Name: _____

GCSE Statistics

SRCC/PMCC

Total marks available: 65

Total marks achieved: _____

Instructions
• Use black ink or ball-point pen.
• Fill in the boxes at the top of this page with your name, centre number and candidate number.
• Answer all questions.
• Answer the questions in the spaces provided – there may be more space than you need.
• Scientific calculators may be used.
• You must show all your working out with your answer clearly identified at the end of your solution.

Information
• 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.

Q1.

A food critic was asked to compare six mince pies (labelled A to F) and to rank them in order of quality.

Jacques wants to see if the price of a mince pie depends on its quality.

The tables show information about these six mince pies.

Quality rank	Mince pie
1 (highest quality)	B
2	A
3	C
4	F
5	D
6 (lowest quality)	E

Price rank	Mince pie
1 (highest price)	C
2	B
3	A
4	F
5	E
6 (lowest price)	D

Jacques calculates Spearman's rank correlation coefficient for the quality ranks and the price ranks.

(a) Explain whether or not this is a sensible statistic for Jacques to calculate.

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(2)

The value of Spearman's rank correlation coefficient calculated by Jacques is 0.77

(b) Based on this value, write down a conclusion that Jacques could reach.
You must justify your answer.

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(2)

(Total for question = 4 marks)

Q2.

There are 11 727 students at a university.
Their nationality is classified as UK, EU or International.

The table shows information about the nationality of these students.

Nationality	UK	EU	International	Total
Number of students	9393	979	1355	11 727

(Source: *www.ox.ac.uk*)

The manager of a book shop wants to carry out a survey into the books read by the students at this university.

Three students, Amy, Beth and Carlos, bought the same eight books from the book shop.

The manager asked Amy, Beth and Carlos to rank these eight books in increasing order of how much they each enjoyed them.

The manager calculated the Spearman's rank correlation coefficient for the ranks given by Amy and Beth.

She got a result of 1.2

(a) Explain how you know that this result is not correct.

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(1)

The manager also calculated the Spearman's rank correlation coefficient for the ranks given by Beth and Carlos.

She got a result of 0.74

(b) (i) What type of correlation is shown by this result?

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(ii) Interpret this result.

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(2)

(Total for question = 3 marks)

Q3.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Raina has been watching the judging of a cake baking competition.

Two judges ranked the 10 bakers for their sponge cakes.

Raina calculated the Spearman's rank correlation coefficient for the ranks given by the judges.

She got a value of 0.8

(a) (i) What type of correlation is shown by the value 0.8?

Put a cross in one of the boxes below.

Negative correlation ☐ **No correlation** ☐ **Positive correlation** ☐

(ii) Interpret Raina's value.

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(2)

The same two judges will also be judging a flower-arranging competition.

(b) Is it possible to say anything about the ranks they are likely to give for flower arranging based on the value of Spearman's rank correlation coefficient that Raina calculated?

Give a reason for your answer.

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(1)

(Total for question = 3 marks)

Q4.

In a television talent contest, 9 acts were given the following ranks by the judges and by a public telephone vote.

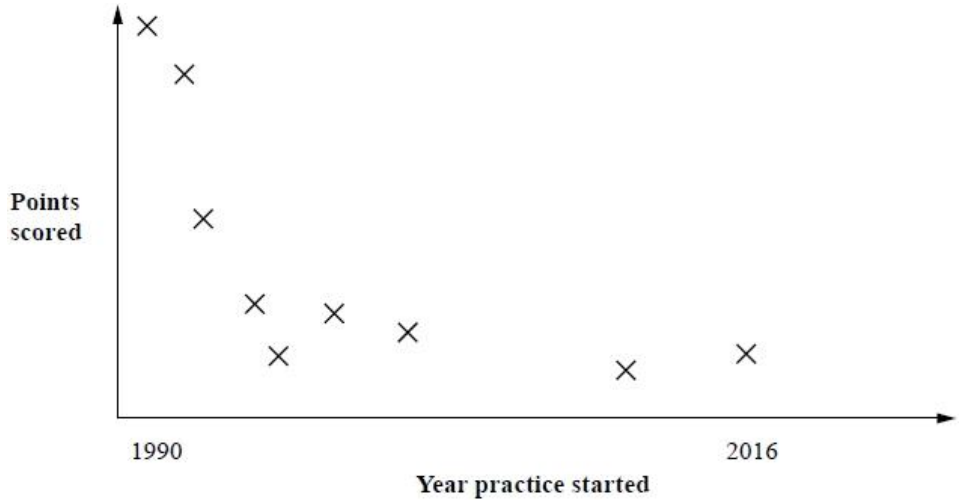
Act	Judges' rank	Public vote rank		
A	9	9		
B	3	2		
C	1	3		
D	4	5		
E	5	8		
F	8	6		
G	6	4		
H	2	1		
I	7	7		

(a) Use calculations to determine how much agreement there is between the judges and the public.

(5)

Gurdeep was investigating the relationship between the number of points scored and the year practice started for each of 9 acts.

This is the scatter diagram he obtained using statistical software.



The statistical software also calculated two correlation coefficients.

Spearman's rank correlation coefficient
Pearson's product moment correlation coefficient

(b) (i) Circle **one** value in each row below to show the most likely **pair** of correlation coefficients for this data.

Spearman's rank correlation coefficient:	−0.9	−0.7	0	0.7	0.9
Pearson's product moment correlation coefficient:	−0.9	−0.7	0	0.7	0.9

(2)

(ii) Explain your choice of answers in part (i).

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(1)

(Total for question = 8 marks)

Q5.

The World Happiness Report 2017 is based on results obtained by surveying a sample of 1000 people in each of 155 countries.

In the report each country is given a happiness score based on the answers the sampled people give to a series of questions.

The table shows the happiness scores for the top 8 countries and the Gross Domestic Product (GDP) per capita of these countries.

For the sample data, the highest happiness score (Happiness rank 1) represents the country with the happiest people and the highest GDP represents the wealthiest country.

Country	GDP per capita (US Dollars)	Happiness score		Happiness rank		
Norway	70 392	7.537		1		
Denmark	53 744	7.522		2		
Iceland	59 629	7.504		3		
Switzerland	79 242	7.494		4		
Finland	43 169	7.469		5		
Netherlands	45 283	7.377		6		
Canada	42 210	7.316		7		
New Zealand	38 345	7.314		8		

(Source: *www.worldhappiness.report*)

(a) Calculate Spearman's rank correlation coefficient for these data.

Give your answer correct to 2 decimal places.

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(4)

(b) Describe and interpret the correlation found in part (a).

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(2)

George wants to compare the happiness scores for these top 8 countries with average life expectancies for those countries.

He works out Spearman's rank correlation coefficient for these data and gets a result of 1.3

(c) Explain how you know that this result is not correct.

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(1)

George also compared the happiness scores for these countries with two other variables.

George calculated Spearman's rank correlation coefficient in each case.

His values are –0.8 and –0.5

(d) Compare these two correlation coefficients.

Give **two** comparisons.

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(2)

(Total for question = 9 marks)

Q6.

In a town music competition, 6 groups competed against each other.

The table shows the marks awarded to each group by the invited independent judge.

The table also shows what the Mayor thought the rank order of the groups should be.
(Best group is given rank 1)

Group	Marks from judge	Mayor's rank			
Artex Monkeys	37	2			
Brevity	39	1			
Carfax	36	5			
Deft Ducks	29	4			
Extinct	27	6			
Flaming Friars	34	3			

Using suitable calculations, investigate how much agreement there is between the judge and the Mayor.

You may use the blank columns in the table for your working.

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(Total for question = 5 marks)

Q7.

Gisele collected data about the age and the salary of each employee at a small company.

She used statistical software to draw a scatter diagram for her data.

(a) Give one advantage of using statistical software when representing data.

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(1)

Gisele calculated correlation coefficients for her data. She obtained the following results.

Spearman's rank correlation coefficient	0.95
Pearson's product moment correlation coefficient	0.77

(b) (i) Describe and interpret the type of correlation represented by 0.95 in the table.

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(2)

(ii) Which of the two correlation coefficients in the table represents the stronger correlation? You must give a reason for your answer.

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(1)

Figure 1 and Figure 2 show two possible scatter diagrams for Gisele's data.

Figure 1

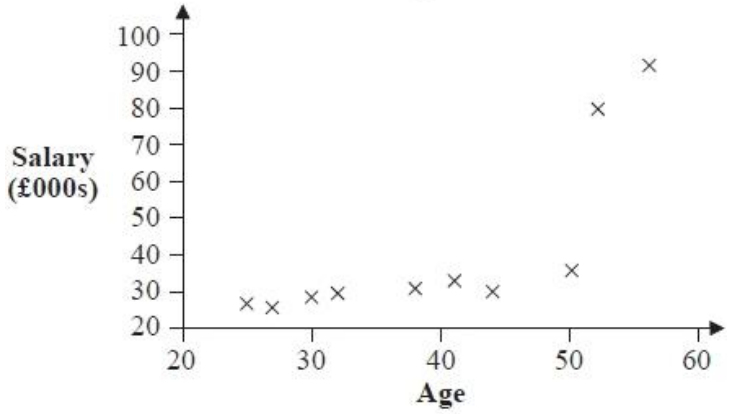
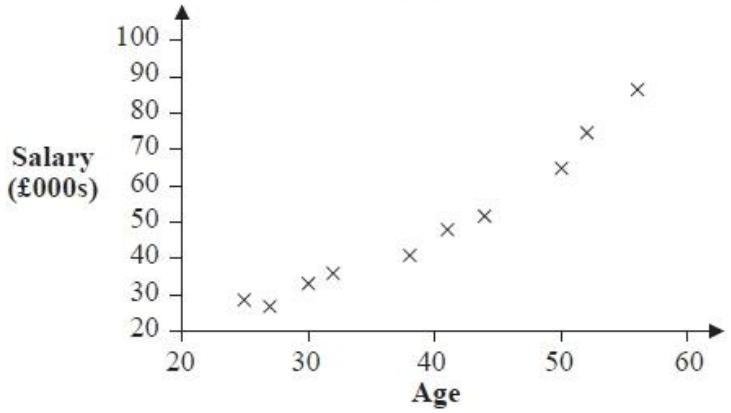


Figure 2



(c) Which one of these two diagrams most likely represents the data?
You must give a reason for your answer.

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(2)

Brett wants to use a Pearson's product moment correlation coefficient (PMCC) to compare the salaries of0020male employees with the salaries of female employees.

(d) Explain whether or not it is appropriate to use the PMCC to make this comparison.

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(1)

(Total for question = 7 marks)

Q8.

Sarah has collected bivariate data. Her data has positive correlation for which Spearman's rank correlation coefficient is greater than Pearson's product moment correlation coefficient.

(a) Using the unscaled axes, sketch a possible scatter diagram for Sarah's data.

(1)

Nick has collected data on the amount of money spent on ski equipment and the time taken to complete a particular ski course.

He finds that for his data Pearson's product moment correlation coefficient is − 0.65

(b) Which of the following conclusions is appropriate for Nick to make?

Tick (✓) the appropriate conclusion.

Spending more money on ski equipment will definitely reduce the time taken to complete the ski course	☐
As the amount of money spent on ski equipment increases, the time taken to complete the ski course decreases	☐
Both of the above	☐
None of the above	☐

(1)

(c) Give a reason for your answer to part (b).

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(1)

(Total for question = 3 marks)

Q9.

Lata is investigating whether there are relationships between the test scores in different school subjects.

Lata has collected the test scores in English and the test scores in Maths for 15 students.

She decides to plot the data on a scatter diagram.

(a) Explain whether or not this is a good choice of diagram for her investigation.

You should refer to the type of data in your answer.

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(2)

Lata worked out Pearson's product moment correlation coefficient for the English test scores and the Maths test scores for the 15 students.

She got a value of 0.65

Lata thinks that this means that if she improves her English test score then her Maths test score will improve.

(b) Is Lata right?

Explain your answer.

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(1)

Lata also collects the Science test scores for the 15 students.
Pearson's product moment correlation coefficient for the Maths test scores and the Science test scores is 0.75

(c) Compare the two correlation coefficients 0.65 and 0.75

Interpret your answer in context.

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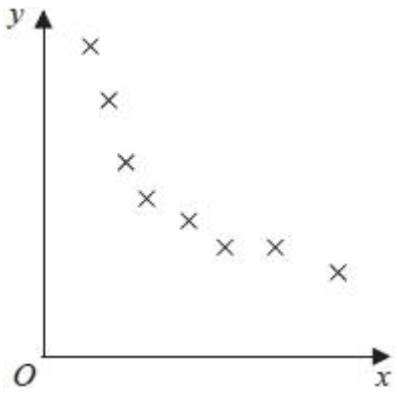
(1)

(Total for question = 4 marks)

Q10.

Here is a scatter diagram.



The Spearman's rank correlation coefficient and the Pearson's product moment correlation coefficient are each going to be calculated for the data shown in the scatter diagram.

(a) How would you expect the values of these two correlation coefficients to compare?

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(2)

The Australian Government collected data on crop yields from fields. The data collected were the yield of wheat grown in a field, in tonnes per hectare (t/ha), and the yield of other crops grown in the same field (t/ha) in a different year.

The table gives the Pearson's product moment correlation coefficient for the wheat yield and the barley yield and for the wheat yield and the oats yield. The table also gives the equation of the regression line in each case.

Explanatory variable (x)	Response variable (y)	Pearson's product moment correlation coefficient	Regression equation
Wheat yield (t/ha)	Barley yield (t/ha)	0.79	$y = 1.24x - 0.30$
Wheat yield (t/ha)	Oats yield (t/ha)	0.51	$y = 1.52x - 1.05$

(Source: *grdc.com.au*)

(b) Compare the relationship between wheat yield and barley yield with the relationship between wheat yield and oats yield.

You should refer to both correlation coefficients and to the equations of both regression lines in your comparison.

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(6)

This year Louise has a field planted with wheat. She wants to use the information in the table to decide whether to plant barley or to plant oats in the field next year. She plans to plant the crop which is predicted to give the greatest yield.

Louise solves the equation $1.24x - 0.30 = 1.52x - 1.05$

She gets the answer $\frac{75}{28}$

(c) (i) Show that the answer Louise gets is correct.

(2)

(ii) Explain how Louise could use her answer to decide which of barley or oats to plant next year.

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(2)

(iii) Give a limitation of the data that could affect the result of Louise's decision.

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(1)

(Total for question = 13 marks)

Q11.

Amelia wants to see if there is a relationship between the height of a female athlete and the time it takes her to run 100 metres.

The table gives information collected by Amelia from the internet on the heights of 8 female athletes and the best time taken by each athlete to run 100 metres.

Athlete	Height (metres)	Time (seconds)	Height ranks	Time ranks		
A	1.79	10.90	1			
B	1.75	10.83	2			
C	1.68	10.94	3			
D	1.67	10.71	4	1		
E	1.65	11.80	5			
F	1.60	10.92	6			
G	1.59	10.87	7			
H	1.52	10.86	8			

(Source: *www.olympic.org*)

Amelia's hypothesis is that the taller the female athlete, the less time it takes her to run 100 metres.

(a) Is Amelia's hypothesis supported by the data?

You must justify your answer.

(5)

(b) Write down one thing that Amelia could do to improve the reliability of her conclusion.

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(1)

(Total for question = 6 marks)