



ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JANUARY 2024

(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.**

18-02-2024  
Morning  
[09.00 – 12.00]

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  $9x^2 - 25$

The factors of the above expression are:

- (1)  $(3x + 5)(3x + 5)$
- (2)  $3(x + 5)$
- (3)  $3(x + 5)^2$
- (4)  $(3x + 5)(3x - 5)$

(03 marks)

1.2 **Suthakar** invested Rs.400,000/- in a fixed deposit at the annual interest rate of 8% compounded annually. The total interest on the investment at the end of 4<sup>th</sup> year would be (to the nearest integer):

- (1) Rs.144,196/-
- (2) Rs.128,000/-
- (3) Rs.187,731/-
- (4) Rs.103,884/-

(03 marks)

1.3 You have given the following information:

$$P(X) = 0.40 \quad P(Y) = 0.55 \quad P(X \cup Y) = 0.85$$

Based on the above information, the  $P(X \cap Y)$  is:

- (1) 0.30                      (2) 0.10                      (3) 0.45                      (4) 0.64  
(03 marks)

1.4 The quantity (in kilograms) of four types of rice (**P, Q, R, S**) used by a family in 2022 and 2023 are tabulated below:

Year \ Type of rice	P	Q	R	S
2022	25	28	30	40
2023	30	28	35	50

The quantity relative of type **S** rice, considering year 2022 as the base year is:

- (1) 80%                      (2) 56%                      (3) 225%                      (4) 125%  
(03 marks)

1.5 The summary of statistics relating to variables  $x$  and  $y$  are as follows:

$$\Sigma x = 293, \quad \Sigma y = 60, \quad \Sigma xy = 2,863, \quad \Sigma x^2 = 20,575, \quad \Sigma y^2 = 928, \quad n = 5$$

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

- (1) -0.7955                      (2) -0.7575                      (3) -0.7759                      (4) -0.7795  
(03 marks)

1.6 The following table shows the number of government employees who went abroad during the year 2023, and their ages collected from the records of a state organization:

Age (in years)	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54
No. of Workers	20	35	20	10	10	5

The median age of the employees who went abroad is (to the nearest integer):

- (1) 25                      (2) 37                      (3) 26                      (4) 34  
(03 marks)

1.7 The table below shows the probability distribution of the discrete random variable  $X$ :

$x$	66	67	68	69	70	71
$P(X = x)$	0.2	0.1	0.15	<b>a</b>	0.25	0.05

The value of “**a**” would be:

- (1) 0.15                      (2) 0.20                      (3) 0.25                      (4) 0.30  
(03 marks)

**1.8 Thamosha** wanted to invest Rs.55,000/- in a bank at a rate of 16% per annum. If the interest is compounded quarterly, the annual effective interest rate would be:

- (1) 16.98%                      (2) 16.88%                      (3) 16.64%                      (4) 16.20%  
(03 marks)

**1.9 Ranjan** borrowed a loan of Rs.2,000,000/- from a bank to start a business. He agreed to repay the loan over 5 years in equal annual installments at 12% per annum. The annual installment, of the loan would be *(to the nearest integer)*:

- (1) Rs.486,618/-    (2) Rs.554,785/-    (3) Rs.640,000/-    (4) Rs.304,927/-  
(03 marks)

**1.10** Quarterly sales figures of a tea factory from 2016 to 2023 were used to determine the following seasonal indices:

Season	1 <sup>st</sup> quarter	2 <sup>nd</sup> quarter	3 <sup>rd</sup> quarter	4 <sup>th</sup> quarter
Seasonal Index	1.12	0.88	0.95	1.05

If the estimated trend value for the 4<sup>th</sup> quarter of 2023 was 1,265, the forecasted sales value for the 4<sup>th</sup> quarter is *(to the nearest integer)*:

- (1) 1,205                      (2) 1,328                      (3) 1,202                      (4) 1,331  
(03 marks)

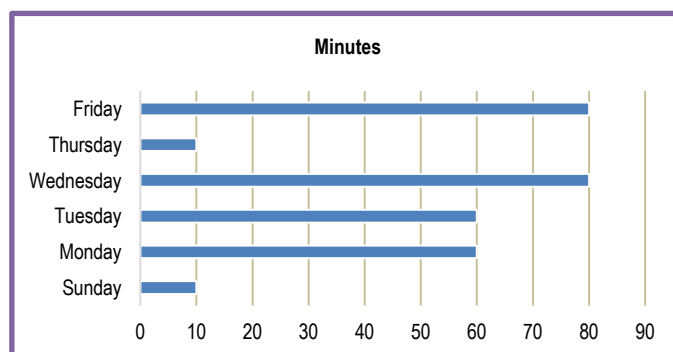
Write the answers for question No. **1.11** to **1.13** in your answer booklet with the number assigned to the question.

**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) Fisher's Index	(1) Present value of cash flows over a period of time.
(B) Net Present Value	(2) The index that base year quantities must be chosen as weights.
(C) Seasonal Variation	(3) The geometric mean of Laspeyres and Paasche's index.
(D) Laspeyre's price Index	(4) Repeated movements involved in a period of time.

(01 mark each, 04 marks)

**1.12** The following bar chart shows the number of minutes a student watched TV over the last 6 days:



Find the total number of minutes the student watched TV on Tuesday and Thursday.

(02 marks)

**1.13** Find the 10<sup>th</sup> term of the following arithmetic series:

$$0, \frac{1}{4}, \frac{1}{2}, \frac{3}{4}, \dots \quad (02 \text{ marks})$$

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** According to the regression model given by  $y = 3 - 2x$ , when a unit increases in the variable  $x$ , 2 units increase in the variable  $y$ . (01 mark)

**1.15** The correlation coefficient between two variables is -0.95, and it is interpreted as a strong negative linear correlation between the variables. (01 mark)

(Total 40 marks)

End of Section A

## **SECTION B**

(Total 40 marks)

### **Question 02**

(a) Profit of a company increases every year by 15% than previous year's profit. The company earned a profit of Rs.500,000/- in first year.

**You are required to:**

**Calculate** the profit earned by the company in 4<sup>th</sup> year. (03 marks)

(b) **Anura** purchased 61 shares from company **A** and 80 shares from company **B** at a total cost of Rs.7,042/-. **Wasana** purchased 61 shares from company **A** and 14 shares from company **B** at a total cost of Rs.3,346/-

**You are required to:**

**Calculate** the cost (price) of a share of each company. (04 marks)

(c) **Nuwan** plans to buy a phone charger for Rs.840/- without VAT. This is subjected to Value Added Tax (VAT) at 15%.

**You are required to:**

**Calculate** the total amount payable by **Nuwan** to buy the phone charger. (03 marks)

(Total 10 marks)

### **Question 03**

The Total Cost (TC) function and the Demand (P) function of a firm per month are given by the following equations:

$$TC = 13q^2 + 5q - 1,000$$

$$P = 13q - 20$$

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

**You are required to:**

- (a) **Identify** the Total Revenue (TR) function and Marginal Cost (MC) function of the firm. (04 marks)
- (b) **Calculate** the Marginal Cost (MC) of the firm when the firm produces 50 units (02 marks)
- (c) **Calculate** the Break-Even Quantity. (04 marks)
- (Total 10 marks)

### Question 04

The owner of a restaurant wanted to expand its dishes offered to customers. Therefore, he varied the number of dishes on the menu in each week and asked his customers to rate their satisfaction.

Each week he noted the number of dishes offered, ( $x$ ), and the average customer satisfaction rating on a scale of 1 to 10, ( $y$ ), where 10 means excellent. The data obtained for 8 weeks are summarized in the below table:

<b>No. of Dishes (<math>x</math>)</b>	15	18	22	23	24	20	17	16
<b>Customer Satisfaction Rating (<math>y</math>)</b>	10	8	6	6	7	8	9	10

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 number of dishes and customer satisfaction. (08 marks)
- (b) **Calculate** the expected rating of customer satisfaction if he offered 19 dishes in a particular week. (02 marks)
- (Total 10 marks)

### Question 05

The following table shows the rainfall (in millimeters) during the month of November 2023:

<b>Rainfall (mm)</b>	50 - 59	60 - 69	70 - 79	80 - 89	90 - 99	100 - 109
<b>No. of Days (<math>f</math>)</b>	3	4	2	9	5	7

Using the above data,

**You are required to:**

**Calculate** the following measures of rainfall:

- (a) Mode. (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) **Manoj** obtained a loan from a bank for 4 years at a rate of 12% per annum and it is to be re-paid in equal annual installments of Rs.65,848/-.

**You are required to:**

- (a) **Calculate** the amount of the loan obtained by **Manoj**. (03 marks)
- (b) **Prepare** the amortization schedule to illustrate the repayments of the loan. (03 marks)

(B) **Mallika** is planning to select an investment plan from 2 options (**A** and **B**). Initial investment cost of the option **A** and **B** are Rs.1,800,000/- and Rs.1,400,000/- respectively. Net cash inflows for next 3 years of both options are as follows:

Option \ Year	1	2	3
A	400,000	800,000	1,000,000
B	500,000	600,000	800,000

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

**You are required to:**

- (a) **Calculate** the Net Present Value (NPV) of each option. (05 marks)
- (b) **Identify** the best investment option with reasons based on the NPV. (02 marks)
- (C) You are given the following information on how the bottles made of following 3 types of plastic are disposed:

Type of Plastic	No. of Bottles	
	Correctly Disposed	Incorrectly Disposed
A	12	5
B	8	7
C	6	12

**You are required to:**

- (a) **Calculate** the probability that a randomly selected bottle is made from **Plastic A**. (02 marks)
- (b) **Calculate** the probability that a randomly selected bottle is made from **Plastic B** given that it is disposed incorrectly. (02 marks)
- (D) The weekly overtime payment of 2,000 minor staff in a company is normally distributed with a mean payment of Rs.7,020/- and a standard deviation of Rs.90/-.

**You are required to:**

**Calculate** the number of minor staff whose weekly overtime payment is more than Rs.7,200/-. (03 marks)

(Total 20 marks)

End of Section C

## **ACTION VERBS CHECK LIST**

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

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

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

Level of Competency	Description	Action Verbs	Verb Definitions
<b>Analysis (4)</b>	Draw Connections Among Ideas and Solve Problems.	<b>Communicate</b>	Share or exchange information.
		<b>Outline</b>	Make a summary of significant features.
		<b>Contrast</b>	Examine to show differences.
		<b>Compare</b>	Examine to discover similarities.
		<b>Discuss</b>	Examine in detail by arguments.
		<b>Differentiate</b>	Constitute a difference that distinguishes something.
		<b>Analyze</b>	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 $\sigma$ :

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):

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

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

### 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:

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

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

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

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

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

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

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

Weighted aggregate indices

1) Base-weighted / Laspeyre'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:

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