ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

LEVEL I EXAMINATION - JANUARY 2022

(102) BUSINESS MATHEMATICS AND STATISTICS

27-03-2022
Morning
[09.00 – 12.00]

No. of Pages : 10
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*** *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

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 $6y - 4 = 36 + y$, the value of y is:

(1) 5 (2) 6 (3) 8 (4) 10

(03 marks)

1.2 **Nikith** invested Rs.45,000/- at the simple interest rate of 8% per annum. The total interest receivable at the end of 3rd year would be:

(1) Rs.9,600/- (2) Rs.10,800/- (3) Rs.10,920/- (4) Rs.12,000 /-

(03 marks)

1.3 There are 50 students in a class of school **A**. It was found that 27 students attend Mathematics tuition classes, 20 students attend Science tuition classes. 10 students attend both Mathematics and Science tuition classes:

The probability that a student of this class attends only Mathematics tuition classes is:

(1) $\frac{27}{50}$ (2) $\frac{10}{50}$ (3) $\frac{17}{27}$ (4) $\frac{17}{50}$

(03 marks)

1.4 You are given the following frequency distribution:

x	10– 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69
f	4	6	20	38	26	6

The mode on the above distribution is:

(1) 38 (2) 45.5 (3) 55.5 (4) 32

(03 marks)

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

$\sum x = 105$, $\sum y = 240$, $\sum xy = 5{,}190$, $\sum x^2 = 2{,}275$, $\sum y^2 = 11{,}870$, $n = 6$

Based on the above data, correlation coefficient between x and y would be:

(1) **-**0.9043 (2) **+**0.9040 (3) **-**0.9934 (4) **+**0.9934

(03 marks)

1.6 A four-member family consumed 50 kilograms of sugar in the year 2016 and 85 kilograms of sugar in the year 2021. Considering year 2016 as the base year, the Quantity Relative for the year 2021 would be:

(1) 170% (2) 120% (3) 70% (4) 59%

(03 marks)

1.7 The following table shows the probability distribution of a discrete random variable:

X	1	2	3	4
Probability P(x)	0.30	0.35	0.15	0.20

The expected value of X would be:

(1) 2.25 (2) 4 (3) 0.80 (4) 1

(03 marks)

1.8 **Naheed** invested Rs.15,000/- in a fixed deposit of a bank for 3 years at the annual interest rate of 12% compounded quarterly. The maturity value of the fixed deposit at the end of 3rd year would be *(to the nearest integer)*:

(1) Rs.22,500/- (2) Rs.21,386/- (3) Rs.21,074/- (4) Rs.20,400/-

(03 marks)

1.9 The following table shows the average annual sales of electrical equipments of **Nano Electricals** from year 2016 to 2021:

Year (x)	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Sales	2,450	2,435	2,392	2,150	1,725	1,685

If the trend equation for sales of electrical equipments have been arrived as, $T = 2{,}759 - 177x$, the estimated average annual sales for the year 2022 would be:

(1) 2,582 (2) 2,140 (3) 1,520 (4) 3,999

(03 marks)

1.10 The selling price of **Product A** is Rs.3,680/- per unit. If the company keeps a profit margin of 15% on cost, the cost of **Product A** is:

(1) Rs.3,128/- (2) Rs.3,200/- (3) Rs.3,400/- (4) Rs.3,600/-

(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) Net Present Value (NPV)	**(1)** Value of the asset at the end of the lease term.
(B) Residual Value	**(2)** Expressing the relationship between two variables in some mathematical form.
(C) Trend	**(3)** Present value of all cash flows at a given rate of discount.
(D) Regression Analysis	**(4)** A component of a time series.

(01 mark each, 04 marks)

1.12 State two(02) random sampling methods. (02 marks)

1.13 Find the sum of first 20 terms of the following arithmetic progression:

(-4), 3, 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 If any constant value is received when any term of a series is divided by the previous term, such series is called as "arithmetic progression". (01 mark)

1.15 Arithmetic mean is used to measure the central tendency. (01 mark)

(Total 40 marks)

End of Section A

SECTION B

(Total 40 marks)

Question 02

(a) You are given the following simultaneous equations:

$$8x + 3y = 42$$

$$5x + 2y = 27$$

You are required to:

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

(b) A person was appointed as the Accountant of an organization with an initial salary of Rs.75,000/- per month. At the end of every year, his salary is increased by 5% per year from the previous year.

You are required to:

Calculate the monthly salary of the Accountant at the end of 5th year. (03 marks)

(c) The following table shows the prices and quantities of 3 items for the year 2021 and 2019.

Item	Quantity (in units)		Price (Rs.)	
	2021 (q_1)	**2019 (q_0)**	**2021 (p_1)**	**2019 (p_0)**
A	450	600	120	80
B	300	400	250	175
C	850	750	60	40

Consider 2019 as the base year,

You are required to:

Calculate the Laspeyre's Price Index (Base Weighted Aggregate Price Index) for the year 2021. (03 marks)

(Total 10 marks)

Question 03

Product X's demand function per month is, P = 49 - q. It requires a monthly Fixed Cost (FC) of Rs.100,000/- and the Variable Cost (VC) per month is VC = - $q^2 + 24q$, where q is the number of units produced.

You are required to:

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

(b) **Identify** the Marginal Cost (MC) function and Marginal Revenue (MR) function. (03 marks)

(c) **Calculate** the break-even quantity. (04 marks)

(Total 10 marks)

Question 04

X PLC conducted a survey on their advertising cost incurred during the last 8 months on the **Product C** and sales quantity of that product. The below table shows the details of the survey:

Advertising Cost (Rs.'000) (x)	8	10	9	12	14	15	16	20
Sales Quantity ('000) (y)	5	10	8	15	16	20	25	40

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 advertising cost and sales quantity. (07 marks)

(b) **Calculate** the expected sales quantity when the advertising cost is Rs.25,000/-. (03 marks)

(Total 10 marks)

Question 05

The table below shows the resting heart beat rate per minute of 150 patients taking part in a medical examination:

Heart Beat Rate	**Frequency (f)**
40 - 49	35
50 - 59	22
60 - 69	28
70 - 79	24
80 - 89	26
90 - 99	15

Using the above data,

You are required to:

Calculate the following:

(a) Mean. (03 marks)

(b) Standard Diviation. (04 marks)

(c) Coefficient of Variation. (03 marks)

(Total 10 marks)

End of Section B

SECTION C

(Total 20 marks)

Question 06

(A) A loan of Rs.120,000/- was obtained by a person at the interest rate of 8% per annum which is to be paid in 3 equal annual installments.

You are required to:

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

(b) **Prepare** the amortization table to illustrate the repayments of the loan. (03 marks)

(B) A company is evaluating 2 investment options to select the best option. The cost of capital (discount rate) of the company is 10%.

Option 1: Initial investment is Rs.500,000/- and net cash inflows for next 3 years is Rs.200,000/- per year.

Option 2: Initial investment is Rs.350,000/- and net cash inflows for next 3 years is Rs.150,000/- per year.

You are required to:

(a) **Calculate** the Net Present Value (NPV) of both options separately. (06 marks)

(b) **Identify** the best investment option with reasons based on the NPV. (02 marks)

(C) The probability that a student passes a written exam is 1/2 and a practical exam is 1/3. Also, the probability that a student passes both the written and practical exams is 1/4.

You are required to:

Calculate the probability that a student passes the practical exam given that he passed the written exam. (03 marks)

(D) The weights of babies born in a hospital are considered normally distributed with a mean of 2.5 kg and a standard deviation of 0.45 kg.

You are required to:

Calculate the probability that a new-born baby in this hospital has weight more than 3 kg. (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:

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:

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

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

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

Quantitative Finance:

Simple interest:

$$S = X\,(1 + nr)$$

Compound Interest:

$$S = X\,\{1 + r\}^n$$

Discounting:

$$\text{Present Value} = \text{Future Value} \times \frac{1}{(1+r)^n}$$

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 $M_d = \frac{(n+1)^{th}}{2}$ term

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):

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

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:

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

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

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

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

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

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

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

Weighted aggregate indices

1) Base-weighted / Laspeyre's:

   Price index $= \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$

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

2) Current-weighted / Paasche's:

   Price index $= \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$

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

3) Using standard weights

   Price index $= \frac{\sum p_1 w}{\sum p_0 w} \times 100$

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

Weighted average of relatives

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

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

$\cup$ - 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

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:

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

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

Normal Distribution:

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