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CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY, 27 APRIL 2023

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) Kazungu Electronics Ltd (KEL) is a computer support company operating in Kigali City. KEL has three branches in Rwanda (Musanze, Nyagatare and Huye). The company has received a total of 900 orders from four customers (A, B, C and D). The company has 900 computers available. The management wishes to minimize delivery costs by dispatching the computers from the appropriate branch for each customer.

Details of the available computers, requirements from the customers, and transport costs (FRW) per computer are given in the following table.

	Customers				
Branches	A	B	C	D	**Availability**
Musanze (M)	1,300	1,100	1,500	2,000	300
Nyagatare (N)	1,700	1,400	1,200	1,300	400
Huye (H)	1,800	1,800	1,500	1,200	200
Requirements	200	300	300	100	900

Required:

i) Give a piece of advice to the management on the optimal transportation schedule from the information provided above using Vogel's Approximation Method. (7 Marks)

ii) Calculate the minimum transportation cost from the transportation schedule formulated above in i). (1 Mark)

b) Berwa Ltd (BL) is a company producing carpets in Nyamagabe District. The company produces two types of carpets (carpet X and carpet Y). Each carpet X type requires 10 kgs of wool and 10 minutes of labor to be produced while each carpet Y type requires 16 kgs of wool and 8 minutes of labor to be produced. The profit for each carpet X type is FRW 4,000 and the profit for each carpet Y type is FRW 6,000. There are 6,000 kgs of wool and 60 labor hours available per day for the production of the two types of carpets.

Required:

i) Formulate a linear programming problem for BL. (3 Marks)

ii) Determine the number of carpets to be produced so as to maximize profit using simplex method. (7 Marks)

iii) State two area of application of linear programming. (2 Marks)

(Total: 20 Marks)

QUESTION TWO

a) i) Differentiate between stratified sampling technique and systematic sampling technique as applied in statistics. (2 Marks)

ii) State two advantages and two disadvantages of stratified sampling technique. (4 Marks)

b) A researcher wished to know the entry age of students in the University. A sample of 80 students from year one was interviewed from one private University and the public University. The data below shows the ages of the students collected in the survey.

18	20	19	21	35	27	36	40	20	37
25	21	28	42	30	31	28	26	33	18
36	26	21	30	21	30	24	22	23	19
32	23	20	36	26	37	25	20	22	25
30	23	26	45	28	27	30	27	29	27
26	24	25	21	39	26	28	30	28	30
27	28	36	24	26	21	21	25	37	33
21	20	34	33	30	29	28	20	23	24

Required:

i) Construct a frequency distribution table for the data provided in the table above and find cumulative frequency, class midpoints and class boundaries. Use a class width of 5 starting from the first class. (9 Marks)

ii) Calculate the mean age of the students (3 Marks)

iii) Calculate the median age for the students (2 Marks)

(Total: 20 Marks)

QUESTION THREE

a) Rugendo Ltd (RL), a transportation company, has just been awarded a contract from RURA to transport people within one of the Kigali City routes for the next five years. RL is considering taking a decision on two possibilities. The first possibility is to buy new buses with an estimated profit of FRW 800 million if the demand is high and FRW 450 million if the demand is low. A second possibility is to subcontract another transportation company which has a fleet of new buses. The subcontract will guarantee a profit of FRW 602 million under high demand conditions and FRW 380 million if the demand is low.

It will cost RL FRW 500 million to purchase new buses for use in the transportation service while the cost of sub contraction will be FRW 150 million.

To assist in making the right decision, RL is considering hiring a sales expert who predicts favorable and unfavorable market. The expert predicts that probability of high demand is 70%.

Required:

i) Draw a decision tree for the problem provided above (6 Marks)

ii) Calculate the expected monetary value (EMV) from the decision tree drawn in i) above. (3 Marks)

iii) Advise RL on the right decision to make (1 Mark)

b) Nyagatare Beverages Ltd is considering several alternatives in production projects of its soft drinks. The financial successes of these projects will depend on three market conditions which are favorable market, stable market or unfavorable market. The projects and their financial returns (in FRW millions) are shown below:

	Market Conditions		
Alternative projects	**Favorable**	**Stable**	**Unfavorable**
A	71	60	46
B	67	54	41
C	76	65	51

Required:

Determine the best decision using

i) Maximax Criterion (1 Mark)

ii) Laplace Criterion (4 Marks)

iii) Minimax Criterion (5 Marks)

(Total: 20 Marks)

QUESTION FOUR

a) In a study to find out whether the pass rate of the CPA candidates per sitting was independent of gender at all the levels of CPA exams, ICPAR selected a random sample of 600 candidates including both males and females. The following table shows the pass rate of CPA candidates at all the 3 levels

Level	**Male**	**Female**	**Total**
Foundation	120	140	**260**
Intermediate	90	110	**200**
Advanced	60	80	**140**
Total	**270**	**330**	**600**

Required:

Test whether the pass rate is independent of gender or not, at 5% level of significance. (12 Marks)

b) In Mahoro Cell it is believed that babies are born with the weight of 3.5 kilograms. In order to establish the validity of the mean birth weight for babies, a pediatrician conducted a survey in one of the health centers in Mahoro Cell. A sample of 25 babies was taken, weighed and the results showed that they weighed 3.0 kilograms. However, the different weights at which the

babies had differed with the standard deviation of 0.5 kilograms. The sample data indicates that the mean birth weight is less than 3.5 kilograms.

Required:

Conduct a statistical test at 1% level of significance to either the belief of the birth weight. Is this conclusion true or not? (5 Marks)

c) Poisson distribution is a discrete distribution that is used to describe situations where occurrences are random and are rare in space and time.

Required:

State three applications of Poisson distribution in analysis of Poisson events (3 Marks)

(Total: 20 Marks)

QUESTION FIVE

The Ministry of Trade and Industry conducted the Consumer Expenditure Survey (CES) on the prices and quantities of a basket of commodities from various markets across the country so as study the cost of living of the citizens of the Northern Province. The summary of the monthly per capita expenditure for the Northern Province during 2020 and 2022 on certain commodities is given below:

Commodity Item	2020		2022	
	Price (FRW)/Kg	Quantity (Kgs)	Price (FRW)/Kg	Quantity (Kgs)
Sugar	1,000	600	1,200	500
Rice	1,500	100	1,700	150
Salt	200	160	250	200
Beans	600	350	800	460
Potatoes	250	420	400	500

Required:

i) Compute the Laspeyre's price index, Paasche's price index and Marshall Edge Worth's Price Index from the data provided in the table above taking 2020 as the base. (15 Marks)

ii) Interpret the results of Laspeyre's price index and Paasche's price index above. (2 Marks)

iii) State three problems associated with the construction of index numbers (3 Marks)

(Total: 20 Marks)

QUESTION SIX

a) Kagubare, a Certified Professional Accountant, started a consultant firm to provide advisory services to the clients on business operations. The firm estimated Sales revenue function and cost function of one of the steel processing companies to be $R = 21x - x^2$ and $C = \frac{x^3}{3} - 3x^2 + 9x + 16$ (in million Rwandan Francs) respectively. Where R is the sales revenue, C is the total cost function and x represents quantity produced in tonnes.

You are required to Calculate:

i) The output when revenue is maximum and find the total revenue at this point (3 Marks)

ii) The marginal cost at a minimum level (4 Marks)

iii)The output that maximizes profit and the maximum profit (7 Marks)

b) The cost, in FRW, to produce Made in Rwanda shoes is $C(x) = 2x + 26$, $x \geq 0$ and the price demand function, in FRW ("000") per shoe, is $p(x) = 30 - 2x$, $0 \leq x \leq 15$.

Required:

i) Determine the profit function (1 Mark)

ii) Find and interpret the break – even points (3 Marks)

iii) Calculate the number of shoes which need to be sold in order to maximize profit and calculate the maximum profit (2 Marks)

(Total: 20 Marks)

QUESTION SEVEN

The table below is a summary of activities required to complete project. The durations of the activities are in weeks

Activity	Optimistic Time (in weeks)	Most Likely Time (in weeks)	Pessimistic Time (in weeks)
(1 – 2)	2	4	6
(2 – 3)	1	2	3
(2 – 4)	1	3	5
(3 – 5)	3	4	5
(4 – 5)	2	3	4
(4 – 6)	3	5	7
(5 – 7)	4	5	6
(6 – 7)	6	7	8
(7 – 8)	2	4	6
(7 – 9)	5	6	7
(8 – 10)	1	2	3
(9 – 10)	3	5	7

Required:

a) Computation of the expected time duration for each activity of the project network (6 Marks)

b) Construct a network diagram for the data provided above. (6 Marks)

c) Identify the critical path of the project (1 Mark)

d) Calculate of variance and standard deviation for the critical path of the project (4 Marks)

e) Find the probability of completing the project within 28 weeks or less (3 Marks)

(Total: 20 Marks)

End of Question Paper

Chi-square Distribution Table

d.f.	0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57

t Distribution: Critical Values of *t*

Degrees of freedom		*Significance level*					
	Two-tailed test:	10%	5%	2%	1%	0.20%	0.10%
	One-tailed test:	5%	2.50%	1%	0.50%	0.10%	0.05%
1		6.314	12.706	31.821	63.657	318.309	636.619
2		2.92	4.303	6.965	9.925	22.327	31.599
3		2.353	3.182	4.541	5.841	10.215	12.924
4		2.132	2.776	3.747	4.604	7.173	8.61
5		2.015	2.571	3.365	4.032	5.893	6.869
6		1.943	2.447	3.143	3.707	5.208	5.959
7		1.894	2.365	2.998	3.499	4.785	5.408
8		1.86	2.306	2.896	3.355	4.501	5.041
9		1.833	2.262	2.821	3.25	4.297	4.781
10		1.812	2.228	2.764	3.169	4.144	4.587
11		1.796	2.201	2.718	3.106	4.025	4.437
12		1.782	2.179	2.681	3.055	3.93	4.318
13		1.771	2.16	2.65	3.012	3.852	4.221
14		1.761	2.145	2.624	2.977	3.787	4.14
15		1.753	2.131	2.602	2.947	3.733	4.073
16		1.746	2.12	2.583	2.921	3.686	4.015
17		1.74	2.11	2.567	2.898	3.646	3.965
18		1.734	2.101	2.552	2.878	3.61	3.922
19		1.729	2.093	2.539	2.861	3.579	3.883
20		1.725	2.086	2.528	2.845	3.552	3.85
21		1.721	2.08	2.518	2.831	3.527	3.819
22		1.717	2.074	2.508	2.819	3.505	3.792
23		1.714	2.069	2.5	2.807	3.485	3.768
24		1.711	2.064	2.492	2.797	3.467	3.745
25		1.708	2.06	2.485	2.787	3.45	3.725
26		1.706	2.056	2.479	2.779	3.435	3.707
27		1.703	2.052	2.473	2.771	3.421	3.69
28		1.701	2.048	2.467	2.763	3.408	3.674
29		1.699	2.045	2.462	2.756	3.396	3.659
30		1.697	2.042	2.457	2.75	3.385	3.646

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

- z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.5	0.496	0.492	0.488	0.484	0.4801	0.4761	0.4721	0.4681	0.4641
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.2	0.4207	0.4168	0.4129	0.4091	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.352	0.3483
-0.4	0.3446	0.3409	0.3372	0.3336	0.33	0.3264	0.3228	0.3192	0.3156	0.3121
-0.5	0.3085	0.305	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.281	0.2776
-0.6	0.2743	0.2709	0.2676	0.2644	0.2611	0.2579	0.2546	0.2514	0.2483	0.2451
-0.7	0.242	0.2389	0.2358	0.2327	0.2297	0.2266	0.2236	0.2207	0.2177	0.2148
-0.8	0.2119	0.209	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.166	0.1635	0.1611
-1	0.1587	0.1563	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.123	0.121	0.119	0.117
-1.2	0.1151	0.1131	0.1112	0.1094	0.1075	0.1056	0.1038	0.102	0.1003	0.0985
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0722	0.0708	0.0694	0.0681
-1.5	0.0668	0.0655	0.0643	0.063	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.8	0.0359	0.0352	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294

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