B. Com. Semester-II

Business Mathematics and Statistics
(Code : 52411202)

M.M. : 100

Note : Answer may be written either in English or in Hindi; but the same medium should be used throughout the paper.

टिप्पणी : इस प्रश्न पत्र का उत्तर **अंग्रेजी** या **हिन्दी** किसी एक भाषा में दीजिए; लेकिन सभी उत्तरों का माध्यम एक ही होना चाहिए।

Attempt any two questions in all.
All questions carry equal marks.
Use of simple calculator is allowed.

(Write your Name and Roll No. on each page of your answer sheet.)

Note : *The maximum marks printed on the question paper are applicable for the students. These marks will, however be scaled down proportionately in respect of the students of regular colleges, at the time of posting of awards for compilation of result.*

Q.1 (a) An amount of Rs. 4,000 is distributed into three investments at the rate of 7%, 8% and 9% per annum respectively. The total annual income is Rs. 317.50 and the annual income from the first investment is Rs. 5 more than the income from the second. Find the amount of each investment using matrix algebra.

(b) A wholesaler of pencils charges Rs. 24 per dozen on orders of 50 dozens or less. For orders in excess of 50 dozens, the price is reduced by 20 paise per dozen in excess of 50 dozens. Find the size of the order that maximizes his total revenue.

(c) A computer is purchased for Rs. 50,000. It is estimated to depreciate at 10% per annum every year. Find its scrap value at the end of 12 years.

Q.1 (ए) रुपये की राशि। 4,000 को क्रमशः 7%, 8% और 9% प्रति वर्ष की दर से तीन निवेशों में वितरित किया जाता है। कुल वार्षिक आय रु। 317.50 और पहले निवेश से वार्षिक आय रु। दूसरे से आय से 5 अधिक। मैट्रिक्स बीजगणित का उपयोग करके प्रत्येक निवेश की मात्रा का पता लगाएं।

(बी) पेंसिल के एक थोक व्यापारी से रु। 50 दर्जनों या उससे कम के आदेश पर 24 प्रति दर्जन। 50 दर्जन से अधिक के ऑर्डर के लिए, कीमत 50 दर्जन से अधिक 20 पैसे प्रति दर्जन से कम हो जाती है। उस ऑर्डर का आकार ज्ञात करें जो उसके कुल राजस्व को अधिकतम करता है।

(सी) एक कंप्यूटर रुपये के लिए खरीदा जाता है। 50,000। हर साल 10% प्रति वर्ष की दर से मूल्यह्रास का अनुमान है। 12 वर्ष के अंत में इसके स्क्रैप मूल्य का पता लगाएं।

Q.2 (a) "Each average has its own special features and it is difficult to say which one is the best". Explain this statement.

(b) The mean age of the combined group of men and women is 30.5 years. If the mean age of the sub-group of men is 35 years and that of the sub-group of women is 25 years, find out percentage of men and women in the group.

(c) The mean and median of a moderately skewed distribution are 42.2 and 41.9 respectively. Find mode of the distribution.

Q.2 (ए) "प्रत्येक औसत की अपनी विशेष विशेषताएं हैं और यह कहना मुश्किल है कि कौन सा सबसे अच्छा है"। इस कथन की व्याख्या कीजिए।

(वी) पुरुषों और महिलाओं के संयुक्त समूह की औसत आयु 30.5 वर्ष है। यदि पुरुषों के उप-समूह की औसत आयु 35 वर्ष है और महिलाओं के उप-समूह की आयु 25 वर्ष है, तो समूह में पुरुषों और महिलाओं का प्रतिशत ज्ञात करें।

(सी) मध्यम तिरछा वितरण का औसत और औसत क्रमशः 42.2 और 41.9 है। वितरण का तरीका ज्ञात कीजिए।

3(a) After settlement, the average weekly wage in a factory had increased from Rs. 8 to 12 and standard deviation had increased from Rs. 1 to 1.5. The wages have become higher and more uniform, after settlement. Comment.

3(b) Calculate the Karl Pearson's coefficient of correlation from the following pairs of values and interpret the result:

Values of X	12	9	8	10	11	13	7
Values of Y	14	8	6	9	11	12	3

Q.3 (c) Distinguish between correlation and regression.

(d) The two regression coefficients are -2.7 and -0.3 and the coefficient of correlation is 0.90. Comment.

Q.3 (ए) निपटान के बाद, एक कारखाने में औसत साप्ताहिक वेतन रुपये से बढ़ गया था। 8 से 12 और मानक विचलन रुपये से बढ़ गया था। 1 से 1.5। निपटान के बाद मजदूरी अधिक और अधिक समान हो गई है। टिप्पणी।

(वी) मूल्यों के निम्नलिखित जोड़े से कार्ल पियर्सन के सहसंबंध के गुणांक की गणना करें और परिणाम की व्याख्या करें:

X का मान	12	9	8	10	11	13	7
Y का मान	14	8	6	9	11	12	3

(सी) सहसंबंध और प्रतिगमन के बीच अंतर।

(डी) दो प्रतिगमन गुणांक -2.7 और -0.3 हैं और सहसंबंध का गुणांक 0.90 है। टिप्पणी।

Q.4 (a) Construct Laspeyres, Paasche and Fisher indices from the following data:

Item	2018		2019	
	Price (Rs.)	Expenditure (Rs.)	Price (Rs.)	Expenditure (Rs.)
A	10	60	15	75
B	12	120	15	150
C	18	90	27	81
D	8	40	12	48

(b) Fit a straight line trend to the following data and estimate the expected profit for the year 2022. What is the average annual change in profit?

Year	2013	2014	2015	2016	2017	2018	2019
Profit (in lacs of Rs.)	60	72	75	65	80	85	95

Q.4 (ए) निम्नलिखित डेटा से लासपेयर, पाशे और फिशर सूचकांकों का निर्माण करें:

मद	2018		2019	
	मूल्य Price (Rs.)	व्यय Expenditure (Rs.)	Price (Rs.)	Expenditure (Rs.)
A	10	60	15	75
B	12	120	15	150
C	18	90	27	81
D	8	40	12	48

(वी) निम्नलिखित डेटा के लिए एक सीधी रेखा प्रवृत्ति को फिट करें और वर्ष 2022 के लिए अपेक्षित लाभ का अनुमान लगाएं। लाभ में औसत वार्षिक परिवर्तन क्या है?

साल	2013	2014	2015	2016	2017	2018	2019
लाभ (रुपये लाख में)	60	72	75	65	80	85	95

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Question :- 4

(a)

Items	2018			2019				
	Price (₹) (P_0)	Exp. (₹) (P_0Q_0)	Qty. (Q_0)	Price (₹) (P_1)	Exp. (₹) (P_1Q_1)	Qty. (Q_1)	P_1Q_0	P_0Q_1
A	10	60	6	15	75	5	90	50
B	12	120	10	15	150	10	150	120
C	18	90	5	27	81	3	135	54
D	8	40	5	12	48	4	60	32
		310			354		435	256

- Laspeyres' method :-

$$P_{01} = \frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times 100 = \frac{435}{310} \times 100$$

$$= 140.32$$

$$Q_{01} = \frac{\Sigma Q_1P_0}{\Sigma Q_0P_0} \times 100$$

$$= \frac{256}{310} \times 100 = 82.58$$

- Paaschyes' method :-

$$P_{01} = \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1} \times 100$$

$$= \frac{354}{256} \times 100 = 138.28$$

$$Q_{01} = \frac{\Sigma Q_1P_1}{\Sigma Q_0P_1} \times 100$$

$$= \frac{354}{435} \times 100 = 81.38$$

- Fishers' ideal method :-

$$P_{01} = \sqrt{L \times P}$$

$$Q_{01} = \sqrt{L \times P}$$

$$P_{01} = \sqrt{\frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times \frac{\Sigma P_1 q_1}{\Sigma P_0 q_1}}$$

$$= \sqrt{\frac{435}{310} \times \frac{354}{256}}$$

$$= \sqrt{\frac{1,53,990}{79,360}} = \sqrt{1.94039819}$$

$$= 1.39298176064$$

$$Q_{01} = \sqrt{L \times P}$$

$$= \sqrt{\frac{\Sigma q_1 P_0}{\Sigma q_0 P_0} \times \frac{\Sigma q_1 P_1}{\Sigma q_0 P_1}}$$

$$= \sqrt{\frac{256}{310} \times \frac{354}{435}} = \sqrt{\frac{90,624}{1,34,850}}$$

$$= \sqrt{0.6720355951}$$

$$= 0.8198$$

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Solution (b)

Year	Sales/ Profits Y	Deviations from 2016 X	X^2	XY	Trend value (Y_c)	Short-term fluctuations ($Y-Y_c$)
2013	60	-3	9	-180	61.42	-1.42
2014	72	-2	4	-144	66.28	5.72
2015	75	-1	1	-75	71.14	3.86
2016	65	0	0	0	76	-11
2017	80	1	1	80	80.86	-0.86
2018	85	2	4	170	85.72	-0.72
2019	95	3	9	285	90.58	4.42
N=7	$\Sigma Y = 532$		$\Sigma X^2 = 28$	$\Sigma XY =$ 136	$\Sigma Y_c =$ 532	$\Sigma (Y-Y_c) =$ 0

Equation of straight line trend is: $Y_c = a + bX$

$$a = \frac{\Sigma Y}{N} = \frac{532}{7} = 76 \quad \text{and} \quad b = \frac{\Sigma XY}{\Sigma X^2} = \frac{136}{28} = 4.86 \text{ (approx)}$$

Equation of straight line trend is: $Y_c = 76 + 4.86(X)$

when $X = -3$, $Y_c = 76 + 4.86(-3) = 76 - 14.58 = 61.42$
when $X = -2$, $Y_c = 76 + 4.86(-2) = 76 - 9.72 = 66.28$
when $X = -1$, $Y_c = 76 + 4.86(-1) = 76 - 4.86 = 71.14$
when $X = 0$, $Y_c = 76 + 4.86(0) = 76 - 0 = 76$
when $X = 1$, $Y_c = 76 + 4.86(1) = 76 + 4.86 = 80.86$
when $X = 2$, $Y_c = 76 + 4.86(2) = 76 + 9.72 = 85.72$

when $X = 3$, $Y_c = 76 + 4.86(3) = 76 + 14.58 = 90.58$

for the year 2020,

~~$X = 2020 - 2016 = 4$~~ $X = 2022 - 2016 = 6$

Straight line trend equation,

~~$Y_c = 76 + 4.86(4) = 76 + 19.44$~~

~~$= 95.44$~~

$Y_c = 76 + 4.86(6) = 76 + 29.16$

$= 105.16$

(d)

The two regression coefficients are -2.7 and -0.3 and the coefficient of correlation is 0.90. Comment.

Given :- Coefficient of correlation is $(r) = 0.90$,
Regression coefficient $(b_{xy}) = -2.7$
" " $(b_{yx}) = -0.3$

we know that, $r = \sqrt{b_{xy} \times b_{yx}}$

$= 0.90 = \sqrt{-2.7 \times -0.3}$

$= 0.9 = \sqrt{0.81}$

$0.9 = 0.9$ Hence proved

Both L.H.S and R.H.S are equal.

It means given statement/line is correct that is the two regression coeff. are -2.7 and -0.3 and the coeff. correlation is 0.90. Then both are equal.

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(C)

Distinguish b/w Correlation and regression.

Basis for Comparison	Correlation	Regression
• Meaning	It's a statistical measure which determines Correlation-Ship or association of two variables.	It describes how an independent variable is numerically
• Usage	To represent linear relationship b/w two variables.	To fit a best line and estimate one variable on the basis of another variable.
• Dependent and Independent variables	No difference	Both variables are different.
• Indicates	Correlation Coeff. indicates the extent to which two variables move together.	Regression indicates the impact of a unit change in the known variable (x) on the estimated variable (y).
• Objective	To find a numerical value expressing the relation-ship b/w variables.	To estimate values of random variable on the basis of the values of fixed variable

(6)

Calculate the Karl pearson's Coef. of correlation from the following data:-

X	Y	$x = X - \bar{X}$	$y = Y - \bar{Y}$	x^2	y^2	xy
12	14	2	5	4	25	10
9	8	-1	-1	1	1	1
8	6	-2	-3	4	9	6
10	9	0	0	0	0	0
11	11	1	2	1	4	2
13	12	3	3	9	9	9
7	3	-3	-6	9	36	18
$\Sigma X = 70$	$\Sigma Y = 63$			$\Sigma x^2 = 28$	$\Sigma y^2 = 84$	$\Sigma xy = 46$

$\therefore$ Coefficient of Correlation, $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$

$= \frac{46}{\sqrt{28 \times 84}} = \frac{46}{\sqrt{2,352}} = \frac{46}{48.5} = 0.948$

$= 1$ Approx.

Interpretation of the result. There is perfect positive correlation b/w x and y.

- Note:-

$\bar{X} = \frac{\Sigma X}{N} = \frac{70}{7} = 10$ $\quad$ $\bar{Y} = \frac{\Sigma Y}{N} = \frac{63}{7} = 9$

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Question :- 3

(a)

After settlement, the average weekly wage in a factory had increased from ₹ 8 to 12. and standard deviation had increased from ₹ 1 to 1.5. The wages have become higher and more uniform, after settlement. Comment.

Mean wages will be affected but standard deviation will not be affected as the standard deviation is independent of origin.

Have the wages become higher and more uniform, we will have to calculate coefficient of variation.

Initially $C.V = \frac{\sigma}{\bar{x}} \times 100 = \frac{1.5}{12} \times 100 = 12.5\%$

Now it means, more uniformity in wages has taken place.