ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I   EXAMINATION - JULY 2020

(102) BUSINESS MATHEMATICS AND STATISTICS

27-09-2020
Morning
[09.00 – 12.00]

No. of Pages   : 09
No. of Questions : 06

- **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** *and* **Graph Papers** *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.*

SECTION A
(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 In a certain town, 70% of the population is Sinhalese, 22% is Tamil and the rest represents other ethnic groups. If 3,200 people belong to the other ethnic groups, the number of Sinhalese in the town is:

(1) 8,800.   (2) 28,000.   (3) 22,400.   (4) 40,000.

(03 marks)

1.2 If $8y + 8 = 3(2y + 8)$, the value of *y* is:

(1) 3   (2) 6   (3) 16   (4) 8   (03marks)

1.3 **Kasun** invested Rs.6,000/- at a simple interest rate of 8% per annum. The total amount of investment at the end of 3rd year is:

(1) Rs.6,960/-   (2) Rs.7,558/-   (3) Rs.7,440/-   (4) Rs.6,480/-

(03marks)

1.4 The quantities of four different commodities produced by a company in 2018 and 2019 are tabulated below:

Commodity	Quantity	
	2018	2019
A	8	6
B	10	5
C	14	10
D	19	13

Based on the above data, simple aggregate quantity index for the year 2019 using 2018 as the base year is *(to the nearest integer)*:

(1) 67%   (2) 85%   (3) 61%   (4) 150%

(03marks)

1.5 Marks obtained by 6 students for a Mathematics assignment are as follows:

          75,   68,   x,   86,   95,   90

If the mean marks of 6 students is 83, the value of x would be:

(1) 82   (2) 83   (3) 84   (4) 85

(03 marks)

1.6 The following summary statistics has been obtained in relation to x and y :

$\sum x = 70$ $\sum y = 30.6$ $\sum xy = 310.5$

$\sum x^2 = 952$ $\sum y^2 = 134.13$ $n = 7$

The correlation coefficient between x and y would be:

(1) 0.6479   (2) $-$ 0.6479   (3) $-$ 0.4697   (4) 0.4697

(03 marks)

1.7 In a group of 65 people, 45 said that they had visited Europe and 26 said that they had visited Asia. 8 people said that they had visited neither Europe nor Asia. The probability that a randomly chosen person visited Europe given that he had visited Asia would be:

(1) $14/45$ (2) $8/26$ (3) $14/26$ (4) $8/45$

(03 marks)

1.8 Manoj obtained a loan of Rs.500,000/- at the annual interest rate of 10% compounded annually repayable in equal annual installments at the end of every year over the next 4 years. The annual repayment would be *(to the nearest integer)*:

(1) Rs.125,000/-   (2) Rs.157,735/-   (3) Rs.137,500/-   (4) Rs.175,521/-

(03 marks)

1.9 **Suresh** has invested 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 2nd year is Rs.63,339/-. The initial amount invested in the fixed deposit was:

(1) Rs.52,782/-.   (2) Rs.50,000/-.   (3) Rs.48,130/-.   (4) Rs.45,000/-.

[03 marks]

1.10 The following table shows the average annual sales quantity of air conditioners at a leading retailer over 6 years from 2014 to 2019:

Year (x)	2014	2015	2016	2017	2018	2019
Number of air conditioners (y)	1,042	1,220	1,345	1,850	1,725	2,025

The trend equation for the above has been obtained as T = 198 x + 841.

The estimated average annual sales quantity for the year 2020 would be:

(1) 2,030   (2) 2,129   (3) 2,227   (4) 1,832

(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 terms given on the left-hand side of the following table with the number of the correct statement of the right-hand side:

Term		Statement	
(A)	Simple interest	**(1)**	Present value of cash flows over a period of time.
(B)	Compounded interest	**(2)**	An agreement whereby a person pays (or receives) a fixed amount at the end of each period.
(C)	Net Present Value	**(3)**	Interest is earned in equal amounts for a fixed period.
(D)	Annuity	**(4)**	Interest earned in previous period is added to the principal amount when calculating the interest.

(01 mark each, 04 marks)

1.12 A financial institution wishes to see what type of savings schemes their customers are using. The institution collected data from a sample of 72 customers and found the following:

Savings Accounts : 30

Current Accounts : 18

Fixed Deposits   : 24

Draw a pie chart using the above data.   (02 marks)

1.13 Suppose $P(A \cup B) = 0.72, P(A) = 0.6$ and $P(B) = 0.3$.

Calculate the $P(A \cap B)$.   (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 Positive correlation is a relationship between two variables in which both variables move in the same direction. (01 mark)

1.15 Effective interest rate is equal to simple interest rate. [01 mark]

[Total 40 marks]

—————————————— *End of Section A* ——————————————

SECTION B
(Total 40 marks)

Question 02

(a) Consider the following two simultaneous equations:

$$3x + 2y = 17$$
$$2x + 5y = 26$$

You are required to:

Calculate the value of x and y. (04 marks)

(b) A company manufactures and sells furniture and keeps a profit margin of 20% on cost of production. A table was sold for Rs.48,000/- by the company to a customer.

You are required to:

Calculate the production cost of the table. (02 marks)

(c) Consider the following inequalities:

$$3x + 2y \leq 12 \qquad x + 2y \leq 6 \qquad x, y \geq 0$$

You are required to:

(i) **Draw** the above inequalities in a graph paper. (03 marks)

(ii) **Identify** the area where all the inequalities are satisfied. (01 mark)

(Total 10 marks)

Question 03

A product's demand function is $p = 1000 - 2q$. It has a fixed cost of Rs.800/- and a variable cost of $100q + 3q^2$, where "q" is the number of units produced and "p" is the unit price.

You are required to:

(a) **Identify** the Total Revenue (TR) function and the Total Cost (TC) function.   (03 marks)

(b) **Identify** the Profit function.   (03 marks)

(c) **Calculate** the number of units which the profit is maximized.   (04 marks)

(Total 10 marks)

Question 04

The following table shows the advertising expenses and sales value for last 6 months of a company:

Advertising Expenses (Rs'000) (x)	44	29	74	12	9	50
Sales Value (Rs.'000) (y)	550	480	630	230	240	610

You are required to:

(a) **Identify** the least square regression line given by $y = a + bx$ to determine the relationship between the advertising expenses and sales value.   (07 marks)

(b) **Calculate** the expected sales value, when the advertising expense is Rs.40,000/-. (03 marks)

(Total 10 marks)

Question 05

The table below shows the time spent by 80 people waiting for a taxi on a Sunday morning:

Waiting time (in minutes)	Frequency (f)
10 - 19	15
20 - 29	09
30 - 39	30
40 - 49	14
50 - 59	12

You are required to:

Calculate the following of the waiting time:

(a) Mean.   (04 marks)

(b) Standard Deviation.   (04 marks)

(c) Co-efficient of Variation.   (02 marks)

(Total 10 marks)

End of Section B

SECTION C

(Total 20 marks)

Question 06

(A) A company wants to evaluate a new project and the initial investment of the project is Rs.150,000/-.

The following table presents the cash inflows of the project for the next 3 years:

Year	1	2	3
Cash inflow (Rs.)	70,000	85,000	50,000

The cost of capital (discount rate) of the company is 15%.

You are required to:

(a) **Compute** the Net Present Value (NPV) of the project. (04 marks)

(b) **State** whether the company should invest in this project based on NPV. (02 marks)

(B) The following table shows the prices and quantities of 3 items, *x*, *y* and *z* for the year 2016 and 2019:

Item	Quantity (in kg)		Price per kg (in Rs.)	
	2016 (q_0)	2019 (q_1)	2016 (p_0)	2019 (p_1)
x	250	300	20	30
y	130	160	18	25
z	180	170	40	50

Consider the year 2016 as the base year.

You are required to:

Calculate the Laspeyre's Price Index *(Base Weightage Aggregate Price Index)* for the year 2019. (04 marks)

(C) (a) 100 students sat for a professional examination of which 55 were girls. Number of students who passed this examination was 35 of whom 15 were boys.

You are required to:

(i) **Draw** a Tree Diagram to represent the above data. (03 marks)

(ii) **Calculate** the probability of a student passing that examination. (02 marks)

(iii) **Calculate** the probability of a selected student, who is a boy, fails the examination. (02 marks)

(b) The time taken by a runner to finish a marathon is modeled by a normal distribution with a mean of 240 minutes and a standard deviation of 40 minutes.

You are required to:

Calculate the probability that the runner takes below 300 minutes to finish the marathon. (03 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:

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:

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

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

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

Quantitative Finance:

Simple interest:
$S = X(1 + nr)$

Compound Interest:
$S = X\{1 + r\}^n$

Discounting:
Present Value = Future Value $\times \dfrac{1}{(1+r)^n}$

Repayment of mortgage / Loan:

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

Numerical Descriptive Measures:

Mean $\bar{x}$:

For ungrouped data: $\dfrac{\sum x}{n}$

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

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):

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

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

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

<u>Index Numbers:</u>

Price Relative $= \dfrac{p_1}{p_0} \times 100$

Quantity Relative $= \dfrac{q_1}{q_0} \times 100$

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

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

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

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

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

Weighted aggregate indices
1) <u>Base-weighted / Laspeyre's:</u>
   Price index $= \dfrac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$

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

2) <u>Current-weighted / Paasche's:</u>
   Price index $= \dfrac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$

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

3) <u>Using standard weights</u>
   Price index $= \dfrac{\sum p_1 w}{\sum p_0 w} \times 100$

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

Weighted average of relatives

Price index $= \dfrac{\sum [\, w \times I_p\,]}{\sum w} \times 100$

Quantity index $= \dfrac{\sum [\, w \times I_q\,]}{\sum w} \times 100$

Time Series:

Multiplicative Model

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

Sets and Probability

$\cup$ - Union; A$\cup$B defines all elements in A plus all elements in B, no element being counted twice.

$\cap$ - Intersection; A$\cap$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

<u>General rules:</u>
P (A$\cup$B) = P (A) + P (B) – P (A$\cap$B)

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

<u>Expectation and Variance of a discrete random variable:</u>

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

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

<u>Normal Distribution:</u>

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