

ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

AA1 EXAMINATION - JULY 2016

(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) **Graph Paper and 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.**

24-07-2016

Morning

[8.45 – 12.00]

No. of Pages : 12

No. of Questions : 06

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 1.8. Write the number of the selected answer in your answer booklet with the number assigned to the question.

1.1 $x^2 - x - 2 = 0$

When the above equation is solved, the answer is:

- (1) $x = -2, x = 1$ (2) $x = 2, x = -1$ (3) $x = 2, x = 1$ (4) $x = -2, x = -1$

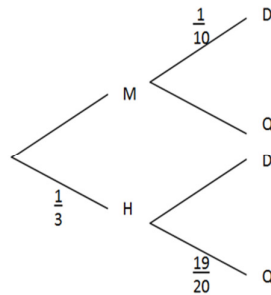
(03 marks)

1.2 The coefficient of determination is given by:

- (1) Square root of correlation coefficient. (2) Square root of coefficient of variation
(3) Square of correlation coefficient. (4) Square of coefficient of variation.

(03 marks)

- 1.3** R manufactures wrist watches. Most of the watches are manufactured with the aid of machines (M) and the rest are handmade (H). The end product could be defective (D) or in good quality (Q).



Using the above tree diagram, the probability that the end product is a defective (D) one is:

- (1) 0.33 (2) 0.81 (3) 0.93 (4) 0.083

(03 marks)

- 1.4** Weekly profit function of a company is given by $P = 1,400q - q^2 - 240,000$ where q is the number of units produced per week.

The number of units to be sold to maximize the weekly profit is:

- (1) 1,600 (2) 700 (3) 750 (4) 800

(03 marks)

- 1.5** The result of a regression analysis between sales income (Y) (in Rs.'000) and advertising expenditure (X) (in Rs.'000) is explained by the regression line: $Y = 180 + 8x$.

This equation explains that:

- (1) as advertising expenditure increases by Rs.1,000/- sales income increases by Rs.8,000/-.
 (2) as advertising expenditure increases by Rs.8,000/-, sales income increases by Rs.1,000/-.
 (3) as advertising expenditure increases by Rs.8/- sales income increases by Rs.180/-.
 (4) as advertising expenditure increases by Rs.1,000/- sales income increases by Rs.188,000/-.

(03 marks)

- 1.6** There are two identical bottles. One bottle contains two blue balls and one red ball. The other contains two red balls and one blue ball. A bottle is selected and a single ball is drawn:

The probability that the ball drawn is red would be:

- (1) $\frac{2}{3}$ (2) $\frac{1}{2}$ (3) $\frac{1}{3}$ (4) $\frac{1}{8}$

(03 marks)

1.7 The Revenue function and the Cost function of an ice cream manufacturer are given below:

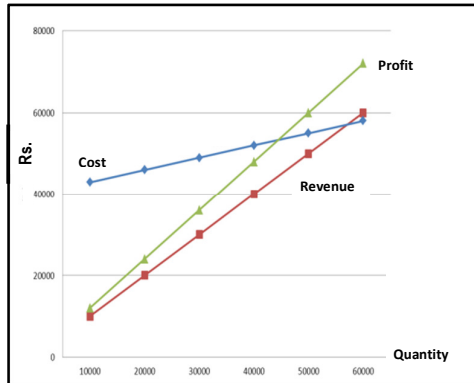
Revenue, $R = 1.5 Q$

Cost, $C = 40,000 + 0.3 Q$

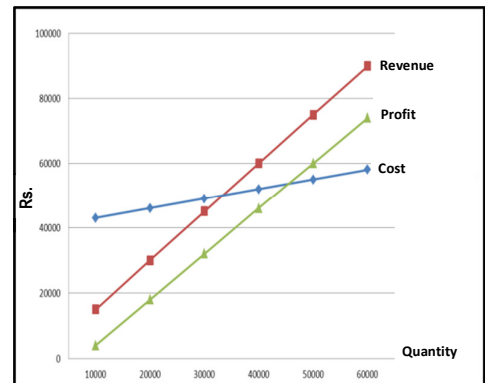
where 'Q' is the quantity.

The correct chart which represents the given functions is:

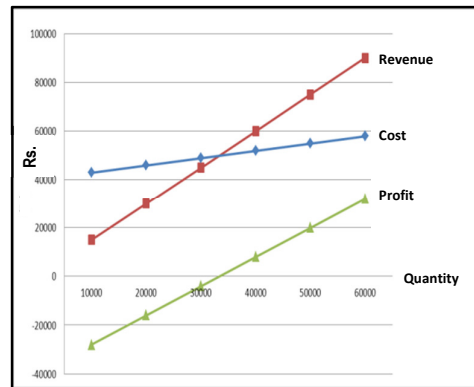
(1)



(2)



(3)



(4) None of the above.

(03 marks)

1.8 The following table shows the price per kilogram of sugar relating to years 2010 and 2015:

Year	Price per kg (Rs.)
2010	50
2015	105

The price index (price relative) for the year 2015 considering 2010 as the base year would be:

- (1) 48% (2) 32% (3) 148% (4) 210%

(03 marks)

Write short answers for question No. 1.9 to 1.11 in your Answer Booklet with the number assigned to the question.

- 1.9** Cost function and revenue function of a company are as follows, where x is the number of units produced and sold:

$$TR = 8x$$

$$TC = 6x + 1,400$$

Calculate the break-even number of units. (03 marks)

- 1.10** A company manufactures product X and the cost of the product X is Rs.150/- per unit. The company keeps a profit margin of 25% on cost.

Calculate the selling price of product X. (03 marks)

- 1.11** State two(02) reasons for sampling. (02 marks)

Use the tables below and information thereon to answer question No. 1.12 to 1.15.

A company is evaluating three power sector investment options.

The initial investment, Cash Flows (CF), Present Values (PV) and Net Present Values (NPV) of two options are given below:

Option 1: Wind Power - The initial investment is Rs.100,000/-. The life span of the project is 8 years.

Year	0	1	2	3	4	5	6	7	8
CF	(100,000)	10,000	26,500	14,100	21,000	28,000	29,000	23,000	10,000
PV	(100,000)	9,009	21,508	10,310	13,833	16,617	15,505	11,078	4,339
NPV	2,199								

Option 2: Hydro Power - The initial investment is Rs.82,000/-. The life span of the project is 6 years.

Year	0	1	2	3	4	5	6
CF	(82,000)	19,152	18,194	17,285	16,420	15,599	14,819
PV	(82,000)	17,254	14,767	12,638	10,817	9,258	7,923
NPV	(9,343)						

The information relevant to 3rd option is as follows:

Option 3: Solar Power – The initial investment is Rs.112,000/-. The project will generate a perpetual cash inflow of Rs.15,000/- per annum.

The cost of capital for all three projects is 11%.

State whether each of the following statements is **True** or **False**. Write the selected answer (True/False) in your answer booklet with the number assigned to the question.

- 1.12** The NPV of the solar power investment is Rs.4,364/-. (02 marks)
- 1.13** If the company is considering only the “Wind power” and “Hydro power” projects, based on the above data, the most suitable power source for this company is “Hydro Power”. (02 marks)
- 1.14** It is recommended to invest in Solar Power project based on the NPV of the 3 options. (02 marks)
- 1.15** If the cost of capital is decreased to 10%, the most suitable investment is Hydro Power Project. (02 marks)

End of Section A

SECTION B

Four (04) compulsory questions

(Total 40 marks)

Question 02

- (a) A factory's revenue function is given by $R(x) = 24x - 2x^2$ and the cost function is given by $C(x) = 40 + 4x$ where x is in units thousands and $R(x)$ and $C(x)$ are in rupees thousands:
- (i) **Identify** the profit function $P(x)$.
 - (ii) **Calculate** the number of units at which the profit is maximized.
 - (iii) **Calculate** the maximum profit. (06 marks)
- (b) The table below shows the price (p) and quantity (q) of sales of three vehicle brands for the year 2014 and 2015. The quantities are given in Units and Prices are given in Rupees Millions:

Vehicle Brand	2014		2015	
	p_0	q_0	p_1	q_1
A	5	200	5	300
B	15	450	12	200
C	4	540	6	600

Calculate the Laspeyre's Price Index / Base Weighted Price Index for the year 2015 considering 2014 as the base year. (04 marks)

(Total 10 marks)

Question 03

- (a) The following table represents marks scored by 38 students in an aptitude test:

Class Interval (Marks)	20-29	30-39	40-49	50-59	60-69	70-79	80-89
Number of students	5	7	5	5	8	4	4

Draw a histogram to represent the above data.

(06 marks)

- (b) Consider the following simultaneous equations:

$$5x + 4y = 24$$

$$4x + 2y = 18$$

You are required to,

Compute the values of x and y .

(04 marks)

(Total 10 marks)

Question 04

- (a) A computer games developing company tested a new computer game copied to CDs. They found that the number of errors (x) per 100 CDs of the new software had the following probability distribution:

No. of errors per 100 CDs. (x)	Probability
2	0.01
3	0.25
4	0.40
5	0.30
6	0.04

You are required to,

Calculate the following:

- (i) The expected number of errors per 100 CDs.

- (ii) The variance of x .

(06 marks)

- (b) You are given the following Total Cost (TC) function and Total Revenue (TR) function of an industrial tool manufacturer.

$$TC = 4x^2 + 23,000$$

$$TR = -2x^2 + 9,000x$$

Where x is the quantity.

You are required to:

Identify the Marginal Revenue (MR) Function and the Marginal Cost (MC) Function. (04 marks)

(Total 10 marks)

Question 05

A company is considering investing its excess cash amounting to Rs.1,000,000/- for 8 years. They have considered two investment options.

Option 1

Invest the total amount in four deposit products (A, B, C & D) of Rs.250,000/- each maturing in 2 years, 4 years, 6 years and 8 years respectively. At the maturity, matured amounts will not be reinvested and the value at maturity will be calculated based on the following simple interest calculation method:

$$\text{Value at maturity} = \text{Capital} + (\text{Capital} \times \text{Return}) \times \text{No. of years}$$

Assume that return for all four deposits is 12% per annum. Partially completed table is given below:

Year Deposit (Rs.'000)	0	1	2	3	4	5	6	7	8
A	250		<i>a</i>						
B	250				370				
C	250						<i>b</i>		
D	250								490
Total	(1,000)								

Option 2

Invest the total amount in a fixed deposit which gives a return of Rs.110,000/- every year for 8 years and the initial investment back at the end of 8 years.

Relevant table is given below:

Year	0	1	2	3	4	5	6	7	8
Cash Flow (Rs.'000)	(1,000)	110	110	110	110	110	110	110	1,110

You are required to,

- Identify** the missing values for *a* and *b* of first option in the table.
- Calculate** the Net Present Value (NPV) for both options separately.
(Assume that the cost of capital is 8% per annum)
- Recognize** the investment option which could be recommended to the company. (10 marks)

End of Section B

SECTION C

One (01) compulsory question

(Total 20 marks)

Question 06

- (A) The quarterly sales figures together with the Moving Averages, Trend Values and Seasonal Components of a winter clothes manufacturer from year 2012 to 2015 is given below:

Year	Quarter		Quarterly Sales	Moving Average	Trend Values	Seasonal Component
2012	1	1	51			
	2	2	80			
	3	3	60	77.75	77.00	(17.00)
	4	4	120	76.25	75.75	44.25
					75.25	
2013	1	5	45		74.63	(29.63)
	2	6	76	74.00	73.50	2.50
	3	7	55	73.00	75.25	(20.25)
	4	8	116	77.50	79.38	36.62
					81.25	
2014	1	9	63		83.38	(20.38)
	2	10	91	85.50	86.50	4.50
	3	11	72	87.50	88.38	(16.38)
	4	12	124	89.25	89.88	34.12
					90.50	
2015	1	13	70		91.50	(21.50)
	2	14	96	92.50	93.50	2.50
	3	15	80	94.50		
	4	16	132			

You are required to:

Compute the seasonal indices using additive model.

(06 marks)

- (B) A salary survey was carried out among 50 accountancy professionals working as accountants in the private sector. The results are summarized and given below:

Salary (in thousands)	No. of Accountants
110 - 119	0
120 - 129	2
130 - 139	5
140 - 149	25
150 - 159	10
160 - 169	8

You are required to,

Calculate the following:

- (a) The mean,
 (b) The standard deviation,
 of salaries of the 50 accountants.

(09 marks)

- (C) The following table shows the advertising expenses of a company against sales income over the last five years:

Year	Advertising Expenses (X) (Rs.'000)	Sales Income (Y) (Rs.'000)	XY	X ²	Y ²
1	2	10	20	4	100
2	1	9	9	1	81
3	4	12	48	16	144
4	3	10	30	9	100
5	2	11	22	4	121
Total	12	52	129	34	546

You are required to,

Calculate the correlation coefficient between Advertising Expenses and Sales Income.

(05 marks)

(Total 20 marks)

End of Section C

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:

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

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

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

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:

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

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: $\frac{\sum x}{n}$

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

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):

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

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):

$$b = \frac{[n \sum xy - \sum x \sum y]}{[n \sum x^2 - (\sum x)^2]}$$

$$a = \bar{y} - b\bar{x}$$

FORMULAE SHEETS

(Continued)

Comparison over time with Economic variables

Index Numbers:

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

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

$$\text{Value Relative} = \frac{v_1}{v_0} \times 100$$

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

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

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

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

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:

Additive model

$$Y = T + S + C + R$$

Multiplicative Model

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

Sets and Probability

U - 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:

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

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

Normal Distribution:

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