



General Certificate of Secondary Education  
2019

Centre Number

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Candidate Number

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# Further Mathematics

Unit 3  
Statistics



**[GFM31]**

\*GFM31\*

**FRIDAY 21 JUNE, AFTERNOON**

**TIME**

1 hour.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.**

**Do not write outside the boxed area on each page.**

Complete in black ink only. **Do not write with a gel pen.**

All working **must** be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.

Where rounding is necessary give answers correct to **2 decimal places** unless stated otherwise.

Answer **all seven** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 50.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You may use a calculator.

The Formula Sheet is on page 2 and the Normal Probability Table is on page 3.

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## FORMULA SHEET

### STATISTICS

Statistical measures: Mean =  $\frac{\sum fx}{\sum f}$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2}$$

where  $\bar{x}$  is the mean

Probability:  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$P(A | B) = \frac{P(A \cap B)}{P(B)}$$

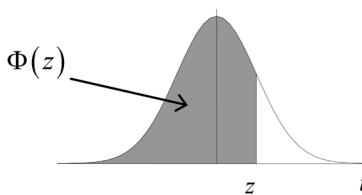
Bivariate Analysis: Spearman's coefficient of rank correlation is given by

$$r = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$



NORMAL PROBABILITY TABLE  
Table of  $\Phi(z)$

<b>Z</b>	<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.03</b>	<b>0.04</b>	<b>0.05</b>	<b>0.06</b>	<b>0.07</b>	<b>0.08</b>	<b>0.09</b>
<b>0.0</b>	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
<b>0.1</b>	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
<b>0.2</b>	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
<b>0.3</b>	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
<b>0.4</b>	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
<b>0.5</b>	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
<b>0.6</b>	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
<b>0.7</b>	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
<b>0.8</b>	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
<b>0.9</b>	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
<b>1.0</b>	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
<b>1.1</b>	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
<b>1.2</b>	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
<b>1.3</b>	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
<b>1.4</b>	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
<b>1.5</b>	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
<b>1.6</b>	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
<b>1.7</b>	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
<b>1.8</b>	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
<b>1.9</b>	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
<b>2.0</b>	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
<b>2.1</b>	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
<b>2.2</b>	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
<b>2.3</b>	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
<b>2.4</b>	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
<b>2.5</b>	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
<b>2.6</b>	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
<b>2.7</b>	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
<b>2.8</b>	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
<b>2.9</b>	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
<b>3.0</b>	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990



[Turn over



1 A solicitor recorded the times, to the nearest minute, spent with clients. The table below shows a summary of the times.

Time (minutes)	Frequency			
10–14	8			
15–19	16			
20–24	34			
25–29	27			
30–34	10			
35–39	5			

(i) Calculate an estimate of the mean time. You **must** show your working.

Answer \_\_\_\_\_ minutes [2]



(ii) Calculate an estimate of the standard deviation of the times. You **must** show your working.

Answer \_\_\_\_\_ minutes [3]

[Turn over



2 Rebekah takes 2 beads at random, without replacement, from a bag containing 6 blue and 4 green beads.

(i) What is the probability that both beads are the same colour?

Answer \_\_\_\_\_ [2]

Rebekah takes a third bead from the remaining 8 beads in the bag.

(ii) What is the probability that all 3 beads are the same colour?

Answer \_\_\_\_\_ [2]



(iii) Given that the first two beads are the same colour, what is the probability that the third bead is also the same colour as the first two?

Answer \_\_\_\_\_ [2]

[Turn over



3 Two boys and twelve girls sat a piano examination.

One boy scored 95% and the other boy scored 76%.

The mean of the girls' results was 82%.

The standard deviation of the girls' results was 6%.

(i) Calculate the mean of all 14 results.

Answer \_\_\_\_\_ % [2]



(ii) Calculate the standard deviation of all 14 results.

Answer \_\_\_\_\_ % [4]

[Turn over

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4 (a) Using Pascal's triangle, write out the expansion of  $(p + q)^6$

Answer \_\_\_\_\_ [2]



(b) A bag contains a large number of red pens and black pens.

The probability that a pen, chosen at random from the bag, is black is  $\frac{4}{5}$ .

Jill picks 6 pens, chosen at random, from the bag.

Find the probability that

(i) none of the pens is red,

Answer \_\_\_\_\_ [3]

(ii) at least 2 of the pens are red.

Answer \_\_\_\_\_ [3]

**[Turn over]**



5 A farmer sold a large number of eggs.

The weights of the eggs were normally distributed with mean 56.84 g and standard deviation 5.6 g.

Eggs weighing over 63 g were graded as large.

Find the probability that an egg, chosen at random, was graded as large.

Answer \_\_\_\_\_ [4]



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**(Questions continue overleaf)**

**[Turn over**

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**\*20GFM3113\***

6 A café recorded the number of hot soups sold and the temperature outside at lunchtime on nine particular days. The results are shown in the table below.

<b>Temperature (°C)</b>	3	5	20	17	10	9	13	15	12
<b>Hot soups sold</b>	106	98	20	38	68	80	55	44	68
<b>Ranks (Temperature)</b>									
<b>Ranks (Hot soups sold)</b>									

(i) Write down, in the table above, the rank orders for the temperatures and the numbers of hot soups sold. [2]

(ii) Calculate Spearman's coefficient of rank correlation.

Answer \_\_\_\_\_ [4]



(iii) Interpret your answer to part (ii).

Answer \_\_\_\_\_ [1]

(iv) Calculate the mean temperature and the mean number of hot soups sold.

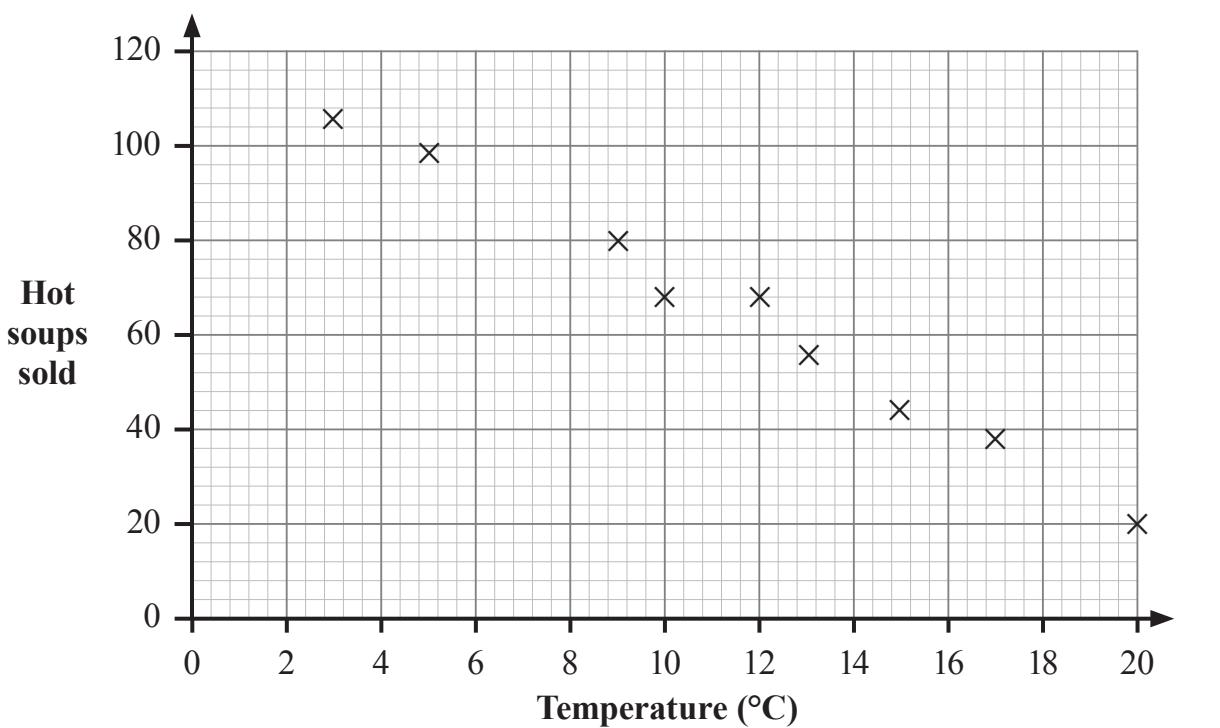
Answer Mean temperature \_\_\_\_\_ °C

Mean number of hot soups sold \_\_\_\_\_ [1]

[Turn over



The data from the table are plotted on the graph below.



(v) Draw your line of best fit on the graph.

[2]



(vi) Determine the equation of the line of best fit which you have drawn.

Answer \_\_\_\_\_ [3]

[Turn over

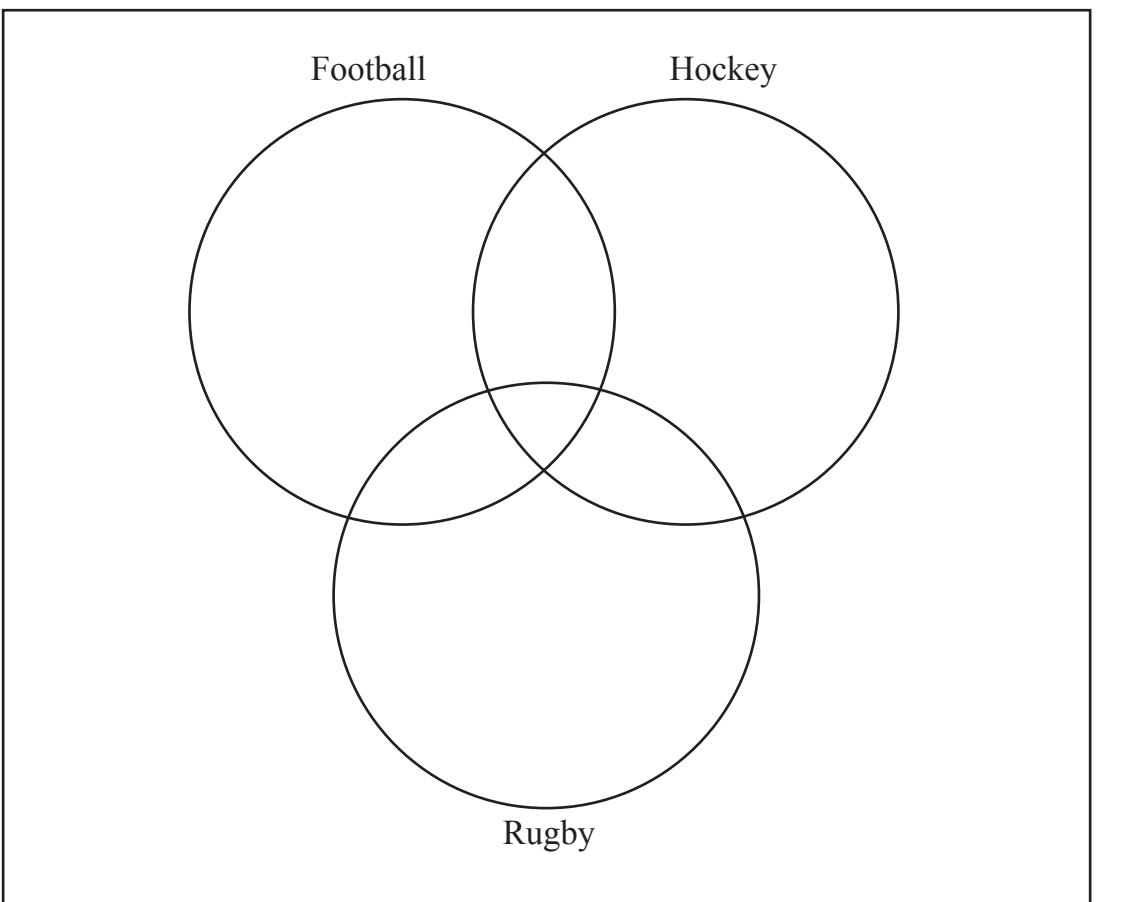
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7 At Eastwood Boys Comprehensive, 120 new pupils were allowed to sign up for three after school sports activities – football, hockey and rugby.

Each pupil signed up for **at least** one activity.

17 chose football only  
12 chose hockey only  
30 chose rugby only  
25 chose all three activities  
39 did not choose rugby



(i) Using the Venn diagram opposite, find the probability that a new pupil, selected at random, chose both football and hockey.

Answer \_\_\_\_\_ [5]

(ii) Calculate the probability that a new pupil, chosen at random, chose exactly two activities.

Answer \_\_\_\_\_ [3]

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**THIS IS THE END OF THE QUESTION PAPER**

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<b>For Examiner's use only</b>	
<b>Question Number</b>	<b>Marks</b>
1	
2	
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5	
6	
7	

<b>Total Marks</b>	

Examiner Number

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