

ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JULY 2023

(102) BUSINESS MATHEMATICS AND STATISTICS

• **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 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.**

27-08-2023

Morning

[09.00 – 12.00]

No. of Pages : 10

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 If, $4 + 4x = x + 16$, the value of x is:

(1) 6

(2) 5

(3) 4

(4) 2

(03 marks)

1.2 Kumara borrowed a loan of Rs.250,000/- from a friend at an interest rate of 18% per annum payable in 3 years and the interest is calculated based on a simple interest scheme. If the loan is settled at the end of 3rd year, the total interest for 3 years would be:

(1) Rs.160,758/-

(2) Rs.155,000/-

(3) Rs.135,000/-

(4) Rs.120,758/-

(03 marks)

1.3 Perera has invested a certain amount in a fixed deposit of a bank at an annual interest rate of 12% compounded quarterly. The maturity value of the fixed deposit at the end of 3rd year would be Rs.228,122/-. The initial amount invested in the fixed deposit was:

(1) Rs.146,148/-

(2) Rs.150,000/-

(3) Rs.123,240/-

(4) Rs.160,000/-

(03 marks)

1.4 In a class of 20 students, 4 of the 9 boys and 3 of the 11 girls are in the athletics team. The team is chosen to take part in an athletic race on Sports Day.

If a student is selected at random in the class, the probability that the student chosen is a girl given that she is a member of athletic team of the class would be:

- (1) $\frac{3}{20}$ (2) $\frac{3}{11}$ (3) $\frac{11}{15}$ (4) $\frac{18}{20}$
(03 marks)

1.5 You are given the following frequency distribution of students' marks in a certain examination:

Marks	0 - 9	10 - 19	20 - 29	30 - 39	40 - 49
No. of students	8	10	11	15	6

The mode of the marks is (approximately):

- (1) 32.08 (2) 32.58 (3) 33.08 (4) 35.28
(03 marks)

1.6 For a given data set of x and y , the following summarized values were calculated for 5 observations:

$$\Sigma x = 61, \quad \Sigma y = 37, \quad \Sigma xy = 527, \quad \Sigma x^2 = 869, \quad \Sigma y^2 = 321$$

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

- (1) -0.99 (2) 0.98 (3) 0.97 (4) 0.96
(03 marks)

1.7 The prices of three brands of organic fertilizer manufactured by a company in 2021 and 2022 are tabulated below:

Brand	Price in Rs. (2021)	Price in Rs. (2022)
A	15	18
B	18	22
C	24	28

The price relative of brand C fertilizer, considering 2021 as the base year is (to the nearest integer):

- (1) 86% (2) 150% (3) 111% (4) 117%
(03 marks)

1.8 In a family, the probability for husband to win a lottery ticket is $\frac{3}{8}$ and the probability for wife to win is $\frac{2}{5}$. The probability that both the husband and the wife will win this lottery ticket would be:

- (1) $\frac{1}{40}$ (2) $\frac{31}{40}$ (3) $\frac{3}{20}$ (4) $\frac{15}{16}$
 (03 marks)

1.9 Monthly sales figures recorded by a photocopy paper supplier between 2015 and 2022 were used to determine the following seasonal indices for 2023, assuming a multiplicative time series model:

Month	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Seasonal Index	1.12	0.88	0.95	1.05	0.92	0.98	0.86	1.06	1.02	0.97	1.03	1.16

The estimated trend value for the month of August in 2023 was 10,265. The forecasted sales for August 2023 would be *(to the nearest integer)*:

- (1) 10,881 (2) 9,684 (3) 10,263 (4) 12,266
 (03 marks)

1.10 Soysa invested Rs.500,000/- in a fixed deposit of bank for 3 years at the interest rate of 18% compounded annually. The maturity value of the fixed deposit at the end of 3rd year would be:

- (1) Rs.821,516/- (2) Rs.696,200/- (3) Rs.864,000/- (4) Rs.770,000/-
 (03 marks)

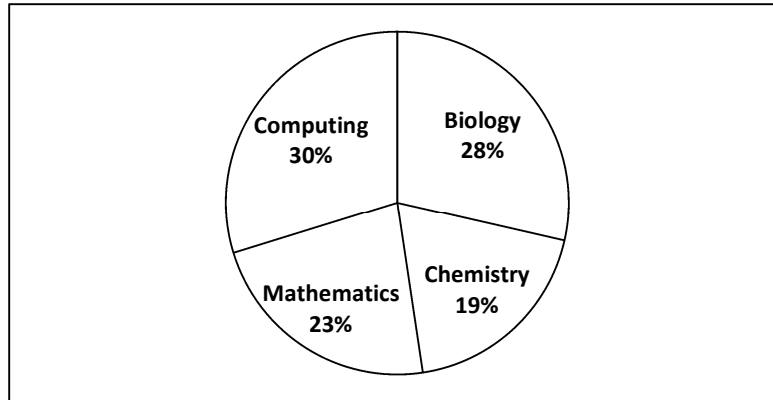
Write the answers for question No. **1.11** to **1.13** in your answer booklet with the number assigned to the question.

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) Trend	(1) Averages are calculated by moving from one overlapping set of values to the next.
(B) Multiplicative Model	(2) Giving weight of the current year to calculate the price index.
(C) Paasche's Price Index	(3) It is assumed that time series variable is the product of four components.
(D) Moving Averages	(4) The direction in which the time series in the long run.

(01 mark each, 04 marks)

- 1.12 There are 240 students in an educational institute. The following pie chart shows the number of students of the 4 subjects studied in the institute:



Find the number of students who are not studying computing. (02 marks)

- 1.13 Find the sum of the first 12 terms of the following arithmetic series:

-7, -1, 5, (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 In a regression analysis used to study the relationship between advertising cost and sales income of a firm, sales income should be considered as the independent variable. (01 mark)

- 1.15 An annuity is an arrangement by which a person receives / pays a series of constant annual amounts. (01 mark)

(Total 40 marks)

End of Section A

SECTION B

(Total 40 marks)

Question 02

- (a) A company has categorized its employees as experienced staff and newcomers. The company is planning to distribute year-end bonuses to its employees such that every new employee gets Rs.50,000/- each and every experienced employee gets Rs.125,000/- each. The company spends Rs.3,875,000/- as the bonus to share among 40 employees.

You are required to:

Calculate the number of newcomers and experienced staff in this company. (04 marks)

- (b) In a manufacturing company, the proportion of employees using public transport is $\frac{7}{25}$ of the total of 350 employees. The company is planning to start a staff transport service for those who are using public transport.

You are required to:

Calculate the number of buses to be allocated, if only 50 employees can be accommodated in one bus. (03 marks)

- (c) A telecommunication provider estimates that its annual profit will go down by 4% in 2023 due to an increase in maintenance charges.

You are required to:

Calculate the expected profit for 2023 if the company has made a profit of Rs.20,000,000/- in 2022. (03 marks)

(Total 10 marks)

Question 03

The Total Cost function per month of a firm is given by $TC = 2q^2 + 2q + 5,600$ and the demand function per month is given by $P = 30 + 2q$.

(Where q is the number of units produced during the month.)

You are required to:

- (a) **Identify** the Total Revenue (TR) function of the firm. (03 marks)

- (b) **Calculate** the Break-Even Quantity. (04 marks)

- (c) **Calculate** the Marginal Cost (MC) of the firm when the firm produces 250 units. (03 marks)

(Total 10 marks)

Question 04

A sample of 8 patients were examined regarding their age and blood sugar level. The data are summarized in the following table:

Age (x)	18	25	30	36	40	50	60	65
Blood sugar level (y)	85	90	96	100	110	115	125	140

Using the above data:

You are required to:

- (a) **Identify** the least square regression line given by $y = a + bx$ to represent the relationship between the age of a patient and the blood sugar level. (07 marks)
- (b) **Calculate** the expected blood sugar level of a patient, if the age is 72. (03 marks)
(Total 10 marks)

Question 05

The following table shows the number of workers at a government office and their ages collected from last year records of that office:

Age	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69
No. of workers (f)	10	18	30	45	17

Using the above data,

You are required to:

- (a) **Calculate** the following for age of workers:
- (i) Median. (04 marks)
- (ii) Mean. (03 marks)
- (b) **Calculate** the coefficient of skewness, if the standard deviation of above data is 11.42. (03 marks)
(Total 10 marks)

End of Section B

SECTION C

(Total 20 marks)

Question 06

- (A) **Kasun** is looking for a loan scheme that supports his higher studies. He comes across a bank from which he can obtain a loan of Rs.800,000/- at an interest rate of 9% per annum.

You are required to:

Calculate the annual installment of the loan if it is to be settled in 5 years. (03 marks)

- (B) A project manager evaluates two (2) projects as **Project P** and **Project Q**. Initial cost and annual net cash flows of two (2) projects are given in the following table:

Project \ Year	0 (Rs.)	1 (Rs.)	2 (Rs.)	3 (Rs.)
P	(450,000)	250,000	200,000	125,000
Q	(400,000)	250,000	200,000	75,000

The cost of capital (*discount factor*) of the company is 10% per annum.

You are required to:

- (a) **Calculate** the Net Present Value (NPV) of each project. (06 marks)
- (b) **Identify** the best investment option with reasons based on the NPV. (02 marks)
- (C) The employees of a company are classified as management, office, and operations. The following table shows the number of employees in each category and whether they are married or not:

Employment Category	Married	Unmarried
Management	6	14
Office	25	10
Operations	45	30

If an employee is chosen at random:

You are required to:

- (a) **Calculate** the probability that the employee is married given that the employee belongs to operations category. (02 marks)
- (b) **Calculate** the probability that the employee is from management category of the company. (03 marks)
- (D) A coffee maker fills jars with coffee. The volume of a coffee jar can be modelled by a normal distribution with a mean of 232ml and a standard deviation of 5ml.

You are required to:

Calculate the probability that the volume of a randomly selected jar is less than 225ml.

(04 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:

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

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

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

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: $\frac{\sum x}{n}$

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

Median:

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

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

Mode:

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

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):

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

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

Comparing Two Quantitative Variables:

Correlation coefficient (r):

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

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:

$$\text{Price Relative} = \frac{p_1}{p_0} \times 100$$

$$\text{Quantity Relative} = \frac{q_1}{q_0} \times 100$$

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

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

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

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

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

Weighted aggregate indices

1) Base-weighted / Laspeyres's:

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

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

2) Current-weighted / Paasche's:

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

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

3) Using standard weights

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

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

Weighted average of relatives

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

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

Time Series:

Multiplicative Model

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

Sets and Probability

U - Union; A∪B defines all elements in A plus all elements in B, no element being counted twice.

∩ - 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:

$$P (A \cup B) = P (A) + P (B) - P (A \cap B)$$

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

Expectation and Variance of a discrete random variable:

$$E(X) = \sum(\text{probability} \times \text{pay off}) = \sum p \times x$$

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

Normal Distribution:

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