CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY27, FEBRUARY 2025

INSTRUCTIONS:

1. **Time allowed: 3 hours and 15 minutes**. (15 minutes reading and 3 hours writing).
2. This paper has **seven questions** and only **five questions** are to be attempted.
3. Marks allocated to each question are shown at the end of the question.
4. Show all your workings and formulas, where applicable.
5. The question paper should not be taken out of the examination room.

QUESTION ONE

a) **Explain four properties of probability as applied to Business Mathematics and Statistics.** (4 Marks)

b) The Managing Director of HEZA Company Limited is considering the investment of two machine. After a thorough market analysis and evaluation, the prediction showed that there is 60% chance that machine A generate a profit of FRW 900,000,000 under favourable market conditions and a profit of FRW100,000,000 under unfavourable market conditions. For machine B, there is a 70% chance that it will generate a profit of FRW 850,000,000 under favourable market conditions and generates a profit of FRW250,000,000 under unfavourable market conditions.

Required:
Calculate the expected profit for each machine and advise the Director on which machine he should consider for investment. (4 Marks)

c) The distribution of customers who purchased products from HEZA Company Limited is shown in the table as follows:

X	0	1	2	3	4
P(X)	0.01	0.15	0.25	0.20	0.39

Required:

Determine the variance and standard deviation of the customers who purchased the products. (4 Marks)

d) The Sports Prefect of Mugahinga High school in Musanze District did a survey of 130 students about the games students liked to play. The following were the results on three main games played at school:
54 students played football
30 students played basketball
50 students played volleyball
26 students played football and volleyball
16 students played football and basketball
11 students played basketball and volleyball
40 students played none of the three games.

Required:

i) Present the above information on a Venn diagram. (4 Marks)
ii) Find the number of students who played all the three games. (2 Marks)
iii) Find the number of students who played exactly one of the three games. (2 Marks)

(Total: 20 Marks)

QUESTION TWO

a) In a recent survey conducted by the returning officer of Mudugudu Cell about the people who had registered for the forth coming elections in that Cell before the deadline set by Election Commissioner. Of 1,000 people asked, 850 people had registered before the set deadline.

Required:

i) Explain what is meant by 'standard error of mean' and identify one area where it is applied in estimation and sampling. (2 Marks)

ii) Estimate the confidence interval of the population proportion of the registered people at the level of confidence of 95%. (4 Marks)

b) The income of the residents of Isonga Sector is normally distribution with a mean of FRW 600,000 and standard deviation of FRW 50,000.

Required:

i) Find the probability of individuals with income less than FRW 470,000 in Isonga Sector. **(**2 Marks)

ii) Find the probability of individuals with income between FRW 550,000 and FRW 600,000. (2 Marks)

iii) Find the probability of individuals with income more than FRW 680,000 in Isonga Sector. (2 Marks)

c) Local authorities of a certain sector complained that some drug shops sold expired drugs. A pharmacist did a test on a random sample of 20 drugs and it was found out that 0.03 drugs had expired:

Required:

i) Find the probability that there are exactly five expired drugs. (3 Marks)

ii) Find the probability that at least one drugs had expired. (3 Marks)

iii)Find the mean number of expired drugs and their standard deviation in the shops. (2 Marks)

(Total: 20 Marks)

QUESTION THREE

a) **Explain two types of capital investment problems that can be solved using discounted cash flows.** (2 Marks)

b) Murangira is considering an investment project that is expected to generate cash flows for five years. He will invest an initial outlay of FRW 850,000,000. There will be no scrap values at the end of project's useful life. The cost of capital is expected to be 10%. The table below shows the cash flows of the project for the five years:

Year	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cash flow (FRW'000')	150,000	200,000	230,000	280,000	320,000

Required:

Calculate the net present value for the project and advise Mr. Murangira on whether to proceed with investment proposal. Round off to 3 decimal places. (6 Marks)

c) Electric motor cyclists in Kigali believe that the motorcycle battery lasts 10 hours before being recharged. A survey was conducted on a random sample of 100 motorcycles and the results indicate that the mean hours that the batteries lasted was 8 hours with a standard deviation of 1.2 hours.

Required:

Conduct a statistical test at 5% level of significance to test whether motorcyclists' belief is true. (6 Marks)

d) The table below shows the prices (in FRW) and quantities (in Kgs) of a given basket of commodities from KIMIRONKO market between 2021 and 2023:

	2021		**2023**	
Commodity	**Price (FRW)**	**Quantity (Kgs)**	**Price (FRW)**	**Quantity (Kgs)**
Maize	1,500	100	1,600	180
Rice	1,900	150	2,100	200
Beef	3,200	200	3,400	150
Chicken	4,500	250	4,800	260

Required:

Taking 2021 as the base year, calculate Laspyre's, Paasche's and Fischer's Price Indices for the given basket of commodities and provide an interpretation of Fischer's Price Index computed. (6 Marks)

(Total: 20 Marks)

QUESTION FOUR

a) **Distinguish between random sampling and non–random sampling and highlight two types of non – probability sampling.** (4 Marks)

b) **Discuss four basic rules of differentiation applied in Business Mathematics.** (4 Marks)

c) **Draw the graph of the function $f(x) = 2x^2 + 4x + 2$ for these values x = (– 3, – 2, 0 and 1).** (4 Marks)

d) A farmer has two plots of land and he is planning for next season. He plans to grow 200 kgs of maize and 300 kgs of beans on plot A**.** He grows 300 kgs of maize and 200 kgs on plot B. It will cost him FRW 1,300 per kg and FRW 1,200 per kg to grow both crops on plot A and plot B respectively.

Required:
Using information from d), solve the simultaneous equation by elimination method to find the cost of each crop per kg. (4 Marks)

e) **Find the inverse of a matrix from information provided above on d.** (4 Marks)

(Total: 20 Marks)

QUESTION FIVE

The data on the scores of 50 candidates in Business Mathematics and Quantitative Methods Mock Test out of 100 from various training institutions was collected in July 2024 and the details are provided in the table below:

Scores	**Frequency**
0 – 20	7
20 – 40	12
40 – 60	18
60 – 80	10
80 – 100	3
Total	**50**

Required:

a) **Differentiate between measures of central tendency and measures of dispersion/variation.** (2 Marks)

b) **Calculate the mean, median and model scores of the candidates who did the Business Mathematics and Quantitative Methods tests.** (7 Marks)

c) **Using the data above, draw a histogram to display the scores of the candidates who did the test.** (7 Marks)

d) **Discuss two branches of statistics.** (2 Marks)

e) **Define what is meant by permutation as applied to statistics.** (2 Marks)

(Total: 20 Marks)

QUESTION SIX

a) Berwa Holdings is planning to invest in various business ventures in the financial year after a thorough analysis of various potential investments. The Business Analyst has collected data for four investment projects under three states of nature.

A table showing various investment projects under various states of nature

	Favourable Market (FRW 000)	Moderate Market (FRW 000)	Unfavourable market (FRW 000)
Real Estates	1,500	850	500
Agri-business	1,300	900	400
Bonds	1,000	750	600

The coefficient of realism is 0.7

Required:

Determine the optimal decision and reason under the following criteria:

i) Maximax. (1 Mark)
ii) Maximin. (1 Mark)
iii) Minimax. (5 Marks)
iv) Hurwitz. (3 Marks)

b) Berwa Holdings produces and distributes its product across five provinces of the country. Due to increasing demand, the company plans to establish distribution centers in each of the five provinces. The challenge is determining the most efficient dispatch routes to these centers to minimize the total travel distance. The matrix table below provides the distances, in kilometers, between the provinces and the proposed distribution centers:

Distribution / Provinces	Centre I	Centre II	Centre III	Centre IV	Centre V
Kigali City	180	150	195	210	220
Northern	155	140	150	180	190
Southern	110	80	125	140	155
Eastern	40	40	70	70	130
Western	45	25	60	70	95

Required:

You have been asked by the Logistics Manager of Berwa to determine the optimal assignment schedule using Hungarian Algorithm and calculate the total minimum distance. (10 Marks)

(Total: 20 Marks)

QUESTION SEVEN

The table below shows the data on sales and advertising expenditure of MUGISHA Co. (in FRW) for each of 6 months:

Sales (FRW '000')	**Advertising Expenditure (FRW '000')**
2,800	800
3,600	1,200
4,600	1,800
6,800	2,600
8,200	3,600
9,800	4,800

Required:

a) **Determine the correlation coefficient between sales advertising expenditure for MUGISHA Co.** (6 Marks)

b) **Forecast the sales of MUGISHA Co. of the ninth month given that the expenditure of the same month is FRW 5,200,000 using a regression line.** (6 Marks)

c) MUGISHA Co. is considering undertaking a project of ten activities. Information about proceeding activities and the duration (in weeks) is provided below:

Proceeding Activities	Activity	Duration (weeks)
-	A	5
-	B	4
A	C	7
B	D	5
B	E	1
C, D	F	6
E	G	2
E	H	7
A	I	7
I, F, G	J	3

Required:

i) Construct an activity network diagram for this project. (5 Marks)
ii) Determine the critical path from the network. (1 Marks)
iii) Estimate the duration for this project from the network. (1 Marks)
iv) Explain what is meant by "network analysis". (1 Marks)

(Total: 20 Marks)

End of Question Paper

Present value interest factor of FRW 1 per period at i% for n periods, PVIF(i,n).

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593
6	0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352
11	0.896	0.804	0.722	0.650	0.585	0.527	0.475	0.429	0.388	0.350	0.317
12	0.887	0.788	0.701	0.625	0.557	0.497	0.444	0.397	0.356	0.319	0.286
13	0.879	0.773	0.681	0.601	0.530	0.469	0.415	0.368	0.326	0.290	0.258
14	0.870	0.758	0.661	0.577	0.505	0.442	0.388	0.340	0.299	0.263	0.232
15	0.861	0.743	0.642	0.555	0.481	0.417	0.362	0.315	0.275	0.239	0.209
16	0.853	0.728	0.623	0.534	0.458	0.394	0.339	0.292	0.252	0.218	0.188
17	0.844	0.714	0.605	0.513	0.436	0.371	0.317	0.270	0.231	0.198	0.170
18	0.836	0.700	0.587	0.494	0.416	0.350	0.296	0.250	0.212	0.180	0.153
19	0.828	0.686	0.570	0.475	0.396	0.331	0.277	0.232	0.194	0.164	0.138
20	0.820	0.673	0.554	0.456	0.377	0.312	0.258	0.215	0.178	0.149	0.124

Normal Distribution Table – Z-table

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	0.115070.11314	0.11123	0.10935	0.10749	0.10565	0.10384	0.10204	0.10027	0.09853
1.3	0.096800.09510	0.09342	0.09176	0.09012	0.08851	0.08692	0.08534	0.08379	0.08226
1.4	0.080760.07927	0.07780	0.07636	0.07493	0.07353	0.07215	0.07078	0.06944	0.06811
1.5	0.066810.06552	0.06426	0.06301	0.06178	0.06057	0.05938	0.05821	0.05705	0.05592
1.6	0.054800.05370	0.05262	0.05155	0.05050	0.04947	0.04846	0.04746	0.04648	0.04551
1.7	0.044570.04363	0.04272	0.04182	0.04093	0.04006	0.03920	0.03836	0.03754	0.03673
1.8	0.035930.03515	0.03438	0.03363	0.03288	0.03216	0.03144	0.03074	0.03005	0.02938
1.9	0.028720.02807	0.02743	0.02680	0.02619	0.02559	0.02500	0.02442	0.02385	0.02330
2.0	0.022750.02222	0.02169	0.02118	0.02068	0.02018	0.01970	0.01923	0.01876	0.01831
2.1	0.017860.01743	0.01700	0.01659	0.01618	0.01578	0.01539	0.01500	0.01463	0.01426
2.2	0.013900.01355	0.01321	0.01287	0.01255	0.01222	0.01191	0.01160	0.01130	0.01101
2.3	0.010720.01044	0.01017	0.00990	0.00964	0.00939	0.00914	0.00889	0.00866	0.00842
2.4	0.008200.00798	0.00776	0.00755	0.00734	0.00714	0.00695	0.00676	0.00657	0.00639
2.5	0.006210.00604	0.00587	0.00570	0.00554	0.00539	0.00523	0.00509	0.00494	0.00480
2.6	0.004660.00453	0.00440	0.00427	0.00415	0.00403	0.00391	0.00379	0.00368	0.00357
2.7	0.003470.00336	0.00326	0.00317	0.00307	0.00298	0.00289	0.00280	0.00272	0.00264
2.8	0.002560.00248	0.00240	0.00233	0.00226	0.00219	0.00212	0.00205	0.00199	0.00193
2.9	0.001870.00181	0.00175	0.00170	0.00164	0.00159	0.00154	0.00149	0.00144	0.00140
3.0	0.001350.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00104	0.00100
3.1	0.000970.00094	0.00090	0.00087	0.00085	0.00082	0.00079	0.00076	0.00074	0.00071
3.2	0.000690.00066	0.00064	0.00062	0.00060	0.00058	0.00056	0.00054	0.00052	0.00050
3.3	0.000480.00047	0.00045	0.00043	0.00042	0.00040	0.00039	0.00038	0.00036	0.00035
3.4	0.000340.00033	0.00031	0.00030	0.00029	0.00028	0.00027	0.00026	0.00025	0.00024
3.5	0.000230.00022	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	0.991800.99202	0.99224	0.99245	0.99266	0.99286	0.99305	0.99324	0.99343	0.99361
2.5	0.993790.99396	0.99413	0.99430	0.99446	0.99461	0.99477	0.99492	0.99506	0.99520
2.6	0.995340.99547	0.99560	0.99573	0.99585	0.99598	0.99609	0.99621	0.99632	0.99643
2.7	0.996530.99664	0.99674	0.99683	0.99693	0.99702	0.99711	0.99720	0.99728	0.99736
2.8	0.997440.99752	0.99760	0.99767	0.99774	0.99781	0.99788	0.99795	0.99801	0.99807
2.9	0.998130.99819	0.99825	0.99831	0.99836	0.99841	0.99846	0.99851	0.99856	0.99861
3.0	0.998650.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99896	0.99900
3.1	0.999030.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
3.2	0.999310.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950
3.3	0.999520.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
3.4	0.999660.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
3.5	0.999770.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983