years and 29 years and had a body mass index (BMI) between 20 and 24

Each man had his systolic blood pressure, x mmHg (millimetres of mercury), measured following three hours of **not** smoking a cigarette.

Then, immediately after smoking a cigarette, each man had his systolic blood pressure, y mmHg, measured again.

The results are given in the table.

Man	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
x	110	117	112	120	119	128	106	109	128	117
y	119	121	120	119	119	123	124	119	125	124

The men may be regarded as a random sample of male regular smokers aged between 20 years and 29 years with a BMI of between 20 and 24

(a) Carry out a Wilcoxon signed-rank test, using the 5% level of significance, to investigate whether, for such men, systolic blood pressure is, on average, lower after three hours of not smoking a cigarette than immediately after smoking a cigarette.

[8 marks]

(b) Give **one** reason why it would be preferable for researchers to select the 10 regular smokers involved in this research from **males only** rather than to select them from both males and females.

[2 marks]

QUESTION PART REFERENCE	**Answer space for question 1**

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QUESTION PART REFERENCE	Answer space for question 1

10

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2 A wholesaler supplies many different types of 100-gram dark chocolate bars.

A customer wants to investigate whether the recommended retail price for a 100-gram dark chocolate bar is associated with the percentage cocoa content of the chocolate in that bar.

The customer decides to select nine types of bar at random from those supplied by the wholesaler.

For each type of bar, the recommended retail price, x pence, and the cocoa content, y per cent, of the chocolate was recorded.

The results are given in the table.

Type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
x	189	209	295	220	175	295	255	195	225
y	57	70	72	80	65	90	95	62	70

(a) Calculate the value of Spearman's rank correlation coefficient between x and y .

[6 marks]

(b) (i) Carry out a hypothesis test, using the 1% level of significance, to investigate whether the correlation coefficient calculated in part **(a)** indicates a positive correlation between recommended retail price and percentage cocoa content for 100-gram dark chocolate bars.

[4 marks]

(b) (ii) Explain the meaning of a Type I error in the context of the test in part **(b)(i)**.

[2 marks]

QUESTION PART REFERENCE	**Answer space for question 2**

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QUESTION PART REFERENCE	Answer space for question 2

12

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3 A researcher investigated the reading ability of children aged seven years.

The 16 children involved in the study were randomly selected from those aged seven years attending primary schools in a large town and with exactly one younger sibling but no older siblings.

The children were categorised according to whether their sibling was 'less than two years younger' or 'at least two years younger'.

The number of words that each child could successfully read from a list of 60 words was recorded.

The results are given in the table.

Sibling age	**Less than two years younger**	21	23	28	20	19	16	18		
	At least two years younger	22	26	29	17	25	28	24	27	24

(a) Carry out a Mann–Whitney test, using the 5% level of significance, to investigate whether a child whose sibling is 'less than two years younger' can successfully read, on average, fewer words than a child whose sibling is 'at least two years younger'.

[9 marks]

(b) Explain how the researcher could obtain information to investigate whether a child aged seven years with **more than one** sibling can, on average, successfully read more words, from the same list of 60 words, than a child aged seven years with **only one** sibling.

[4 marks]

QUESTION PART REFERENCE	**Answer space for question 3**

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QUESTION PART REFERENCE	Answer space for question 3

13

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4 An agriculturalist wanted to investigate the effect of weed density on corn yield.

She obtained information from randomly selected corn-producing farms and recorded, for each farm, both corn yield and weed density.

Weed density was categorised as very low, low, moderate or high.

The corn yields, in $100\ \text{kg}$ per hectare, are given in the table below.

(a) Complete the table by inserting the missing rank values.

[3 marks]

(b) Carry out a Kruskal–Wallis test, using the 1% level of significance, to determine whether there is evidence of a difference, on average, between corn yield for the four categories of weed density.

Interpret your conclusion in the context of this question.

[12 marks]

QUESTION PART REFERENCE

Answer space for question 4

Weed density							
Very low		Low		Moderate		High	
Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank
15.9	3	11.0		11.2		10.1	
15.6	4	13.3	9	10.8		9.3	
14.1	8	15.3	5	9.4		9.9	
16.3	1	12.3	11	11.3	13	10.7	
14.3	7	14.8	6	12.1	12	9.9	
12.4	10	16.2	2	10.8		10.8	

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QUESTION PART REFERENCE	Answer space for question 4

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QUESTION PART REFERENCE	Answer space for question 4

15

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5 A clinic carried out investigations into the effectiveness of the treatments offered at the clinic.

(a) The effectiveness of the treatment offered for patients suffering frequent panic attacks was investigated.

Three different types of treatment, Cognitive Therapy (CT), Relaxation Therapy (RT) and Sympathetic Listening (SL), were offered.

Patients were allocated at random to receive one of these three types of treatment during a six-month time period. Following treatment, each patient was asked to report whether the frequency of their panic attacks had reduced or not reduced.

Of the 58 patients involved in this investigation, 17 were allocated to CT and 19 were allocated to RT.
Following treatment, a total of 23 patients reported that the frequency of their panic attacks had not reduced.
Following treatment with CT, 14 patients reported that the frequency of their panic attacks had reduced.
Following treatment with SL, 9 patients reported that the frequency of their panic attacks had reduced.

(i) Complete the contingency table below to illustrate this information.

[4 marks]

(ii) Investigate, at the 5% significance level, whether the reduction, or not, of the frequency of panic attacks is associated with the type of treatment.

[9 marks]

(iii) By comparing observed and expected frequencies, identify, in context**, two** important facts concerning type of treatment and effect on frequency of panic attacks.

[4 marks]

QUESTION PART REFERENCE

Answer space for question 5(a)

	Reduced	Not reduced	Total
CT			
RT			
SL			
Total			

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QUESTION PART REFERENCE	Answer space for question 5(a)

Question 5 continues on page 18

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QUESTION PART REFERENCE	Answer space for question 5(a)

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QUESTION PART REFERENCE	Answer space for question 5(a)

Question 5 continues on the next page

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5 (b) The effectiveness of the social competence training (SCT) offered at the clinic was also investigated.

A sample of 12 patients undertaking SCT was selected. Each patient was assigned a social competence score before the training and again after the training.

Social competence scores are on a scale of 0 to 7, where 7 indicates the highest level of social competence.

The scores are given in the table.

	Score	
Patient	**Before**	**After**
A	3	2
B	5	6
C	2	3
D	5	7
E	4	6
F	5	7
G	4	4
H	1	3
I	3	3
J	2	4
K	3	5
L	4	3

(i) Carry out a sign test, at the 5% level of significance, to investigate whether a patient's social competence score increases, on average, following SCT.

[6 marks]

(ii) State the assumption that was necessary, regarding the patients involved in this investigation, for the test carried out in part **(b)(i)** to be valid.

[2 marks]

QUESTION PART REFERENCE	**Answer space for question 5(b)**

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QUESTION PART REFERENCE	Answer space for question 5(b)

END OF QUESTIONS

25

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