

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC
BRANCH: QEDS

SEMESTER : III
SESSION : MO/2023

SUBJECT: ED211 LINEAR STATISTICAL MODELS AND REGRESSION ANALYSIS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. F-table and t-table to be supplied to the candidates in the examination hall.

- Q.1(a) An experiment has a single factor with five groups and seven values in each group. The [5] CO 3 BL 3
SSB=60, SST=210. Calculate the following:
i) SSW (within sum of square)
ii) Degrees of freedom for between-group variation?
iii) Degrees of freedom for within-group variation?
iv) Total degrees of freedom
v) The value of F-statistic
- Q.1(b) Derive the estimates of the coefficients (β_0 and β_1) for a simple linear regression model [5] 2 2
using OLS method.
- Q.2 The following data present height of plants grown under different levels of watering [10] 3 4
frequency (daily, weekly) and sunlight exposure (None, low, medium and high) for one
month. Use an appropriate statistical tool to test at $\alpha=0.05$ level whether the different
levels of these two factors influence the plant's height.

	Sunlight Exposure			
Watering Frequency	None	Low	Medium	High
Daily	4.5	5	6.4	6.3
	4.4	5.2	6.2	6.4
	3.2	5.6	4.7	5.6
Weekly	4.4	4.9	5.8	6
	4.2	5.3	6.2	4.9
	3.8	5.7	6.3	4.6

- Q.3 For an economy, the 'price index' is assumed to depend on 'interest_rate' and [10] 4 4
'unemployment_rate'. The OLS output of multiple linear regression model is given below:

	coef	std err	t	P> t
const	1798.4040	899.248	2.000	0.059
interest_rate	345.5401	111.367	3.103	0.005
unemployment_rate	-250.1466	117.950	-2.121	0.046

Based on the output, answer the following:

- i) How 'interest_rate' is influencing the price index?
- ii) How 'unemployment_rate' is influencing the price index?
- iii) Suppose the model's R^2 is 0.89, what does it suggest?
- iv) The calculated F-statistic for the model is 92.6 and the corresponding p-value is 3.83064×10^{-11} . Comment whether the regression model is significant at $\alpha=0.05$ level.

- Q.4 The yield y of a chemical process is a random variable whose value is considered to be a linear function of the temperature x . The following data present the values of x and y : [10] 1 3

Temperature in °C (X)	0	25	50	75	100
Yield in grams(Y)	14	38	54	76	95

- i) Fit a regression line Y on X and comment on how yield is getting affected by temperature.
- ii) At $\alpha=0.05$ level, test the statistical significance of the slope (t – test for β_1 coefficient) and evaluate if temperature is a significant predictor of yield.
- Q.5(a) State the assumptions of Multiple Linear Regression analysis. [5] 4 2
- Q.5(b) Why is residual analysis done after fitting a regression model? Which plot is used to check the normality assumption of residuals in regression analysis? [5] 5 2

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