



ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JANUARY 2021

(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.**

14-03-2021

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** Due to the COVID-19 pandemic, the total electricity bill of a household for last 3 months was Rs.18,000/-. However, considering the consumers' request, the government has decided to allow the consumers to settle the last 3 months' bill by paying only 45% of the total value. The amount deducted by the government from this bill is:

- (1) Rs.8,100/-      (2) Rs.9,900/-      (3) Rs.10,000/-      (4) Rs.10,800/-

(03 marks)

**1.2** In 2018, the price of one kilogram of rice was Rs.80/- while in 2020 it was Rs.140/-. The price relative of one kilogram of rice in 2020; considering 2018 as the base year was (to the nearest integer):

- (1) 43%      (2) 57%      (3) 133%      (4) 175%

(03marks)

**1.3** The following summary statistics are provided in relation to  $x$  and  $y$  :

$$\Sigma x = 25, \quad \Sigma x^2 = 65.68, \quad \Sigma y = 50, \quad \Sigma y^2 = 260.48, \quad \Sigma xy = 130.64, \quad n = 10$$

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

- (1) +0.977                      (2) -0.977                      (3) +0.971                      (4) -0.971

(03marks)

**1.4** 2, 2, 6, 7, 7, 7, 7, 11, 11, 11, 13, 16, 16, 16, 16, 17, 17, 17, 17, 17

The mode of the above set of scores would be:

- (1) 7                                      (2) 13                                      (3) 16                                      (4) 17

(03marks)

**1.5** **Nirmal** borrowed Rs.75,000/- from his friend to settle in 2 years at the simple interest rate of 12% per annum. The total amount of the interest paid by him for 2 years would be:

- (1) Rs.9,000/-                      (2) Rs.10,000/-                      (3) Rs.18,000/-                      (4) Rs.93,000/-

(03 marks)

**1.6** **Peter** invests Rs.6,000/- in a savings account at the end of each year for 5 years that pays interest at the rate of 5% per annum compounded annually. The present value of this annuity at the end of 5<sup>th</sup> year would be *(to the nearest integer)*:

- (1) Rs.31,500/-.                      (2) Rs.30,000/-.                      (3) Rs.28,500/-.                      (4) Rs.25,980/-.                      (03 marks)

**1.7** You have given the following information:

$$P(A) = 0.38 \quad P(B) = 0.22 \quad P(A \cap B) = 0.06$$

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

- (1) 0.66                                      (2) 0.60                                      (3) 0.54                                      (4) 0.40

(03 marks)

**1.8** A person invested Rs.75,000/- in a fixed deposit of a bank at an annual interest of 12% compounded quarterly. The maturity value of the fixed deposit at the end of the 2<sup>nd</sup> year would be *(to the nearest integer)*:

- (1) Rs.95,008/-.                      (2) Rs.93,000/-.                      (3) Rs.94,080/-.                      (4) Rs.81,750/-.                      (03 marks)

- 1.9 Quarterly sales figures of a chemical supplier between 2010 and 2020 were used to determine the following seasonal index:

Season	1 <sup>st</sup> quarter	2 <sup>nd</sup> quarter	3 <sup>rd</sup> quarter	4 <sup>th</sup> quarter
Seasonal Index	0.93	0.84	1.09	1.14

The estimated trend values for the four quarters of the year 2021 are 7617, 7764, 7912 and 8060, respectively. Assuming a multiplicative model, the quarterly forecasted sales values of 2021 would be (*Assume C = 1 and R = 1*):

- (1) 7,084, 6,522, 8,624, 9,188.                      (2) 7,838, 6,522, 7,122, 6,940.  
 (3) 7,838, 7,289, 8,624, 6,940.                      (4) 7,084, 5,950, 6,485, 9,188.  
 (03 marks)

- 1.10 **John** wishes to mortgage his house for 5 years and borrow Rs.400,000/- from a bank. He is planning to pay the mortgage loan with the interest in equal annual installments. If the annual interest rate is 12%, the annual installment that **John** is supposed to pay would be (*to the nearest integer*):

- (1) Rs.140,987/-.    (2) Rs.128,000/-.    (3) Rs.110,964/-.    (4) Rs.86,862/-.  
 (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) Seasonal variation	(1) A normal and economically stable year.
(B) Moving average	(2) Measuring changes in price over a specific period of time.
(C) Base year	(3) Repeated movements involved in a period of time.
(D) Price index	(4) A set of averages where each one corresponding to a trend value of a time series.

(01 mark each, 04 marks)

- 1.12 The mean, median and variance of a set of data are calculated as 710, 690 and 144 respectively.

Calculate the coefficient of skewness: (02 marks)

- 1.13 Find the 10<sup>th</sup> term of the following arithmetic progression:

4, 7, 10, ..... (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 At the profit maximization point, Marginal Cost (MC) is equal to Marginal Revenue (MR). (01 mark)

- 1.15 A least square regression line of  $y$  on  $x$  is expressed by  $y = 3.59x + 6.72$ . This means if  $x$  increases by 1 unit then  $y$  will increase by 3.59 units. (01 mark)

(Total 40 marks)

## **SECTION B**

(Total 40 marks)

### **Question 02**

- (a) You have given the following equation:

$$3(4x + 2) = 30$$

**You are required to:**

**Calculate** the value of  $x$ . (03 marks)

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

$$3x + 5y = -7$$

$$11x - 8y = 27 \quad \text{(04 marks)}$$

- (c) The company is selling school bags to local market. Selling price of the bag for the year 2020 is Rs.800/- and the company policy is the increasing in selling price at the rate of 5% in every year.

**You are required to:**

**Calculate** the selling price of a bag in the year 2023. (03 marks)  
(Total 10 marks)

### **Question 03**

- (a) A company produces and sells a product. Its monthly fixed cost is Rs.12,000/- and Variable Cost (VC) function per month and Demand (D) function per month are given below:

$$VC = 2q^2 - 12q$$

$$D = q + 8$$

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

**You are required to:**

- (i) **Identify** the Total Cost (TC) function and Total Revenue (TR) function. (04 marks)
- (ii) **Calculate** the number of units at which the profit is maximized. (03 marks)
- (b) The Total Revenue (TR) function and Total Cost (TC) function of **Product X** are given below:

$$TR = 2q^2 + 4q$$

$$TC = 2q^2 + 2q + 200,000$$

*(Where  $q$  is the number of units produced during the year.)*

**You are required to:**

**Calculate** the Break-Even Quantity. (03 marks)  
(Total 10 marks)

### Question 04

A study is wanted by an organization to identify the factors that impact life expectancy among countries. In that study, they have chosen a few countries and measured the average amount spent on healthcare per person annually against the average life expectancy in those countries. The table below shows the data from six different countries:

Average amount spent on healthcare per person per annum ( $x$ ) (Rs.'000)	Average life expectancy ( $y$ ) (in years)
38	42
42	44
60	52
80	71
90	75
110	76

**You are required to:**

- (a) **Identify** the least square regression line given by  $y = a + bx$  to determine the relationship between the average amount spent on healthcare per person annually and the average life expectancy. (07 marks)
- (b) **Calculate** the average life expectancy when average amount spent on healthcare per person annually is Rs.75,000/-. (03 marks)
- (Total 10 marks)

### Question 05

The following table shows the monthly salary of 40 employees in a company:

Monthly salary (Rs.'000)	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69
No. of Employees ( $f$ )	5	15	8	4	5	3

Using the above data,

**You are required to:**

**Calculate** the following of the monthly salary:

- (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) A company is in the process of evaluating two investment projects. The following cash inflows for the next 3 years have been forecasted for the two projects, **Project A** and **Project B**:

Year Project	1 (Rs.)	2 (Rs.)	3 (Rs.)
<b>A</b>	20,000	50,000	90,000
<b>B</b>	45,000	65,000	50,000

Initial investment of **Project A** and **Project B** are Rs.160,000/- and Rs.130,000/- respectively. The cost of capital (discount rate) 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 project from **Project A** and **Project B** with reasons based on the NPV. (02 marks)
- (B) The following table shows the probability distribution of the age of children in daycare centres across the country:

<b>Age of Children (x)</b>	2	3	4	5	6
<b>Probability P(x)</b>	0.14	0.13	0.23	0.24	0.26

**You are required to:**

**Calculate** the expected age  $[E(x)]$  of a child in Daycare Centres. (04 marks)

- (C) In a survey, 87 people who are having a Computer (C) and / or a Smart Phone (S) were questioned. 37 people have a Computer only and 17 people have both a Computer and a Smart Phone.

**You are required to:**

- (a) **Draw** a Venn Diagram to show the above data. (03 marks)
- (b) **Calculate** the probability of having a smartphone by that person given that he has a Computer, if a person is selected randomly. (02 marks)
- (D) The time taken by a car servicing centre to service a car has a normal distribution with a mean of 1.35 hours and a standard deviation of 0.35 hours.

**You are required to:**

**Calculate** the probability that the car servicing centre takes less than one hour to service a car. (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 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  $M_d = L_1 + \left\{ \frac{\frac{n}{2} - F_c}{f_m} \right\} \times C$

#### 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):

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

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

### 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 / 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:

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