VPM's
DR VN BRIMS, Thane
Programme: MMS (2023-25)
First Semester Regular Examination December 2023

Course Name:	Business Statistics	**Course Code**	C103
Roll No.		**Marks**	60
Total No. of Questions	6	**Duration**	3 Hours
Total No. of printed pages	4	**Date**	25-12-2023

Course Outcome Statements:

CO1. DEFINE the basic terminologies related to the concepts taught through the syllabus of Business Statistics
CO2. EXPLAIN the concepts related to Data Representation, Central Tendency, Dispersion, Skewness, kurtosis, Probability, Probability Distribution, Sampling Distribution, Estimation, Hypothesis, and the various Statistical Tests.
CO3. MAKE USE OF data to calculate the value of various statistical measures to solve a business problem
CO4. EXAMINE the value of statistical findings to analyse the various business problem
CO5. PRAISE the results of statistical tests for taking a business decision.

Instructions: - For solving Qn1 a, Q2 a and Q2 b refer the tables attached with the question paper.

Q. No 1 (All Questions are Compulsory)

Q. No.		Questions	Marks	BL	CO
Q. 1		Case/Case-let Study (500-800 words)			
	a.	In Research facility, a team of diligent scientists embarked on an intriguing experiment to unravel the mysteries of tomato growth. They sought to ascertain whether there existed any significant disparity in the growth rates of three distinct tomato varieties: Variety A, Variety B, and Variety C. Five separate greenhouses were meticulously set up, each designated for the cultivation of these tomatoes under controlled conditions. As the experiment unfolded, meticulous records were maintained, documenting the growth progression of each tomato variety in their respective greenhouses. The data, represented in the table, revealed the height measurements of the tomato plants at five different time points. The researchers claim that there is no statistically significant difference in the growth rates of these tomato varieties in the given greenhouses. PLOTS / Variety A / Variety B / Variety C 1 / 5 / 5 / 3 2 / 6 / 4 / 2 3 / 2 / 2 / 6 4 / 4 / 4 / 5 5 / 2 / 5 / 4 **Analyse** the data given in the table and verify the claim at 5 % Significance level	**6**	**Level 4**	**CO4**
	b.	**Compare** the growth rates of three distinct tomato varieties (Variety A, Variety B, and Variety C) based on their mean and standard deviation of height measurements.	**6**	**Level 5**	**CO5**
Q. 2		Answer **Any one** from the following.			
	a.	A group of friends gathered together to engage in a game of chance. They rolled a die 174 times, noting each outcome:	**6**	**Level 5**	**CO5**

		<table><tr><th>Face Value</th><th>Occurrence</th></tr><tr><td>1</td><td>28</td></tr><tr><td>2</td><td>32</td></tr><tr><td>3</td><td>28</td></tr><tr><td>4</td><td>32</td></tr><tr><td>5</td><td>28</td></tr><tr><td>6</td><td>26</td></tr></table> Rumours swirled that the die favoured certain numbers, prompting a claim of bias. **Decide** whether this claim is true at 5 % significance level.			
	b.	A random sample of 27 girls gave a mean weight of 60 kilograms with a standard deviation of 4 kgs. Test the hypothesis that mean weight of the population is 55 kgs. **Decide** whether this claim is true a 0.05 level of significance	**6**	**Level 5**	**CO5**
Q. 3		Answer **Any one** from the following.			
	a.	Sales and adverting cost of the retail company is given in the below table. **Analyse** the relationship between the online advertising expenditure (X) and the number of smartphones sold (Y) using correlation. <table><tr><td>X</td><td>Y</td></tr><tr><td>100</td><td>185</td></tr><tr><td>120</td><td>195</td></tr><tr><td>125</td><td>170</td></tr><tr><td>130</td><td>140</td></tr><tr><td>120</td><td>165</td></tr><tr><td>160</td><td>170</td></tr></table>	**6**	**Level 4**	**CO4**
	b	Two analysts Sarah and David examined the diameters of ten ball bearings from different manufacturing batches. Sarah measured Batch A's ball bearings (21, 22, 21, 21, 27, 27, 28, 22, 22, and 24 units), while David observed Batch B's (24, 28, 29, 22, 23, 23, 28, 28, 27, and 28 units). **Examine** the given data using variance.	**6**	**Level 4**	**CO4**
Q. 4		Answer **Any two** from the following.			
	a.	A company produces various models of smartphones. Over the last seven years, the company invested in different advertising channels. The table below displays the amount of online advertising expenditure (X, in dollars) and the number of smartphones sold (Y) during each year. **Develop** the regression equation of Y on X. <table><tr><td>X</td><td>Y</td></tr><tr><td>90</td><td>105</td></tr><tr><td>85</td><td>120</td></tr><tr><td>85</td><td>130</td></tr><tr><td>75</td><td>150</td></tr><tr><td>70</td><td>115</td></tr></table>	**6**	**Level 3**	**CO3**
	b	Fair coin is tossed 6 times. **Apply** probability concept to determine the probability of obtaining a minimum of 4 heads	**6**	**Level 3**	**CO3**

	c.	A detergent Company has launched a new advertisement on TV. The company estimates that a person who comes across the advertisement will buy a product with the probability of 0.55 and those who do not see advertisement will buy a product with the probability of 0.2. The ad agency estimates that 60% of the target population will see the advertisement. If a person taken at random has purchased the product, **Solve for** the probability that he has seen the advertisement?	**6**	**Level 3**	**CO3**
Q. 5		Answer **Any two** from the following.			
	a.	**Explain** with the help of suitable example concept of mean median and mode.	**6**	**Level 2**	**CO2**
	b	**Illustrate** any one type of probability distribution.	**6**	**Level 2**	**CO2**
	c.	**Explain** conditions applicable for binomial distribution.	**6**	**Level 2**	**CO2**
Q. 6		Answer **Any two** from the following.			
	a.	**List** business applications of statistics**.**	**6**	**Level 1**	**CO1**
	b	**What** is type I and Type II errors.	**6**	**Level 1**	**CO1**
	c.	**Define** hypothesis testing.	**6**	**Level 1**	**CO1**

F-table of Critical Values of α = 0.05 for F(df1, df2)

	DF1=1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
DF2=1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.95	248.01	249.05	250.10	251.14	252.20	253.25	254.31
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25

t Distribution						
	α					
Degrees of freedom	.005 (one tail) .01 (two tails)	.01 (one tail) .02 (two tails)	.025 (one tail) .05 (two tails)	.05 (one tail) .10 (two tails)	.10 (one tail) .20 (two tails)	.25 (one tail) .50 (two tails)
1	63.657	31.821	12.706	6.314	3.078	1.000
2	9.925	6.965	4.303	2.920	1.886	.816
3	5.841	4.541	3.182	2.353	1.638	.765
4	4.604	3.747	2.776	2.132	1.533	.741
5	4.032	3.365	2.571	2.015	1.476	.727
6	3.707	3.143	2.447	1.943	1.440	.718
7	3.500	2.998	2.365	1.895	1.415	.711
8	3.355	2.896	2.306	1.860	1.397	.706
9	3.250	2.821	2.262	1.833	1.383	.703
10	3.169	2.764	2.228	1.812	1.372	.700
11	3.106	2.718	2.201	1.796	1.363	.697
12	3.054	2.681	2.179	1.782	1.356	.696
13	3.012	2.650	2.160	1.771	1.350	.694
14	2.977	2.625	2.145	1.761	1.345	.692
15	2.947	2.602	2.132	1.753	1.341	.691
16	2.921	2.584	2.120	1.746	1.337	.690
17	2.898	2.567	2.110	1.740	1.333	.689
18	2.878	2.552	2.101	1.734	1.330	.688
19	2.861	2.540	2.093	1.729	1.328	.688
20	2.845	2.528	2.086	1.725	1.325	.687
21	2.831	2.518	2.080	1.721	1.323	.686
22	2.819	2.508	2.074	1.717	1.321	.686
23	2.807	2.500	2.069	1.714	1.320	.685
24	2.797	2.492	2.064	1.711	1.318	.685
25	2.787	2.485	2.060	1.708	1.316	.684
26	2.779	2.479	2.056	1.706	1.315	.684
27	2.771	2.473	2.052	1.703	1.314	.684
28	2.763	2.467	2.048	1.701	1.313	.683
29	2.756	2.462	2.045	1.699	1.311	.683
Large (z)	2.575	2.327	1.960	1.645	1.282	.675

Critical values of the Chi-square distribution with *d* degrees of freedom

	Probability of exceeding the critical value						
d	0.05	0.01	0.001	*d*	0.05	0.01	0.001
1	3.841	6.635	10.828	11	19.675	24.725	31.264
2	5.991	9.210	13.816	12	21.026	26.217	32.910
3	7.815	11.345	16.266	13	22.362	27.688	34.528
4	9.488	13.277	18.467	14	23.685	29.141	36.123
5	11.070	15.086	20.515	15	24.996	30.578	37.697
6	12.592	16.812	22.458	16	26.296	32.000	39.252
7	14.067	18.475	24.322	17	27.587	33.409	40.790
8	15.507	20.090	26.125	18	28.869	34.805	42.312
9	16.919	21.666	27.877	19	30.144	36.191	43.820
10	18.307	23.209	29.588	20	31.410	37.566	45.315

***INTRODUCTION TO POPULATION GENETICS*, Table D.1**