
CERTIFIED ACCOUNTING TECHNICIAN(CAT)

LEVEL 1 EXAMINATION

L1.4: BUSINESS MATHEMATICS

WEDNESDAY: 6 JUNE 2018

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, where applicable.

@iCPAR

QUESTION ONE

- (a) The number of jobs K , an audit firm undertakes in a given period depends on the number of unsuccessful pre-qualifications p , during the previous audit period. The relationship is given by the formula $K = (5 + p)^4 p^{-4}$

REQUIRED.

Find the number of jobs the audit firm undertook if 10 out of the 15 pre-qualifications in the previous audit period were successful.

(4 Marks)

- (b) Giramata Jacqueline has planted both orange and mango trees on her farm. The number of orange trees, x and the number of mango trees, y satisfy the two equations:

$$5y = 5x + 25$$

$$3y + 4x = 120$$

REQUIRED:

- (i) Given that $0 \leq x \leq 30$, $0 \leq y \leq 50$, plot the two equations above on the same axes.

(5 Marks)

- (ii) From the graph, find the values of x and y .

(2 Marks)

- (c) Shyaka Emmanuel has acquired two adjacent plots of land to construct a chicken house. One of the plots is of a square shape while the other is rectangular. The width of the rectangular plot is shorter than the side of the square plot by 5m and its length is longer than the side of the square plot by 2m.

REQUIRED:

Given that the total area of the two plots of land is 809m^2 ; determine the length of the:

- (i) square plot of land.

(6 Marks)

- (ii) barbed wire which can be used to fence the rectangular plot of land..

(3 Marks)

(Total 20 Marks)

QUESTION TWO:

- (a) The table below shows the number of people employed in five sectors in the province of Kigali.

Sector	Number of people
Health	23,000
Education	25,000
Tourism	18,000
Energy	12,500
Finance	35,000

REQUIRED:

Calculate the:

- (i) ratio of workers in the health sector to those in the tourism sector. **(2 Marks)**
- (ii) percentage of workers in the finance sector. **(3 Marks)**
- (b) Nkuzi's radio system has three components: the memory card, the cassette and the compact disc (CD). While using it, the memory card facility had failed 40% of the time, the cassette 25% and the CD 35%. The three components work independently.

REQUIRED

Calculate the probability that:

- (i) all the three components had not failed. **(3 Marks)**
- (ii) only the CD component had not failed. **(3 Marks)**
- (c) Mr. Mugabo sells pineapples and water melons. Each week, he puts either pineapples or water melons for sale. In order to determine which fruit he should put out for sale the following week, he conducted a market research. He involved 800 different people who visited his stall whom he asked what they would prefer to buy.

The results from market research are shown in the table below:

Customer choice	Pineapples on sale	Water melons on sale
Pineapples	604	92
Water melon	90	620
No fruit	<u>106</u>	<u>88</u>
Total	<u>800</u>	<u>800</u>

The following week, he expects 400 people to visit his fruit stall. Estimates of profit per unit are given as:

	Pineapples on sale	Water melons on sale
Pineapples (Frw)	25	40
Water melons (Frw)	45	30

REQUIRED

- (i) Calculate the following week's expected sales. **(4 Marks)**
 - (ii) Compute the expected profit if he puts up pineapples for sale. **(2 Marks)**
 - (iii) Compute the expected profit if he puts up water melons for sale. **(2 Marks)**
 - (iv) Advise Mr. Mugabo on the fruit to put up for sale in order to maximise profit. **(1 Mark)**
- (Total 20 Marks)**

QUESTION THREE:

- (a) Distinguish between data and information and give an example in each case. **(4 Marks)**
- (b) Kamanzi Enterprises Ltd imports three brands of cement A, B and C. The price (in Frw) per bag and hence the quantities purchased changed over a period of two years as in the table below.

Brand of cement	2016		2017	
	Price	Quantity	Price	Quantity
A	7,800	2,000	8,000	1,800
B	8,000	1,200	8,300	1,500
C	8,900	1,500	9,000	1,500

REQUIRED:

- (i) Compute Paasche's price index for 2017 taking 2016 as the base year **(4 Marks)**
- (ii) Comment on your answer in (b) (i) above **(1 Mark)**
- (c) Nyarutarama Auto Service Garage reviewed their performance for the year 2017. The table below shows the weekly record of the vehicles handled at the garage over the 52 weeks of review period:

Vehicles handled	Number of weeks
150 - 154	3
155 - 159	6
160 - 164	10
165 - 169	15
170 - 174	8
175 - 179	6
180 - 184	4

REQUIRED:

Calculate the:

- (i) Mean **(3 Marks)**
 - (ii) standard deviation **(3 Marks)**
 - (iii) Pearson's coefficient of skewness for the number of vehicles handled. **(5 Marks)**
- (Total 20 Marks)**

QUESTION FOUR

- (a) Eight students sat for two pilot Business Statistics examinations and their scores were as tabulated below.

Student	A	B	C	D	E	F	G	H
Exam I	37	34	32	41	55	53	62	59
Exam II	40	33	33	25	41	38	55	47

REQUIRED:

- (i) Calculate Spearman's rank correlation coefficient **(7 Marks)**
(ii) Comment on your result. **(1 Mark)**
- (b) In a study about the operating efficiency of a chemical plant, the following data was collected relating the output (y) in metric tonnes, to the fuel consumption (x) in litres.

y (output)	1.8	4.5	5.3	7.9	1.4	2.9	5.2	7.2
x (fuel consumption)	2	4	6	8	1	3	5	7

REQUIRED

- (i) Plot a scatter diagram for the above data. **(7 Marks)**
(ii) Compute the mean values of x and y, and hence draw the line of best fit. **(3 Marks)**
(iii) Using the line of best fit, estimate the value of y when x is 5.5 litres. **(2 Marks)**
(Total 20 Marks)

QUESTION FIVE

- (a) The number of tourists per month who booked at Kigali Marriot Hotel in a period of 10 months from July, 2016 to April, 2017 is as shown below.

	2016						2017			
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Tourists	200	250	260	254	210	290	300	298	274	310

REQUIRED:

- (i) Calculate 3-month moving averages. **(4 Marks)**
- (ii) On the same axes, draw the original tourist data line and the 3-month moving averages trend line. **(5 Marks)**
- (b) The Human Resource Manager of Earth-enable Construction Company wanted to assess the impact of working overtime (x hours) to the project duration (y days). The data below shows the relationship between x and y.

x	1	2	3.5	4	5	6	7	8	9	10
y	8	7	7	5.5	5	5	3.5	2.5	2.5	2

REQUIRED:

- (i) Determine the regression line and hence; **(9 Marks)**
- (ii) Predict the duration of the project for workers who spent 5.5 hours overtime. **(2 Marks)**
- (Total 20 Marks)**

QUESTION SIX

- (a) Mr. Ntarugera Dominic earned Frw 21,000 as simple interest after depositing Frw 150,000 and keeping his money with Star Commercial Bank for four years. If the bank pays interest at rate of R% per annum;

REQUIRED:

Determine the:

- (i) value of R. (3 Marks)
- (ii) amount of money in Mr. Ntarugera's account after $5\frac{1}{2}$ years, assuming he does not make any withdrawal. (4 Marks)
- (b) An institute expanding some of its facilities took up a loan of Frw 4,000,000 from a bank. The Institute is required to pay back the loan in 6 months and the bank charges an interest rate of 9.0% per annum, compounded monthly.

REQUIRED:

- (i) Determine the value of each payment to the nearest Frw. (3 Marks)
- (ii) Construct an amortization schedule for the Institute. (7 Marks)
- (iii) Express the interest paid as a percentage of amount borrowed. (3 Marks)
- (Total 20 Marks)**

QUESTION SEVEN:

- (a) (i) Explain **four** advantages of electronic spreadsheets. (4 Marks)
- (ii) Give **two** users of spreadsheets and in each case identify one area where they apply the spread sheets. (4 Marks)
- (b) The table below shows details of water meter readings for six different customers of Water and Sanitation Corporation (WASAC) at the beginning of the months of March and April, 2018.

Serial number	Customer's name	Meter readings as at	
		1 March, 2018	1 April, 2018
0119	Ngoga	87649	87933
0121	Shema	12874	13890
0122	Bakunda	38021	38361
0140	Akimana	18923	19173
0194	Ingabire	4589	6789
0877	Manzi	20093	21073

The cost of one unit of water is Frw 650 and each customer pays a constant user fee Frw 900 per month regardless of the number of units of water consumed.

REQUIRED:

Calculate the water bills for Ngoga, Shema and Ingabire.

(6 Marks)

- (c) Bizimungu Hotel hosted a one day workshop for Living Earth Rwanda, a Non-Governmental Organisation based in Butare. Before making the tax deductions, the accounts department captured the information for billing the workshop organizers in the spreadsheet below:

4	U	V	W	X	Y
5	Service ID	service	Units consumed	Unit price (Frw)	Sales (Frw)
6	1	Accommodation	40 rooms	50,400	2,016,000
7	2	Meals	60 plates	2,500	150,000
8	3	Soda	60 bottles	1,000	60,000
9	4	Water	A bottles	1,000	200,000
10	5	Internet	40 clients	0	0
11	6	Tea	160 cups	1,000	160,000
12	Total				B

REQUIRED:

- (i) Describe the entry in cell W10.
- (ii) Write down the formula in cell Y7.
- (iii) Write down the formula in cell Y12 and find the value of B.
- (iv) Find the value of A.

(1 Mark)

(1 Mark)

(3 Marks)

(1 Mark)

(Total 20 Marks)

FORMULAE

1. Combination ${}^nC_r = \frac{n!}{(n-r)!r!}$
2. Permutations ${}^nP_r = \frac{n!}{(n-r)!}$
3. Mean of the binomial distribution = np
4. Standard deviation = \sqrt{npq}
5. Variance of the binomial distribution = $np(1-p)$
6. Standard error of population proportion $S_{ps} = \sqrt{\frac{pq}{n}}$
7. Spearman's rank correlation coefficient $r = 1 - \frac{6\sum d^2}{n(n^2-1)}$
8. Product moment coefficient of correlation =
$$\frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2) \times (n\sum y^2 - (\sum y)^2)}}$$
9. Cost slope =
$$\frac{\text{crash cost} - \text{normal cost}}{\text{normal time} - \text{crash time}}$$
10. Harmonic mean (ungrouped data) $hm = \frac{n}{\sum \frac{1}{x}}$
11. Sample mean $\bar{x} = \frac{\sum x}{n}$
12. Harmonic mean (grouped data) $hm = \frac{n}{\sum \frac{f}{x}}$
13. Quartile coefficient of dispersion = $\frac{Q_3 - Q_1}{Q_3 + Q_1}$
14. Mean $\bar{x} = A + \frac{\sum fd}{\sum f}$ or Mean $\bar{x} = \frac{\sum fx}{\sum f}$
15. Median = $Lb + \left(\frac{\frac{N}{2} - Cfb}{fm} \right) C$
16. Mode = $lm + \left(\frac{d_1}{d_1 + d_2} \right) C$

17. Variance $Var(x) = \frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2$
18. Standard deviation $\delta = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2} = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$
19. Sample standard deviation $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$
20. Least squares regression equation of y on x is given by; $y = a + bx$
21. Where; $b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$ and $a = \frac{\sum y}{n} - \frac{b \sum x}{n}$
22. Least squares regression equation of x on y is given by; $x = c + dy$
Where $c = \frac{\sum x}{n} - \frac{d \sum y}{n}$ and $d = \frac{n \sum xy - \sum x \sum y}{n \sum y^2 - (\sum y)^2}$
23. Standardizing normal. $z = \frac{\bar{x} - \mu}{\sigma}$
24. Confidence interval for sample mean $= \bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$
25. $\chi^2 = \sum \frac{(O - E)^2}{E}$
26. Confidence interval of proportion $= p \pm z_{\alpha/2} \sqrt{\frac{pq}{n}}$
27. Pearson coefficient of skewness $Sk = \frac{(\bar{x} - \text{mode})}{s_d}$ or $Sk = \frac{3(\bar{x} - \text{median})}{s_d}$
28. Expectation $= \sum xP(X = x)$
29. Laspeyres' price index $= \frac{\sum (p_1 \times q_0)}{\sum (q_0 \times p_0)} \times 100$
30. Weighted aggregate price index $= \frac{\sum wv_n}{\sum wv_0} \times 100$
31. Additive law of probability; $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
32. Conditional probability $P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$

33. Independence of A, B $P(A/B) = P(A)$ or $P(A \cap B) = P(A) \times P(B)$

34. Continuous compounding $A = P(1+r)^n + \frac{b(1+r)^n - b}{r}$

35. Quotient rule of differentiation $f = \frac{vu^1 - uv^1}{v^2}$; where $f = \frac{u}{v}$

36. $Paasche's Model = \frac{\sum (p_1 \times q_1)}{\sum (q_1 \times p_0)} \times 100$

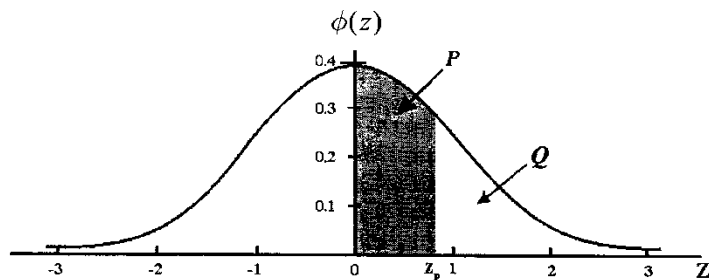
37. $Poisson Model P(X = x) = e^{-\lambda} \frac{\lambda^x}{x!}$

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	21	24	27
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	11	13	16	19	22	24
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	6	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	15	17
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	3	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. $P(Z > |Z_p|) = 1 - 2P = 2Q$



END OF QUESTION PAPER