

EXAMINER'S REPORT

LEVEL I EXAMINATION - JULY 2024

(102) BUSINESS MATHEMATICS & STATISTICS

SECTION A

Question No. 01

Overall, the performance of the candidates was at average level. However, a small number of candidates have scored very low marks. It is very important to practice the past papers well to get successful results at the exam.

- 1.1 The objective of this question is to find the factors of the quadratic expression. This is a very simple question and possible to find the answer using basic knowledge of factors. But a significant number of candidates did not give the correct answers. Candidates should be more interested in acquiring knowledge of factorization, which is often used in mathematics. However, majority of the candidates had given the correct answer.
- 1.2 This is a compound interest sum. Majority of the candidates had marked the correct answer. Other applicants were found to have the following deficiencies. Although the total interest was to be found, a significant number of candidates had chosen Rs.786,760/- as the total amount at the end of four years as the answer. The reason is that the question was misunderstood by them. Some candidates have failed to select the correct formula and substitute the values correctly.
- 1.3 This is a present value calculation sum in financial mathematics. As usual, the shortcomings of substitution and trivialization among candidates were seen. This is the least successful sum compared with the other questions.
- 1.4 This is a sum related to the topic of index numbers, in business statistics. Calculation of price relative was expected here. Considering 2020 as the base year, the price relative for rice should be calculated using $\frac{p_1}{p_0} \times 100$ formula. A large number of candidates answered this question correctly.
- 1.5 It is expected to calculate the correlation coefficient correctly for the given data. Correlation coefficient (r) can be calculated by correctly substituting the values into the formula below:

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

The main reason for failure in this sum is that the relevant formula is given in the formula sheet, but the values are not correctly substituted into the formula. Furthermore, candidates should be more careful about correctly trivializing a large formula.

Majority of the candidates had marked the correct answer.

1.6 This is a probability question about removing items from a box without replacement. This can be easily answered using a tree diagram. It should be noted that one card will be deducted for the second drawn because the first card will not be replaced. This was a very easy sum, and a majority of candidates had written the answers successfully.

1.7 Here a probability distribution of a discrete variable is given. It was requested to get the probability related to $P(X < 1)$. Some candidates had taken $P(X \leq 1) = 0.66$, as the correct answer. The main reason for this is that they do not have a proper understanding of inequalities. Also, some candidates did not understand to find the probabilities of discrete random variables they must be added. Candidates should understand that $P(X < 1) = P(-2) + P(-1) + P(0)$.

It appears that some candidates are confused by the presence of negative values among the values given for X here. The main reason is discussing past papers without proper understanding of theory.

1.8 Mode value of a given grouped frequency distribution calculation is expected here.

Correctly substituting values into the formula $M_0 = L_1 + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times C$ to obtain the mode of a grouped frequency distribution, the answers to this question fail due to incorrect substitution and incorrect trivialization.

It is very important to correctly identify the mode class and correctly substitute the class boundary in the substitution for L_1 .

1.9 Under financial mathematics, it is expected to find the maturity value of fixed deposits at the end of 3 years. This is a quarterly calculation of compound interest for which the following formula should be used.

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

Reasons for failure of this problem was due to the absence of correctly substituting the figures to the formula and errors in trivialization.

1.10 This is a time series question. The number of units sold for each year from 2018 to 2023 is given in a table. The relationship between time and sales trend T is shown below:

$$T = 1,160 + 182.86x$$

Here take $X=7$ and find T . Then T can be taken as 2.44

1.11 The definitions of the given four terms are correctly expected here:

(A) Mutually exclusive event

Events that do not occur simultaneously are mutually exclusive events.

(B) Paasche's Price index

The quantities of the current year must be taken as weights

(C) Laspeyre's Price index

Base year quantities must be chosen as weights.

(D) Union of events

The set of all outcomes of two events. This is a main operation of the sets operations.

The candidates tried different ways to answer this question but finally all agreed on the following answers:

A-3 B-4 C-2 D-1

But some candidates had also provided answers in the following way:

1-D 2-C 3-A 4-B

1.12 It was expected to answer the question based on the given pie chart. Since the total number of degrees in the pie chart is 360° , the fraction for hotels must be found first. Then by multiplying that figure by the total cost of Rs.36,000/-, the cost for hotels can be arrived.

$$\text{Amount to be spend for the hotels} = \frac{126}{360} \times 3,600$$

It was observed that some candidate's poor knowledge on percentages and ratios.

1.13 This is a geometric series question. It is important to identify $a=5$ and $r=2$. Candidates should recognize that the n^{th} term of a geometric series with first term "a" and common ratio "r" is given by $T_n = ar^{n-1}$

It was seen that a significant number of the candidates had a low level of knowledge about powers.

Various wrong values were used for 2^8 even though they arrived $T_n = 5 \times 2^8$.

Some candidates had got wrong answers considering it as an arithmetic progression.

Candidates should be familiar with the correct use of and $T_n = ar^{n-1}$

$S_n = \frac{a(r^n-1)}{r-1}$ formulas in a geometric series.

For questions **1.14** and **1.15** we were required to read the given statements and indicate "T" if true and "F" if false.

1.14 The question asked about correlation coefficient between two variables. As X and Y move in the same direction, as X increases, the value of Y must also increase. Then there is a positive correlation between the two variables. But, here it was stated that there was a negative correlation. Thus, the statement was false.

1.15 Main components of the time series are trend, seasonal variation, cyclic variation and random variation. Thus, the statement was true.

Majority of the candidates answer these true and false questions very easily.

Section - B

Question No. 02

- (a) This question was prepared by applying the functions and differentiation. Candidates need to read the given statements carefully and construct two simultaneous equations based on those statements. A significant number of candidates did not successfully construct these two correct equations. However, in addition to solving equations, trivialization skills were tested. Many candidates had successfully secured full marks.
- (b) This is a sum based on ratio. After reading the given problem properly and understanding it correctly. The overhead cost of Rs.300/- should be deducted from the total cost and the rest should be obtained according to the ratio of 3:2 to material cost and labor cost. Thus, it is very important for candidates to come to the exam having prepared by practicing for such similar questions.
- (c) A simple equation was expected to be solved here. Many candidates answered this correctly.

Question No. 03

- (a) This question prepared by application of functions and differentiation.

Candidates should understand that Fixed Costs (FC) and Variable Costs (VC) must be added together to get the Total Cost (TC). Applicants should also understand that the demand function and the number of units must be multiplied together to get the total revenue.

Profit Function = Revenue Function - Cost Function

$$TP = TR - TC$$

Profit Function is quadratic Function of q . When the profit is maximum $\frac{dp}{dq} = 0$

Small number of the candidates had not mastered the differentiation of a function.

If $p = q^n$ then $\frac{dp}{dq} = nq^{n-1}$. This concept was not used correctly.

Candidates should practise more exercises on differentiation. As an alternative method, candidates can use the fact that when a function is in quadratic form, its maximum or minimum values are obtained when $x = b/2a$. Accordingly, in addition to differentiation, the minimum of this problem can be calculated algebraically.

- (b) The minimum point can be obtained by differentiating the given total cost function and finding $\frac{dTC}{dq}$ and finding the value of q , where $\frac{dTC}{dq} = 0$ and it can be shown by checking the second differentiation coefficient that TC is minimum when $\frac{d^2TC}{dq^2} > 0$

Candidates should develop their knowledge on differentiation. Multiplying the q value by 1,000 was not done by a small number of candidates.

Question No. 04

- (a) It is expected to obtain the values of coefficients 'a' and 'b' by fitting the least squares regression line, which represents the relationship between the given sales revenue (x) and profit (y).

First the following values should be calculated.

$$\sum x, \quad \sum y, \quad \sum xy, \quad \sum x^2$$

"a" and "b" should be calculated using the following formulas. For this \bar{x} and \bar{y} must be calculated.

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2} \quad a = \bar{y} - b\bar{x}$$

After that the regression line $Y = a + bX$ should be introduced. Some candidates has tried to show the regression line by graphing the relationship between X and Y. The values of 'a' and 'b' in this problem should have been obtained correctly.

- (b) Substitute $X = 90$ in the obtained equation $Y = a + bX$ above (a) and multiply the value obtained for Y by 100. But a small number of candidates have not multiplied 100.

Question No. 05

- (a) It is expected to calculate the mean, standard deviation and coefficient of variation of a given grouped frequency distribution.

This formula $\frac{\sum fx}{\sum f}$ should have been used to calculate the mean, for which the mid points should have been obtained first. All the candidates who did not get the mid points did not get the fx correctly.

- (b) Majority of candidates have calculated the mean (\bar{x}) but failed to calculate the variance.

The standard deviation can be calculated using the following formula.

$$\sqrt{\left[\frac{\sum fx^2}{\sum f} \right] - \bar{x}^2}$$

- (c) It was observed that a large number of applicants had transposed the equation to

$$CV = \frac{\bar{x}}{\sigma} \times 100$$

even though the coefficient of variation was ,

$$CV = \frac{\text{standard deviation}(\sigma)}{\text{mean}(\bar{x})} \times 100$$

Section - C

Question No. 06

- (A) It was expected here to calculate the installment of the annual loan amount under financial mathematics.

This can be calculated using the following formulas.

$$A = \frac{SR^n(R-1)}{(R^n-1)} \quad \text{or} \quad S = \frac{500,000}{3.5172}$$

But, a significant number of candidates had made mistakes in trivializing and making mistakes in substituting into the formula.

- (B) This is a sum of choosing the best investment project under financial mathematics. Accordingly, the net present value of each project should be calculated based on the cash flows of the two projects. Out of this the highest positive net present value should have been selected but it had been transferred by the candidates. Some applicants had not taken the discount factors correctly. Some candidates did not get the net present values correctly by assuming the approximate value. Candidates should practice more past papers as every past paper contains these types of questions.
- (C) The conditional probability concept of probability theory was examined here. A significant number of candidates answered the questions in **Part (a)** correctly, but very few candidates answered **Part (b)** correctly. Accordingly, both answers $2/45$ or $2/6 = 1/3$ were taken as the correct answers.
- (D) This is a question with normal distribution.

$$\begin{aligned} P(X < 465) &= P\left(\frac{x-l}{4} < \frac{465-540}{48}\right) \\ &= P(< -1.56) \end{aligned}$$

A large number of candidates did not correctly use $Z = \frac{x-\mu}{\sigma}$ to calculate the standard normal distribution values for given X values.

Some candidates have mistakenly substituted in $Z = (M-x)/\sigma$ and took the value of Z as 1.56.

Candidates should also be more interested in finding correct probability values using the table of a standard normal distribution.

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.