

**EXAMINER'S REPORT****LEVEL I EXAMINATION - JULY 2020****(102) BUSINESS MATHEMATICS & STATISTICS**

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This Question paper consist of 3 Sections A,B and C.

A total of 40 marks is allocated to **Section A** comprising 10 compulsory (O.T.Q.) multiple choice questions Numbers **1.1** to **1.10** for 30 marks at 3 marks per question, and 5 short questions, numbers **1.11** to **1.15** for **10** marks.

A few shortcomings generally observed in the answers provided by candidates to part of question 01 are set out below:

**SECTION A****Question No. 01**

Generally candidates had attempted all ten multiple choice questions. But, there were **instances** of a few of them had not written answers. Though the probability of the answer being correct was 25%, if they had guessed and written an answer, they had missed that opportunity.

- 1.1** Since other ethnic groups comprised 3200, total population is  $\frac{3200}{0.08} = 40,000$ . Though the correct answer is (2) becomes the percentage of Sinhala population being 70%, that in  $40,000 \times \frac{70}{100} = 28,000$ , some candidates had marked (4) as the correct answer. Certain other candidates had marked (1) as the correct answer taking  $40,000 \times \frac{22}{100} = 8,800$ .
- 1.2** This is a simple question set to test the knowledge of solving a simple equation with one variable. 80% the candidates had marked the correct answer. A limited number of candidates had taken  $8y-6y = 24+8$  instead of  $8y-6y = 24-8$ , and marked the wrong answer (3), that is  $y = 16$ .
- 1.3** This question tested the knowledge of candidates on computation of simple interest. The value of the total investment at the end of 3 years of an investment for a period of 3 years at the rate of 8% interest was expected. Majority of the candidates had provided correct answers. Those who went wrong had used 1 instead of 3 in substituting for the number of years in the simple interest formula  $S=x(1+nr)$ , that is  $S = 6000 \left(1 + \frac{8}{100}\right) = 6,480$ . They had marked (4) instead of (3) as the correct answer.

- 1.4** By this question the quantities of **commodities** for the years 2018 and 2019 had been given, and the simple aggregate quantity **index** for the year 2019 using 2018 as the base year was required to be computed. Majority of candidates had marked the correct answer, that is (1).

Those who went wrong had incorrectly taken  $\frac{\sum q_0}{\sum q_1} \times 100$  instead of  $= \frac{\sum q_1}{\sum q_0} \times 100$  as the simple aggregate quantity index. Therefore they had taken it as  $\frac{\sum q_0}{\sum q_1} \times 100 = \frac{51}{34} \times 100 = 150\%$  and (4) as the correct answer.

- 1.5** Giving the marks of 6 students in a Mathematics assignment, with marks of one of them as 'X', and the mean marks as 83, the value of X was required to be arrived at. Most of the candidates had correctly arrived at the value of x as 84 and marked answer (3) which was correct. A limited number of candidates had erroneously taken the mean is 83 as the value of x, and marked (2) as the correct answer and made a mistake.

- 1.6** Having given the following summary statistics in relation to two variables x and y:

$$\sum x = 70, \sum y = 30.6, \sum xy = 310.5, \sum x^2 = 952, \sum y^2 = 134.3, n = 7$$

It was expected to arrive at the correlation coefficient between x and y using,

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

in this question.

Most of the candidates had not provided correct answers to this part. It was observed in the process of examining workings that values had not been substituted and simplified till the end to find the value of r. That was answering by guessing without getting the final answer. Some of the candidates who obtained the answer by simplification, had marked the wrong answer that is -0.4697.

- 1.7** In this question relating to probability although the correct answer is  $P(A \setminus B) = \frac{P(A \cap B)}{P(B)} = \frac{14}{16}$ , most of the students had taken **instead** of  $P(A \setminus B)$

as  $P(B \setminus A) = \frac{P(A \cap B)}{P(A)} = \frac{14}{45}$  and made the mistake.

- 1.8** Only a limited number of candidates had provided correct answers to this part of the question. Most of the students had obtained the annual repayment installment as Rs.175,521/- and marked the answer incorrectly as (4).

- 1.9** Majority of candidates had provided correct answer of this part. Most candidates had not been able to obtain the correct answer being mark to correctly substitute the formula for calculation of compound interest quarterly.

**1.10** Majority candidates had correctly answered this part. Majority of candidates who went wrong had taken the value of  $x$  as 6 instead of 7 in the substitution and had marked erroneously answer (2) 2,129 which is incorrect.

**1.11** Most of the candidates had correctly related the terms denoted by A, B, C, D meaningfully. A smaller number had misunderstood simple interest and annuity, by marking (2) against (A) and (3) against D.

Some candidates without understanding the instructions of the question correctly had wasted valuable time by writing the whole statement without writing the number only.

**1.12** Some candidates had drawn column charts instead of the pie chart. A considerable number of candidates, without proportionating dividing  $360^\circ$  or percentage wise the given values of 30, 18 and 24 had just divided the circle into three parts.

Although some candidates had correctly obtained,

$$\frac{30}{72} * 360^\circ = 150^\circ, \frac{18}{72} * 360^\circ = 90^\circ, \frac{24}{72} * 360^\circ = 120^\circ, \text{ they had not named those in the chart.}$$

Some candidates had drawn Venn diagrams instead of pie charts.

**1.13** Most of the candidates, using the probability rule for additions of using the formula

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) \text{ had correctly arrived at}$$
$$P(A \cap B) = P(A) + P(B) - P(A \cup B), P(A \cap B) = 0.6 + 0.3 - 0.72 = 0.18$$

But, some candidates had made the following mistakes in simplification after substitution

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) \text{ was written incorrectly}$$

as  $P(A \cap B) = P(A \cup B) - P(A) + P(B)$  in simplification of

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$0.72 = 0.6 + 0.3 - P(A \cap B),$$

$0.72 - 0.6 - 0.3 = P(A \cap B)$ , that is an incorrect value as  $P(A \cap B) = -0.18$  had been taken by them.

**1.14** and **1.15** Most of the candidates had answered correctly.

## SECTION B

The following matters were observed in the evaluation of answers of this section which consisted of 4 compulsory questions.

### Question No. 02

A larger number of candidates attempted this question and a considerable number had earned full marks.

- (a) This is a question about two simultaneous equations consisting of two variables. Calculations of the values of  $x$  and  $y$  was expected through simplification. Majority of candidates obtained maximum marks. Further, some of them had written the answers only without workings, but earned maximum marks. Further, although correct answers were arrived at, it observed that the knowledge of candidates was poor with regard to simplification. For example, when substituting the value of the variable arrived at first to equation 1 or 2, it should be;

When substituting the value  $y = 4$  to 1<sup>st</sup> equation,

$$3x+2y = 17, 3x+2 \times 4 = 17, 3x+8 = 17, 3x+8 = 17-8, 3x = 9, x = 3$$

Some candidates made mistakes in subtracting one equation from another equation due to lack of knowledge of simplifying brackets when deducting.

It had erroneously been taken as follows:

$$6x+15y-(6x+4y) = 78-34$$

$$6x+15y-6x+4y = 44, 19y = 44, y = 44/19, y = 2.31$$

It appeared that the knowledge of simplifying simultaneous equations of some candidates is very low. These candidates' were not answers in an order to arrive at one variable the coefficient of the other variable had to be equalized.

Number of other candidates attempted to solve the problem by multiplying by other figures so that the coefficient of one variable of the two equations would not be equal.

- (b) This question required calculation of the production cost of a table when a furniture manufacturing company sold a table for Rs.48,000/- keeping a profit margin of 20%. A considerable number of candidates lacked understanding of the relationship between profit, selling price and production cost.

$$\text{some candidates had calculated profit} = 48000 \times \frac{20}{100} = \text{Rs.}9,600,$$

$$\text{and production cost} = 48,000 - 9600 = \text{Rs.} 38,400$$

$$\text{some others had calculated production cost} = 48000 \times \frac{120}{100} = \text{Rs.} 57,600$$

- (c) This part of the question had given 2 equations with inequalities and required candidates to (i) draw a graph, and (ii) identify the area where the inequalities are satisfied.

Only a small number of candidates had obtained full marks. Some other candidates had drawn  $3x+2y = 12$  and  $x+2y = 6$  lines correctly. A few candidates had drawn the two x and y axes only and therefore had obtained only one mark each for that question.

### Question No. 03

This question consist of 3 parts (a), (b), and (c). When the demand function, Fixed Cost (FC) function and Variable Cost (VC) function are given candidates were expected to identify (a) Total Revenue (TR) function and the Total Cost (TC) function and (b) profit function and (c) calculate the number of units by which the profit is maximized. More than half of the candidates had provided correct answers to this question and earned full marks.

- (a) Having given the demand function  $p = 1000-2q$ , fixed cost (FC)= Rs.800 and Variable Cost (VC) =  $100q+3q^2$ , it was required by this part to identify total revenue function (TR) and total cost function (TC). A few shortcomings of candidates in answering this part are set out below:

- (1) It appears that many candidates do not have sufficient knowledge to identify that  $TC = FC+VC$  and  $TR = p \times q$ .
- (2) In arriving at Total Cost (TC) function, incorrect answers had been provided taking  $TC = FC \times VC$  instead of  $TC = FC + VC$ .
- (3) Some other candidates had attempted to write answers taking as  $TC = VC + p$ .
- (4) Most candidates had incorrectly simplified  $TR = p \times q = (1000-2q)$  as  $TR = 1000-2q^2$ .
- (5) Certain candidates had shown as  $TR = 1000-2q$ .

- (b) It was expected to identify profit function (TP) using the TR and TC identified in part (a). A few shortcomings of candidates in doing so are given below:

- (1) Although the profit function should be taken as  $TP = TR-TC$ , certain candidates had attempted to solve the question taking  $TP = TC-TR$  and also as  $TR = TC$ .

- (2) Some candidates had simplified  $TP = TR-TC$  as,

$$TP = (1000-2q)q - (800+100q+3q^2) = 1000q-2q^2-800+100q+3q^2 = 1100q+q^2-800$$

It was observed that most students' ability to simplify was weak when brackets are used.

- (3) Other candidates had considered as,

$$TR = 1000-2q \text{ and taken as,}$$

$$TP = (1000-2q) - (800+100q+3q^2) = 1000-2q-800+100q+3q^2 = 200+98q+3q^2$$

(c) This part required calculation of the number of units by which profit is maximized using the profit function at (b) or any other method. Majority of the candidates who correctly identified the profit function at (b) arrived at the number of units that maximized the profit accurately. Some other candidates were able to equate the marginal income to marginal cost (MR=MC) and were able to obtain correctly the number of units that maximizing the profit. The other candidates failed to earn full marks as a result of the following matters.

- (1) It is clear that some candidates had no understanding to find out the number of units maximizing the profit by using calculus and equating that to  $\frac{d(p)}{dq} = 0$ .
- (2) Some candidates had erroneously simplified as
 
$$\frac{d(p)}{dq} = 0, 900 - 10q = 0, 900 = 10q, q = 9$$
- (3) It appears that some candidates did not have sufficient knowledge about calculus.
- (4) Some candidates had done profit function, that is TP = 0 and attempted to find out the number of units maximizing the profit.
- (5) In trying to solve taking MR=MC, although correctly equated as  $100 + 6q = 1000 - 4q$ , in the process of simplification has done  $6q - 4q = 1000 - 100$  and  $6q + 4q = 1000 + 100$ .
- (6) Some candidates had attempt to solve the problem treating as TR=TC instead of MR=MC.

#### Question No. 04

This question relates to regression. The advertising expenses (x) and sales values (y) of a company for the last 6 months have been provided in a data table.

(a) Part (a) requires identification of the least square regression line given by  $(y=a+bx)$  to determine the relationship between the advertisement expenses and sales value. A considerable number of candidates had correctly identified the regression line and obtained full marks. Some candidates had to lost full marks because of using wrong formula.

Although calculators had been used fixed  $\sum x, \sum y, \sum x^2, \sum xy$  which are required to calculate  $b = \frac{[n \sum xy - \sum x \sum y]}{[n \sum x^2 - (\sum x)^2]}$  which is a regression coefficient. Most of the candidates were unable to obtain correct answers due to lack of knowledge in basic mathematical concepts. Even some candidates correctly identified “b”, they failed to find out “a”, substituting  $a = \bar{y} - b \bar{x}$ . Further, some candidates failed to correctly find  $\bar{x} = \frac{\sum x}{n}, \bar{y} = \frac{\sum y}{n}$ .

(b) Calculation of expected sales value when advertising expenses are Rs.40,000/- is required by this part. Majority of the candidates who correctly identified the least square regression line, provided correct answers to this part as well. Due to errors in simplification and not understanding the question properly, other candidates had failed to answer the question.

## Question No. 05

This question comprised 3 **parts (a), (b) and (c)**. Calculation of **(a)** mean **(b)** standard deviation and **(c)** coefficient of variation, using the data given in the question. A considerable number of candidates were able to earn full marks for the question.

**(a)** The means of the waiting time for a taxi, using the data given had to be calculated. Most of the candidates had correctly calculated the mean. A few candidates were not able to correctly calculate the mean, because of not correctly calculating the mid value of class intervals, calculating class interval number as (5), understanding the values of “f” and “x”, mixing them up, and not taking the total of  $\sum fx$  correctly.

**(b)** The calculation of standard deviation of waiting time for a taxi is expected in this part. The following were reasons for those who failed to answer correctly;

- Not using correct formula
- Not copying the relevant formula  $\sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$
- Not identifying the difference between  $(\sum fx)^2$  and  $\sum fx^2$
- Not calculating the necessary terms
- Not correctly substituting  $fx \times fx$  and  $fx \times f$  in arriving at  $fx^2$
- Not using  $\sqrt{\quad}$

**(c)** Calculating the coefficient of variation using the mean and Standard Deviation arrived at in **parts (a) and (b)** was expected by this part. Only a very few number of candidates had provided correct answers substituting values correctly to the formula  $cv = \frac{\sigma}{\bar{x}} \times 100$ . It is apparent that knowledge and understanding of coefficient of variation in candidates is not enough. Further, inability to provide correct answers to **part (a) and (b)** and errors in simplification permutated candidates from earning full marks to this part of the question.

## SECTION C

### Question No. 06

This question comprises of 3 **Sections A, B and C**. Part A tested on net present value, **Section B** on price index and **Section C** on probability.

A large number of candidates attempted this question, but no one was able to earn full marks.

**(A)** A company is evaluating a new project with an initial investment of Rs.150,000/- at 15% discount rate. The expected cash inflows for the next 3 years have been given.

**(a)** The objective was to calculate the net present value using the given information.

Although a considerable number of candidates were able to calculate the present value for every year correctly, a few of them could not compute correctly the net present value.

Reasons for not being able to calculate the net present value:

- (1) Lack of understanding about net present value.
- (2) Neglecting + and – signs and simplification errors.
- (3) Using +150.000 instead of -150,000 as the initial investment, in calculating NPV.
- (4) Using other discounting factors instead of 15%.
- (5) There were candidates who made the mistake of adding up cash flows given for the 3 years as  $\frac{(70000+85000+50000)}{1.15^3}$ ,  $\frac{70000}{1.15^3} + \frac{85000}{1.15^3} + \frac{50000}{1.15^3}$

**(b)** This part expected to state whether the project should be selected for investment based on the NPV derived from **(a)**. There were candidates who gave the correct recommendation based on incorrect NPV and others who were not aware that a recommendation was expected in the question.

**(B)** This question related to index numbers. The base weightage aggregate (Laspeyre's) price index for the year 2019, treating 2016 as the base year had to be calculated from the given data for 3 items x, y and z.

Majority of candidates had substituted data into the correct formula, obtained the correct answer, and earned the full quantum of marks.



The other candidates who attempted this question could not earn full marks for the following reasons:

- (1) Not selecting  $\frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$ , the formula relevant to calculate the base weight aggregate price index.
  - (2) Some candidates using  $\frac{\sum q_1 p_0}{\sum p_0 q_0} \times 100$ , the formula applicable for quantity index for this calculation.
  - (3) Mixing up the columns necessary for calculation of  $\sum p_1 q_0$  and  $\sum p_0 q_0$ .
  - (4) Calculating using  $\sum p_1 \times \sum q_0$  instead of  $\sum p_1 q_0$ .
  - (5) Finding the total of  $\sum p$  and  $\sum q$  separately and multiplying.
  - (6) Not copying correctly to the answer booklet, the quantities and prices given in the question.
  - (7) Errors in multiplications and divisions.
  - (8) Although it is necessary to multiply by 100 to become a price index, some candidates indicated the answers without multiplying by 100. The value received by such calculator is only a ratio and not an index number.
- (C) This question consisted of two **parts (a)** and **(b)**. **Part (a)** related to a question on probability while **part (b)** tested on normal distribution.
- (a) This is a question on probability. Drawing a tree diagram to represent the given data and writing answers relating to that were expected.
- (1) Majority of the candidates attempted this question. Due to inability to draw a tree diagram correctly, most of the candidates could not earn the full marks allocated to this question. Some of the reasons that may have affected are given below:-
    - (i) It appears that some of the candidates lacked knowledge of the basic concept of probability.
    - (ii) In order to represent the data given in the question the first tree should depict the students who passed the examination. Some candidates had mixed up and drawn these first and second trees.
    - (iii) Some candidates failed to indicate correctly the percentages of male / female, pass / fail students in drawing the tree diagram.

- (2) Those candidates who were unable to draw the tree diagram found it difficult to answer this question. But, some candidates who could not draw the tree diagram correctly had answered this question correctly. Candidates who drew the tree diagram correctly also failed to answer this part. When calculating probability, while travelling along a branch, according to a concept in probability, namely  $P(A \cap B) = P(A|B) * P(B)$  the probabilities of those branches have to be multiplied. Some candidates did not have correct knowledge about that. The knowledge of candidates that total of probability is 1, and percentages could be converted to decimals was also at a low level.
- (3) What was expected in this part was calculation of the probability of a selected student who is a boy failing the examination. Majority of the candidates had not understood this question correctly. Majority of the candidates had stated  $\frac{30}{100} = 0.30$  as the answer. It appeared that the knowledge of majority of the candidates about the principles of probability  $[P(A|B) = \frac{P(A \cap B)}{P(B)}]$  is inadequate.

**(b)** This question test the knowledge about normal distribution. Only a few out of those candidates who attempted this question earned full marks. Some of the reasons that affected providing correct answers to this question are set out below:

- (1) Lack of basic knowledge about normal distribution and standard normal distribution.
- (2) Lack of adequate knowledge to correct normal distribution to standard normal distribution.
- (3) Lack of sufficient knowledge to substitute correctly median ( $\mu = 240$ ) and standard deviation ( $\sigma = 40$ ) into formula  $z = \frac{x-\mu}{\sigma}$  and arrive at  $z=1.5$ .
- (4) Some other candidates had substituted the values of  $\mu$  and  $\sigma$  exchanging their values and arrived at  $z = -1.5$ .
- (5) Not being conversant with arriving at the probability relevant to  $z=1.5$  with the help of standard table.
- (6) Not being answer that 0.5 had to be added to  $z<1.5$  to arrive at the relevant probability even if the relevant  $z=1.5$  had been obtained with the help of the standard table.

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**General matters for attention to improve performance level of candidates:**

- (1) Study the full contents of the syllabus completely paying more attention to any newly introduced subject matter.
- (2) Workings should be clearly shown along with answers where applicable.
- (3) It is required to correctly apply the basic mathematical rules and simplifications in copying formulae and in substitutions. Use the most convenient formula when several formulae could be applied to answer certain questions. Further, when formulae are copied, it should be done without changing “+” and “-” signs.
- (4) Some candidates may obtain final answer using calculators. However, it is appropriate to present the final answer showing the steps correctly, writing the formula and substituting the values in it. In doing so, there is a possibility of scoring the marks for steps even when the final answer may not be correct.
- (5) It should be noted to correctly apply the mathematical principles in solving equations and calculus of functions.
- (6) Handwriting should be legible and the numbers of questions should be correctly and clearly written.
- (7) Follow the instructions given in the question paper.
- (8) Perusal of past question papers and suggested answers would help sharpening knowledge and experience.
- (9) Proper management of time is important.
- (10) Re-check the question numbers before handing over the answer scripts.
- (11) There were instances when answers to new questions had been started in a small space at the end of the previous answer without starting the next answer on a new page. Each answer should be started on a new page at all times for easy reference.
- (12) Appear for the examination with a firm determination of passing the examination with due preparation.