



NUMERACY & STATISTICS

December 2019

Time allowed

Three hours

Instructions

- Write the question number next to each answer in your answer booklet.
- You are not required to rewrite the question in your answer booklet.
- Ensure that you pay particular attention to words in **bold**.

Information

- Different questions may carry a different number of marks.
- Marks for each question are shown in [].

Advice

- Read each question carefully before you start to answer it.
- Use the full time permitted and check all your answers.

Materials

- No other computer equipment, notes or books are permitted.
- For those exams in which numeracy skills are required:
 - a) Non-programmable calculators are permitted.
 - b) All data tables are included at the back of the paper if necessary.



ICM

ANSWER ALL QUESTIONS IN PART A AND ANY THREE QUESTIONS IN PART B.

Part A carries 40% of the final mark and Part B carries 60% of the final mark.

You must show all of your workings.

All graphs should be plotted on the graph paper provided.

Part A (answer ALL questions)

1. Calculate the following:

(a) $\frac{15-3}{8} \times \frac{3}{5}$

[3 marks]

(b) $2^3 + 2^0 - 3^2$

[3 marks]

(c) The price for a pair of shoes is £24.50 in a sale. The shoes had been reduced by 15%. Calculate the price for the shoes *before* the sale.

[4 marks]

2. An investor needs your advice as to whether she should invest in a business opportunity. The table below shows the **only** five potential outcomes. The probability of making a profit of \$6000 is 17%. The probability of making a profit of \$3500 is 0.14. The probability of making a loss of \$1250 is one-quarter. The probability of making a loss of \$6000 is 18%.

Profit of \$6000
Profit of \$3500
Profit of \$500
Loss of \$1250
Loss of \$6000

(a) Calculate the expected value of profit or loss for this investment.

[7 marks]

(b) What advice would you give to the investor? Explain your reasons.

[3 marks]

3. The data in the table below shows the sales for different types of vehicles over a three-month period.

Type of vehicle	August 2019	September 2019	October 2019
Saloon	3	2.5	3.2
Crossover	4	4	4
Sports	0.5	0	0.75
Other	2	1.5	4

Figures are given as '000

Plot a multiple bar chart for these data.

[10 marks]

continued overleaf

4. A company is interested in how wages have changed over time. They have asked you to conduct research into this.
- (a) You have been asked to develop a questionnaire to give to employees of the company.
- (i) Suggest **one** question you could ask that would produce **quantitative** data only. [1 mark]
- (ii) Suggest **one** question you could ask that would produce **qualitative** data only. [2 marks]
- (b) Describe how you would investigate how wages have changed over time using **secondary** data. [4 marks]
- (c) Three years ago the average wage at the company was £37250. Today it is 3.62% higher. Calculate what the average wage is today. [3 marks]

Part B (answer THREE questions from the FOUR)

5. A bank is advertising a new savings account. It is an account that will last for eight years.
- The annual rate of interest is 1.37% for the first two years.
- It increases to 1.55% for the next four years.
- For the final two years it increases to 3.14%.
- Carole decides to put €7325 into the account and never withdraws from it.
- Calculate how much will be in Carole's account:
- (a) after 2 years [3 marks]
- (b) after 5 years [5 marks]
- (c) after 8 years [4 marks]
- (d) Vanessa decided to open one of the accounts too. She puts €10000 into the account. There is no penalty for withdrawing any money. Interest is calculated annually and is based on how much is in the account on April 1st each year.
- (i) After the end of year 2, Vanessa withdraws €2000 on April 2nd. Calculate how much will be in Vanessa's account at the end of year 3. [4 marks]
- (ii) After the end of year 3, Vanessa withdraws \$2500 on April 2nd. Calculate how much will be in Vanessa's account at the end of year 8 as she does not withdraw any more money from the account. [4 marks]

6. The table below shows the production levels over a 12-month period for a new line of sports clothing. Total costs are also shown.

Production Levels ('00)	Total costs (\$'000)
55	135
52	101
43	87
32	72
17	54
24	83
24	92
35	63
51	88
50	99
63	124
75	150

- (a) Draw a scatter diagram of these data **and** draw a line of best fit. [10 marks]
- (b) Use the scatter diagram to estimate the fixed monthly cost of producing the sports clothing. [3 marks]
- (c) Using the line of best fit, what would be the total cost of producing 4000 items of clothing? [3 marks]
- (d) The company sells one of its new pairs of trainers for \$125.99. The profit on each pair of trainers is 72%. Calculate how much it costs to produce one pair of trainers. [4 marks]

7. The table below shows the distribution of annual wages in a company of 13500 employees.

Wages (£'000) [W]	Frequency
$0 \leq W \leq 10$	4852
$10 \leq W \leq 15$	3589
$15 \leq W \leq 20$	3257
$20 \leq W \leq 30$	1573
$30 \leq W \leq 100$	229

- (a) A class refers to one of the intervals in the table above.
For example, $20 \leq W \leq 30$ is a class.
- (i) State the modal class for these data. Explain why it is the modal class. [2 marks]
- (ii) State the median class for these data. Explain how you calculated this. [3 marks]
- (b) Estimate the arithmetic mean for these data. Leave your answer to the **nearest pound**. [11 marks]
- (c) Draw and label the **axes** you would need to be able to plot the data as an ogive (cumulative frequency). Do **not** plot the data. [4 marks]

8. Blessing has been recording the amount of time people spend in her shop. She has noticed that the data is normally distributed with a mean time of 17 minutes and a standard deviation of 7.3 minutes.

(a) Calculate the proportion of people who spend less than 8 minutes in her shop.

Your answer must be to **four decimal places**.

[5 marks]

(b) Calculate the percentage of people who spend between 15 minutes and 23 minutes in her shop. Your answer must be a **whole number**.

[10 marks]

A different shop also recorded the amount of time people spent there. The data was also normally distributed. The mean time spent in the shop was 11 minutes and the percentage of people spending less than eight minutes in the shop was 30.153%

(c) Calculate the standard deviation of time spent in this shop.

[5 marks]

END OF QUESTIONS

FORMULA SHEET

Quadratic Formula

For a quadratic equation in the form $ax^2 + bx + c = 0$:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Normal Distribution

The z score for a normal distribution:

$$z = \frac{x - \mu}{\sigma}$$

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Table of the standard normal distribution values ($z \leq 0$)

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-0.0	0.50000	0.49601	0.49202	0.48803	0.48405	0.48006	0.47608	0.47210	0.46812	0.46414
-0.1	0.46017	0.45621	0.45224	0.44828	0.44433	0.44038	0.43644	0.43251	0.42858	0.42466
-0.2	0.42074	0.41683	0.41294	0.40905	0.40517	0.40129	0.39743	0.39358	0.38974	0.38591
-0.3	0.38209	0.37828	0.37448	0.37070	0.36693	0.36317	0.35942	0.35569	0.35197	0.34827
-0.4	0.34458	0.34090	0.33724	0.33360	0.32997	0.32636	0.32276	0.31918	0.31561	0.31207
-0.5	0.30854	0.30503	0.30153	0.29806	0.29460	0.29116	0.28774	0.28434	0.28096	0.27760
-0.6	0.27425	0.27093	0.26763	0.26435	0.26109	0.25785	0.25463	0.25143	0.24825	0.24510
-0.7	0.24196	0.23885	0.23576	0.23270	0.22965	0.22663	0.22363	0.22065	0.21770	0.21476
-0.8	0.21186	0.20897	0.20611	0.20327	0.20045	0.19766	0.19489	0.19215	0.18943	0.18673
-0.9	0.18406	0.18141	0.17879	0.17619	0.17361	0.17106	0.16853	0.16602	0.16354	0.16109
-1.0	0.15866	0.15625	0.15386	0.15151	0.14917	0.14686	0.14457	0.14231	0.14007	0.13786
-1.1	0.13567	0.13350	0.13136	0.12924	0.12714	0.12507	0.12302	0.12100	0.11900	0.11702
-1.2	0.11507	0.11314	0.11123	0.10935	0.10749	0.10565	0.10384	0.10204	0.10027	0.09853
-1.3	0.09680	0.09510	0.09342	0.09176	0.09012	0.08851	0.08692	0.08534	0.08379	0.08226
-1.4	0.08076	0.07927	0.07780	0.07636	0.07493	0.07353	0.07215	0.07078	0.06944	0.06811
-1.5	0.06681	0.06552	0.06426	0.06301	0.06178	0.06057	0.05938	0.05821	0.05705	0.05592
-1.6	0.05480	0.05370	0.05262	0.05155	0.05050	0.04947	0.04846	0.04746	0.04648	0.04551
-1.7	0.04457	0.04363	0.04272	0.04182	0.04093	0.04006	0.03920	0.03836	0.03754	0.03673
-1.8	0.03593	0.03515	0.03438	0.03363	0.03288	0.03216	0.03144	0.03074	0.03005	0.02938
-1.9	0.02872	0.02807	0.02743	0.02680	0.02619	0.02559	0.02500	0.02442	0.02385	0.02330
-2.0	0.02275	0.02222	0.02169	0.02118	0.02068	0.02018	0.01970	0.01923	0.01876	0.01831
-2.1	0.01786	0.01743	0.01700	0.01659	0.01618	0.01578	0.01539	0.01500	0.01463	0.01426
-2.2	0.01390	0.01355	0.01321	0.01287	0.01255	0.01222	0.01191	0.01160	0.01130	0.01101
-2.3	0.01072	0.01044	0.01017	0.00990	0.00964	0.00939	0.00914	0.00889	0.00866	0.00842
-2.4	0.00820	0.00798	0.00776	0.00755	0.00734	0.00714	0.00695	0.00676	0.00657	0.00639
-2.5	0.00621	0.00604	0.00587	0.00570	0.00554	0.00539	0.00523	0.00509	0.00494	0.00480
-2.6	0.00466	0.00453	0.00440	0.00427	0.00415	0.00403	0.00391	0.00379	0.00368	0.00357
-2.7	0.00347	0.00336	0.00326	0.00317	0.00307	0.00298	0.00289	0.00280	0.00272	0.00264
-2.8	0.00256	0.00248	0.00240	0.00233	0.00226	0.00219	0.00212	0.00205	0.00199	0.00193
-2.9	0.00187	0.00181	0.00175	0.00170	0.00164	0.00159	0.00154	0.00149	0.00144	0.00140
-3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00104	0.00100
-3.1	0.00097	0.00094	0.00090	0.00087	0.00085	0.00082	0.00079	0.00076	0.00074	0.00071
-3.2	0.00069	0.00066	0.00064	0.00062	0.00060	0.00058	0.00056	0.00054	0.00052	0.00050
-3.3	0.00048	0.00047	0.00045	0.00043	0.00042	0.00040	0.00039	0.00038	0.00036	0.00035
-3.4	0.00034	0.00033	0.00031	0.00030	0.00029	0.00028	0.00027	0.00026	0.00025	0.00024
-3.5	0.00023	0.00022	0.00022	0.00021	0.00020	0.00019	0.00019	0.00018	0.00017	0.00017

Table of the standard normal distribution values ($z \geq 0$)

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.50000	0.50399	0.50798	0.51197	0.51595	0.51994	0.52392	0.52790	0.53188	0.53586
0.1	0.53983	0.54380	0.54776	0.55172	0.55567	0.55962	0.56356	0.56749	0.57142	0.57535
0.2	0.57926	0.58317	0.58706	0.59095	0.59483	0.59871	0.60257	0.60642	0.61026	0.61409
0.3	0.61791	0.62172	0.62552	0.62930	0.63307	0.63683	0.64058	0.64431	0.64803	0.65173
0.4	0.65542	0.65910	0.66276	0.66640	0.67003	0.67364	0.67724	0.68082	0.68439	0.68793
0.5	0.69146	0.69497	0.69847	0.70194	0.70540	0.70884	0.71226	0.71566	0.71904	0.72240
0.6	0.72575	0.72907	0.73237	0.73565	0.73891	0.74215	0.74537	0.74857	0.75175	0.75490
0.7	0.75804	0.76115	0.76424	0.76730	0.77035	0.77337	0.77637	0.77935	0.78230	0.78524
0.8	0.78814	0.79103	0.79389	0.79673	0.79955	0.80234	0.80511	0.80785	0.81057	0.81327
0.9	0.81594	0.81859	0.82121	0.82381	0.82639	0.82894	0.83147	0.83398	0.83646	0.83891
1.0	0.84134	0.84375	0.84614	0.84849	0.85083	0.85314	0.85543	0.85769	0.85993	0.86214
1.1	0.86433	0.86650	0.86864	0.87076	0.87286	0.87493	0.87698	0.87900	0.88100	0.88298
1.2	0.88493	0.88686	0.88877	0.89065	0.89251	0.89435	0.89617	0.89796	0.89973	0.90147
1.3	0.90320	0.90490	0.90658	0.90824	0.90988	0.91149	0.91308	0.91466	0.91621	0.91774
1.4	0.91924	0.92073	0.92220	0.92364	0.92507	0.92647	0.92785	0.92922	0.93056	0.93189
1.5	0.93319	0.93448	0.93574	0.93699	0.93822	0.93943	0.94062	0.94179	0.94295	0.94408
1.6	0.94520	0.94630	0.94738	0.94845	0.94950	0.95053	0.95154	0.95254	0.95352	0.95449
1.7	0.95543	0.95637	0.95728	0.95818	0.95907	0.95994	0.96080	0.96164	0.96246	0.96327
1.8	0.96407	0.96485	0.96562	0.96638	0.96712	0.96784	0.96856	0.96926	0.96995	0.97062
1.9	0.97128	0.97193	0.97257	0.97320	0.97381	0.97441	0.97500	0.97558	0.97615	0.97670
2.0	0.97725	0.97778	0.97831	0.97882	0.97932	0.97982	0.98030	0.98077	0.98124	0.98169
2.1	0.98214	0.98257	0.98300	0.98341	0.98382	0.98422	0.98461	0.98500	0.98537	0.98574
2.2	0.98610	0.98645	0.98679	0.98713	0.98745	0.98778	0.98809	0.98840	0.98870	0.98899
2.3	0.98928	0.98956	0.98983	0.99010	0.99036	0.99061	0.99086	0.99111	0.99134	0.99158
2.4	0.99180	0.99202	0.99224	0.99245	0.99266	0.99286	0.99305	0.99324	0.99343	0.99361
2.5	0.99379	0.99396	0.99413	0.99430	0.99446	0.99461	0.99477	0.99492	0.99506	0.99520
2.6	0.99534	0.99547	0.99560	0.99573	0.99585	0.99598	0.99609	0.99621	0.99632	0.99643
2.7	0.99653	0.99664	0.99674	0.99683	0.99693	0.99702	0.99711	0.99720	0.99728	0.99736
2.8	0.99744	0.99752	0.99760	0.99767	0.99774	0.99781	0.99788	0.99795	0.99801	0.99807
2.9	0.99813	0.99819	0.99825	0.99831	0.99836	0.99841	0.99846	0.99851	0.99856	0.99861
3.0	0.99865	0.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99896	0.99900
3.1	0.99903	0.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
3.2	0.99931	0.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950
3.3	0.99952	0.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
3.4	0.99966	0.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
3.5	0.99977	0.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983