ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

AA1 EXAMINATION - JULY 2019

(AA12) QUANTITATIVE METHODS FOR BUSINESS

- **Instructions to candidates** (Please Read Carefully)**:**

  (1) **Time allowed:** *Reading* - *15 minutes.*

  Writing - *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)

Fifteen (15) compulsory questions

(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 $8y + 6 = 3y + 21$, the value of y is:

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

(03 marks)

1.2 On 01st January 2017, **Nuwan** borrowed Rs.12,000/- from **Perera** at the simple interest rate of 12% per annum. If the loan is settled on 31st December 2019, the total amount of interest on loan would be:

(1) Rs.1,440/-.   (2) Rs.4,320/-.   (3) Rs.2,880/-.   (4) Rs.5,760/-.

(03 marks)

1.3 If the Total Cost (TC) Function of a best-selling product of a manufacturer is given by $TC = 3,000x - 4x^2 + 10,000$, the Marginal Cost (MC) function for the product would be:

(1) MC = $1,500x^2$ - 4 + $10,000x$

(2) MC = $3,000x$ - $8x$ + 10,000

(3) MC = 3,000 - $8x$

(4) MC = 3,000 - $4x$

(03 marks)

1.4 The following simultaneous equations are provided:

$$2x + y = 14$$
$$3x + 2y = 24$$

The values of x and y would be:

(1) $x = 6$ and $y = 3$

(2) $x = 3$ and $y = 4$

(3) $x = 14$ and $y = 24$

(4) $x = 4$ and $y = 6$

(03 marks)

1.5 The following summary statistics relates to a set of six pairs of observations of the variable x and y.

$$\Sigma x = 30 \quad , \quad \Sigma y = 180 , \quad n = 6$$

It is found that the linear regression line of the above data set is, $y = a + 2x$.

The value of "a" is:

(1) 20

(2) 120

(3) -30

(4) 60

(03 marks)

1.6 The following table shows the individual price indices of three items **X, Y** and **Z** with their relative weights:

Item	Price Relative (I_p)	Weight (W)
X	115	7
Y	110	8
Z	118	10

Based on the above data, the weighted average relative price index for the three items would be *(to the nearest integer)*:

(1) 110

(2) 115

(3) 120

(4) 118

(03 marks)

1.7 The following table shows the average annual sales figures of a company over the last six years:

Year (x)	2011	2012	2013	2014	2015	2016
Sales (Rs.'000)	6,531	8,550	7,458	9,250	8,725	9,450

The corresponding trend equation for the above data could be obtained as: T = 483x + 6,636. The estimated average sales for the year 2017 would be (Rs.'000):

(1)   8,568   (2)   9,051   (3)   10,017   (4)   8,085

(03 marks)

1.8 The probability of happening event **A** is 0.57 and the probability of happening event **B** is 0.28. If **A** and **B** are two mutually exclusive events, the probability of happening either event **A** or event **B** would be:

(1)   0.16   (2)   0.69   (3)   0.85   (4)   0.29

(03 marks)

1.9 The following probability distribution presents the monthly profit / loss of an agent selling newspapers and magazines to foreign customers:

Profit / (Loss) (Rs.) (x)	(6,000)	8,000	11,000	15,000
Probability (p)	0.30	0.35	0.15	0.20

The expected monthly profit of the agent would be:

(1)   Rs.9,250/-.   (2)   Rs.5,650/-   (3)   Rs.7,450/-   (4)   Rs.28,000/-

(03 marks)

1.10 20th term of the arithmetic sequence : 22, 27, 32, 37, …….. would be:

(1)   117   (2)   122   (3)   125   (4)   100

(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 An investor has four options to invest money in four different projects as mentioned below:

Project	NPV (Rs.'000)	IRR
A	12.15	22%
B	9.45	12%
C	(15.54)	16%
D	14.06	20%

Identify the best investment option in terms of Net Present Value (NPV) and Internal Rate of Return (IRR) technique separately.

(02 marks)

1.12 A finance company pays interest at the rate of 16% per annum. Calculate the Effective Annual Rate if the interest is compounded quarterly. (02 marks)

1.13 The Total Revenue (TR) function and Total Cost (TC) function of a company are given below:

$$TR = 22x$$

$$TC = 15x + 12,600$$

Where x is number of units.

Identify the profit function of the company. (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 An annuity is an agreement whereby a person pays or receives a fixed amount at the end or beginning of each period. (02 marks)

1.15 The value of correlation coefficient between a pair of variables is always a positive figure.

(02 marks)

(Total 40 marks)

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

SECTION B

Four (04) compulsory questions

(Total 40 marks)

Question 02

(a) **Rose** invested Rs.500,000/- in a bank account at an interest rate of 9% compounded annually.

You are required to:

Calculate the total amount in her account at the end of the 3rd year. (03 marks)

(b) **Ann** obtains a loan of Rs.75,000/- at an annual interest rate of 8%, compounded annually, repayable in equal annual installments at the end of each year over the three years.

You are required to:

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

(ii) **Prepare** the loan amortization schedule for the above loan. (04 marks)

(Total 10 marks)

Question 03

(a) The Total Revenue (TR) function and the Total Cost (TC) function of **product A** are given by,

$$TR = 20x + 3x^2$$

$$TC = 4x^2 - 500x + 1{,}500, \quad \text{where } x \text{ is the number of units produced.}$$

You are required to:

Calculate the number of units at which the profit is maximized. (05 marks)

(b) A company produces and sells a product. Its monthly fixed cost is Rs.400,000/-. Total Variable Cost (VC) per month and Total Revenue (TR) per month are given below:

$$VC = 2q^2 + 5q$$

$$TR = 2q^2 + 9q + 250{,}000$$

(where q is the number of units produced during the month).

You are required to:

(i) **Identify** the Total Cost (TC) function. (02 marks)

(ii) **Calculate** the break-even quantity. (03 marks)

(Total 10 marks)

Question 04

(a) The following table presents the lifetime (in weeks) of a sample of 100 batteries:

Lifetime (weeks)	50-54	55-59	60-64	65-69	70-74	75-79
Number of batteries	02	29	37	16	14	02

You are required to:

(i) **Calculate** the mean lifetime of a battery. (03 marks)

(ii) **Calculate** the standard deviation of the lifetime of a battery. (04 marks)

(b) The weight of a newborn baby is normally distributed with the mean of 3.43 kilogram and standard deviation of 0.65 kilogram.

You are required to:

Calculate the probability of newborn babies with weight more than 3.55 kilogram. (03 marks)

(Total 10 marks)

Question 05

A shopkeeper sells books and sweets. He thinks that the more books he sells in a week (7 days) the more sweets he can sell during that week. He recorded the amount of money he received from book sales (x) and sweet sales (y) each week for seven weeks. The data are shown in the following table:

Book Sales (Rs.x)	Sweet Sales (Rs.y)	$\sum x^2$	$\sum y^2$	$\sum xy$
380	560	144,400	313,600	212,800
402	543	161,604	294,849	218,286
370	564	136,900	318,096	208,680
365	573	133,225	328,329	209,145
410	550	168,100	302,500	225,500
390	544	152,100	295,936	212,160
385	530	148,225	280,900	204,050
2,702	**3,864**	**1,044,554**	**2,134,210**	**1,490,621**

You are required to:

(a) **Identify** the least square regression line given by $y = a + bx$ to determine the linear relationship between the above two variables.   (07 marks)

(b) **Calculate** the expected sales income from sweets, if the sales income from books is Rs.350/-.

(03 marks)
(Total 10 marks)

——————— *End of Section B* ———————

SECTION C

One (01) compulsory question

(Total 20 marks)

Question 06

(A) The following table shows the prices and quantities of three items **A, B** and **C** for the years 2015 and 2018:

Item	Quantity (in units)		Price per Unit (Rs.)	
	2015 (q_0)	2018 (q_1)	2015 (P_0)	2018 (P_1)
A	45	35	120	155
B	25	40	80	105
C	60	55	75	100

Consider the year 2015 as the base year.

You are required to:

Calculate the base weighted aggregate price index (Laspeyre's Price Index) for the year 2018.

(04 marks)

(B) The following table presents the quarterly sales, 4 quarter moving average and centered moving average figures relating to sales of a company. Assume **a multiplicative model** in which there are no cyclical and random variations [R=1 ; C=1] :

Year	Quarter	t	Y	4 Quarter Moving Average	Centered Moving Average (T)	Y/T
2016	1	1	200			
	2	2	205			
				211.25		
	3	3	215		215.00	1
				218.75		
	4	4	225		222.50	1.01
				226.25		
2017	1	5	230		230.625	0.99
				235.00		
	2	6	235		239.375	0.98
				243.75		
	3	7	250		250.00	1
				256.25		
	4	8	260		263.125	_ _ **(e)** _ _
				270.00		
2018	1	9	280		_ _ **(c)** _ _	_ _ **(f)** _ _
				_ _ **(a)** _ _		
	2	10	290		_ _ **(d)** _ _	1
				_ _ **(b)** _ _		
	3	11	300			
	4	12	320			

You are required to:

Identify the respective values for **(a)** to **(f)** of the above table.   (06 marks)

(C) In a factory, **machines A, B** and **C** produce electronic components. **Machine A** produces 16% of the components, **machine B** produces 50% of the components and **machine C** produces the rest. However, some of the components produced are defective. The defective percentages produced by **machine A, B,** and **C** are 4%, 3% and 7% respectively:

You are required to:

(a) **Draw** a tree diagram to represent the above information.   (04 marks)

(b) **Calculate** the probability that a randomly selected component is:

   (i)   a defective.   (03 marks)

   (ii)   a defective and produced by **machine B**.   (03 marks)

─────── *End of Section C* ───────   (Total 20 marks)

ACTION VERB CHECK LIST

Knowledge Process	Verb List	Verb Definitions
Level 01 Comprehension Recall & explain important information	**Define**	Describe exactly the nature, scope, or meaning.
	Draw	Produce (a picture or diagram).
	Identify	Recognize, establish or select after consideration.
	List	Write the connected items one below the other.
	Relate	To establish logical or causal connections.
	State	Express something definitely or clearly.
	Calculate/Compute	Make a mathematical computation
	Discuss	Examine in detail by argument showing different aspects, for the purpose of arriving at a conclusion.
	Explain	Make a clear description in detail revealing relevant facts.
	Interpret	Present in an understandable terms.
	Recognize	To show validity or otherwise, using knowledge or contextual experience.
	Record	Enter relevant entries in detail.
	Summarize	Give a brief statement of the main points (in facts or figures).

Knowledge Process	Verb List	Verb Definitions
Level 02 Application Use knowledge in a setting other than the one in which it was learned / Solve closed-ended problems	**Apply**	Put to practical use.
	Assess	Determine the value, nature, ability, or quality.
	Demonstrate	Prove, especially with examples.
	Graph	Represent by means of a graph.
	Prepare	Make ready for a particular purpose.
	Prioritize	Arrange or do in order of importance.
	Reconcile	Make consistent with another.
	Solve	To find a solution through calculations and/or explanation.

Knowledge Process	Verb List	Verb Definitions
Level 03 Analysis Draw relations among ideas and compare and contrast / Solve open-ended problems.	**Analyze**	Examine in detail in order to determine the solution or outcome.
	Compare	Examine for the purpose of discovering similarities.
	Contrast	Examine in order to show unlikeness or differences.
	Differentiate	Constitute a difference that distinguishes something.
	Outline	Make a summary of significant features.

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:

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

Internal Rate of Return:

$$IRR = \frac{[N_1 r_2 - N_2 r_1]}{[N_1 - N_2]}\%$$
Or
$$IRR = a\% + \frac{NPV_A}{[NPV_A - NPV_B]}(b - a)\%$$

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):

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

Comparing Two Quantitative Variables:

Pearson's Product Moment Correlation.

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 coefficients (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 $= \dfrac{p_1}{p_0} \times 100$

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

Value Relative $= \dfrac{v_1}{v_0} \times 100$

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) Base-weighted / Laspeyre's:

   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) Current-weighted / Paasche's:

   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) Using standard weights

   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:

Additive model
Y = T + S + C + R

Multiplicative Model

Y = T × S × C × R

Sets and Probability

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

$\cap$ - 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∪B) = P (A) + P (B) – P (A∩B)

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

Expectation and Variance of a discrete random variable:

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

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

Normal Distribution:

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