

ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JULY 2021

(102) BUSINESS MATHEMATICS AND STATISTICS

31-10-2021

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 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 : 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 $9x + 4 = 3x + 34$, the value of x is:

(1) 6

(2) 5

(3) 4

(4) 3

(03 marks)

1.2 **Pipe A** takes 3 hours to fill a water tank and **pipe B** takes $\frac{1}{6}$ th of the time taken by **pipe A** to fill the same tank. The time taken by **pipe B** to fill the water tank is:

(1) 180 minutes

(2) 90 minutes

(3) 30 minutes

(4) 20 minutes

(03 marks)

1.3 On the day that **Chameli** was born, her father deposited Rs.50,000/- in a bank account at the annual interest rate of 6% compounded annually. The amount available in her account on her 10th birthday would be *(to the nearest integer)*:

- (1) Rs.89,542/- (2) Rs.84,473/- (3) Rs.80,000/- (4) Rs.70,926/-

(03 marks)

1.4 A survey was conducted by a university to study the ability of a group of students who are having a computer or / and a mobile phone to attend online classes. The number of students who had a computer in their homes was 210, whereas 350 of the students had a mobile phone. The total number of students participated in the survey was 420.

If a student having a mobile phone was selected randomly from this group, the probability that the student also has a computer at home is:

- (1) $\frac{2}{5}$ (2) $\frac{2}{3}$ (3) $\frac{3}{5}$ (4) $\frac{1}{4}$

(03 marks)

1.5 1, 4, 5, 8, 10, 16, 18, 18, 19, 19, 19, 25

The median of the above set of data is:

- (1) 16 (2) 17 (3) 18 (4) 19

(03 marks)

1.6 The prices of three different commodities in year 2019 and 2020 are tabulated below:

Commodity	Price (Rs.) - 2019	Price (Rs.) - 2020
A	8	6
B	10	8
C	12	10

The price relative of **commodity C** for the year 2020, considering 2019 as the base year is *(to the nearest integer)*:

- (1) 75% (2) 80% (3) 83% (4) 85%

(03 marks)

1.7 If $P(A) = 0.3$, $P(B) = 0.5$ and $P(A \cup B) = 0.7$, then $P(A \cap B)'$ would be:

- (1) $P(A \cap B)' = 0.1$ (2) $P(A \cap B)' = 0.15$
 (3) $P(A \cap B)' = 0.8$ (4) $P(A \cap B)' = 0.9$

(03 marks)

1.13 Find the 8th term of the following geometric sequence:

1, 3, 9, 27, (02 marks)

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

1.14 Mean and standard deviation are the parameters of normal distribution. (01 mark)

1.15 The correlation coefficient between the heights of a sample of football players and the number of goals they took in a game of football was found to be 0.86. This implies that the two variables have a weak positive correlation. (01 mark)

(Total 40 marks)

End of Section A

SECTION B

(Total 40 marks)

Question 02

(a) You have given the following inequality:

$$3 - 5x \leq -12$$

You are required to:

Solve the above inequality. (02 marks)

(b) **Solve** the following simultaneous equations:

$$2a + 5b = 13$$

$$3a - 2b = 10$$

(04 marks)

(c) A company sells four products **A, B, C** and **D**. Number of units sold during the last quarter is as follows:

Product	No. of Units
A	180
B	90
C	45
D	45
	360

You are required to:

Draw a pie chart for the above data. (04 marks)

(Total 10 marks)

Question 03

In a certain product, the monthly fixed cost is Rs.200/-. The Variable Cost (VC) function per month and Demand (P) function per month are given below:

$$VC = -q^2 - 60q$$

$$P = 40 - q$$

(where "q" is the number of units produced per month in thousands.)

You are required to:

- (a) **Identify** the Total Cost (TC) function and Total Revenue (TR) function. (04 marks)
- (b) **Identify** the Profit Function. (02 marks)
- (c) **Calculate** the break-even quantity. (04 marks)
- (Total 10 marks)

Question 04

A university conducts a written examination and a practical examination for the students who are following a special degree. The table below shows the marks obtained by 8 students for two examinations:

Marks for Written Examination (X)	3	6	8	5	9	10	11	12
Marks for Practical Examination (Y)	3	2	5	7	6	9	12	15

Using the above data:

You are required to:

- (a) **Identify** the least square regression line in terms of $y = a + bx$ to represent the relationship between the marks obtained for written examination and practical examination. (07 marks)
- (b) **Calculate** the marks obtained for written examination by a student when marks obtained for practical examination is 8. (03 marks)
- (Total 10 marks)

Question 05

In a particular week, a customer care officer provides her service to 100 customers. The time taken to the nearest minute for each customer is summarized in the table below:

Time taken (minutes)	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69
No. of Customers (<i>f</i>)	25	18	30	17	6	4

Using the above data,

You are required to:

Calculate the following for the time taken:

- (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) A person deposited Rs.300,000/- in a fixed deposit for 3 years.

You are required to:

- (a) **Calculate** the total amount in the fixed deposit at the end of 3rd year if the simple interest rate is 8% per annum. (02 marks)
- (b) **Calculate** the total amount in the fixed deposit at the end of 3rd year if the interest is calculated at 12% per annum compounded quarterly. (02 marks)

- (B) A company wishes to evaluate two investment projects (**Project A** and **Project B**) to select the most viable project. The life time of each project is 3 years and the cost of capital (discounting factor) of the company is 10%. Each project requires an initial investment of Rs.500,000/-.

The expected cash inflows from the **Project A** for the next 3 years are as follows:

Year	1	2	3
Cash inflow (Rs.)	250,000	375,000	50,000

The Net Present Value (NPV) of **Project B** has already been calculated at Rs.80,400/-.

You are required to:

- (a) **Compute** the Net Present Value (NPV) of **Project A**. (04 marks)
- (b) **State** which project should be undertaken by the company, with reasons based on the NPVs of two projects. (02 marks)
- (C) (a) The following table shows the probability distribution of a discrete random variable:

X	- 1	0	1	2	3	4
P(x)	0.32	0.01	0.02	0.04	0.4	0.21

You are required to:

Calculate the expected value of **X**. (03 marks)

- (b) The height of an adult male is normally distributed with a mean of 177 cm and a standard deviation of 6.4 cm.

You are required to:

Calculate the probability that a randomly chosen adult male has a height between 166 cm and 185 cm. (03 marks)

- (D) The following table shows the prices and quantities of 3 items **X**, **Y** and **Z** for the years 2020 and 2018:

Item	Quantity (in kg)		Price per kg (in Rs.)	
	2020 (q₁)	2018 (q₀)	2020 (p₁)	2018 (p₀)
X	100	70	20	15
Y	250	280	35	40
Z	130	90	80	60

Consider the year 2018 as the base year.

You are required to:

Calculate the Laspeyre's Quantity Index (*Base Weightage Aggregate Quantity Index*) for the year 2020. (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:

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

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:

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