UPES
End Semester Examination, December 2023

Course: Statistical Modelling and Simulation   Semester: I
Program: M Tech HSE   Time: 03 hrs.
Course Code: HSFS 7029   Max. Marks: 100

Instructions: Attempt all the questions;

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain why the denominator (n-1) is used in the calculation of standard deviation for sample whereas simply n is used for population standard deviation?	4	CO1
Q 2	The following are the monthly evaporation data (Jan.-Dec.) at a Dam in a certain year in cm: **16.7, 14.3, 17.8, 25.0, 28.6, 21.4, 16.7, 16.7, 16.7, 21.4, 16.7, 16.7** Calculate the skewness for the data and interpret its physical significance.	4	CO1
Q 3	From a random sample of 36 New Delhi civil service personnel, the mean age and the sample standard deviation were found to be 40 years and 4.5 years respectively. Construct a 95 per cent confidence interval for the mean age of civil servants in New Delhi.	4	CO2
Q 4	Define the following terms: a) Homoscedasticity b) Multi-collinearity	4	CO3
Q 5	Differentiate between the following: a) Regression and correlation. b) Pearson's and Spearman's Coefficient of Correlation	4	CO3

SECTION B
(4Qx10M= 40 Marks)

Q 6	The table given below shows the data obtained during outbreak of	10	CO2

	Attacked	Not attacked	Total
Vaccinated	31	469	500
Not vaccinated	185	1315	1500
Total	216	1784	2000

Test the effectiveness of vaccination in preventing the attack from smallpox. Test your result

	with the help of χ^2 at 5 per cent level of confidence.		

<div align="center">OR</div>

Q 6	Genetic theory states that children having one parent of blood type A and the other of blood type B will always be of one of three types, A, AB, B and that the proportion of three types will on an average be as 1:2:1. A report states that out of 300 children having one A parent and B parent, 30 per cent were found to be types A, 45 per cent per cent type AB and remainder type B. Test the hypothesis by χ^2 test.	10	CO2
Q 7	Write a python program to calculate for linear regression to predict y using x and validate the model. Assume any arbitrary data for the code.	10	CO1
Q 8	Demonstrate the applicability of two way ANOVA classification with the help of an example.	10	CO3
Q 9	What are the different methods of trend analysis? Explain the each in detail.	10	CO1

<div align="center">

SECTION-C
(2Qx20M=40 Marks)

</div>

Q 10	Following are the data of gauge and discharge collected at a particular section of the river by stream gauging operation. (a) Develop a gauge-discharge relationship for this stream at this section for use in estimating the discharge for a known gauge reading. What is the coefficient of correlation of the derived relationship? Use a value of a = 7.50 m for the gauge reading corresponding to zero discharge. (b) Estimate the discharge corresponding to a gauge reading of 10.5 m at this gauging section.	20	CO4

Gauge reading (m)	Discharge (m³/s)	Gauge reading (m)	Discharge (m³s)
7.65	15	8.48	170
7.70	30	8.98	400
7.77	57	9.30	600
7.80	39	9.50	800
7.90	60	10.50	1500
7.91	100	11.10	2000
8.08	150	11.70	2400

The relationship between the discharge (Q) and gauge reading (G) is non-linear and given as:

$$Q = C_r. (G - a)^b$$

a = constant which represents the gauge reading corresponding to zero discharge, C_r and b are rating curve constants.

<div align="center">**OR**</div>

Q 10	a) A sample of 400 male students is found to have a mean height 67.47 inches. Can it be reasonably regarded as a sample from a large population with mean height 67.39 inches and standard deviation 1.30 inches? Test at 5% level of significance. b) Explain the properties of normal distribution	15+5	CO4
Q 11	For the data given below, plot the series and detrend the data using the interval of 3 months and 4 months using moving average method. Plot all the three series on a single plot and explain the inference of each plot.	20	CO4

Month	Passengers	Month	Passengers
Jan-49	112	Jan-50	115
Feb-49	118	Feb-50	126
Mar-49	132	Mar-50	141
Apr-49	129	Apr-50	135
May-49	121	May-50	125
Jun-49	135	Jun-50	149
Jul-49	148	Jul-50	170
Aug-49	148	Aug-50	170
Sep-49	136	Sep-50	158
Oct-49	119	Oct-50	133
Nov-49	104	Nov-50	114
Dec-49	118	Dec-50	140