Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022

Further Mathematics

Unit 3 **(With calculator)**
Statistics

MV18

[GFM31]

FRIDAY 24 JUNE, AFTERNOON

Time

1 hour, plus your additional time allowance.

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.
Complete in black ink only.
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 at the end of each question 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 the Insert provided.

Formula Sheet

Statistics

Statistical measures: Mean $= \dfrac{\Sigma fx}{\Sigma f}$

Standard deviation $= \sqrt{\dfrac{\Sigma fx^2}{\Sigma f} - (\overline{x})^2}$

where $\overline{x}$ is the mean

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

$P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$

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

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

1 The table below shows the numbers of pupils in a class who are right-handed and left-handed.

	Right-handed	**Left-handed**
Boys	8	3
Girls	5	7

One boy and one girl are selected at random.

Calculate the probability that both pupils are left-handed.
[2 marks]

Answer _____

2 Ten students had part-time jobs during the summer.

Jack recorded the numbers of hours they worked each week and the corresponding amounts they were paid each week. The results are shown in the table opposite.

(i) Write down, in the table opposite, the rank orders for the Hours worked and the Amount paid. [2 marks]

(ii) Calculate Spearman's coefficient of rank correlation. [4 marks]

Answer _____

Student	A	B	C	D	E	F	G	H	I	J
Hours worked	40	24	15	32	10	48	16	28	12	35
Amount paid (£)	460	320	120	360	180	430	260	350	180	340
Ranks (Hours worked)										
Ranks (Amount paid)										

(iii) Interpret your answer to part **(ii)**. [1 mark]

Answer _____

(iv) Calculate the mean Hours worked and the mean Amount paid. [1 mark]

Answer Mean Hours worked _____ hours

Mean Amount paid **£** _____

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

(v) Draw your line of best fit on the graph. [2 marks]

Amount paid (£)
550
500
450
400
350
300
250
200
150
100
50
0
Hours worked
0
5
10
15
20
25
30
35
40
45
50
55
60

(vi) Determine the equation of the line of best fit which you have drawn. [3 marks]

Answer _____

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(Questions continue overleaf)

3 Paul recorded his golf scores over the course of a year.

His results are summarised in the table below.

Score	**Frequency**			
65 – 67	4			
68 – 70	12			
71 – 73	24			
74 – 76	32			
77 – 79	6			
80 – 82	2			

(i) Calculate an estimate of the mean score. [2 marks]

You **must show clearly** each step of your work using the table above.

Answer _____

(ii) Explain why the answer for the mean in part **(i)** is only an estimate. [1 mark]

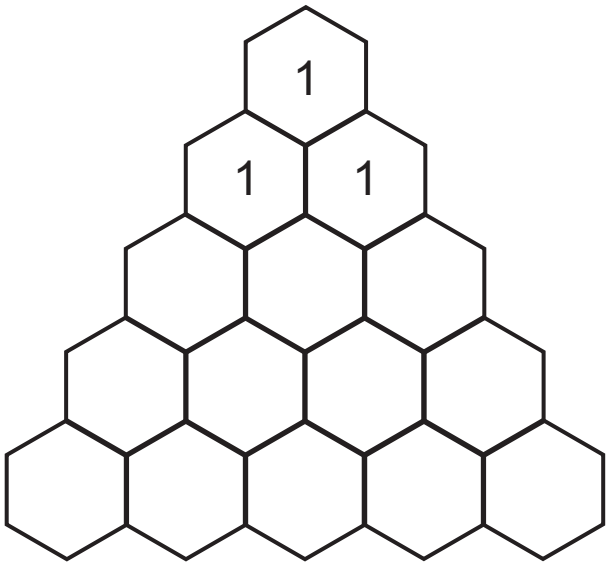
Answer _____

(iii) Calculate an estimate of the standard deviation of the scores. [3 marks]

You **must show clearly** each step of your work using the table opposite.

Answer _____

4 **(i)** Complete Pascal's triangle in the grid below. [1 mark]



(ii) Hence write down the expansion of $(p + q)^4$ [1 mark]

Answer _____

Charlotte goes into a room where there are four windows.

Each window is either open or closed.

The probability that a window is open is 0.7

(iii) Find the probability that exactly three windows are closed. [3 marks]

Answer _____

(iv) Find the probability that at least two windows are closed. [3 marks]

Answer _____

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(Questions continue overleaf)

5 Throughout the year Alice took nine written tests and five practical tests in Music.

The mean mark of her nine written tests was 69

The mean mark of her five practical tests was 83

(i) Calculate the mean mark of all 14 tests. [2 marks]

Answer _____

The standard deviation of her nine written tests was 15.4

The standard deviation of her five practical tests was 7.8

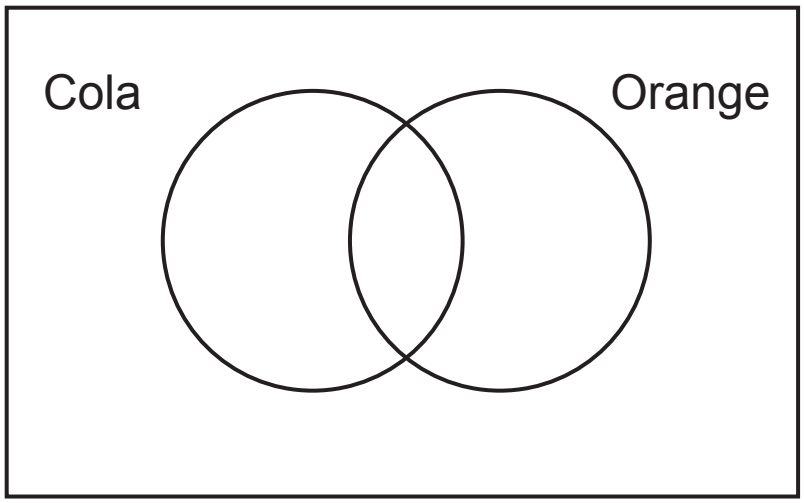
(ii) Calculate the standard deviation of all 14 tests.
[4 marks]

Answer _____

6 Students at a school were asked which drinks they drink regularly.

88%	drink Cola
65%	drink Orange
7%	drink neither Cola nor Orange.

(i) Using the diagram below, or otherwise, find the percentage of students who drink both Cola and Orange. [2 marks]



Answer _____ %

(ii) Find the probability that a student, selected at random, does not drink Orange, given that they drink Cola. [2 marks]

Answer _____

Two students are selected at random.

(iii) Find the probability that one of them drinks Cola only and the other one drinks Orange only, giving your answer to 3 decimal places. [2 marks]

Answer _____

7 A teacher recorded the times taken to complete a cross-country race by Year 12 pupils.

The times were normally distributed with mean 46 minutes and standard deviation 8 minutes.

(i) Find the probability that a pupil, chosen at random, took less than 60 minutes to complete the race. Give your answer correct to 4 decimal places. [3 marks]

Answer _____

(ii) Find the probability that a pupil, chosen at random, took less than 34 minutes to complete the race. Give your answer correct to 4 decimal places. [4 marks]

Answer _____

(iii) Find the probability that a pupil, chosen at random, took less than 34 minutes to complete the race, given that they took less than 60 minutes to complete the race.
Give your answer correct to 4 decimal places.
[2 marks]

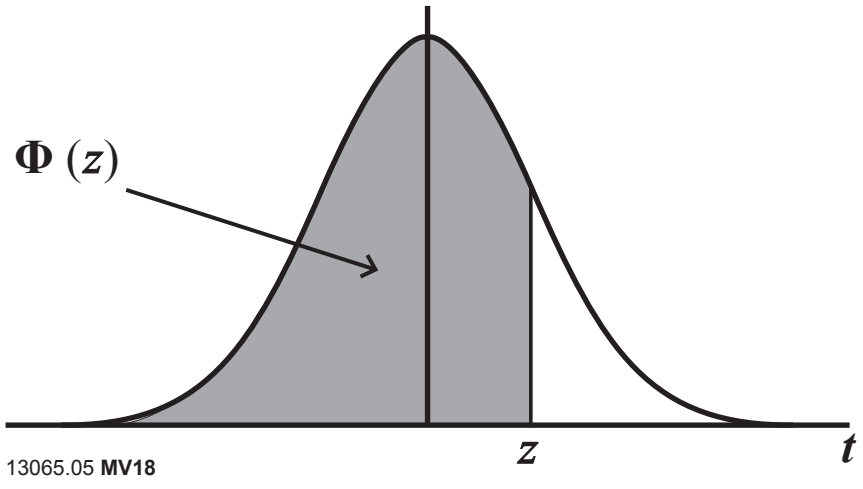
Answer _____

This is the end of the question paper

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
Total Marks	

Normal Probability Table
Table of $\Phi(z)$

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



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