THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF BASIC SCIENCES
ACADEMIC YEAR 2020/2021 – SEMESTER 02

BACHELOR OF PHARMACY HONOURS
BACHELOR OF MEDICAL LABORATORY SCIENCES HONOURS
BSU5230 – APPLIED STATISTICS - LEVEL 5
FINAL EXAMINATION
DURATION: 2 HOURS

DATE: 30th SEPTEMBER 2022 TIME: 2.00 PM – 4.00 PM

INDEX NO: .....

IMPORTANT INSTRUCTIONS/ INFORMATIONS TO CANDIDATES

- This question paper consists of **08 pages** with **04 Essay Questions.**
- Write your **Index Number** in the space provided.
- Answer **ALL** questions.
- **All the questions should be answered in the booklet provided.**
- Necessary formulae/tables are given in the pages 5-8.
- Mobile phones and any other electronic equipment are **NOT** allowed.
- **Non-programmable calculators are allowed to use.**

Essay Questions
(100 Marks)

1.

a)

i) A researcher collected data on the following variables from a sample of 100 men and 100 women who attended a medical clinic in a hospital.

Name of the patient, Family size, age (in years), Blood Glucose Level (mg/dL), Type of disease, HDL level (mg/dL) Heart Rate (beats per minute), Total cholesterol (mg/dL) and obese or not.

From the above mentioned variables

List two nominal variables.
List two dichotomous variables.
List two discrete variables.
List two continuous variables. **(8 marks)**

ii) List four graphical methods used in descriptive statistics. **(2 marks)**

iii) List four numerical methods used in descriptive statistics. **(2 marks)**

b) The number of episodes of relapses in a group of patients with depression are given below.

4, 8, 5, 2, 5, 5, 7, 2, 8 4, 6, 6, 5, 3, 5

i) Calculate the mean and mode of the above data set. **(2 marks)**

ii) Calculate the Standard Deviation of the above data set. **(4 marks)**

iii) Calculate the Standard error (SE) of the above data set. **(2 marks)**

iv) Calculate a 95% confidence interval for the mean number of relapses in the target population. **(5 marks)**

2.

a)

i) List 4 characteristics of the standard normal curve. **(2 marks)**

ii) What is the relationship among mean, median and mode in a positively skewed distribution **(2 marks)**

iii) What is the relationship among mean, median and mode in a negatively skewed distribution **(2 marks)**

b) A pharmacist is interested in checking whether perindopril is more effective than ramipril in reducing systolic blood pressure (SBP). He observed that in a sample of 100 hypertensive patients who were given 4 mg of perindopril, mean and SD of SBP reduction was 30mmHg and 10mm Hg respectively. In a sample of 100 hypertensive patients who were given 4 mg of ramipril, mean and SD of SBP reduction was 20mmHg and 10mmHg respectively.

i) State null and alternative hypothesis for this test **(4 marks)**
ii) Write down the test statistic. **(4 marks)**
iii) Test the null hypothesis at 5% level. **(8 marks)**
iv) What is the conclusion? **(3 marks)**

3. A Medical Laboratory Scientist in Anuradapura is interested in identifying whether there is an association between Chronic Kidney Disease (CKD) and drinking water. The status of CKD and drinking water source of a group of 300 randomly selected people in Anuradapura were as follows.

	Pipe water	**Well water**
CKD positive	40	40
CKD negative	60	160

i) State the null and alternative hypotheses. **(4 marks)**

ii) Prepare a 2x2 contingency table for the above data, with row and column totals. **(4 marks)**

iii) Calculate the expected frequencies for each of the observed frequencies. **(6 marks)**

iv) Calculate the test statistic. **(4 marks)**

v) Test the null hypothesis at 5% significance level and clearly state your findings, in relation to this study. **(7 marks)**

4.

(a) i) List 2 differences of parametric and non-parametric tests. **(2 marks)**

ii) List 2 differences of probability and non-probability sampling methods. **(2 marks)**

iii) What is type I error in hypothesis testing? **(2 marks)**

iv) What is type II error in hypothesis testing? **(2 marks)**

(b) Age (in years) of 6 people and their BMI are given in the following table.

x (Age)	y (BMI Kg/m^2)
45	25
30	24
62	26
20	22
50	25
55	27

i) Complete the following table

x Value	y Value	$x \times y$	$x \times x$	$y \times y$
45	25			
30	24			
62	26			
20	22			
50	25			
55	27			

(6 marks)

ii) Calculate $\sum_{i=1}^{6} y$, $\sum_{i=1}^{6} x$, $\sum_{i=1}^{6} xy$, $\sum_{i=1}^{6} x^2$, $\sum_{i=1}^{6} y^2$ **(5 marks)**

iii) Calculate the correlation coefficient (r).

$$r = \frac{n\sum_{i=1}^{n} xy - [\sum_{i=1}^{n} x][\sum_{i=1}^{n} y]}{\sqrt{n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2}\ \sqrt{n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2}}$$

(3 marks)

iv) How would you interpret your result obtained for question part (iii)? **(3 marks)**

Necessary Formulae

The following equations are given in the usual/ standard notation.

Confidence interval

$$\bar{x} \pm z\frac{SD}{\sqrt{n}}$$

$$p \pm z\sqrt{\frac{pq}{n}}$$

Test statistic

$$z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$$

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^{\ 2}}{n_1} + \frac{\sigma_2^{\ 2}}{n_2}}}$$

$$z = \frac{(P_1 - P_2)}{\sqrt{p(1-p)}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$x^2 = \sum \frac{(o-e)^2}{e}$$

Percentage Points of the Chi-Square Distribution

Degrees of Freedom	Probability of a larger value of x^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.558	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
11	3.053	4.575	5.578	7.584	10.341	13.70	17.28	19.68	24.72
12	3.571	5.226	6.304	8.438	11.340	14.85	18.55	21.03	26.22
13	4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
14	4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
15	5.229	7.261	8.547	11.037	14.339	18.25	22.31	25.00	30.58
16	5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
17	6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
18	7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
19	7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
22	9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
24	10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.42	42.98
26	12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.89	45.64
28	13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
30	14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
40	22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
50	27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
60	37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38

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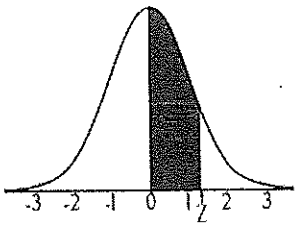

STANDARD NORMAL TABLE (Z)

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean (0) and z is 0.3944.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998

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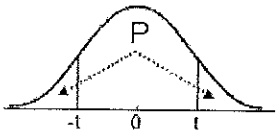
t table



DF	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
1	3.078	6.314	12.706	31.820	63.657	127.321	318.309	636.619
2	1.886	2.920	4.303	6.965	9.925	14.089	22.327	31.599
3	1.638	2.353	3.182	4.541	5.841	7.453	10.215	12.924
4	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8	1.397	1.860	2.306	2.897	3.355	3.833	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	1.345	1.761	2.145	2.625	2.977	3.326	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	1.337	1.746	2.120	2.584	2.921	3.252	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792