CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY, 02 DECEMBER 2021

INSTRUCTIONS:

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

QUESTION ONE

a) **Differentiate Single price index from composite price index** (2 Marks)

b) The owner of a Musanze company Ltd manufactures single product. Since he started the company, the number of units sold is represented by the following time series:

Year	2005	2006	2007	2008	2009	2010	2011
Units Sold (Kgs)	100	120	95	105	108	102	112

Required:

Compute secular trend and comment on trend line using the method of semi-average. (3 Marks)

c) The owner of a small shop in Nyamata selling food items collected the following information regarding the price and quantity sold of two items.

Item	**Average price (000'FRW/unit)**		**Quantity sold (units)**	
	2019	**2020**	**2019**	**2020**
A	1	2	10	5
B	1	x	5	2

Required:

If the ratio between Laspeyre's and Paasche's index number is L:P = 28:27,**find value of x**. (6 Marks)

d) A food processing uses a moving average to forecast next month's demand. Past actual demand (in units) is shown below:

Month	43	44	45	46	47	48	49	50	51
Actual demand	105	106	110	110	114	121	130	128	137

Required:

i. Compute a simple five-month moving average and forecast the demand for month 52. (5 Marks)

ii. **Compute weighted three-month average where the weights are highest for the latest months and descend in order 3,2,1.** (4 Marks)

(Total: 20 Marks)

QUESTION TWO

a) What are Three advantages of using a computer in Project Evaluation and Review Technique (PERT) and Critical Path method (CPM) (3 Marks)

b) R & D company Ltd has a list of tasks to be performed whose time estimates are given in the table, as follows

Activity	Activity name	Optimistic time (in days)	Most likely time (in days)	Pessimistic time (in days)
1-2	A	4	6	8
1-3	B	2	3	10
1-4	C	6	8	16
2-4	D	1	2	3
3-4	E	6	7	8
3-5	F	6	7	14
4-6	G	3	5	7
4-7	H	4	11	12
5-7	I	2	4	6
6-7	J	2	9	10

Required:

i) **Construct the project network** (10 Marks)

ii) **Find the critical path** (2Marks)

iii) **Find the probability that the project is completed in 19 days** (2 Marks)

iv) **If the probability is less than 20%, find the probability of completing it in 26 days** (3 Marks)

(Total: 20 Marks)

QUESTION THREE

a) The linear programming method is applicable in problems characterized by the presence of decision variables. The objective function and the constraints can be expressed as linear functions of the decision variables. The decision variables represent quantities that are, in some sense, controllable inputs to the system being modeled.

Required:

Explain what represent the objective function and constraints equations. (2 Marks)

b) Kamali Ltd Company has three machine shops A, B and C and it produces three products X_1, X_2 and X_3 using these three machine shops. Each product involves the operation of the machine shops. The time available at the machine shops A, B and C are 100, 72 and 80 hours respectively. The profit in 0000's per unit of product X_1, X_2 and X_3 is FRW 22, FRW 6 and FRW 2 respectively. The following table shows the time required for each operation for unit amount of each product.

Machine / Products	A	B	C	Profit/unit
X_1	10	7	2	FRW 22
X_2	2	3	4	FRW 6
X_3	1	2	1	FRW 2
Available Hours	100	72	80	

Required:

Use the simplex method to determine an appropriate product mix to maximize the profit. (9 Marks)

c) A company manufacturing beer in Rwanda has three plants located at Rubavu, Gicumbi and Kigali with a capacity of 120 units, 70 and 50 units per day respectively. The company supplies the beer to its four showrooms situated at Rusizi, Huye, Rwamagana and Nyagatare which have a maximum demand of 60, 40, 30 and 110 units respectively. The transportation costs in 000' Frw are shown in table below:

Origin	Destination				a_i
	Rusizi	**Huye**	**Rwamagana**	**Nyagatare**	
Rubavu	20	22	17	4	120
Gicumbi	24	37	9	7	70
Kigali	32	37	20	15	50
b_j	60	40	30	110	240

where a_i = capacity (supply) and b_j = requirement (demand).

Required:

Use the Vogel Approximation Method (VAM) to determine the initial basic feasible solution of the transportation problem. (9 Marks)

(Total: 20 Marks)

QUESTION FOUR

a) **Discuss the difference between decision making under certainty, under risk and under uncertainty**? (3 Marks)

b) A company manufactures goods for a market in which the technology is changing rapidly. The research and development department has produced a new product that appears to have potential for commercial exploitation. A further FRW 60,000 is required for development testing. The company has 100 customers and each customer might purchase, at the most, one unit of the product. Market research suggests a selling price of FRW 6,000 for each unit, with total variable costs and manufacturing and selling estimate as FRW 2,000 for

each unit. From the previous experience, it has been possible to derive a probability distribution relating to the proportion of customers who will buy the products as follows:

Proportion of customers:	0.04	0.08	0.12	0.16	0.20
Probability :	0.10	0.10	0.20	0.40	0.20

Required:

Determine the expected opportunity losses, given no other information than that stated above, and state whether or not the company should develop the product (10 Marks)

c) The manager of a multinational company and the union of workers are preparing to sit down at the bargaining table to work out the details of a new contract for the workers. Each side has developed certain proposals for the contents of the new contract. Let us call union proposals "Proposal 1", "Proposal 2" and "Proposal 3", and manager's proposals "Contract A", "Contract B", "Contract C" and "Contract D". Both parties are aware of the financial aspects of each proposal–contract combination. The reward matrix is represented by the following table

		Player B			
		Contract A	Contract B	Contract C	Contract D
Player A	Proposal 1	4	2	3	6
	Proposal 2	3	4	7	5
	Proposal 3	6	3	5	4

Required:

i) **Is there any saddle point?** (2 Marks)

ii) **Find the mixed strategies for the union and the manager?** (5 Marks)

(Total: 20 Marks)

QUESTION FIVE

a) **State two characteristics of Normal Probability Distribution** (3 Marks)

b) As a chemist working for a battery manufacturer, you are given the task of developing an improved battery for a calculator that will last "significantly longer" than the current battery. You know that the current battery´s life are normally distributed with $\mu = 100.3$ min and $\sigma = 6.25$ min. You develop an improved battery that theoretically should last longer, and its lifetime measures are also normally distributed with $\sigma = 6.25$ min. To do a test of $H_0 : \mu = 100.3$ min, you take a sample of n=40 lifetimes of the improved battery in the calculator and find that $\bar{x} = 105.6$ min.

Does your new battery prove that it is more improved than the current one at $\alpha = 0.01$**? Consider** $\boldsymbol{Z\frac{a}{2} = Z\frac{0.01}{2} = z0.005 = 2.5758}$ (5 Marks)

c) A market survey was conducted in four cities in Rwanda to find out the preference for a new beer brand. The responses are shown below:

	Nyamata	Musanze	Muhanga	Rubavu
Yes	45	55	60	50
No	35	45	35	45
No opinion	5	5	5	5

Required:

i) **What is the probability that a consumer selected at random, preferably the new brand?** (2 Marks)

ii) **What is the probability that a consumer preferred the new brand and was from Muhanga?** (2 Marks)

iii) **What is the probability that a consumer preferred the new brand, given that he was from Muhanga?** (2 Marks)

iv) **Given that a consumer preferred the new brand, what is the probability that he was from Rubavu?** (2 Marks)

d) A manufacturer who produces medicine bottles finds that 0.1 per cent of the bottles are defective. The bottles are packed in boxes containing 500 bottles. A drug manufacturer buys 100 boxes from the producer of the bottles.

Required:

Using Poisson distribution, find how many boxes will contain:

i) **No defectives** (2 Marks)

ii) **At least two defectives** (2 Marks)

(Total: 20 M arks)

QUESTION SIX

a) **Give three relationships between mean, median and mode** (3 Marks)

b) The mean and variance of 5 observations are 4.80 and 6.16 respectively. **If three of the observations are 2,3 and 6, what are the remaining observations?** (5 Marks)

c) The mean of the following frequency distribution was found to be 1.46

No. of Accidents	No. of Days (frequency)
0	46
1	?
2	?
3	25
4	10
5	5
Total	200 days

Required:

Calculate the missing frequencies. (6 Marks)

d) we are given the following series:

Class interval	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	6	12	22	37	17	8	5

Required:
Draw both types of ogive from these data and to determine the median. (6 Marks)

(Total: 20 Marks)

QUESTION SEVEN

a) A random sample of 81 workers at a company showed that they work an average of 100 hours per month with a standard deviation of 27 hours. **At 95% confidence, how many more workers need to be included in the sample to provide a confidence interval with length 4 (i.e., the margin of error being 2)?** (2 Marks)

b) Ten entries are submitted for a competition. Three judges study each entry and list the ten in rank order. Their rankings are as follows:

Entry	A	B	C	D	E	F	G	H	I	J	B
Judge 1	9	3	7	5	1	6	2	4	10	8	3
Judge 2	9	1	10	4	3	8	5	2	7	6	1
Judge 3	6	3	8	7	2	4	1	5	9	10	3

Required:

Calculate the appropriate rank correlation to help you answer the following questions:

i) **Which pair of judges agrees the most**? (7 Marks)

ii) **Which pair of judges disagree the most?** (7 Marks)

c) A small firm knows from its past experience that its monthly average expenses (X) on advertisement are FRW 25,000 with standard deviation of FRW 25.25. Similarly, its average monthly product sales (Y) have been FRW 45,000 with standard deviation of FRW 50.50.

Required:

Given this information and also the coefficient of correlation between sales and advertisement expenditure as 0.75, estimate:

(i) The most appropriate value of sales against an advertisement expenditure of FRW 50,000 (2 Marks)

(ii) the most appropriate advertisement expenditure for achieving a sales target of FRW 80,000 (2 Marks)

(Total: 20 Marks)

End of question paper

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
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999							