
CERTIFIED PUBLIC ACCOUNTANT
FOUNDATION LEVEL 1
EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE
METHODS

TUESDAY: 3 DECEMBER
2019

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 are to be attempted.
3. Marks allocated to each question are shown at the end of the question.
4. Show all your workings

QUESTION ONE

- a) Give any three demerits of Harmonic Mean. **(3 Marks)**
- b) Find the two values where arithmetic mean (A.M) and geometric mean (G.M) are 10 and 8 respectively. **(5 Marks)**
- c) GANZA Ltd is considering whether to spend Frw 5,000 on an item of equipment. The cash profit, the excess of income over cash expenditure from the project would be Frw 3,000 in the first year and Frw 4,000 in the second year. The company will not invest in any project unless it offers a return in excess of 15% per annum. **(6 Marks)**

REQUIRED:

Use the NPV method to assess whether the investment is worthwhile, or viable.

- d) KAGABO receives on an average 4 calls per minute. Find the probability on the basis of Poisson distribution, if he receives:
- i. 2 or less call per minute; **(2 Marks)**
 - ii. Up to 4 calls per minute; **(2 Marks)**
 - iii. More than 4 calls per minute. **(2 Marks)**

(Given that $e^{-4} = 0.0183$)

20 (Marks)

QUESTION TWO

- a) Define the term non-mutually exclusive events. Support your definition by providing an example **(2 Marks)**
- b) A number of particular kinds of small animals have been classified according to their weights. After starvation of two weeks, the same animals have been weighted and similarly classified. It is known that the median weight in the first weighing was 35.8 kgs while in the second weighing it was 19.8 kgs, some frequencies f_1 and f_2 in the first weighing and f_3 and f_4 in the second weighing are missing. It is known that $f_1 = \frac{1}{3} f_3$ and $f_2 = \frac{1}{4} f_4$.

Class (kgs)	Frequencies first weighing	Frequencies second weighing
0-6	f_1	f_3
6-12	f_2	f_4
12-18	11	40
18-24	52	65
24-30	75	28
30-36	23	13
36-42	14	6
42-48	5	2

REQUIRED:

Find out the values of the missing frequencies

(10 Marks)

- c) The monthly salary of 1000 workers is normally distributed about mean of Frw 70,000 and standard deviation of Frw 5,000

REQUIRED:

Estimate the number of workers whose monthly salary will be:

- i. Between Frw 70,000 and Frw 72,000 **(2 Marks)**
 - ii. Less than Frw 63,000 **(2 Marks)**
- d) A book contains 100 pages numbering from 1 to 100. A page is opened at random and is selected.

REQUIRED:

Find the probability that opened page is a multiple of 6 or 10

(4 Marks)

20 (Marks)

QUESTION THREE

- a) Give two limitations of regression analysis **(2 Marks)**
- b) An economist wanted to find out whether there is any relationship between the unemployment rate in a country and its inflation rate. Data from 7 countries for the year 2017 are given below:

Country	Unemployment rate (percent) (x)	Inflation rate (percent) (y)
A	4.0	3.2
B	8.5	8.2
C	5.5	9.4
D	0.8	5.1
E	7.3	10.1
F	5.8	7.8
G	2.1	4.7

REQUIRED:

Use rank correlation method to determine the degree of linear association between unemployment rate in a country and its inflation rate, i.e. find the spearman's rank correlation coefficient and interpret **(8 Marks)**

c) Given a transportation problem represented in the following table

Unit	Deposit	B ₁	B ₂	B ₃	B ₄	Stock
A ₁		2	3	5	1	8
A ₂		7	3	4	6	10
A ₃		4	1	7	2	20
Requirement		6	8	9	15	38

REQUIRED:

Find the basic feasible solution using Vogel's approximation method **(10 Marks)**

20 (Marks)

QUESTION FOUR

a) Explain the term "amortization of a debt" **(2 Marks)**

b) Output at MANZI's factory appears to vary with the day of the week. Output over the last 3 weeks has been as follows:

	Week1	Week2	Week3
	(000 units)	(000 units)	(000 units)
Monday	80	82	84
Tuesday	104	110	116
Wednesday	94	97	100
Thursday	120	125	130
Friday	62	64	66

REQUIRED:

Find the seasonal variation for each of the 15 days and the average seasonal variation for each day of the week using the moving average of 5 days method for additive model **(10 Marks)**

c) SIMBI Ltd is investing in gardens, the following table shows activities and times to improve an overgrown home garden.

	Activity	Time (5 min)	% Activity
A	Clear garden	5	-
B	Measure area	1	-
C	Design patio	2	B
D	Choose fencing	1	B
E	Buy pots and plant	3	A, C
F	Plant all pots	1	E
G	Purchase slabs	1	C
H	Construct garden	6	D, G

REQUIRED:

- i. Draw an activity network on arrow and determine the critical path (2 Marks)
 - ii. Draw an activity on node and determine the critical path (2 Mark)
 - iii. Calculate event times, forward and backward and, hence determine critical path. (4 Marks)
- (20 Marks)**

QUESTION FIVE

- a) An organization follows the following linear programming problem in manufacturing three products each of which passes through 3 processes x, y, and z (10 Marks)

$$\text{Maximize } z = -x + 3y - 2z$$

Subject to the constraints

$$3x_1 - x_2 + 2x_3 \leq 7$$

$$-2x_1 + 4x_2 \leq 12$$

$$-4x_1 + 3x_2 + 8x_3 \leq 10$$

$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$$

REQUIRED:

Solve the above linear programming problem by simplex method.

- b) The Impala troupe is scheduled to carry an outdoor concert on Sunday afternoon at Nyamirambo stadium. The promoter is worried about the weather on that Sunday that it might rain. Meteorology department forecasters predict the probability of rain on that afternoon will be 0.24. If it doesn't rain the promoter is certain to net Frw 1,000,000 but if it rains the promoter estimates to net only Frw 100,000. An insurance company agrees to insure the concert worth Frw 1,000,000 against rain at a premium of Frw 200,000. (5 Marks)

REQUIRED:

Should the promoter, insure the concert against rain?

- c) Calculate the compound interest to nearest cent on Frw 1,000 for 20 years at 6% per annum, interest being calculated each 6 months (5 Marks)
- (20 Marks)**

QUESTION SIX

- a) Differentiate the maximum basis from Maximax basis (2 Marks)
b) Solve the payoff matrix given below: (5 Marks)

		Player B				
Player A	Strategies	I	II	III	IV	V
	I	-2	0	0	5	2
	II	3	2	1	2	2
	III	-4	-3	0	-2	6
	IV	-5	3	-4	2	-6

- c) A Lecturer from a private university in Rwanda claims that the average attendance of students in his class is 1,600 hours. We want to test the validity of this claim. A sample of 100 students was taken at random and the average attendance per semester was computed to be 1,570 hours with a standard deviation of 120 hours. At $\alpha = 0.01$, test the claim of the Lecturer. (5 Marks)
- d) The weekly sales of 2 products A and B were recorded as given below:

Product A	Product B
59	150
75	200
27	125
63	310
27	330
28	250
56	225

REQUIRED:

Find out which of the two products has greater fluctuation in sales (conclude basing on their coefficient of variation) (8 Marks)

20 (Marks)

QUESTION SEVEN

- a) A beverage company in Rwanda, is interested into beverage manufacturing. The chief executive is not sure whether to start a small plant or a large plant. The market demand is uncertain and will become known only after the plant has been built.

If the demand is indeed high and a small plant is built initially then it can be expanded to accommodate high demand. The marketing department has estimated that the probability of high demand is 0.7 and for low demand is 0.3. The cost benefit analysis has provided the following information.

- Cost of building a large plant: Frw 6 million
- Cost of building a small plant: Frw 4 million
- Cost of expanding a small plant: Frw 3 million
- Revenue for high demand for large plant or small expanded plant: Frw 18 million
- Revenue for high demand without expansion of small plant: Frw 11 million **(10 Marks)**

REQUIRED:

Determine what should be optimal policy using a decision tree diagram

- b) The fixed cost at a company are Frw 1,000,000 annually. The main product has revenue of Frw 8.90 per unit and Frw 4.50 variable cost.

REQUIRED:

- i. Determine the breakeven quantity per year **(2 Marks)**
 - ii. Determine the annual profit if 200,000 units are sold. **(3 Marks)**
- c) The total cost and revenue of a firm are given by
 $C(x) = x^3 - 12x^2 + 48x + 11$ and $R(x) = 83x - 4x^2 - 21$

REQUIRED:

Find the output when the profit is maximum. **(3 Marks)**

- d) What is a saddle point in the game theory **(2 Marks)**
(20 Marks)

APPENDIX 1

CUMULATIVE NORMAL DISTRIBUTION $P(z)$											ADD								
Z	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
0.0	0.0000	0040	0080	0120	0160	0199	0239	0279	0319	0359	4	8	12	16	20	24	28	32	36
0.1	0.0398	0438	0478	0517	0557	0596	0636	0675	0714	0753	4	8	12	16	20	24	28	32	36
0.2	0.0793	0832	0871	0910	0948	0987	1026	1064	1103	1141	4	8	12	15	19	22	27	31	35
0.3	0.1179	1217	1255	1293	1331	1368	1406	1443	1480	1517	4	8	11	15	19	22	26	30	34
0.4	0.1554	1591	1628	1664	1700	1736	1772	1808	1844	1879	4	7	11	14	18	22	25	29	32
0.5	0.1915	1950	1985	2019	2054	2088	2123	2157	2190	2224	3	7	10	14	17	21	24	27	31
0.6	0.2257	2291	2324	2357	2389	2422	2454	2486	2517	2549	3	6	10	13	16	19	23	26	29
0.7	0.2580	2611	2642	2673	2704	2734	2764	2794	2823	2852	3	6	9	12	15	18	22	25	28
0.8	0.2881	2910	2939	2967	2995	3023	3051	3078	3106	3133	3	6	8	11	14	17	20	22	25
0.9	0.3159	3186	3212	3238	3264	3289	3315	3340	3365	3389	3	5	8	10	13	16	18	21	23
1.0	0.3413	3438	3461	3485	3508	3531	3554	3577	3599	3621	2	5	7	10	12	14	17	19	22
1.1	0.3643	3665	3686	3708	3729	3749	3770	3790	3810	3830	2	4	7	9	11	13	15	18	20
1.2	0.3849	3869	3888	3907	3925	3944	3962	3980	3997	4015	2	4	6	8	10	12	14	16	18
1.3	0.4032	4049	4066	4082	4099	4115	4131	4147	4162	4177	2	4	5	7	9	11	13	14	16
1.4	0.4192	4207	4222	4236	4251	4265	4279	4292	4306	4319	2	3	5	6	8	10	11	13	14
1.5	0.4332	4345	4357	4370	4382	4394	4406	4418	4429	4441	1	2	4	5	6	7	8	10	11
1.6	0.4452	4463	4474	4484	4495	4505	4515	4525	4535	4545	1	2	3	4	5	6	7	8	9
1.7	0.4554	4564	4573	4582	4591	4599	4608	4616	4625	4633	1	2	3	3	4	5	6	7	8
1.8	0.4641	4649	4656	4664	4671	4678	4686	4693	4699	4706	1	1	2	3	4	4	5	6	6
1.9	0.4713	4719	4726	4732	4738	4744	4750	4756	4761	4767	1	1	2	2	3	4	4	5	5
2.0	0.4772	4778	4783	4788	4793	4798	4803	4808	4812	4817	0	1	1	2	2	3	3	4	4
2.1	0.4821	4826	4830	4834	4838	4842	4846	4850	4854	4857	0	1	1	2	2	2	3	3	4
2.2	0.4861	4864	4868	4871	4875	4878	4881	4884	4887	4890	0	1	1	1	2	2	2	3	3
2.3	0.4893	4896	4898	4901	4904	4906	4909	4911	4913	4916	0	0	1	1	1	2	2	2	2
2.4	0.4918	4920	4922	4925	4927	4929	4931	4932	4934	4936	0	0	1	1	1	1	1	2	2
2.5	0.4938	4940	4941	4943	4945	4946	4948	4949	4951	4952									
2.6	0.4953	4955	4956	4957	4959	4960	4961	4962	4963	4964									
2.7	0.4965	4966	4967	4968	4969	4970	4971	4972	4973	4974									
2.8	0.4974	4975	4976	4977	4977	4978	4979	4979	4980	4981									
2.9	0.4981	4982	4982	4983	4984	4984	4985	4985	4986	4986									
3.0	0.4987	4990	4993	4995	4997	4998	4998	4999	4999	5000									

The table gives $P(z) = \int_0^z \phi(z) dz$

If the random variable Z is distributed as the standard normal distribution $N(0,1)$ then:

1. $P(0 < Z < z_p) = P(\text{Shaded Area})$
2. $P(Z > z_p) = Q = \frac{1}{2} - P$
3. $P(Z > |Z_p|) = 1 - 2P = 2Q$

