Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

End Semester Examination, May 2025

Program Name: BT-BIOMEDICAL — **Semester : VI**
Course Name : Data Visualization — **Time : 3 hrs**
Course Code : CSEG3052_2 — **Max. Marks : 100**
Nos. of page(s): 3

Instructions: Please attempt according to the time provided and given weightage.
[T -Table and Chi Square Table attached]

Section A : 20 Marks
(Answer all the questions)

S. No.		Marks	COs
Q 1	Articulate five guidelines for designing clear and truthful charts (e.g., histograms, bar charts, line graphs). Illustrate each guideline with a brief example of "good" versus "bad" practice.	**4**	**CO1**
Q 2	Compare the strengths and limitations of Heatmaps and Scatter Plots for visualizing relationships between variables. In your answer, consider scenarios involving (i) multiple variables and (ii) a mix of continuous and categorical data.	**4**	**CO1**
Q 3	What are the steps involved in hypothesis testing? Explain in detail.	**4**	**CO2**
Q 4	(a) Describe the role of geographical analysis in data visualization. Provide a use case. (b) Discuss the importance of exploratory data analysis	**4**	**CO2**
Q 5	(a) Differentiate between a T-test and a Chi-square test. When is each used? (b) List and briefly explain two types of EDA.	**4**	**CO2**
	Section B : 40 Marks **(Answer all the questions)**		
Q 6	Discuss how different types of charts (stacked bar, line chart, scatter plot, multi-line chart, area graph) are used to visualize multivariate and time-series data. Use examples to explain when each type of chart is most appropriate.	**10**	**CO2**
Q 7	Explain the role of EDA in machine learning pipeline development. Discuss how EDA helps in identifying important features, data quality issues, and model assumptions with relevant charts and examples.	**10**	**CO2**
Q 8	Discuss why feature selection is vital for predictive modelling. Explain in detail with the following techniques (i) Complete, (ii) Heuristic and (iii) Random.	**10**	**CO3**
Q 9	Define hypothesis testing and explain the steps involved in performing the Chi-square test. In your answer, discuss the types of hypotheses, significance levels, test statistics, and p-values with examples.	**10**	**CO3**
Q 10	(a) Explain why EDA is considered a prerequisite for formal modelling. In your answer, discuss at least three risks that can arise if EDA is skipped. (b) Compare univariate, bivariate, and multivariate analysis.	**10**	**CO2**

Section C : 40 Marks
(Attempt any 2 questions)
(Long answer type questions)

Q 11 (20 marks, CO4)

You are provided with an Excel file named sales_data.xlsx containing details of six employees from a sales team. The dataset has the following five columns:

Employee	Monthly Sales (₹)	Experience (years)	Age	Region
John	45000	2	25	North
Mary	52000	3	29	South
Alex	60000	5	32	East
Sarah	48000	2	27	West
David	55000	4	30	North
Emma	47000	1	24	South

(i) Write the line of code to load the data from the Excel file using the appropriate Python package. **(2 Marks)**

(ii) Write the Python code for displaying the first five rows and checking for missing data. **(2 Marks)**

(iii) Write the python code for the bar chart to display the monthly sales of each employee. **(3 Marks)**

(iv) Write the python code for line chart to show the years of experience for each employee. **(3 Marks)**

(v) Write the python code for histogram to visualize the distribution of employee ages. **(5 Marks)**

(vi) Write the python code for heatmap using seaborn package to show the correlation between Monthly Sales, Experience, and Age. **(5 Marks)**

Q 12 (20 marks, CO4)

Compute the T-test to examine the association between two categorical variables.

A researcher wants to examine whether there is a significant difference in the **average test scores** between **Male and Female** students in a class. The test scores for the two groups are as follows:

Gender	Test Scores
Male	78, 85, 80, 76, 74
Female	82, 88, 84, 90, 86

(i) Clearly state the null hypothesis (H_0) and alternative hypothesis (H_1).**(4 marks)**

(ii) Compute the sample means and standard deviations for both groups. **(3 marks)**

(iii) Calculate the pooled standard deviation and the t-test statistic. **(6 marks)**

(iv) Determine the degrees of freedom (df) and find the critical value from the t-distribution table at a $\alpha = 0.05$ significance level (two-tailed). Hint: For the two tailed test, the α should be ($\alpha/2$) to look up in T-table. **(4 marks)**

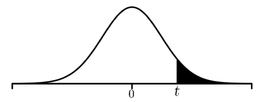
	(v) Compare the calculated t-value with the critical value. State whether the null hypothesis should be rejected and interpret the result in the context of test score differences between genders. **(3 marks)**		
Q 13	Explain in detail the different types of SQL joins and their significance in combining data from multiple tables. For each type of join—Inner Join, Left Join, Right Join, Full Join, and Cross Join—provide a clear definition, a detailed example demonstrating the use. Additionally, discuss when to use each type of join by taking an example on your own.	**20**	**CO3**

******

Chi-square Distribution Table

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57
22	8.64	9.54	10.98	12.34	14.04	30.81	33.92	36.78	40.29
24	9.89	10.86	12.40	13.85	15.66	33.20	36.42	39.36	42.98
26	11.16	12.20	13.84	15.38	17.29	35.56	38.89	41.92	45.64
28	12.46	13.56	15.31	16.93	18.94	37.92	41.34	44.46	48.28
30	13.79	14.95	16.79	18.49	20.60	40.26	43.77	46.98	50.89
32	15.13	16.36	18.29	20.07	22.27	42.58	46.19	49.48	53.49
34	16.50	17.79	19.81	21.66	23.95	44.90	48.60	51.97	56.06
38	19.29	20.69	22.88	24.88	27.34	49.51	53.38	56.90	61.16
42	22.14	23.65	26.00	28.14	30.77	54.09	58.12	61.78	66.21
46	25.04	26.66	29.16	31.44	34.22	58.64	62.83	66.62	71.20
50	27.99	29.71	32.36	34.76	37.69	63.17	67.50	71.42	76.15
55	31.73	33.57	36.40	38.96	42.06	68.80	73.31	77.38	82.29
60	35.53	37.48	40.48	43.19	46.46	74.40	79.08	83.30	88.38
65	39.38	41.44	44.60	47.45	50.88	79.97	84.82	89.18	94.42
70	43.28	45.44	48.76	51.74	55.33	85.53	90.53	95.02	100.43
75	47.21	49.48	52.94	56.05	59.79	91.06	96.22	100.84	106.39
80	51.17	53.54	57.15	60.39	64.28	96.58	101.88	106.63	112.33
85	55.17	57.63	61.39	64.75	68.78	102.08	107.52	112.39	118.24
90	59.20	61.75	65.65	69.13	73.29	107.57	113.15	118.14	124.12
95	63.25	65.90	69.92	73.52	77.82	113.04	118.75	123.86	129.97
100	67.33	70.06	74.22	77.93	82.36	118.50	124.34	129.56	135.81

Critical Values for Student's t-Distribution.



	Upper Tail Probability: $\Pr(T > t)$									
df	0.2	0.1	0.05	0.04	0.03	0.025	0.02	0.01	0.005	0.0005
1	1.376	3.078	6.314	7.916	10.579	12.706	15.895	31.821	63.657	636.619
2	1.061	1.886	2.920	3.320	3.896	4.303	4.849	6.965	9.925	31.599
3	0.978	1.638	2.353	2.605	2.951	3.182	3.482	4.541	5.841	12.924
4	0.941	1.533	2.132	2.333	2.601	2.776	2.999	3.747	4.604	8.610
5	0.920	1.476	2.015	2.191	2.422	2.571	2.757	3.365	4.032	6.869
6	0.906	1.440	1.943	2.104	2.313	2.447	2.612	3.143	3.707	5.959
7	0.896	1.415	1.895	2.046	2.241	2.365	2.517	2.998	3.499	5.408
8	0.889	1.397	1.860	2.004	2.189	2.306	2.449	2.896	3.355	5.041
9	0.883	1.383	1.833	1.973	2.150	2.262	2.398	2.821	3.250	4.781
10	0.879	1.372	1.812	1.948	2.120	2.228	2.359	2.764	3.169	4.587
11	0.876	1.363	1.796	1.928	2.096	2.201	2.328	2.718	3.106	4.437
12	0.873	1.356	1.782	1.912	2.076	2.179	2.303	2.681	3.055	4.318
13	0.870	1.350	1.771	1.899	2.060	2.160	2.282	2.650	3.012	4.221
14	0.868	1.345	1.761	1.887	2.046	2.145	2.264	2.624	2.977	4.140
15	0.866	1.341	1.753	1.878	2.034	2.131	2.249	2.602	2.947	4.073
16	0.865	1.337	1.746	1.869	2.024	2.120	2.235	2.583	2.921	4.015
17	0.863	1.333	1.740	1.862	2.015	2.110	2.224	2.567	2.898	3.965
18	0.862	1.330	1.734	1.855	2.007	2.101	2.214	2.552	2.878	3.922
19	0.861	1.328	1.729	1.850	2.000	2.093	2.205	2.539	2.861	3.883
20	0.860	1.325	1.725	1.844	1.994	2.086	2.197	2.528	2.845	3.850
21	0.859	1.323	1.721	1.840	1.988	2.080	2.189	2.518	2.831	3.819
22	0.858	1.321	1.717	1.835	1.983	2.074	2.183	2.508	2.819	3.792
23	0.858	1.319	1.714	1.832	1.978	2.069	2.177	2.500	2.807	3.768
24	0.857	1.318	1.711	1.828	1.974	2.064	2.172	2.492	2.797	3.745
25	0.856	1.316	1.708	1.825	1.970	2.060	2.167	2.485	2.787	3.725
26	0.856	1.315	1.706	1.822	1.967	2.056	2.162	2.479	2.779	3.707
27	0.855	1.314	1.703	1.819	1.963	2.052	2.158	2.473	2.771	3.690
28	0.855	1.313	1.701	1.817	1.960	2.048	2.154	2.467	2.763	3.674
29	0.854	1.311	1.699	1.814	1.957	2.045	2.150	2.462	2.756	3.659
30	0.854	1.310	1.697	1.812	1.955	2.042	2.147	2.457	2.750	3.646
31	0.853	1.309	1.696	1.810	1.952	2.040	2.144	2.453	2.744	3.633
32	0.853	1.309	1.694	1.808	1.950	2.037	2.141	2.449	2.738	3.622
33	0.853	1.308	1.692	1.806	1.948	2.035	2.138	2.445	2.733	3.611
34	0.852	1.307	1.691	1.805	1.946	2.032	2.136	2.441	2.728	3.601
35	0.852	1.306	1.690	1.803	1.944	2.030	2.133	2.438	2.724	3.591
36	0.852	1.306	1.688	1.802	1.942	2.028	2.131	2.434	2.719	3.582
37	0.851	1.305	1.687	1.800	1.940	2.026	2.129	2.431	2.715	3.574
38	0.851	1.304	1.686	1.799	1.939	2.024	2.127	2.429	2.712	3.566
39	0.851	1.304	1.685	1.798	1.937	2.023	2.125	2.426	2.708	3.558
40	0.851	1.303	1.684	1.796	1.936	2.021	2.123	2.423	2.704	3.551
41	0.850	1.303	1.683	1.795	1.934	2.020	2.121	2.421	2.701	3.544
42	0.850	1.302	1.682	1.794	1.933	2.018	2.120	2.418	2.698	3.538
43	0.850	1.302	1.681	1.793	1.932	2.017	2.118	2.416	2.695	3.532
44	0.850	1.301	1.680	1.792	1.931	2.015	2.116	2.414	2.692	3.526
45	0.850	1.301	1.679	1.791	1.929	2.014	2.115	2.412	2.690	3.520
46	0.850	1.300	1.679	1.790	1.928	2.013	2.114	2.410	2.687	3.515
47	0.849	1.300	1.678	1.789	1.927	2.012	2.112	2.408	2.685	3.510
48	0.849	1.299	1.677	1.789	1.926	2.011	2.111	2.407	2.682	3.505
49	0.849	1.299	1.677	1.788	1.925	2.010	2.110	2.405	2.680	3.500
50	0.849	1.299	1.676	1.787	1.924	2.009	2.109	2.403	2.678	3.496
60	0.848	1.296	1.671	1.781	1.917	2.000	2.099	2.390	2.660	3.460
70	0.847	1.294	1.667	1.776	1.912	1.994	2.093	2.381	2.648	3.435
80	0.846	1.292	1.664	1.773	1.908	1.990	2.088	2.374	2.639	3.416
90	0.846	1.291	1.662	1.771	1.905	1.987	2.084	2.368	2.632	3.402
100	0.845	1.290	1.660	1.769	1.902	1.984	2.081	2.364	2.626	3.390
120	0.845	1.289	1.658	1.766	1.899	1.980	2.076	2.358	2.617	3.373
140	0.844	1.288	1.656	1.763	1.896	1.977	2.073	2.353	2.611	3.361
180	0.844	1.286	1.653	1.761	1.893	1.973	2.069	2.347	2.603	3.345
200	0.843	1.286	1.653	1.760	1.892	1.972	2.067	2.345	2.601	3.340
500	0.842	1.283	1.648	1.754	1.885	1.965	2.059	2.334	2.586	3.310
1000	0.842	1.282	1.646	1.752	1.883	1.962	2.056	2.330	2.581	3.300
∞	0.842	1.282	1.645	1.751	1.881	1.960	2.054	2.326	2.576	3.291
	60%	80%	90%	92%	94%	95%	96%	98%	99%	99.9%
	Confidence Level									

Note: $t(\infty)_{\alpha/2} = Z_{\alpha/2}$ in our notation.