RV UNIVERSITY Go, change the world an initiative of RV EDUCATIONAL INSTITUTIONS	USN School of Computer Science and Engineering B.Tech (Hons.) CP-3 Question Paper (Set A) Academic Year 2024-2025		
Course: Probability, Statistics and Numerical Methods		**Course Code: CS2801**	**Semester: III**
Time: 9:45 AM - 11:00 AM	**Duration: 75 minutes**	**Date : 05 November, 2024**	**Max Marks: 15**

Notes/ Instructions:

a) **Answer all the questions.**
b) **This paper contains 4 questions.**
c) **Any use of laptops, phones or smartwatches and unfair means will be considered as malpractice and results in ZERO marks.**
d) **You may use calculators if required.**

Sl. No.	Questions	Marks	L1-L6	CO
1.	The theory predicts the proportion of beans in the four groups A, B, C and D should be 9 : 3 : 3 : 1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287, and 118. Does the experimental result support the theory? (Use Chi-square goodness of fit with 90% confidence)	**4**	**L4**	**CO4**
2.	A poll sampled 300 voters from District A and 200 voters from District B, revealing that 56% of voters in District A and 48% in District B favor a particular candidate. Using a 0.05 level of significance, test the hypothesis that the candidate is preferred in District A.	**4**	**L3**	**CO4**
3.	A survey was conducted to determine the effectiveness of two different study programs. Out of 120 students in Program A, 90 passed the final exam. In Program B, 105 out of 150 students passed. a. Using the p-value method, check whether the following is a significant difference in the pass rates between the two programs at a 0.03 significance level? b. Find the interval where most of the effectiveness of the two programs lie.	**3+1**	**L4**	**CO4**

L1- Remember, L2- Understand, L3 – Apply, L4- Analyse, L5 – Evaluate, L6 – Create

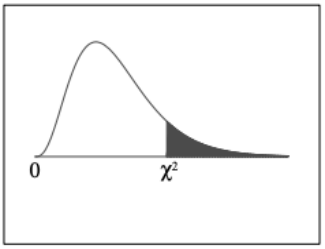
4.	A pharmaceutical company wants to determine if Drug A is less effective than Drug B in lowering blood pressure. A sample of 60 patients taking Drug A showed an average blood pressure reduction of 8 mmHg with a standard deviation of 1.5 mmHg. In contrast, a sample of 70 patients taking Drug B showed an average reduction of 7.5 mmHg with a standard deviation of 2 mmHg. Test this hypothesis at a 7% level of significance.	**3**	**L3**	**CO4**

Course Outcomes

Perform hypothesis testing using methods like critical value, p-value and chi-square tests for goodness of fit and independence of attributes.

Marks Distribution									
L1	L2	L3	L4	L5	L6	CO1	CO2	CO3	CO4
-	-	7	8	-	-	-	-	-	15

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900

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School of Computer Science and Engineering

B.Tech (Hons.)

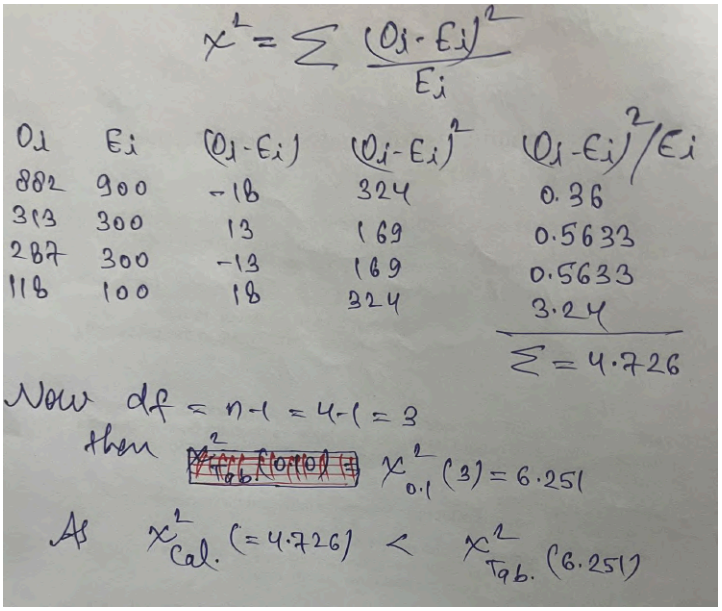
CP-3 Answer Scheme (Set A)

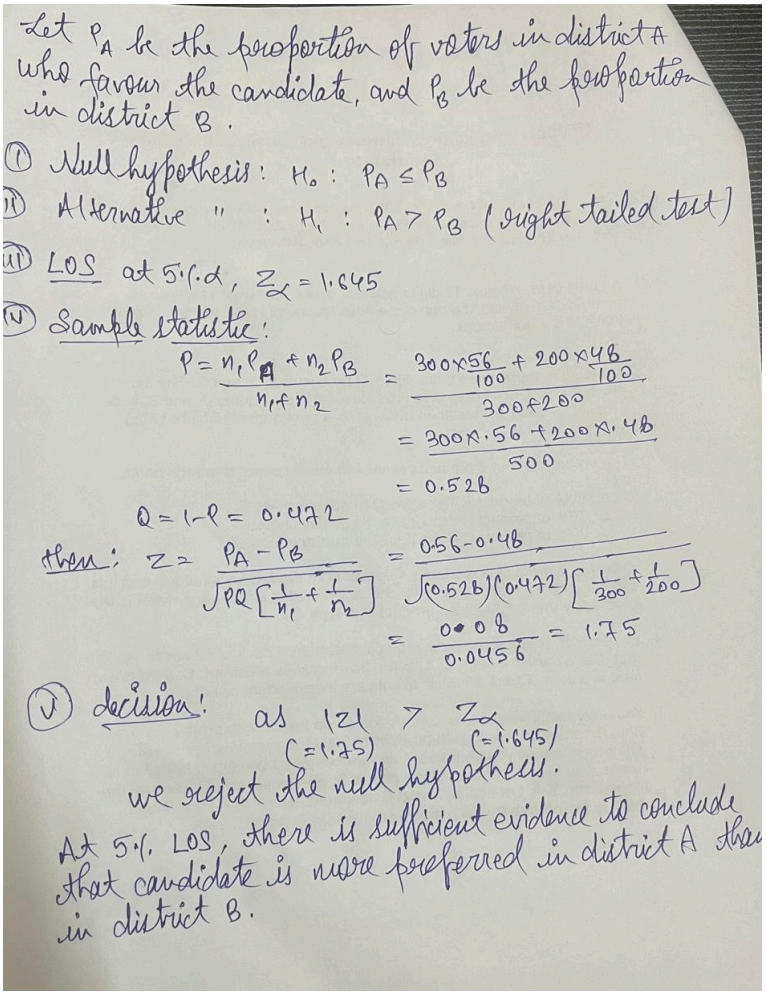
Academic Year 2024-2025

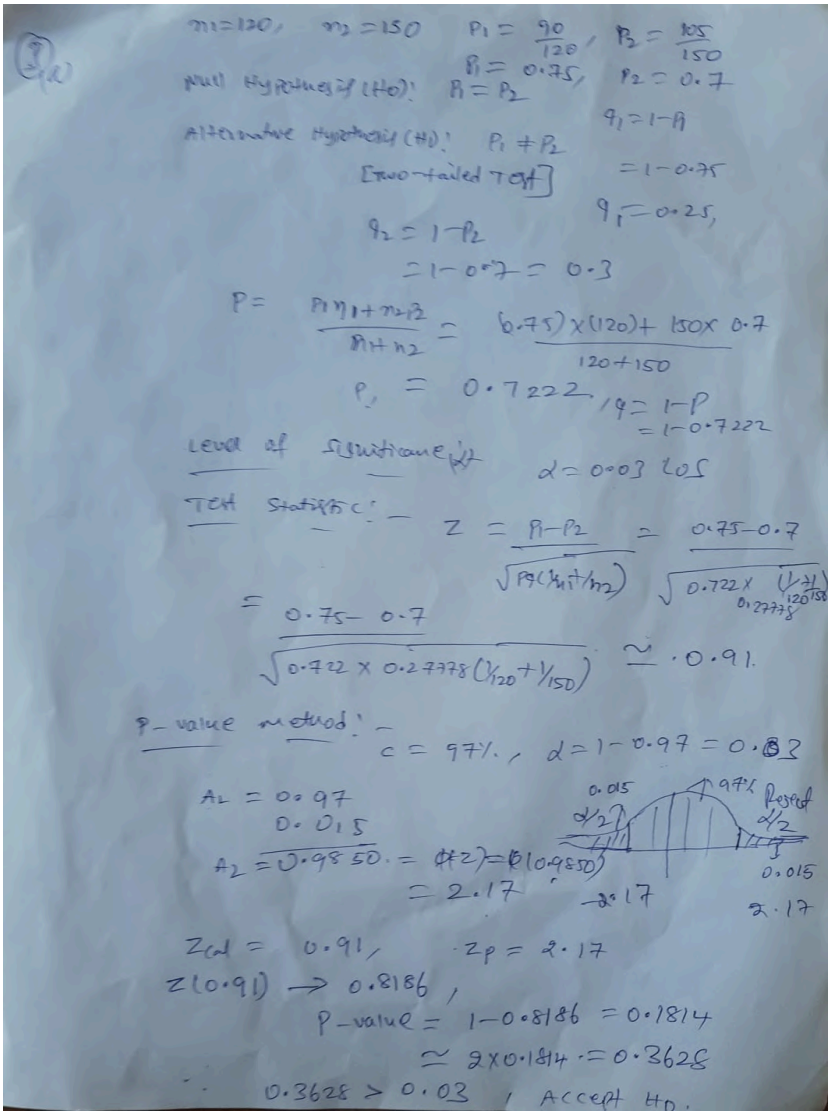
Course: PSN	**Course Code: CS2801**	**Semester: III**
Time: 75 Minutes	**Max Marks: 15**	**Date : 05/11/2024**

Notes/ Instructions:

a) **Answer all the questions.**
b) **Any use of laptops, phones or smartwatches and unfair means will be considered as malpractice and results in ZERO marks.**

Sl. No.	Answers and Mark distribution	Marks	L1-L6	CO
1.	**Null Hypothesis** : The theory fits well into the experiment. i.e. the experimental results support the theory. **Alternative Hypothesis**: The theory does not fit well into the experiment. Under the null hypothesis, the expected (theoretical) frequencies can be computed as follows: Total number of beans = 880 + 315 + 285 + 120 = 1600 These are to be divided in the ratio 9 : 3 : 3 : 1 $E(882) = (9/16) * 1600 = 900$ $E(313) = (3/16) * 1600 = 300$ $E(287) = (3/16) * 1600 = 300$ $E(118) = (1/16) * 1600 = 100$  Hence the null hypothesis may be accepted at 10% level of	1 2.5 0.5		CO1

	significance and we may conclude that there is good correspondence between theory and experiment.			
2.		**1** **2.5** **0.5**		
3.	**Null hypothesis (H_0)**: There is no significant difference in the pass rates between Program A and Program B i.e $p_A = p_B$ **Alternative hypothesis (H_1)**: There is a significant difference in the pass rates between Program A and Program B,i.e., $p_A \neq p_B$. (Two tailed test)	**1**		



$n_1 = 120$, $n_2 = 150$ $P_1 = \frac{90}{120}$, $P_2 = \frac{105}{150}$

$P_1 = 0.75$, $P_2 = 0.7$

Null Hypothesis (Ho): $P_1 = P_2$

Alternative Hypothesis (H1): $P_1 \neq P_2$

[Two-tailed Test]

$q_1 = 1 - P_1$

$= 1 - 0.75$

$q_1 = 0.25$,

$q_2 = 1 - P_2$

$= 1 - 0.7 = 0.3$

$P = \frac{P_1 n_1 + n_2 P_2}{P_1 + n_2} = \frac{0.75 \times 120 + 150 \times 0.7}{120 + 150}$

$P = 0.7222$, $q = 1 - P$

$= 1 - 0.7222$

Level of significance: $\alpha = 0.03$ LOS

Test Statistic:-

$Z = \frac{P_1 - P_2}{\sqrt{pq(1/n_1 + 1/n_2)}} = \frac{0.75 - 0.7}{\sqrt{0.722 \times \left(\frac{1}{120} + \frac{1}{150}\right)}}$

0.27778

$= \frac{0.75 - 0.7}{\sqrt{0.722 \times 0.27778 (1/120 + 1/150)}} \simeq 0.91.$

P-value method:-

$c = 97\%$, $\alpha = 1 - 0.97 = 0.03$

$A_2 = 0.97$

0.015

$A_2 = 0.9850 = \phi(z) = \phi(0.9850)$

$= 2.17$

$Z_{cal} = 0.91$, $Z_p = 2.17$

$z(0.91) \rightarrow 0.8186$,

P-value $= 1 - 0.8186 = 0.1814$

$\simeq 2 \times 0.1814 = 0.3628$

$0.3628 > 0.03$, Accept H_0.

2

There is a significant d/w two programs in terms of pass rate.

(3) (b)

The confidence limits to true proportion is $P_1 - P_2 \pm Z_\alpha \sqrt{pq(\frac{1}{n_1} + 1/n_2)}$.

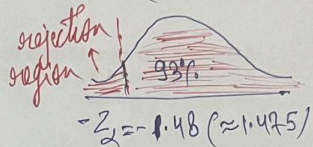
$Z_\alpha = 2.17$ (from z-table 3% LOS)

$(0.75 - 0.7 \pm 2.17 \sqrt{0.7222 \times 0.27778 (\frac{1}{120} + 1/150)})$

$(-0.068, 0.168)$

The true difference in pass rates between two programs is likely to 6.8% to 16.8%.

1

4.	Let μ_A represents the true mean reduction in blood pressure for patients taking drug A, and μ_B represent the true mean reduction for those taking Drug B. (i) Null hypothesis : $H_0 : \mu_A \geq \mu_B$ (ii) Alternative " : $H_1 : \mu_A < \mu_B$ (left tailed) (iii) LOS: $\alpha = 7\%$. then $z_\alpha = -1.475$  $-z_\alpha = -1.48 \ (\approx 1.475)$ (iv) Sample statistic :- $z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} = \frac{\frac{8}{60} - \frac{7.5}{70}}{\sqrt{\frac{(1.5)^2}{60} + \frac{(2)^2}{70}}} = \frac{0.133 - 0.10}{\sqrt{0.0375 + 0.05}{71}}$ $= \frac{0.033}{0.3076} = 0.1072$ (v) decision :- as value of z lies in acceptance region; we accept H_0. Thus at 7% LOS, there is not enough evidence to conclude that drug A is less effective than drug B.	1 1 1		

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School of Computer Science and Engineering

B.Tech (Hons.)

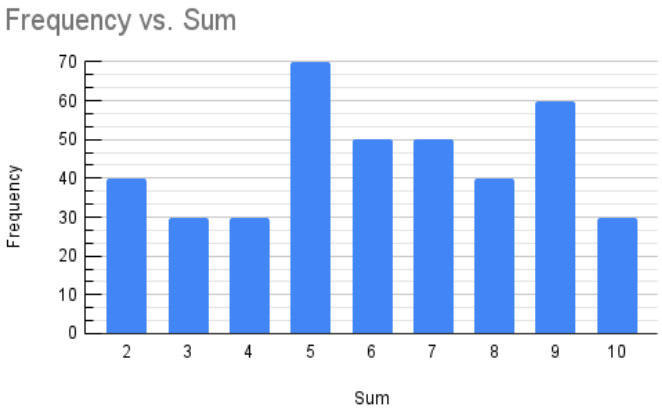
CP-3 Question Paper (Set B)

Academic Year 2024-2025

Course: Probability, Statistics and Numerical Methods		Course Code: CS2801	Semester: III
Time: 9:45 AM - 11:00 AM	Duration: 75 minutes	Date : 05 November, 2024	Max Marks: 15

Notes/ Instructions:

a) **Answer all the questions.**
b) **This paper contains 4 questions.**
c) **Any use of laptops, phones or smartwatches and unfair means will be considered as malpractice and results in ZERO marks.**
d) **You may use calculators if required.**

Sl. No.	Questions	Marks	L1-L6	CO
1.	A student performs an experiment using a pair of 5 sided dice to check if the dice are unbiased. She rolls the dice 400 times, recording the frequency of each possible sum and plotting the results. She is then told to submit her conclusion for the goodness of fit of the data obtained with a 95% confidence. What will be her conclusion? 	4	L4	CO4
2.	A survey of 250 employees from Company X and 180 employees from Company Y showed that 62% of employees at Company X and 55% at Company Y are in favor of adopting a remote work policy. At a 0.05 level of significance, test the hypothesis that Company X employees are more likely to support the remote work policy.	4	L3	CO4

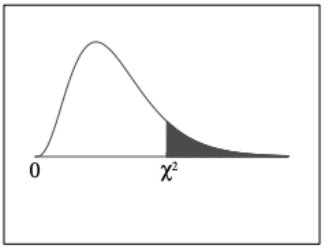
3.	A random sample of 10 students had the following IQ, 70, 120, 110, 101, 88, 83, 95, 98, 107 and 100, with a sample standard deviation of 14.27. a. Using the p-value method, check whether the following data supports the assumption made with 3% significance that the population mean is 100. b. Find the interval where most of the IQ values lie.	**3+1**	**L4**	**CO4**
4.	At Hogwarts, it is believed that Gryffindor students spend less time on Quidditch than Slytherin students. To investigate this hypothesis, Professor Dumbledore randomly selects 200 students: 125 from Gryffindor and 75 from Slytherin. The sample mean time spent per week on Quidditch is 400 minutes for Gryffindor students, with a standard deviation of 100 minutes, and 450 minutes for Slytherin students, with a standard deviation of 150 minutes. Test this hypothesis using a 6% level of significance.	**3**	**L3**	**CO4**

Course Outcomes

Perform hypothesis testing using methods like critical value, p-value and chi-square tests for goodness of fit and independence of attributes.

Marks Distribution									
L1	L2	L3	L4	L5	L6	CO1	CO2	CO3	CO4
-	-	7	8	-	-	-	-	-	15

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
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16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900

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School of Computer Science and Engineering

B.Tech (Hons.)

CP-3 Answer Scheme (Set B)

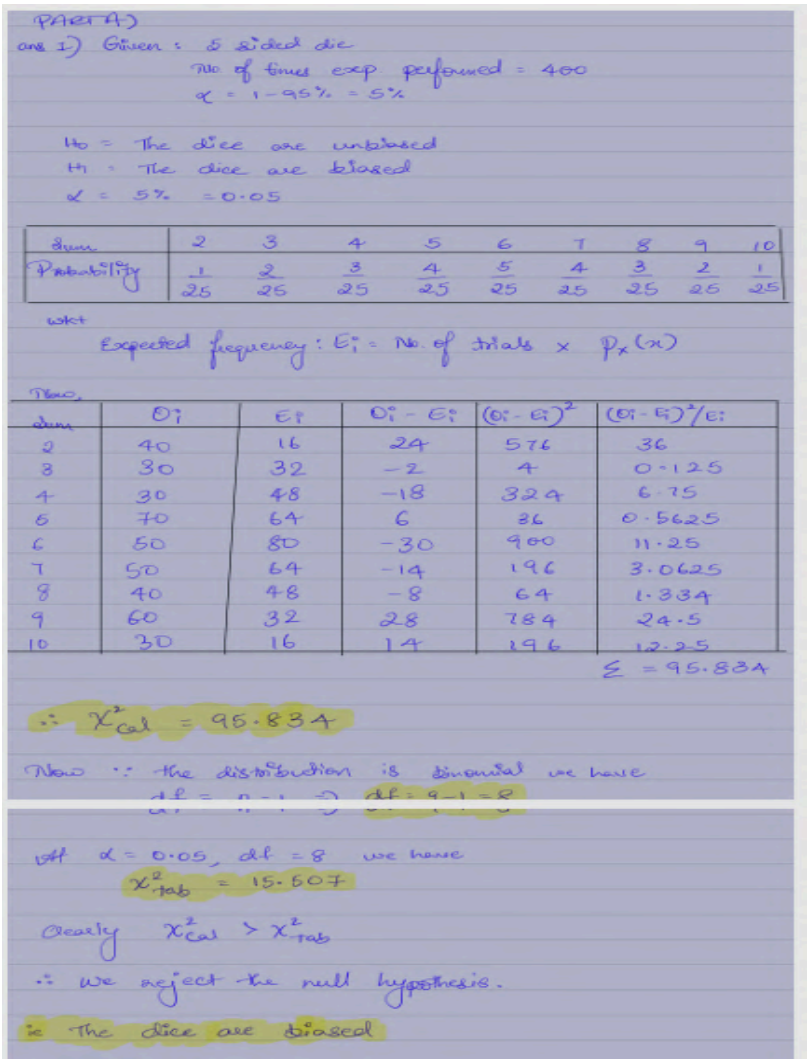
Academic Year 2024-2025

Course: PSN	**Course Code: CS2801**	**Semester: III**
Time: 75 Minutes	**Max Marks: 15**	**Date : 05/11/2024**

Notes/ Instructions:

a) **Answer all the questions.**

b) **Any use of laptops, phones or smartwatches and unfair means will be considered as malpractice and results in ZERO marks.**

Sl. No.	Answers and Mark distribution	Marks	L1-L6	CO
1.		1 2.5 0.5		CO1

PART A)

ans 1) Given : 5 sided die

No of times exp performed = 400

$\alpha = 1 - 95\% = 5\%$

H_0 = The dice are unbiased

H_1 = The dice are biased

$\alpha = 5\% = 0.05$

Sum	2	3	4	5	6	7	8	9	10
Probability	1/25	2/25	3/25	4/25	5/25	4/25	3/25	2/25	1/25

wkt

Expected frequency : E_i = No. of trials × $P_x(x)$

Now,

Sum	O_i	E_i	$O_i - E_i$	$(O_i - E_i)^2$	$(O_i - E_i)^2/E_i$
2	40	16	24	576	36
3	30	32	−2	4	0.125
4	30	48	−18	324	6.75
5	70	64	6	36	0.5625
6	50	80	−30	900	11.25
7	50	64	−14	196	3.0625
8	40	48	−8	64	1.334
9	60	32	28	784	24.5
10	30	16	14	196	12.25

$\Sigma = 95.834$

$\therefore \chi^2_{cal} = 95.834$

Now ∵ the distribution is binomial we have

$df = n - 1 \Rightarrow df = 9 - 1 = 8$

Wkt $\alpha = 0.05$, $df = 8$ we have

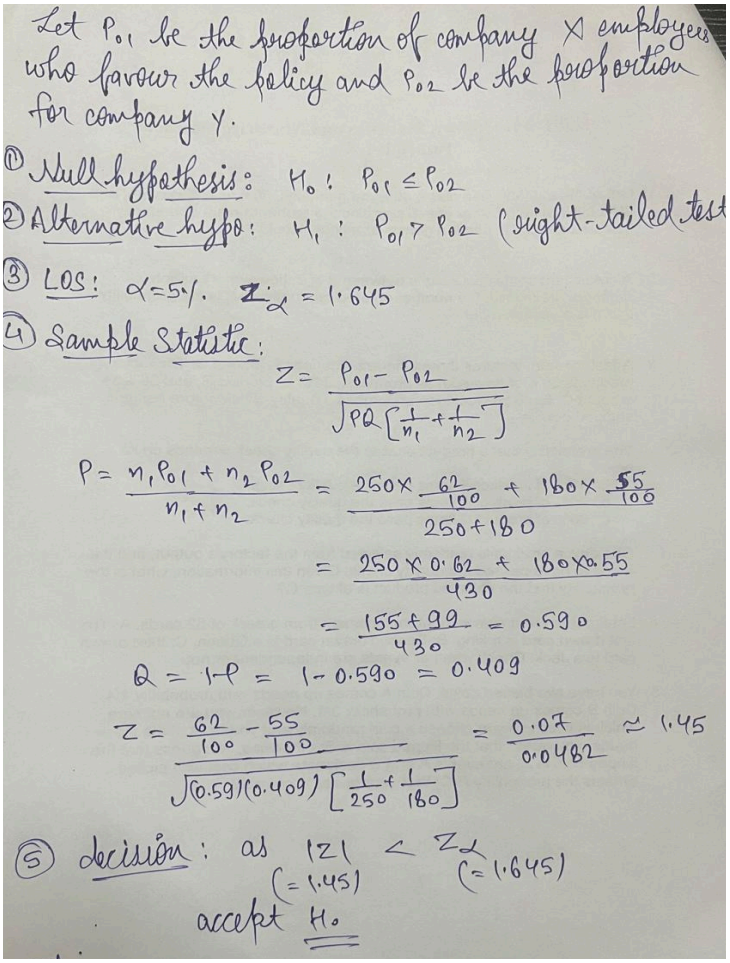
$\chi^2_{tab} = 15.507$

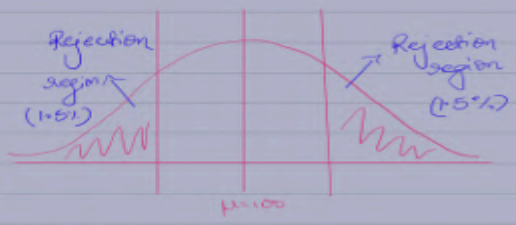
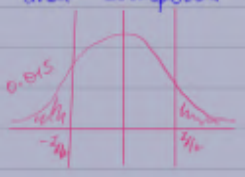
Clearly $\chi^2_{cal} > \chi^2_{tab}$

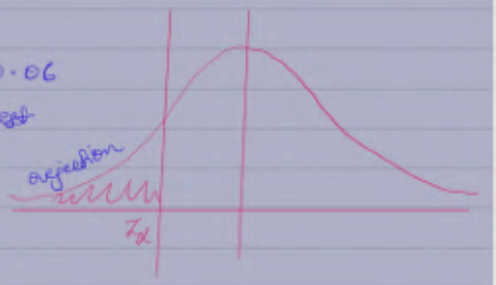
∴ We reject the null hypothesis.

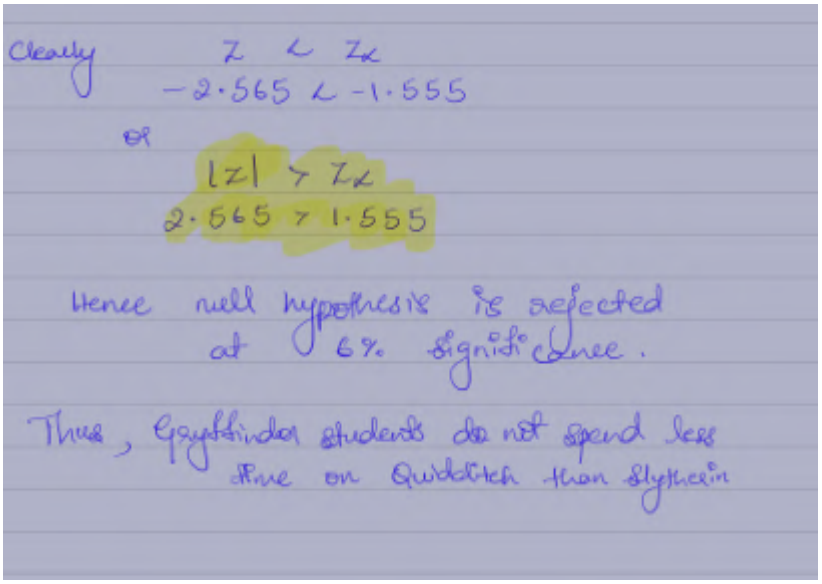
ie The dice are biased

L1- Remember, L2- Understand, L3 – Apply, L4- Analyse, L5 – Evaluate, L6 – Create

2.	 Let P_{01} be the proportion of company X employees who favour the policy and P_{02} be the proportion for company Y. ① Null hypothesis: $H_0: P_{01} \leq P_{02}$ ② Alternative hypo: $H_1: P_{01} > P_{02}$ (right-tailed test) ③ LOS: $\alpha = 5\%$. $z_\alpha = 1.645$ ④ Sample Statistic: $Z = \frac{P_{01} - P_{02}}{\sqrt{PQ\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$ $P = \frac{n_1 P_{01} + n_2 P_{02}}{n_1 + n_2} = \frac{250 \times \frac{62}{100} + 180 \times \frac{55}{100}}{250 + 180}$ $= \frac{250 \times 0.62 + 180 \times 0.55}{430}$ $= \frac{155 + 99}{430} = 0.590$ $Q = 1 - P = 1 - 0.590 = 0.409$ $Z = \frac{\frac{62}{100} - \frac{55}{100}}{\sqrt{(0.591)(0.409)\left[\frac{1}{250} + \frac{1}{180}\right]}} = \frac{0.07}{0.0482} \simeq 1.45$ ⑤ decision: as $\lvert z \rvert < z_\alpha$ ($1.45 < 1.645$) accept H_0 This suggests that there is insufficient evidence to conclude that Company X employees are significantly more likely than Company Y employees to support the remote work policy at the 5% significance level.	**1** **2.5** **0.5**		

3.	3 (a) Given :- $\mu = 100$, $\alpha = 3\%$, $s = 14.27$ Soln: $\bar{x} = \frac{70+120+110+101+88+83+95+98+107+100}{10}$ $\bar{x} = 97.2$ $H_0 \rightarrow \mu = 100$ $H_1 \rightarrow \mu \neq 100$ Case 2 Two tail test  Test statistic is given by: $\frac{\bar{x}-\mu}{s/\sqrt{n}} = Z$ $\Rightarrow \frac{97.2-100}{\frac{14.27}{\sqrt{10}}} \simeq -0.6205 = Z$	1		
	Now $\phi(-0.6205) = 1 - \phi(0.6205)$ $\simeq 1 - 0.7857$ $\phi(-0.6205) = 0.2643$ = Left Rejection Area $\therefore$ p-value $= 2 \times \phi(-0.6205)$ $= 2 \times 0.2643$ p-value $= 0.5286$ Clearly, p-value $>$ α i.e $0.5286 > 0.03$ $\therefore$ We accept the null hypothesis. Thus the population mean can be considered as 100 at 3% level of significance.	2		
	3 (b) The interval where most values lie is the confidence interval that corresponds to $\alpha = 0.03$  $\phi(z_{\alpha/2}) = 1 - 0.015$ $\phi(z_{\alpha/2}) = 0.9850$ $\therefore z_{\alpha/2} = 2.17$ Thus the confidence intervals are $\left(\bar{x} - z_{\alpha/2} \cdot \frac{s}{\sqrt{n}}, \bar{x} + z_{\alpha/2} \cdot \frac{s}{\sqrt{n}}\right)$ $= 97.2 - \left[(2.17) \cdot \frac{14.27}{\sqrt{10}}\right], 97.2 + \left[(2.17) \cdot \frac{14.27}{\sqrt{10}}\right]$ $= (97.2 - 9.792, 97.2 + 9.792)$ $= (87.408, 106.992)$	1		

4.	Ans 4) Given: Total no. of students = $n = 200$ Gryffindor students = $n_1 = 125$ Slytherin students = $n_2 = 75$ $\bar{x}_1 = 400$ min $\quad s_1 = 100$ mins $\bar{x}_2 = 450$ min $\quad s_2 = 150$ mins $\alpha = 6\%$ Solution: $H_0 : \mu_1 < \mu_2$ [Gryffindor students spend less time than Slytherin students] $H_1 : \mu_1 \geq \mu_2$ $\alpha = 6\% = 0.06$ Case: Left tail test  Test statistic $= Z = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ $\Rightarrow Z = \dfrac{400 - 450}{\sqrt{\frac{100^2}{125} + \frac{150^2}{75}}} \Rightarrow Z = \dfrac{-50}{\sqrt{80 + 300}}$	**1**		
	$\Rightarrow Z = \dfrac{-50}{\sqrt{380}} \approx Z = \dfrac{-50}{19.493}$ $\Rightarrow Z = -2.565$ OR $\alpha = 6\%$ we have $\phi(Z_\alpha) = 6\% = 0.06$ Now $1 - 0.06 = 0.94$ $\Rightarrow \phi(Z_{\alpha_1}) = 0.94$ $Z_{\alpha_1} = 1.555$ [$\because$ 0.94 lies exactly blw 1.55 & 1.56] Thus $Z_\alpha = -1.555$	**1**		

	 Clearly $Z < Z_\alpha$ $-2.565 < -1.555$ or $\|z\| > Z_\alpha$ $2.565 > 1.555$ Hence null hypothesis is rejected at 6% significance. Thus, Gryffindor students do not spend less time on Quidditch than Slytherin			