# EXAMINER'S REPORT

## LEVEL I EXAMINATION - JANUARY 2025

# (102) BUSINESS MATHEMATICS & STATISTICS

## SECTION A

### Question No. 01

This section has 10 OTQ questions with question numbers **1.1** to **1.10**. It is expected to write the number of the most correct answer from the given 4 options. Almost all the candidates had attempted all the 10 OTQs. Some candidates had obtained the correct answer instead of correct number.

The following are some of the common errors / weaknesses identified with the answers given by the candidates for each sub-section:

**1.1** The objectives of the question is to find the factors of a quadratic expression. Majority of candidates had marked the correct answer. A limited number of students had marked wrong answers as $(4x + 9)\ (4x + 9)$.

**1.2** A sum expected to test the knowledge of calculating Net Present Value in financial mathematics. A significant number of candidates provided the correct answer.

The reasons for impossibility to calculate Net Present Value accurately are as follows:

(1) Ignoring + and – signs and trivialization errors.

(2) In calculating the Net Present Value, the initial investment should be deducted from the present value. But, some candidates had added the initial investment to the discounted value of the cash flows.

(3) Use of other discount factors instead of 10% discount factor.

(4) Not knowing that the year of the initial investment should be taken as year 0 and the discount factor should be taken as 1.

(5) Not multiplying the cash flows by the discount factor.

**1.3** This is a sum related to probability. A majority of candidates had substituted the basic law of sets into the formula $P(x \cup y) = P(x) + P(y) - P(x \cap y)$ and marked the correct answer for P(x U y).

A very few candidates had obtained incorrect answers using the following formulas:

$p(x \cup y) = P(x) + P(x \cap y)$

$p(x \cup y) = P(x) + P(y) + P(x \cap y)$

**1.4** This is a sum related to price index. It is expected to calculate the quantity relative of Brand "D" fertilizer considering 2023 as the base year.

A majority of candidates answered this question very successfully. A very few candidates have obtained incorrect answers due to performing calculations using $\frac{q_0}{q_1} \times 100$ instead of $\frac{q_1}{q_0} \times 100$.

**1.5** It is expected to calculate correlation coefficient for the given data. Majority of candidates had calculated the correlation coefficient between two variables X and Y using calculators and marked the correct answer. Some candidates had obtained the correct answer by substituting the values into the formula given below.

Formula is, $r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]\}}}$

Only a very small number of candidates had received incorrect answers due to incorrect substitutions.

**1.6** The objective of the question is to find the Mode of a given grouped frequency distribution.

Only a significant number of candidates obtained the correct answer using formula $M_0 = L_1 + \frac{\Delta_1}{\Delta_1 + \Delta_2} xC$.

**1.7** It was tested to calculate the expected value of a probability distribution of discrete random variable.

It was observed that many candidates did not understand the question correctly. Some candidates had obtained incorrect answers by adding up all the given probability values. Only a small number of candidates provided correct answers.

**1.8** This is a simple interest related problem that comes under financial mathematics. A very few candidates had solved the sum using the formula [S = X(1 +nr)] and marked the correct answer.

Substituting the formula gives the total amount with interest, and many candidates had not subtracted the principal amount from that figure.

**1.9** This is a time series question. It is expected to forecast the sales value using the given seasonal index.

A significant number of candidates had successfully answered.

**1.10** This question is related to the conditional probability. It is expected to calculate, the probability that the randomly selected employee is married given that she is a female.

The majority of candidates answered successfully. It was observed that some candidates did not have sufficient knowledge to distinguish the conditional probability of two events from intersection of two events

**1.11** It is expected that the appropriate explanation related to the terms indicated by the letters **A, B** and **C** on the left-hand side will be selected from the right-hand side and written correctly in front of the English letter. Majority of candidates correctly selected the answer corresponding to **C**, but they failed to provide the correct answers corresponding to **A** and **B**:

**1.12** This question tested the candidates' knowledge of price indices. Given a table of prices and quantities of items **A** and **B** for the years 2020 and 2024 and asked to calculate the Laspeyre's Price Index for the year 2024, taking 2020 as the base year.

A very few candidates had obtained the correct answer using the correct formula under the Laspeyre's Price Index.

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

(1) The formula used to calculate the Laspeyre's Price Index ($\frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$) is not selected from the formula sheet.

(2) The calculation was made using the formula ( $\frac{\sum q_1 p_0}{\sum q_0 p_0} \times 100$) for the Laspeyre's Quantity Index.

(3) Misusing the columns required to calculate $\sum q_1 p_0$ and $\sum q_0 p_0$ .

(4) Performing calculations using $\sum q_1 \times \sum p_0$ instead of $\sum q_1 p_0$.

(5) Taking the sum of $\sum p$ and $\sum q$ and then multiplying seperately.

(6) Failure to accurately copy the prices and quantities given in the question to the answer script.

(7) Multiplication and division errors.

(8) Some candidates had calculated $\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0}$ and wrote the answers eventhough they had to multiply by 100 to be a price index. It should be understood that the value obtained in the calculation is a ratio not an index.

**1.13** This is a question on arithmetic series. Given the first term "a" and the common difference "d", the formula used to find the $n^{th}$ term is $T_n = a + (n-1)d$ . It was expected to obtain $T_8$ by substituting a = 5,000, d = 500 to formula.

Since most of the applicants did not include the Rs. 500 for the first day in the calculation and value of the prize has been calculated as Rs.8,000/-.

Some candidates have tried to get an answer by adding Rs.500/- each without using the formula.

Some candidates had tried to get the answer using geometric series without understanding the question.

The two questions **1.14** and **1.15** are expected identify and mentioned as **"True"** or "**False"**.

**1.14** It was stated that at the break-even point, marginal revenue equals marginal cost and asked about its True of False. Average number of candidates have provided the correct answer.

**1.15** Price index is a ratio of the price of a certain number of commodities at the present year as against base year. It was required to state whether this statement is True of False. Average number of candidates correctly answered this question correctly.

## Section - B

### Question No. 02

**(a)** A simple question related to ratios in Business mathematics. A majority of candidates had provided the correct answes.

The following deficiencies found in the evaluation of the answer sheets:

(1) Since some candidates had not calculated the material cost of 2023 correctly, they were unable to accurately calculate the total production cost of a shirt in 2024.

(2) Some candidates had calculated the total production cost of a shirt in 2024 as Rs.640/-. ($\frac{20}{100} \times 800 + \frac{60}{100} \times 800 = 640$)

(3) Although some candidates correctly calculated the material cost and labour cost in 2023 and the total production cost of a shirt in 2024 was calculated as Rs.400/- ($\frac{20}{100} \times 200 + \frac{60}{100} \times 600 = 400$), the production cost in the year 2023 has not been added to find the total production cost of a shirt.

(4) Although some candidates correctly calculated the material cost and labour cost in year 2023, they were unable to accurately calculate the total production cost in the year 2024 as Rs. 1200. ($\frac{120}{100} \times 200 + \frac{160}{100} \times 600 = 1200$).

(5) Some candidates calculated the material cost as ( $\frac{120}{100} \times 200 = 240$) Rs. 240 and the labour cost as ($\frac{160}{100} \times 600 = 960$) Rs.960/- separately. But, they did not add them up to obtain the production cost of the shirt.

**(b)** This creates a pair of simultaneous equations and aims to solve them. The majority of candidates who attempted to answer this question solved the sum correctly and scored full marks. Some candidates had only provided the answer without workings. Some candidates had constructed incorrect equations and provided incorrect answers. A very small number of candidates had not provided answer for this question.

**(c)** Given $4x + 3y \leq 12$ and $3x + 5y \leq 15$, it is expected that these inequalities graphed and the regions that satisfy all the inequalities, should be identified.

It was observed that the candidates' knowledge about inequalities was very limited. A minority of candidates obtained full marks by correctly drawing the graph.

Some candidates had drawn the graph correctly but had not identified the areas where the inequalities were satisfied. Some candidates had not labeled the axes as X and Y correctly. Some other candidates had drawn separate graphs for each equation. Some candidates had marked the points on the graph but had not drawn straight lines. It was observed that some candidates had drawn three horizontal lines on the graph paper.

## Question No. 03

This question consisted three parts **(a), (b)** and **(c)** and the total marks given was 10.

The demand function of a firm's output for a month, Fixed Cost (FC) for a month and monthly Variable Cost (VC) are given. It was expected **(a)** to identify the total revenue function and the Total Cost (TC) function, **(b)** to identify the profit function **(c)** to calculate the number of units that maximize profit.

A large number of candidates attempted this question and minority of candidates scored full marks by answering all three parts **(a), (b)** and **(c)** correctly.

**(a)** Given the demand function of a product P = 23 - 4q, fixed cost Rs.15,000/- and variable cost (VC) = -q2 + 3q, the Total Revenue (TR) and Total Cost (TC) functions are examined in this section. The following deficiencies were observed in the evaluation of the answer sheets of candidates:

(1) It appears that some candidates do not have sufficient knowledge to identify the total cost function and the total revenue function as TC = FC + VC and TR = p×q.

(2) Although some candidates wrote TC = FC + VC correctly, when substituting values, they have solved it as TC = FC - VC =15,000 -($q^2$ +3q) = 15,000 - $q^2$ -3q.

(3) Incorrect answers were given by taking TC = FC × VC instead of TC = FC + VC when finding the total cost function.

(4) Some other candidates had tried to write the answer by taking TC = VC + P.

(5) Many candidates had incorrectly calculated the total revenue function (TR) as TR = 23 - 4q × q = 23 - 4q2 instead of TR = p × q = (23 - 4q )q.

**(b)** This section is expected to identify the profit function using (TR) and (TC) identified in **part (a)** above. The following deficiencies were were found in the evaluation of the candidates' answer sheets:

(1) Although the profit function should be taken as PF = TR - TC, some students had tried to solve the problem by considering PF = TC - TR and TR = TC and PF = p - VC.

(2) When calculating PF = TR - TC, some candidates had calculated PF = (23q - $4q^2$) – ($q^2$ + 3q + 15,000) = 23q - $4q^2$ - $q^2$ - 3q – 15,000 and then incorrectly calculated it as 20q - $5q^2$ +15,000 and PF = (23q - $4q^2$) – (q2 + 3q + 15,000) = 23q -$4q^2$ - $q^2$ - 3q + 15,000 = 20q – $3q^2$ – 15,000.

It was observed that many candidates had less ability to simplify numbers inside the brackets.

**(c)** This section was asked the number of units that maximize profit. Average number of candidates have taken MR = MC and calculated q = 2 as the profit-maximizing point, but they have failed to find the number of units that maximize profit. Only a minority number of candidates provided the correct answer.

## Question No. 04

**(a)** This question consisted of two parts, **(a)** and **(b)**, and the total marks given was 10.

A small number of candidates scored full marks by providing correct answers to both **(a)** and **(b)** sections.

The question was asked about using the least squares method to obtain the equation of the regression line. An average number of candidates correctly calculated $b = \frac{[n\Sigma xy - \Sigma x \Sigma y]}{[n\Sigma x^2 - (\Sigma x)^2]}$ and $a = \bar{Y} - b \times \bar{X}$ and scored all 7 marks for this section.

Some of the candidates could not identify the least squares regression line correctly due to the reasons given below:

(1) It was observed that some candidates found a and b but did not have understanding about the least squares regression line.

(2) Entries marks were forfeited by some candidates by using incorrect formulas.

(3) It was observed that some other candidates had mixed up the columns when calculating XY and $X^2$.

(4) It appears some candidates knowledge about simplification is lacking.

(5) Many candidates used calculators to calculate Coeffiient of regression,

$b = \frac{[n\Sigma xy - \Sigma x \Sigma y]}{[n\Sigma x^2 - (\Sigma x)^2]}$ and $a = \bar{y} - b\bar{x}$ and find the required ∑ X, ∑ Y, ∑ X2 , ∑ Xy . But due to lack of knowledge of basic mathematical concepts they failed to obtain the correct answer.

(6) Some of the candidates who calculated **"b"** correctly failed to find **"a"** by substituting $a = \bar{y} - b\,\bar{x}$ into it.

(7) Some candidates failed to find $\bar{x} = \frac{\Sigma x}{n}$, $\bar{y} = \frac{\Sigma y}{n}$ correctly.

(8) Using the formula for finding the correlation coefficient $r = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{(n\Sigma x^2 - (\Sigma x)^2)(n\Sigma y^2 - (\Sigma y)^2)}}$ ( ), **"r"** was calculated instead of **"b"**.

(9) Some candidates had calculated incorrect answers for **a** and **b** due to errors in copying the values given in the question paper.

(10) Incorrect answers were obtained due to errors in multiplication X × Y.

(11) Some candidates had substituted the values ∑X and ∑Y for the values $\bar{X}$ and $\bar{Y}$.

(12) Although the values of **a** and **b** were found correctly, the equation of the regression line was not written as y = a + bx.

**(b)** Although many candidates had simplified as Y = -2.44+0.63× 40 = 22.76, small number of students had written the answers correctly.

## Question No. 05

This question consisted of three parts, **(a) ,(b)** and **(c)** the total marks given was 10. Given the number of days off taken by 60 teachers in a school in the year 2023, it is expected to calculate the **(a)** median, **(b)** mean and **(c)** standard deviation.

The vast majority of candidates attempted to answer this question.

**(a)** Average number of candidates used the formula $Md = \mathrm{L1} + \frac{(\frac{n}{2} + Fc)}{fm} \times \mathrm{C}$ to find the median and provided the correct answer. Some candidates used the correct formula but failed to correctly substitute the values of $\mathrm{L1}$, $Fc, fm$ and c, could not calculate the median correctly.

**(b)** A majority of candidates used the $\bar{x} = \frac{\Sigma fx}{\Sigma f}$ formula to calculate the mean correctly and obtained all 3 marks.

A very small number of candidates could not calculate the Mean due to the following errors:

(1) Not calculating the midpoint of the class intervals

(2) Not calculating the mid points of the class intervals correctly.

(3) Not getting the sum of $\Sigma fx$ correctly.

(4) Not copying the frequency value correctly to the answer sheet.

(5) It was observed that a very small number of candidates did not have any understanding of finding the mean ( $\bar{x}$ ).

**(c)** A very small number of candidates had correctly calculated the standard deviation using the following formulas:

$$\sqrt{\frac{\Sigma f(x-\bar{x})^2}{\Sigma f}} \quad \text{or} \quad \sqrt{\frac{\Sigma fx^2}{\Sigma f} - (\bar{x})^2}$$

There were also candidates who failed to find the standard deviation correctly due to the following errors:

(1) A very small number of candidates did not calculate the mid points of the class intervals correctly and substituted $\Sigma f_i x_i$ . Therefore, the value of the standard deviation could not be calculated accurately.

(2) Not copying the formula correctly $\sqrt{\frac{\Sigma fx^2}{\Sigma f} - (\bar{x})^2}$ .

(3) Some candidates used incorrect formulas. Eg: $\sqrt{\frac{\Sigma f \Sigma f x^2}{\Sigma f} - (\bar{x})^2}$, $\frac{\Sigma f \Sigma (x-\bar{x})^2}{\Sigma f}$.

(4) Some candidates have calculated the following sums instead of $\Sigma f x^2$

$\Sigma f \Sigma x^2, \{\Sigma f x\}^2, \Sigma f^2 x^2$ .

(5) In finding $fx^2$, it is incorrectly substituted as fx × fx or fx × f.

(6) Some candidates lacked accurate knowledge of finding the standard deviation.

(7) Some candidates lacked understanding of finding the square root.

## Section - C

**Question No. 06**

This question had four parts **(A), (B), (C)** and **(D)**, and the total marks awarded were 20. This section tested candidates' knowledge in the areas of interest calculations, present value and discount factors, probability, and normal distribution.

Overall, it was observed that a majority of candidates scored very low marks for this question. A very small number of candidates answered correctly and obtained full marks.

**(A)** **(a)** It was expected to calculate the annual installment of the loan when **Jude** repays a loan, he took out at a 10% interest rate to complete his higher education to be paid in 3 years.

This problem requires the calculation of the value of an annual installment (s), using the formula $A = \frac{sR^n(R-1)}{(R^n-1)}$.

Majority of candidates were not able to calculate the annual installment of the loan amount due to the following errors:

(1) Not recognizing the correct formula.

(2) Even though the correct formula is identified, the interest rate is not entered correctly.

(3) Not substituting correct data for formula.

(4) Various errors of solving the sum.

(5) Not using R = r + 1.

**(b)** This section was asked to prepare the amortization schedule to show the loan repayment. It appears that the majority of candidates have no knowledge about this.

**(B)** **(a)** This is a problem about calculating the effective interest rate. A very small number of candidates solved the problems using the EIR=$[(1+r)^n-1] \times 100\%$ formula and marked the correct answer 12.55%.

**(b)** This is a question related to the compound interest. An average number of candidates correctly calculated the total amount in the fixed deposits at the end of the third year using the formula $S = X(1 + \frac{r}{f})^{n \times f}$.

A small number of candidates had solved the problems by calculating the interest year by year for 3 years.

Some candidates had provided incorrect answers because they did not take r/f = 0.12/8 = 0.03 and nf = 4 × 3 = 12 when substituting into the formula.

**(c)** Some candidates calculated the total amount (S) using the formula, but did not calculate the interest by subtracting the principal amount from that value.

A small number of candidates have also attempted to solve this problem using the formula for simple interest [ S = X (1 +nr) ].

**(C)** This section was expected to test knowledge of probability. The 40 students surveyed were asked about the pets they had in their homes.

**(a)** This section asked for the number of students who had at least two pets at home. An average number of candidates answered this section correctly. Some candidates were unable to get the correct answer due to the fact that the number of students with all three types of animals was not considered.

**(b)** When a student is randomly chosen the probability that that student has a dog at home was asked in this question. A majority of candidates answered this section correctly.

**(D)** This question tested knowledge of the Normal distribution . The average time it takes a runner to finish their race modled in a normal dristibution with a mean of is 112 minutes and the standard deviation is 17.2 minutes. Accordingly, they were asked to calculate the probability that a runner would take more than 120 minutes to complete a race.

A minority of candidates answered this question correctly.

Below are some of the reasons that contributed to not being able to answer this question correctly:

(1) Lack of basic knowledge of Normal distribution and standard Normal distribution.

(2) Insufficient knowledge to convert values from the Normal distribution into values of the standard Normal distribution

(3) Not knowing enough to correctly substitute the mean (μ = 112) and the standard deviation [(σ) = 17.2] for the $Z = \frac{X-\mu}{\sigma}$ and obtain the correct values for Z.

(4) In substituting for the value for $Z = \frac{X-\mu}{\sigma}$, instead of $\mu$ = 112, the value are shifted and substituted as x = 112. Hence the wrong value for z is obtained.

(5) In calculating the probability for P(X>120), it was incorrectly calculated as 0.5 - 0.4651.

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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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