

ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JULY 2022

(102) BUSINESS MATHEMATICS AND STATISTICS

28-08-2022

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 : 11

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  $-5x^2 - 4x + 12$

The factors of the above quadratic expression are:

(1)  $(5x + 6)(x + 2)$

(2)  $(-5x + 6)(x - 2)$

(3)  $(-5x + 6)(x + 2)$

(4)  $(5x - 6)(x + 2)$

(03 marks)

1.2 **Krish** deposited Rs.50,000/- at the annual interest rate of 7% compounded annually. The total interest receivable at the end of 3<sup>rd</sup> year would be (to the nearest integer):

(1) Rs.7,000/-

(2) Rs.7,245/-

(3) Rs.10,500/-

(4) Rs.11,252/-

(03 marks)

- 1.3 The following simple linear regression equation shows the relationship between the investment ( $x$ ) (in Rs.000's) and the profit ( $y$ ) (in Rs.000's) of a company:

$$y = 0.33 + 0.667x$$

When the investment is Rs.250,000/-, the expected profit of the company would be (*to the nearest integer*):

- (1) Rs.830,167/-    (2) Rs.83,167/-    (3) Rs.166,750/-    (4) Rs.167,080/-  
(03 marks)

- 1.4 The number of Test Kits produced by a company for three different diseases in 2020 and 2021 are tabulated below:

Test	Quantity of Test Kits Produced	
	2020	2021
P	11	9
Q	10	8
R	12	10

Considering year 2020 as the base year, the quantity relative of test **R** for 2021, would be (*to the nearest integer*):

- (1) 120%    (2) 118%    (3) 81%    (4) 83%  
(03 marks)

- 1.5 There are 10 marbles in a box of which 6 are blue and 4 are green. A marble is drawn at random from the box is replaced and another marble is drawn. The probability of getting a blue marble and a green marble respectively is:

- (1)  $\frac{24}{90}$     (2)  $\frac{24}{100}$     (3)  $\frac{15}{90}$     (4)  $\frac{15}{100}$   
(03 marks)

- 1.6 You are given the following frequency distribution:

$x$	12 – 19	20 – 27	28 – 35	36 – 43	44 – 51	52 – 59
$f$	08	12	12	15	10	03

The median of the above frequency distribution is (*approximately*):

- (1) 35.8    (2) 34.2    (3) 33.3    (4) 32.7  
(03 marks)

1.7 The sixth term of a geometric progression of 2, 6, 18, ..... would be:

- (1) 486                      (2) 162                      (3) 72                      (4) 36

(03 marks)

1.8 A finance company pays interest at 8% per annum compounded quarterly. The annual effective rate of interest would be:

- (1) 36.05%                      (2) 1.36%                      (3) 24%                      (4) 8.24%

(03 marks)

1.9 Quarterly sales figures of a gas supplier from 2013 to 2021 were used to calculate 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	0.92	0.86	1.07	1.15

If the estimated trend value for the second quarter of 2021 was 9,575, the forecasted sales value for the 2<sup>nd</sup> quarter is (to the nearest integer):

- (1) 11,134                      (2) 1,340                      (3) 8,809                      (4) 8,235

(03 marks)

1.10 An annuity is structured in such a way that you should pay Rs.14,000/- a year at the end of each year for next 5 years. If the interest rate is 9% per annum, the present value of the annuity would be (to the nearest integer):

- (1) Rs.61,455/-                      (2) Rs.56,385/-                      (3) Rs.54,446/-                      (4) Rs.58,557/-

(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) Histogram	(1) A measure of changes in price over a specific period of time.
(B) Annuity	(2) A component of a time series.
(C) Cyclical Variation	(3) An agreement by which a person receives a series of constant annual amount.
(D) Price Index	(4) A graphical representation of a frequency distribution.

(01 mark each, 04 marks)

1.12 State two(02) limitations of index numbers. (02 marks)

1.13 You are given the following information with reference to employees' monthly salaries of a company:

	Rs.
Mean	74,500
Median	83,000
Standard Deviation	1,900

Calculate the Coefficient of Skewness. (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 Under the simple random sample, each member of the population has an equal chance of being selected. (01 mark)

1.15 If the coefficient of correlation of two variables is +0.45, there is a positive strong relationship between the variables. (01 mark)  
(Total 40 marks)

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End of Section A

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## **SECTION B**

(Total 40 marks)

### **Question 02**

(a) You are given the following simultaneous equations:

$$9a + 4b = 42$$

$$5a + 3b = 28$$

**You are required to:**

**Calculate** the value of 'a' and 'b'. (04 marks)

(b) A family has two (2) businesses (**A** and **B**) and earned a profit of Rs. 6 million from both businesses during the last financial year. Business **B's** profit is twice of the profit of Business **A**.

**You are required to:**

**Calculate** the profit earned during the last year from Business **A** and **B** separately. (03 marks)

- (c) The ratio between male and female employees in a factory is 3 : 5. It was found that there are 120 female employees than male employees.

**You are required to:**

**Calculate** the number of female employees in the factory. (03 marks)  
(Total 10 marks)

### Question 03

- (a) The Variable Cost (VC) function per month of **Product A** is  $VC = -q^2 + 32q$  and monthly Fixed Cost (FC) is Rs.496,800/-. The demand function per month is  $P = 400 - q$ . (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. (03 marks)  
(ii) **Calculate** the break-even quantity. (04 marks)

- (b) Total Cost (TC) function of **Product Y** is given below:

$$TC = 4q^2 - 16q + 600,000$$

(where  $q$  is the number of units produced during the year in thousands).

**You are required to:**

**Calculate** the number of units at which the cost is minimized. (03 marks)  
(Total 10 marks)

### Question 04

A sample of eight (8) families were interviewed regarding their annual family income and the average annual expenditure on children's education:

<b>Annual Income (Rs.'000) (x)</b>	660	750	650	730	540	900	870	850
<b>Average Annual Expenditure on Children's Education (Rs.'000) (y)</b>	11	14	12	13	6	18	17	15

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 average annual expenditure on children's education of families and their annual income. (07 marks)
- (b) **Calculate** the expected annual education expenditure, if the annual income of a family is Rs.800,000/- (to the nearest integer). (03 marks)
- (Total 10 marks)

### Question 05

The age limit of 60 voters and the number of votes cast by them at an election during one hour period are summarized in the following table:

Age	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69	70 – 79
No. of Votes ( $f$ )	8	6	5	21	14	6

Using the above data,

**You are required to:**

**Calculate** the following for age of voters:

- (a) Mode. (03 marks)
- (b) Mean. (03 marks)
- (c) Standard Deviation. (04 marks)
- (Total 10 marks)

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*End of Section B*

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## **SECTION C**

(Total 20 marks)

### **Question 06**

- (A) **Nisal** borrows a loan of Rs.600,000/- from a bank for 5 years at the interest rate of 10% per annum. It is to be paid in equal annual installments.

**You are required to:**

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

- (B) A company is planning to select an investment project from two (2) investment projects (**Project X** and **Project Y**). Forecasted net cash inflows of both projects are as follows:

<b>Project \ Year</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>X</b>	250,000	250,000	250,000
<b>Y</b>	380,000	350,000	300,000

Initial investment of **Project X** and **Project Y** are Rs.600,000/- and Rs.800,000/- respectively. The cost of capital (*Discounting Factor*) of the company is 10% per annum.

**You are required to:**

- (a) **Calculate** the Net Present Value (NPV) of both projects separately. (04 marks)
- (b) **Identify** the best investment option with reasons. (02 marks)
- (C) You are given the following information about the employees of a company:

	<b>Male</b>	<b>Female</b>
Managers	08	07
Executives	15	18
Non-Executives	22	30
<b>Total</b>	<b>45</b>	<b>55</b>

**You are required to:**

**Calculate** the following, if an employee is selected at random:

- (a) The probability that the employee is a male. (02 marks)
- (b) The probability that the employee is a female, given that she is a manager. (02 marks)

- (D) (a) The following table shows the probability distribution of the number of children in a family:

<b>No. of Children (<math>x</math>)</b>	0	1	2	3
<b>P (<math>x</math>)</b>	0.125	0.375	0.375	0.125

**You are required to:**

**Calculate** the expected value of the number of children in a family. (03 marks)

- (b) The weight of a fish caught by a fisherman is modeled by a normal distribution with a mean of 7.5 kg and a standard deviation of 1.8 kg.

**You are required to:**

**Calculate** the probability of catching a fish whose weight is more than 10 kg. (04 marks)

(Total 20 marks)

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*End of Section C*

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## **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):

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

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

### 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:

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