ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA

AA1 EXAMINATION - JANUARY 2016

(AA12) QUANTITATIVE METHODS FOR BUSINESS

07-02-2016
Morning
[8.45 – 12.00]

No. of Pages : 11
No. of Questions : 06

- **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.*

SECTION A

Objective Test Questions (OTQs)

Sixteen (16) 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 A manufacturer keeps a profit margin of 25% on a selected item which is sold at Rs.937.50 per item. Last month he sold 100 units. His last month's profit is:

(1) Rs.56,250/-. (2) Rs.93,750/-. (3) Rs.23,437.50 (4) Rs.18,750/-.

(03 marks)

1.2 A person deposits Rs.15,000/- in a savings account at the beginning of every year. If simple annual interest rate of 7% is paid for this savings account, the balance of the savings account at the end of 10^{th} year would be (to the nearest rupee):

(1) Rs.222,185/-. (2) Rs.221,754/-. (3) Rs.221,869/-. (4) Rs.221,640/-.

(03 marks)

1.3 The following table shows the output (X) against the total cost (Y) in rupees million for a particular product.

X	Y (Rs. million)	XY	X^2	Y^2
60	3.1	186	3,600	9.61
61	3.6	219.6	3,721	12.96
62	3.8	235.6	3,844	14.44
63	4	252	3,969	16
65	4.1	266.5	4,225	16.81
311	**18.6**	**1,159.7**	**19,359**	**69.82**

The correlation co-efficient between output and total cost would be:

(1) 0.91 (2) 0.82 (3) 0.31 (4) 0.55

(03 marks)

1.4 The Treasury Department of a bank expects the following interest rates with the given probabilities for the next year:

Interest Rate	Probability
7.50%	0.10
7.80%	0.22
8.00%	0.26
8.60%	0.20
8.80%	0.15
9.50%	0.07

The expected interest rate for the next year would be:

(1) 8.00% (2) 8.37% (3) 8.67% (4) 8.25%

(03 marks)

1.5

x	$x-\bar{x}$	$(x-\bar{x})^2$
5	-7.5	56.25
10	-2.5	6.25
15	2.5	6.25
20	7.5	56.25

The co-efficient of variation for the above data would be:

(1) 0.1 (2) 2 (3) 0.4 (4) 0

(03 marks)

1.6 Two commonly used methods of obtaining a regression line are:

(1) Free hand method and Laspeyres method.

(2) Paasche method and least square method.

(3) Laspeyres method and Paasche method.

(4) Free hand method and least square method. (03 marks)

1.7 The following table shows the price relatives and their weights for five different companies:

Company	Price relative	weight
A	120	16
B	80	25
C	160	15
D	75	12
E	220	20

The weighted average price relative for the above data set is:

(1) 131 (2) 132.04

(3) 17.74 (4) 125.60

(03 marks)

1.8 Match each of the following basic sampling term with the correct definition:

Term	Definition
P : Population	**T** : Subset of items from a larger set
Q : Sample space	**U** : A set of all possible outcomes of an experiment
R : Sample	**V** : All members or items of a defined group

(1) **P** → **U** : **Q** → **V** : **R** → **T** (2) **P** → **V** : **Q** → **U** : **R** → **T**

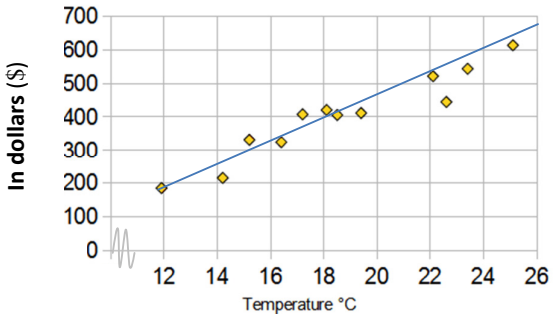
(3) **P** → **T** : **Q** → **U** : **R** → **V** (4) **P** → **U** : **Q** → **T** : **R** → **V**

(03 marks)

*Use the graph below to answer question No. **1.9** to **1.13**.*

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.

In a country, electricity usage changes with the outside temperature. The Electricity Board has done a survey on the electricity bill per house verses the outside temperature during day time. The following is the scatter plot drawn and the line of best fit for the data collected from that survey.



1.9 The two(02) variables have a strong negative correlation. (02 marks)

1.10 A similar scatter diagram will probably exists if we draw a scatter diagram for the cost of repair (Y axis) against the age of a vehicle (X axis). (02 marks)

1.11 The equation of the regression line is Y = -200 + 33.33X. (02 marks)

1.12 If the outside temperature is 21^{o}c, the amount of the electricity bill would be in between $450 to $500. (02 marks)

1.13 The gradient of the regression line takes a value between -1 to +1. (02 marks)

*Write short answers for question Nos. **1.14** to **1.16** in your Answer Booklet with the number assigned to the question.*

*Use the table below to answer question No. **1.14** to **1.16**.*

Hybrid technology in vehicles is a new concept and the vehicle manufacturers are still experimenting.

There have been reported several instances where the vehicle manufacturers have recalled their hybrid vehicles due to hybrid battery related problems.

The below table shows the number of vehicles recalled by three leading hybrid vehicle manufacturers from a selected sample of 600 vehicles.

	Prius	**Honda - FIT**	**Benz Hybrid**
Recalled due to Battery Error	6	11	x
Not Recalled	194	y	197

1.14 If the overall probability of a vehicle been recalled is 0.03, what is the value of "x" ? (02 marks)

1.15 What is the value of "y" ? (02 marks)

1.16 What is the probability of a recalled vehicle given that it's a Prius ? (02 marks)

End of Section A

SECTION B

Four (04) compulsory questions

(Total 40 marks)

Question 02

(a) The life span distribution of 150 LED bulbs is given below:

Life Span (hours)	No. of Bulbs
501 - 600	18
601 - 700	21
701 - 800	**X**
801 - 900	30
901 - 1,000	24
1,001 - 1,100	20
1,101 - 1,200	14

Calculate the mean and standard deviation of the life span of a LED bulb. (06 marks)

(b) **ABB Bank** offers two loan schemes for its customers:

- Personal Loan - Where the interest is computed based on the outstanding loan balance.
- Mortgage Loan - Where the repayments are made in equal monthly installments.

Perera is going to apply for a 5 year loan of Rs.300,000/- to purchase a motor bike. The bank offers the following two repayment schedules for the above two options. Assume the interest rate as 6% per annum.

Option 1 - Personal Loan

Year	**1**	**2**	**3**	**4**	**5**
Capital	60,000	60,000	60,000	60,000	60,000
Interest	24,000	18,000	12,000	6,000	3,000

Option 2 - Mortgage Loan

Year	**1**	**2**	**3**	**4**	**5**
Repayment	73,000	73,000	73,000	73,000	73,000

Identify the most suitable option to **Perera** with calculations. (04 marks)

(Total 10 marks)

Question 03

(a) One of the machineries of a company is capable of producing a maximum of 10,000 units per week. The weekly cost to produce "x" No. of units is given by,

$$c(x) = 75,000 + 100x - 0.03x^2 + 0.000004x^3$$

and the demand function for the units is given by the following price function.

$$p(x) = 200 - 0.005x$$

Identify the marginal cost, marginal revenue and marginal profit functions. (06 marks)

(b) Rs.350/- is needed to buy 5 units of product **A** and 8 units of product **B**. The price of one unit of **A** is Rs.5/- more than the price of product **B**:

Compute the unit price of product **A** and product **B** separately. (04 marks)

(Total 10 marks)

Question 04

(a) An investment company invests its funds in 6 broad sectors as shown below. As the Investment Manager, you are required to prepare a presentation on sector wise investments to the Board of Directors:

	Rs. (million)
Power & Energy	12
Food & Beverages	18
Agriculture	22
Finance Companies	8
Metal & Construction	9
Others	11

Draw a Bar Chart and a Pie Chart to present the above data to include in your presentation.

(05 marks)

(b) A person expects to deposit Rs.10,000/- in a commercial bank in Sri Lanka for a period of 3 years. The bank offers him the following two deposit schemes:

Scheme **A** - 5% simple annual interest.

Scheme **B** - 5% annual interest compounded annually.

You are required to:

(i) **Compute** the maturity value if the person selects the scheme **A**.

(ii) **Compute** the total interest receivable at the end of 3rd year if the person selects the scheme **B**.

(iii) **Compute** effective rate of interest if the rate of interest of 5% per annum compounded semi-annually. (05 marks)

(Total 10 marks)

Question 05

The Air ticket prices in euro (€) from Europe to Sri Lanka from 2011 to 2015 are given below:

Year	Quarter		Ticket Price (€)	Four quarterly centered Moving Average	Centered moving average Trend	Y/T
2011	1	1	900			
	2	2	960			
				1,030.0		
	3	3	1,010		1,022.5	0.99
				1,015.0		
	4	4	1,250		997.5	1.25
				980.0		
2012	1	5	840		971.3	0.86
				962.5		
	2	6	820		930.0	0.88
				897.5		
	3	7	940		917.5	1.02
				937.5		
	4	8	990		956.9	1.03
				976.3		
2013	1	9	1,000		996.3	1.00
				1,016.3		
	2	10	975		1,051.3	0.93
				1,086.3		
	3	11	1,100		1,095.6	1.00
				1,105.0		
	4	12	1,270		1,119.4	1.13
				1,133.8		
2014	1	13	1,075		1,153.8	0.93
				1,173.8		
	2	14	1,090		1,183.8	0.92
				1,193.8		
	3	15	1,260		1,203.1	1.05
				1,212.5		
	4	16	1,350		1,228.8	1.10
				1,245.0		
2015	1	17	1,150		1,253.8	0.92
				1,262.5		
	2	18	1,220		1,275.0	0.96
				1,287.5		
	3	19	1,330			
	4	20	1,450			

You are required to:

Compute the seasonal indices using multiplicative model. (10 marks)

End of Section B

SECTION C

One (01) compulsory questions

(Total 20 marks)

Question 06

(a) The table below shows the price and quantity of sales of some items in a Hardware shop for the year 2014 and 2015. The items selected are the main items sold during the two years with highest profit margins.

Item	Price per Unit (Rs.)		Quantity of Sales (Ton)	
	2014	2015	2014	2015
Cement	850	1,150	1,100	980
Steel	600	610	500	500
Tiles	450	350	1,400	1,650

Calculate the weighted aggregate price index for the year 2015 with 2014 = 100 and also using the base year quantities. (04 marks)

(b) There is one potential project that **CNC Company** wishes to appraise with the following features:

- It requires an initial investment of Rs.50,000/-.
- It will last for four years and the cash inflows during the four years will be as follows:

Year	Cash Inflow (Rs.)
1	15,000
2	20,000
3	25,000
4	18,000

CNC Company has a cost of capital of 15% and wishes to evaluate this project. The company's policy is to evaluate projects based on the Internal Rate of Return (IRR).

Calculate the Internal Rate of Return (IRR) of this project. (08 marks)

(c) A wooden table manufacturer has the following fixed cost structure:

	Rs.
Rent	120,000
Electricity Bill	175,000
Machine Cost	500,000
Other	105,000

Variable cost is $10,000\ Q + 1,000\ Q^2$, where, Q is the monthly output of the manufacturer.

The monthly demand / price function is $P = -1,000\ Q + 120,000$, where P is the price per table.

Compute the following:

(i) Total monthly cost function.

(ii) Monthly break-even quantity (number of tables).

(iii) Quantity and the price at which the profit is maximized. (08 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:

$$S = a\,\frac{\{r^n - 1\}}{\{r-1\}} \qquad r \neq 1$$

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):

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

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

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

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

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:

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)

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

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:

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