

**EXAMINER'S REPORT****LEVEL I EXAMINATION - JANUARY JULY 2021****(102) BUSINESS MATHEMATICS & STATISTICS**

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

A total of 40 marks is allocated to **Section A** comprising, 15 compulsory Objective Test Questions (O.T.Qs.), with 10 multiple choice questions numbers **1.1** to **1.10** for 30 marks at 3marks per question, question number **1.11** for 4 marks, 2 short questions number **1.12** to **1.13** for 4 marks at 2 marks per question and 2 short questions number **1.14** to **1.15** for 2 marks at 1 marks per question.

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**

In this section we expect to mention the number corresponding to the most correct answer for 10 multiple choice questions **1.1** to **1.10** in the given booklet. In general, the candidates had answered all the 10 multiple choice questions.

But there were instances when some candidates did not write an answer. If they guessed or wrote down an answer it was very unlikely that the answer would be correct but they were found to have missed that opportunity. Some candidates have entered the correct answer instead of the number corresponding to the correct answer, which is a time consuming task. Some other candidates have marked the correct answers in the question paper and attached it to the answer script.

Below mentioned are the general observations made against the sub-sections of Question No. 1:

- 1.1** Solve this simple equation and find the value of **X** was expected from this question. The majority of the candidates had marked the correct answer. Even though the equation has solved correctly, some candidates have marked the wrong answer. Some candidates have chosen the wrong answer, due to the lack of basic knowledge on solving a simple equation and making mistakes in solving the equation.
- 1.2** This is a very simple problem of speed. The fact that the time of the question was given in hours and the answer in minutes can be misleading the candidates. However, most candidates have given the correct answers.

**1.3** This is a compound interest related question. Many candidates used the formula  $S = (1+r)^n$  to mark the correct answer. Some candidates have attempted to solve the problem by calculating and collecting interest year after year for 10 years. If the given formula sheet was used, the correct answer to this question could be arrived.

**1.4** This is a question of set and probability. Having computers and telephones was not perceived as an exception. The given data could be marked in a Venn Diagram and the questions can be answered there.

**1.5** This is a problem of finding the Median of a data set. This was a very easy question but the correct answer was given by a small number of candidates. The data here should be arranged in ascending or descending order and the position in the middle should be identified as Median.

**1.6** This is a question of Price Index. Given the prices of 3 commodities **A**, **B** and **C** for 2019 and 2020, the price comparator of commodity **C** for the year 2020 compared to 2019 has been inquired. Many candidates answered correctly, but some had not used the correct formula and done wrong mathematical calculations.

$$\text{The price comparator} = \frac{P_1}{P_0} \times 100$$

The formula should be used and the price in 2020 should be substituted as  $P_1$  and the price in 2019 as  $P_0$ .

**1.7** This is a question of sets and probability. A small number of candidates used the formula  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ , the rule of probability addition, to find  $P(A \cap B) = 0.1$  and mark the correct answer  $P(A \cap B)' = 1 - P(A \cap B) = 0.9$ . Many applicants marked the wrong answer with  $P(A \cap B) = 0.1$  instead of  $P(A \cap B)' = 0.9$  because a number of them did not understand the question correctly.

**1.8** This is a problem that needs to be solved with the use of compound interest. Many applicants had marked incorrect answers due to not using the formulas to be used for the calculation, using incorrect substitutes for the correct formula, and not solving until the final answer was arrived. The correct answer can be obtained by;

$$6,000 (1.075)^8 + 6,000 (1.075)^7 + \dots + 6,000 (1.075) \text{ or } \left[ \frac{(1.075)^8 - 1}{(1.075) - 1} \right]$$

**1.9** This is a very easy time series question. It aims to forecast quarterly sales. A small number of candidates marked the wrong answers by changing the seasonal indicators and trend values between quarters, and confusing the beginning and the end.

**1.10** Expect to find the value of an installment when replacing a loan with the formula  $A = \frac{SR^n(R-1)}{R^n-1}$  this formula is also mentioned in the formula sheet.

Many candidates marked incorrect answers because they did not use the correct formula and did not make substitutions correctly.

**1.11** Most of the candidates had selected and noted the correct definitions on the right hand side in relation to the letters **A, B, C, D** shown on the left hand side. Some candidates had confused **A** and **B** answers. It is important to study the syllabus carefully and remember the definitions.

**1.12** The business of buying and selling office bags was expected to calculate the purchase price of a bag when it sells a bag to a customer for Rs.1,170/= with a profit margin of 30% on the purchase price. It seems that many candidates had not understand the relationship between selling price, purchase price and the profit.

Also, the candidates had added a profit of 30% back to the selling price.

The correct answer should be  $\frac{1,170}{130} \times 100 = \text{Rs.900/-}$

**1.13** This is a question on geometric series. Should be solved using the  $S_n = \frac{a(r^n-1)}{r-1}$  formula. The majority of the candidates had marked the correct answer. A small number of people considered this to be an arithmetic series and tried to answer using the  $T_n = a + (n-1)d$ , formula. Some candidates used  $2^7$  and they used **2** as common differences instead of **3**. The correct answer should be  $T_n = ar^{n-1}$ ,  $T_8 = 1 \times 3^7$ ,  $T_8 = 2,187$

**1.14** The majority of the candidates were answered as "**True**" for this question.

**1.15** Candidates had given correct answers to this question as "**False**"

## SECTION B

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

### **Question No. 02**

This question consists of three parts **(a)**, **(b)** & **(c)** and the total marks given are ten. A significant number of candidates answered all three sections **(a)**, **(b)** & **(c)**, and obtained total marks.

**(a)** This is a question on inequality. Some students forgot to switch the two sides of the equation when multiplying the two sides of the equation by "-" mark. Basic knowledge of inequality must be understood in solving such problems.

**(b)** This part is a problem of two simultaneous equations with two variables. It was expected to find the **a** and **b** values by solving these equations. Most of the candidates had obtained maximum marks. Minimum number of candidates wrote only the answers without workings.

However, some candidates have made mistakes as no understanding on brackets when subtracting one equation from another.

Then substitute it to one equation and find out the value of the other variable. But it was observed that some minimum number of candidates had no proper understanding on solving simultaneous equations.

- (c) Expected to draw a pie chart from this part. Because it's so easy, most of candidates got full marks for it, but minimum number of candidates have drew a bar chart.

### Question No. 03

This question consists of three parts (a), (b) and (c) and the total marks given are 10.

The expectation of the question was to identify the (a) Total Revenue (TR) function, Total Cost (TC) function, (b) profit function and (c) break-even quantity, when demand function (P), Fixed Cost (FC) and Variable Cost (VC) were given.

Most of the candidates have attempted to answer this question, but minimum candidates got full marks for all three sections (a), (b), and (c).

- (a) Identify the Total Cost (TC) function and Total Revenue (TR) function, when Demand function  $P = 40 - q$ , Fixed cost Rs.200/- and Variable Cost  $VC = -q^2 - 60q$  are given.

Following shortcomings were noted in the evaluation of the answer scripts of the candidates:

- (1) Some candidates, they did not have enough knowledge to identify the total cost and total revenue as  $TC = FC + VC$  and  $TR = P \times Q$ .
  - (2) Although some candidates wrote it  $TC = FC + VC$  correctly, the values were substituted and solved as  $TC = FC - VC = 200 - (-q^2 - 60q) = 200 + q^2 + 60q$
  - (3) Some candidates did not write the data given in the question in the answer script accurately. Ex: -  $FC = 200$  was marked as  $FC = 20$ .
  - (4) The Variable Cost  $VC = -q^2 - 60q$ , incorrectly written as  $VC = q^2 - 60q$ , as well as,  $VC = -q^2 - 6q$  in the answer script.
  - (5) When identifying the Total Cost  $TC = FC + VC$  was incorrectly written as  $TC = FC \times VC$ .
  - (6) Some other candidates had taken as  $TC = VC + p$  and tried to write answers.
  - (7) Many candidates misused  $TR = 40 - q \times q = 40 - q^2$  and  $TR = 40 - q$  instead of  $TR = P \times Q = (40 - q) q$  when calculating total revenue.
- (b) Identify the Profit Function by using Total Cost (TC) function and Total Revenue (TR) function in part (a).

Below are some of the shortcomings made by the candidates:

- (1) Profit Function should be taken as  $PF = TR - TC$  but some candidates consider it as  $PF = TC - TR$ ,  $TR = TC$  and  $PF = P - VC$  and tried to solve the question.
- (2) Some candidates have incorrectly solved,  $PF = (40 - q) q - (-q^2 - 60q + 200) = 40q - q^2 + 60q$  and  $40 - q - q^2 - (-q^2 - 60q + 200) = 40 - q - q^2 - 200 - q^2 - 60q$ , as  $PF = TR - TC$ . Most of the candidates seemed to have little ability to solve formulas with brackets.

- (3) Also, incorrect answers were obtained as  $PF = 80q - 200$  and  $PF = 20q - 200$  instead of  $PF = 100q - 200$ .
- (c) Here it was expected to find out the number of break-even units using the (b) Profit Function or some other method. The majority of candidates who identified the Profit Function in this (b) section accurately calculated the break-even quantity.

- (1) Some applicants,  $TR = TC$  by  $40q - q^2 = -q^2 - 60q + 200$ ,  $100q = 200$ ,  $q = 2$  as or  $PF = TR - TC = 0$ , or by  $40q^2 - (-q^2 - 60q + 200) = 0$ ,  $100q - 200 = 0$ ,  $100q = 200$ ,  $q = 2$ , It is clear that there was no understanding on finding the break-even quantity.
- (2) Calculating the break-even quantity by solving  $TR = TC$ ,  $40q - q^2 = -q^2 - 60q + 200$ , some candidates solved  $40q - 60q - q^2 = -q^2 + 200$  and arrived at  $-20q = 200$ ,  $q = 200/20 = 10$ .
- (3) Although the correct statement was written  $100q/100 = 200/100$  as instead of  $100q = 200$ ,  $q = 200/100$ , it was miswritten as  $q = 200$  when solving. Some of the other candidates had also obtained incorrect answers by substituting for the below formula:

$$q = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- (4) Some candidates equate the marginal income to marginal cost and attempted to find the number of break-even quantity using  $MR = MC$ .

## Question No. 04

This question consists of two parts (a) and (b) and the total marks given is 10.

This is a regression related question and a university gave a table containing the marks obtained for the written (X) and practical (Y) tests by 8 undergraduate students. The average number of candidates who gave correct answers for both part a and b sections earned the total marks.

- (a) Identify the least square regression line in terms of  $y = a + bx$  to represent the relationship between the marks obtained for written examination (X) and practical examination (Y).

The majority of candidates used  $b = [n\sum xy - \sum x \sum y] / [n\sum x^2 - (\sum x)^2]$  and  $a = \bar{y} - b\bar{x}$  to identify the correct least square regression line for this part and scored 7 points for this part.

Factors that could be identified as factors contributing to the inability to accurately identify the least square regression line.

- (1) Accurately calculated a and b but no understanding of the least square regression line.
- (2) Using the wrong formulas
- (3) Confused columns in search of  $xy$  and  $x^2$ .
- (4) Lack of knowledge on solving.

- (5) Calculators were used to calculate the regression coefficient  $b = \frac{[n\sum xy - \sum x \sum y]}{[n\sum x^2 - (\sum x)^2]}$  and the  $\sum x$ ,  $\sum y$ ,  $\sum x^2$ ,  $\sum xy$  required for it, but did not get the correct answer due to lack of knowledge of basic mathematical concepts.
  - (6) Although  $b$  is calculated correctly, substituting  $a = \bar{y} - b\bar{x}$  and failing to find  $a$ .
  - (7) Failure to  $\bar{X} = \sum x / n$   $\bar{Y} = \sum y / n$  correctly.
  - (8) Even if the  $n$  is equal to 8 wrong answers were obtained due to wrong substitution.
  - (9) When searching for  $b$ , the formula for finding the correlation coefficient was incorrectly written and the  $r$  value was calculated instead of  $b$ .
- (b)** This section aims to calculate the number of marks obtained in the written test by candidates who have obtained 8 marks in the practical test using the least square regression line calculated in **part (a)**.

The majority of the candidates who obtained the regression line correctly answered this section.

Some applicants had found  $y$  by substituting the value corresponding for  $y$  to  $x$ . Some other candidates failed to provide correct answers due to minor errors and lack of accurate understanding of the question.

### Question No. 05

This question consists of three parts **a**, **b** and **c** and the total marks given is ten.

**Part (a)** mode, **part (b)** mean, and **part (c)** standard deviation, should be sought by the time spent by the customer service officer for 100 customers was provided by a table.

- (a)** This section considers the mode of time spent by the customer service officer on behalf of the customer.

Very few applicants answered this question correctly and got all three marks, and some students considered the mode to be the middle end of the class. Applicants will be treated as Mode Class 30 - 39 and Mode Class Lower Boundary 30. But it should be taken as 29.5 – 39.5 and the lower boundaries are 29.5.

$$\text{Mode (M}_0) = L_1 + \frac{\Delta_1}{\Delta_1 + \Delta_2} C$$

- (b)** Calculate the mean,  $\bar{x} = \frac{\sum fx}{\sum f}$  of the time spent by a customer service officer for a customer using the table.

The majority of the candidates substituted the correct values for the formula and provided the correct answer and earned 3 marks. A small number of candidates, even if the mean of the class intervals was not calculated correctly. If the data exchange of  $f$  and  $x$ , then  $\sum fx$  was incorrect and the calculated mean value was incorrect. But it was observed that the minimum number of candidates did not have an understanding of the mean calculation.

- (c) Calculate the standard deviation ( $\sigma$ ), using the table. Lessor number of candidates answered this question correctly. Some candidates used wrong equation, but correct equation  $\sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$  did not properly write down and substitutes were changed.

Eg: used  $\sum f \sum x^2$ ,  $[\sum fx]^2$  for  $\sum fx^2$  and also used  $fx \times fx$  and  $fx \times f$  when calculating  $fx^2$ .

But it was observed that some candidates did not have an understanding of the standard deviation. Since mode, mean, variance, standard deviation are definitely important coefficient, it is advisable for the candidates to resolve the issues contained in the exercises or past question papers before facing the exams.

### SECTION C

#### Question No. 06

This question was divided into four sections **A**, **B**, **C** and **D** and the total marks given was 20.

- (A) This question consists of two sub-sections **a** and **b**, which test the applicants' knowledge on simple interest and compound interest.

- (a) The majority of candidates calculated the simple interest rate using the formula,

**A = P (1 + rt)** and substituting the interest rate of 8% and the term as 3 years. But some candidates mistakenly thought that **X = 300,000 (1 + 0.08 x 3)** was just interest and added another **300,000** in calculating the total.

- (b) A small number of applicants answered correctly using the formula **A = P (1 + r/n)<sup>nxN</sup>** to calculate the compound interest. The following are some of the reasons why very few students are unable to calculate interest on a quarterly basis without using formulas.

- (1) The annual interest rate was not calculated as 0.03 by dividing the annual interest rate by 4 when calculating the interest rate per quarter.
- (2) Used 12% instead of **r = 12%/4 : 3%**.
- (3) When calculating interest for a quarter, calculate the interest rate as 4% per quarter divided by 3 instead of 4.
- (4) Because there was no enough knowledge about solving,

$$(1 + r / n) = 1 + 0.12 / 4 = 1.12/4 = 0.28$$

- (5) Use 3 or 36 instead of 12 quarters.

**(B)** This question consists of two sub-sections **a** and **b**. A company expects to launch the most suitable project out of two projects with an initial investment of Rs.500,000/-. The expected cash flow and discount rate for the next 3 years with the 15% discount factor of the project.

**(a)** Knowledge on calculating the net present value of **Project A** was tested using the information provided in this section. This question was answered correctly by a small number of candidates.

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

- (1) Lack of understanding of Net Present Value (**NPV**). For this reason, it was stated that the project with the lowest **NPV** value should be selected as the better project.
- (2) Ignoring “+” and “-” and calculation errors.
- (3) The initial investment should be deducted when calculating the **NPV**. But initial investment has added to the discounted value of cash flows (using + 500,000 instead of -500,000).
- (4) Use other discount factors instead of 10% as discount factor.
- (5) Not knowing that the initial investment year should be taken as year 0 and the discount factor should be considered as 1.
- (6) The initial investment was multiplied by the first year discount factor of 0.909 instead of the initial year 1 discount factor of 1.
- (7) Some candidates had miscalculated the cash flow without multiplying it by the discount factor.

$$\text{Ex: - Rs.250,000 + Rs.375,000 + Rs.50,000 = Rs.675,000}$$

$$\text{NPV = Rs.675,000 - Rs.500,000 = Rs.175,000}$$

**(8)** Adding cash inflows provided for 3 years

$$\frac{250,000 + 375,000 + 50,000}{1.1^3}, \frac{250,000}{1.1^3}, \frac{375,000}{1.1^3}, \frac{50,000}{1.1^3}$$

There were also candidates who were miscalculated as.

**(b)** This question is intended to select the project to be invested by comparing the net present value of Project **A** obtained in the above part with the net present value given for Project **B**. The majority of candidates who provided correctly answers for **part (a)** had correctly answered for **part (b)** as well.



(C) This question consisted of two subsets **a** and **b**, and part **a** tested the search for the expected value of a discrete random variable and part **b** tested the knowledge of the standard distribution.

(a) In this case, the probability distribution of a discrete random variable named **x** was expected to find the desired value of **x**.

Many students did not understand how to calculate the expected value of **x**. Furthermore, there was no proper knowledge of the addition of negative numbers as well as the addition of numbers obtained by multiplying  $\sum X P(X)$ . Most students mentioned  $\sum P = 1$ .

(b) This part was intended to calculate the probability of positioning an adult male height between 166 cm and 185 cm at random selection given the mean and standard deviation of the height. Very few candidates answered the question correctly.

The following are some of the reasons for not being able to answer this question correctly:

- (1) Lack of basic knowledge of distribution and standard primary distribution and sufficient knowledge to convert distribution into standard distribution.
- (2) Mean ( $\mu = 177$ ) and standard deviation ( $\sigma = 6.4$ ). Lack of sufficient knowledge to accurately substitute  $z = \frac{(x-\mu)}{\sigma}$  for correct **z** values.
- (3) When substituting for  $z = \frac{(x-\mu)}{\sigma}$ , the values were changed to  $x = 177$  instead of  $\mu = 177$  and incorrect values were obtained for **z**.
- (4) Lack of awareness about finding the probabilities of  $z = 1.72$  and  $1.25$  using standard table.

(c) This tests students' knowledge of price indices. The **X**, **Y** and **Z** were given a table with prices and quantities for the years 2020 and 2018 and asked to calculate the Laspeyre's Quantity Index for 2020 considering 2018 as the base year.

The average number of candidates obtained the correct answer using the correct formula for the Laspeyre's Quantity index.

The following are the reasons why the candidates who tried to answer this question could not earn full marks:

- (1) The formula used to calculate the Laspeyre's Quantity index is  $\frac{\sum p_0 q_1}{\sum p_0 q_0} \times 100$   
Failure to select correctly from the formula sheet.
- (2) Perform calculations using is  $\frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$  for the Laspeyre's Quantity Index.
- (3) Misusing the columns required to calculate  $\sum p_1 q_0$  and  $\sum p_0 q_0$
- (4) Calculate using  $\sum q_1 \times \sum q_0$  instead of  $\sum p_1 q_0$

- (5) Find and multiply the sum of  $\sum p$  and  $\sum q$  separately.
- (6) Do not accurately copy the quantities and prices in question to the answer script.
- (7) Multiplication and division errors.
- (8) Some candidates had calculated  $\frac{\sum p_1q_0}{\sum p_0q_0}$  and wrote the answers even though they had to multiply by 100 to be a price index. It should be understood that the value obtained in this calculation is a ratio, not an index.

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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.

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