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SRI LANKA

ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JANUARY 2025

(102) BUSINESS MATHEMATICS AND STATISTICS

09-02-2025
Morning
[09.00 – 12.00]

- **Instructions to candidates** (Please Read Carefully):

  (1) **Time:** *03 hours.*

  (2) **All questions should be answered.**

  (3) **Answers** *should be in* **one language**, *in the* **medium** *applied for, in the* **booklets** *provided.*

  (4) *Submit all workings and calculations. State clearly assumptions made by you, if any.*

  (5) *Use of Non-programmable calculators is* **only** *permitted.*

  (6) **Mathematical Tables** *and* **Graph Papers** *will be provided.*

  (7) **Action Verb Check List** *with definitions is attached. Each question will begin with an* **action verb** *excluding OTQ's. Candidates should answer the questions based on the* **definition** *of the verb given in the Action Verb Check List.*

  (8) **Formulae Sheets** *are attached.*

  (9) *100 Marks.*

No. of Pages : 09
No. of Questions : 06

SECTION A
Objective Test Questions (OTQs)
(Total 40 marks)

Question 01

Select the most correct answer for question No. **1.1** *to* **1.10**. *Write the number of the selected answer in your answer booklet with the number assigned to the question.*

1.1 Factors of, $16x^2 - 81$ are:

(1) $(4x + 9)(4x + 9)$ (2) $(4x - 9)(4x + 9)$

(3) $(4x - 9)(4x - 9)$ (4) $(4x - 9)(x + 9)$ (03 marks)

1.2 The company is planning to make an investment project. The net cash inflow of the investment project for next 3 years is Rs.50,000/- per year. The cost of capital (discounting factor) of the company is 10% per annum and the initial investment cost of the project is Rs.100,000/-. The Net Present Value (NPV) of the project would be *(to the nearest integer)*:

(1) Rs.45,450/-   (2) Rs.58,400/-   (3) Rs.74,300/-   (4) Rs.24,300/-

(03 marks)

1.3 You are given the following information:

$$P(A) = \frac{2}{3} \qquad P(B) = \frac{1}{4} \qquad P(A \cap B) = \frac{1}{6}$$

Based on the above information, the $P(A \cup B)$ is:

(1) $\frac{11}{12}$ (2) $\frac{9}{12}$ (3) $\frac{2}{12}$ (4) $\frac{5}{12}$

(03 marks)

1.4 The quantity (in kilograms) of four brands of fertilizer manufactured by a company in year 2023 and year 2024 are tabulated below:

Brand of Fertilizer	2023 (kg)	2024 (kg)
A	250	275
B	215	200
C	190	240
D	265	305

The quantity relative of brand **D**, considering the year 2023 as the base year is:

(1) 115%   (2) 90%   (3) 111%   (4) 87%

(03 marks)

1.5 The summary of statistics relating to variables **X** and **Y** are as follows:

$$\sum x = 375 \quad \sum y = 997 \quad \sum xy = 42{,}070 \quad \sum x^2 = 16{,}125 \quad \sum y^2 = 111{,}277 \quad n = 10$$

Based on the above data, the correlation co-efficient between "x" and "y" would be:

(1) 0.9461   (2) 0.8194   (3) -0.8194 (4) 0.8951

(03 marks)

1.6 You are given the following frequency distribution:

x	0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59
f	8	7	15	19	14	7

The mode of the above frequency distribution is (approximately):

(1) 36.4   (2) 34.9   (3) 33.9   (4) 35

(03 marks)

1.7 Consider the following probability distribution of the discrete random variable **X**:

X	-5	-3	0	1	2
Probability P(x)	0.2	0.15	0.15	0.22	0.28

The expected value of "**X**" would be:

(1) -1.95   (2) -0.52   (3) -0.67   (4) 0.28

(03 marks)

1.8 **Sathish** borrowed a loan of Rs.165,000/- from a friend at an interest rate of 8% per annum payable in 3 years and interest is calculated based on the simple interest. Total interest to be paid by **Sathish** at the end of 3rd year would be:

(1) Rs.42,850/-　　(2) Rs.39,600/-　　(3) Rs.13,200/-　　(4) Rs.26,400/-

(03 marks)

1.9 Quarterly sales figures of a biscuit factory from years 2017 to 2024 were used to determine the following seasonal indices:

Season	1st quarter	2nd quarter	3rd quarter	4th quarter
Seasonal Index	1.05	0.95	0.90	0.85

If the estimated trend value for the 4th quarter of 2024 was 7,520, the forecasted sales value for the 4th quarter is:

(1) 6,539　　(2) 8,648　　(3) 8,847　　(4) 6,392

(03 marks)

1.10 In a factory, there are 100 employees and 70 employees are females. Further, 60% of female employees are married and all the male employees are also married. The probability that a randomly selected employee is married given that she is female is:

(1) $\dfrac{7}{12}$　　(2) $\dfrac{3}{7}$　　(3) $\dfrac{3}{10}$　　(4) $\dfrac{6}{10}$

(03 marks)

*Write the answers for question No. **1.11** to **1.13** in your answer booklet with the number assigned to the question.*

1.11 Relate the terms given on the left hand side of the following table with the number of the appropriate explanation given on the right hand side:

Term		Explanation
(A) A sinking fund	(1)	The relationship between two quantitative variables.
(B) Annuity	(2)	An investment into which equal annual installment is paid in order to earn interest.
(C) Correlation	(3)	An arrangement by which a person receives /pays a series of constant amount.

(01 mark each, 03 marks)

1.12 The following table shows the prices and quantities of two items (**A** and **B**) for the years 2020 and 2024.

Item	Quantity (in units)		Price (Rs.)	
	2020 (q_0)	2024 (q_1)	2020 (p_0)	2024 (p_1)
A	130	180	80	140
B	240	260	120	250

Consider 2020 as the base year.

Based on the above information,

Calculate the Laspeyre's Price Index for the year 2024.

(03 marks)

1.13 In a live daily television programme, a prize is offered for the correct answer to a question asked live. The value of the prize of the first day is Rs.5,000/-. The sponsor increases the prize value by Rs.500/- at the end of each day if the question was not answered by anyone. Nobody was able to answer the question consecutively for 7 days.

Find the value of prize for a viewer who will answer the question on the 8th day.

(02 marks)

*State whether each of the following statements (1.14 and 1.15) is **True** or **False**. Write the answer (True/False) in your answer booklet with the number assigned to the question:*

1.14 At the breakeven point, the marginal revenue is equal to marginal cost. (01 mark)

1.15 Price index is a ratio of the price of a certain number of commodities at the present year as against base year. (01 mark)

(Total 40 marks)

———————— *End of Section A* ————————

SECTION B
(Total 40 marks)

Question 02

(a) In 2023, the cost of a shirt of a garment manufacturing company was Rs.800/- which consists of material cost and labour cost and the ratio between material cost and labour cost of a shirt is 1:3 respectively. The material cost and labor cost increased in 2024 by 20% and 60% respectively.

You are required to:

Calculate the total production cost of a shirt in 2024 . (02 marks)

(b) A dancing academy consists of both male and female dancers. A group of 30 dancers are going to take part in an upcoming event. The cost of a male costume is Rs.3,500/- and the cost of a female costume is Rs.5,000/-. The academy spent Rs.135,000/- for all the costumes.

You are required to:

Calculate the number of male dancers and female dancers separately taking part in the upcoming event. (04 marks)

(c) Consider the following inequalities:

$$4x + 3y \leq 12 \qquad 3x + 5y \leq 15 \qquad x, y \geq 0$$

You are required to:

(i) **Draw** the above inequalities in a graph paper. (03 marks)

(ii) **Identify** the area where all the inequalities are satisfied. (01 mark)

(Total 10 marks)

Question 03

The product's demand function per month is P = 23 − 4q. It has a fixed cost of Rs.15,000/- per month and the Variable Cost (VC) function is $q^2 + 3q$ per month.

Where "q" is the number of units produced during the month in thousands.

You are required to:

(a) **Identify** the Total Revenue (TR) function and Total Cost (TC) function. (04 marks)

(b) **Identify** the profit function. (03 marks)

(c) **Calculate** the number of units at which profit is maximized. (03 marks)

(Total 10 marks)

Question 04

The following table shows the annual profit and the amount of tax paid by a company for last eight (8) years:

Annual Profit (x) (Rs. million)	10	12	8	14	15	16	11	18
Tax Paid (y) (Rs. million)	4	5	3	6	7	8	4	9

Using the above data,

You are required to:

(a) **Identify** the least squares regression line given by $y = a + bx$ to represent the relationship between Annual Profit and Tax paid. (07 marks)

(b) **Calculate** the expected tax amount to be paid, if the annual profit of the company is Rs.40 million. (03 marks)

(Total 10 marks)

Question 05

The following table shows the leave (in days) taken by 60 teachers in a school during the year 2023:

No. of Days	0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 – 59
No. of Teachers (f)	8	18	15	14	3	2

Using the above data,

You are required to:

Calculate the following:

(a) Median. (03 marks)

(b) Mean. (03 marks)

(c) Standard Deviation. (04 marks)

(Total 10 marks)

———————————————— *End of Section B* ————————————————

SECTION C
(Total 20 marks)

Question 06

(A) **Judy** plans to obtain a student loan of Rs.600,000/- from a bank to be paid in 3 years at an interest rate of 10% per annum in order to complete her higher studies. She intends to settle the loan in equal annual installments.

You are required to:

    (a)   **Calculate** the annual installment of the loan.   (03 marks)

    (b)   **Prepare** the amortization schedule to illustrate the repayments of the loan.
   (03 marks)

(B) **Riza** deposited Rs.8,000,000/- at a bank that pays interest at an annual rate of 12% per annum and the interest is compounded quarterly.

You are required to:

Calculate the following:

    (a)   The effective interest rate.   (02 marks)

    (b)   The total amount in the fixed deposit at the end of 3rd year.   (03 marks)

    (c)   Total interest earned by **Riza** at the end of 3rd year.   (02 marks)

(C) A survey was carried out among 40 students and they were asked what kind of pet that they have at home. The results are shown in the following Venn diagram.
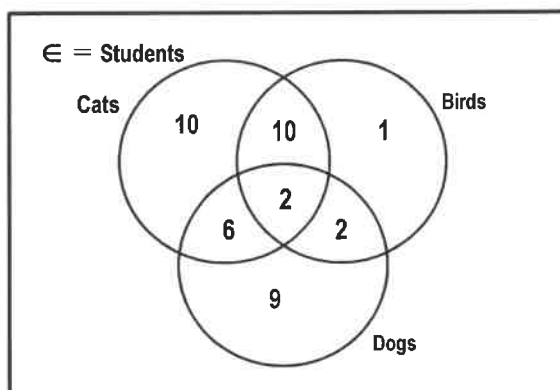
You are required to:

Calculate the following:

    (a)   How many students have at least two pets at home?   (02 marks)

    (b)   If a student is chosen randomly, the probability that the student has a dog at home.
                                                   (02 marks)

(D) The time taken by a runner to finish his race is modeled a normal distribution with a mean of 112 minutes and a standard deviation of 17.2 minutes.

You are required to:

Calculate the probability that the runner takes more than 120 minutes to finish the race.
                                                         (03 marks)
                                                             (Total 20 marks)

End of Section C

ACTION VERBS CHECK LIST

Level of Competency	Description	Action Verbs	Verb Definitions
Knowledge (1)	Recall Facts and Basic Concepts.	**Draw**	Produce a picture or diagram.
		Relate	Establish logical or causal connections.
		State	Express details definitely or clearly.
		Identify	Recognize, establish or select after consideration.
		List	Write the connected items.

Level of Competency	Description	Action Verbs	Verb Definitions
Comprehension (2)	Explain & Elucidates Ideas and Information.	**Recognize**	Show validity or otherwise, using knowledge or contextual experience.
		Interpret	Translate into understandable or familiar terms.
		Describe	Write and communicate the key features.
		Explain	Make a clear description in detail using relevant facts.
		Define	Give the exact nature, scope or meaning.

Level of Competency	Description	Action Verbs	Verb Definitions
Application (3)	Use and Adapt Knowledge in New Situations.	**Reconcile**	Make consistent / compatible with another.
		Graph	Represent by graphs.
		Assess	Determine the value, nature, ability or quality.
		Solve	Find solutions through calculations and/or explanation.
		Prepare	Make or get ready for a particular purpose.
		Demonstrate	Prove or exhibit with examples.
		Calculate	Ascertain or reckon with mathematical computation.
		Apply	Put to practical use.

Level of Competency	Description	Action Verbs	Verb Definitions
Analysis (4)	Draw Connections Among Ideas and Solve Problems.	**Communicate**	Share or exchange information.
		Outline	Make a summary of significant features.
		Contrast	Examine to show differences.
		Compare	Examine to discover similarities.
		Discuss	Examine in detail by arguments.
		Differentiate	Constitute a difference that distinguishes something.
		Analyze	Examine in details to find the solution or outcome.

FORMULAE SHEETS

Mathematical Fundamentals:

Quadratic equation:
The solutions of a quadratic equation,
$ax^2 + bx + c = 0$ is given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Arithmetic sequence:

Term of an arithmetic sequence:

$T_n = a + (n - 1)\,d$

The sum of first n terms of an AP:
$$S = \frac{n}{2}\{2a + (n - 1)d\}$$

Geometric sequence:
The term of a geometric sequence,

$T_n = ar^{n-1}$

The sum of first n terms of a GP:

$$S = a\,\frac{\{r^n - 1\}}{\{r-1\}} \quad \text{if} \quad r > 1$$

$$S = a\,\frac{\{1 - r^n\}}{\{1-r\}} \quad \text{if} \quad r < 1$$

$$S = na \quad \text{Otherwise} \quad r = 1$$

Quantitative Finance:

Simple interest:
$S = X\,(1 + nr)$

Compound Interest:
$S = X\,\{1 + r\}^n$

Discounting:

$$\text{Present Value} = \text{Future Value} \times \frac{1}{(1+r)^n}$$

Repayment of mortgage / Loan:

$$A = \frac{SR^n(R - 1)}{\{R^n - 1\}}$$

Effective Interest Rate:

$\text{EIR} = \{(1 + r)^n - 1\}\,100\%$

Numerical Descriptive Measures:

Mean $\bar{x}$:

For ungrouped data: $\dfrac{\sum x}{n}$

For grouped data: $\dfrac{\sum fx}{\sum f}$

Median:

For Ungrouped data $M_d = \dfrac{(n + 1)^{th}}{2}$ term

For Grouped data $M_d = L_1 + \left(\dfrac{\frac{n}{2} - F_c}{f_m}\right) \times C$

Mode:

Grouped data $M_0 = L_1 + \dfrac{\Delta_1}{\Delta_1 + \Delta_2} \times C$

Standard deviation σ:

For ungrouped data:

$$\sqrt{\frac{\sum(x - \bar{x})^2}{n}} \quad \text{or} \quad \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$$

For grouped data:

$$\sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} \quad \text{or} \quad \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$$

Coefficient of variation (CV):

$$\frac{Standard\ deviation}{Mean} = \frac{\sigma}{\bar{x}} \times 100$$

$$\text{Coefficient of skewness} = \frac{3(\text{Mean - Median})}{\text{Standard Deviation}}$$

Comparing Two Quantitative Variables:

Correlation coefficient (r):

$$\frac{[n\sum xy - \sum x \sum y]}{\sqrt{\{[n\sum x^2 - (\sum x)^2] \times [n\sum y^2 - (\sum y)^2]\}}}$$

Regression line under least square method (a and b):

$$b = \frac{[n\sum xy - \sum x \sum y]}{[n\sum x^2 - (\sum x)^2]}$$

$a = \bar{y} - b\bar{x}$

Comparison over time with Economic variables

Index Numbers:

Price Relative $= \dfrac{p_1}{p_0} \times 100$

Quantity Relative $= \dfrac{q_1}{q_0} \times 100$

Value Relative $V_{1/0} = \dfrac{p_1 q_1}{p_0 q_0} \times 100$

Simple aggregate price index $= \dfrac{\sum p_1}{\sum p_0} \times 100$

Simple aggregate quantity index $= \dfrac{\sum q_1}{\sum q_0} \times 100$

Average price relative $= \dfrac{1}{n} \sum \dfrac{p_1}{p_0} \times 100$

Average quantity relative $= \dfrac{1}{n} \sum \dfrac{q_1}{q_0} \times 100$

Weighted aggregate indices
1) Base-weighted / Laspeyre's:

   Price index $= \dfrac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$

   Quantity index $= \dfrac{\sum q_1 p_0}{\sum q_0 p_0} \times 100$

2) Current-weighted / Paasche's:

   Price index $= \dfrac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$

   Quantity index $= \dfrac{\sum q_1 p_1}{\sum q_0 p_1} \times 100$

3) Using standard weights

   Price index $= \dfrac{\sum p_1 w}{\sum p_0 w} \times 100$

   Quantity index $= \dfrac{\sum q_1 w}{\sum q_0 w} \times 100$

Weighted average of relatives

Price index $= \dfrac{\sum [w \times I_p]}{\sum w} \times 100$

Quantity index $= \dfrac{\sum [w \times I_q]}{\sum w} \times 100$

Time Series:

Multiplicative Model

$Y = T \times S \times C \times R$

Sets and Probability

$\cup$ - Union; AUB defines all elements in A plus all elements in B, no element being counted twice.

$\cap$ - Intersection; A∩B defines all elements included in both A and B.

P (A) – Probability of event A
P (A/B) – Probability of event A, given B

General rules:
P (A∪B) = P (A) + P (B) – P (A∩B)

$P(A/B) = \dfrac{P(A \cap B)}{P(B)}$

Expectation and Variance of a discrete random variable:

$E(X) = \sum(probability \times pay\,off) = \sum p \times x$

$VAR(X) = \sum px^2 - \left(\sum px\right)^2$

Normal Distribution:

$Z = \dfrac{x - \mu}{\sigma}$