Indian Statistical Institute, Bangalore

MS (QMS) First Year

Second Semester - Multivariate Data Analysis

Maximum marks: 50 **Date: July 12, 2019** **Duration: 3 hours**

Answer as many questions as you can. The maximum you can score is only 50 marks

1. The data on multivariate output characteristics namely thickness and diameter of bearing end-plate machining process is given below: [15]

Part Id	Diameter	Thickness	Part Id	Diameter	Thickness
1	82.61	14.94	13	82.27	14.95
2	82.41	15.01	14	82.52	14.87
3	82.12	14.86	15	82.56	14.98
4	82.35	14.85	16	82.48	15.12
5	82.5	14.69	17	82.29	14.91
6	82.01	15	18	82.46	14.88
7	82.34	14.93	19	82.28	14.9
8	82.27	14.9	20	81.97	14.77
9	82.25	14.94	21	82.34	14.64
10	82.1	14.94	22	82.12	15
11	82.36	14.84	23	82.52	14.93
12	82.17	14.85	24	82.37	15.07

   a. Check whether the characteristics are multivariate normally distributed or not?
   b. Compute the mean vector and covariance matrix?
   c. Test providing all details whether the mean vector of diameter and thickness is [81, 15]? Consider the F table value as 3.44?

2. In a pulp cooking process, the output characteristics pulp yield (y_1) and viscosity (y_2) are related to the process parameters sulphidity (x_1), black liquor (x_2) and cooking time (x_3) as follows:

$$y_1 = 34.875 + 0.133\, x_1 + 0.02\, x_2$$

$$y_2 = 60.9 + 0.485\, x_1 - 0.29\, x_3$$

   a. Suppose x_1 is normally distributed with mean 18 and standard deviation 1, x_2 is normally distributed with mean 5 and standard deviation 1.5 and x_3 is normally distributed with mean 60 and standard deviation 1.4, generate 100 values of y_1 & y_2 and check whether (y_1, y_2) is multivariate normally distributed?
   b. Compute the mean vector and covariance matrix of (y1, y2) ?
   c. Suppose the upper and lower specifications of (y1, y2) are LSL = (37.2, 50.0) and USL = (38.2, 53.5), compute the % of rejection?

[15]

3. A telecom service provider used to take the opinion of customers who interacted with their call centre for resolving issues. The survey is conducted after the call. The questions asked on the survey are the following:

x1: How satisfied are you with our service?

x2: How likely are you to recommend our services to others?

x3: Rate your satisfaction with our team in resolving your issue?.

x4: Did you feel that our team answered your questions correctly?

x5: Did your issue was effectively resolved?

x6: How likely you to recommend our services to others?

The customers need to rate each question on a 1 to 7 scale. The correlation matrix of the responses is given below. Perform principal component analysis and identified the proportion of variance explained by each component. Identify the optimum number of components required through Scree plot as well as cumulative proportion method?
[8]

	x1	x2	x3	x4	x5	x6
x1	1	0.72	0.32	0.05	0.17	0.86
x2	0.72	1	0.12	0.21	0.07	0.65
x3	0.32	0.12	1	0.81	0.69	0.13
x4	0.05	0.21	0.81	1	0.72	0.18
x5	0.17	0.07	0.69	0.72	1	0.31
x6	0.86	0.65	0.13	0.18	0.31	1

4. An IT company has conducted a conjoint analysis with its employees to identify the best strategy to be adopted during the Covid-19 lockdown period. The details of the conjoint analysis are given below. Each row in the table is representing an option. Kindly simulate 5 responses for each option from the distribution given in the score column. Analyze the simulated data, compute part-worth utilities and importance scores. Which is the best choice company can adopt during a lockdown? [15]

SL No	Work Style	Salary	In case of becoming Covid +ve	Score
1	Work from Office	Give full salary	No reimbursement of medical expenses	Normal with $\mu = 4$ and $\sigma = 1$
2	Work from Office	Up to 30% salary cut	Partial Reimbursement of Medical Expenses	Poisson with $\lambda = 5$
3	Work from Office	More than 50% salary cut	Full reimbursement medical expenses	Poisson with $\lambda = 3$
4	Work from Home	Give full salary	Full reimbursement medical expenses	Normal with $\mu = 7$ and $\sigma = 1$
5	Work from Home	Up to 30% salary cut	No reimbursement of medical expenses	Normal with $\mu = 3$ and $\sigma = 1$
6	Work from Home	More than 50% salary cut	Partial Reimbursement of Medical Expenses	Poisson with $\lambda = 6$
7	Partially work from office	Give full salary	Partial Reimbursement of Medical Expenses	Poisson with $\lambda = 8$
8	Partially work from office	Up to 30% salary cut	Full reimbursement medical expenses	Normal with $\mu = 7$ and $\sigma =$

				1
9	Partially work from office	More than 50% salary cut	No reimbursement of medical expenses	Normal with $\mu = 4$ and $\sigma = 1$