THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF BASIC SCIENCES
ACADEMIC YEAR 2019/2020 – SEMESTER 02

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

DATE: 20th MAY 2021 TIME: 09.30 AM – 11.30 AM

INDEX NO: .....

IMPORTANT INSTRUCTIONS/ INFORMATIONS TO CANDIDATES

- This question paper consists of **6 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 formulaes/tables are given in the pages 5-6.
- Mobile phones and any other electronic equipment are **NOT** allowed.
- **Non-programmable calculators are allowed to use.**

Essay Questions
(100 Marks)

1.

a)

i) List 2 examples of variables that can be measured using the following scales of measurements.

1. Nominal
2. Ordinal
3. Interval
4. Ratio

(8 marks)

ii) List two measures of central tendency applicable for continuous data set.

(2 marks)

iii) List two measures of dispersion applicable for a continuous data set.

(2 marks)

iv) What is the relationship between standard Deviation (SD) and Standard error (SE) of the sample mean?

(3 marks)

b) In a sample of 400 nurses, a researcher found that 100 nurses were having back pain.

i) Find a point estimate of the population proportion of nurses who have back pain.

(2 marks)

ii) Calculate the Standard error (SE) of the estimate found in part(i).

(2 Marks)

iii) Calculate a 95% confidence interval for the percentage of nurses in the population who have back pain.

(4 marks)

iv) How would you interpret the results that you have obtained for 95% confidence interval?

(2 marks)

2.

a)

i) List 2 characteristics of a normal curve. **(2 marks)**

ii) Give two examples for each of the following.

a. Continuous variable

b. Discrete variable **(4 marks)**

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

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

b) Suppose a psychiatric nurse wants to determine whether or not a given drug has any effect on the scores of human subjects performing a cognitive task. She randomly assigned her research participants to one of two groups. Nine hundred subjects in group 1 (the experimental group) received an oral administration of the drug prior to testing. In contrast, 1000 subjects in group 2 (control group) received a placebo. She found that for the drug group, the mean score on the cognitive test was 9.78 and SD was 4.05 and for the control group, the mean was 15.10 and the SD was 4.28.

i. State null and alternative hypothesis. **(4 marks)**

ii. Write down the test statistic. **(2 marks)**

iii. Test the null hypothesis at 5% level. **(6 marks)**

iv. What is the conclusion? **(3 marks)**

3. Diabetes status of a group of 300 randomly selected people was examined. Results are given below.

	Male	**Female**
Diabetes positive	40	40
Diabetes negative	60	160

The researcher is interested in identifying whether there is a gender difference in diabetes prevalence in the population.

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

ii) Prepare 2x2 contingency table using above data. **(4 marks)**

iii) Calculate expected frequencies for each of the observed frequencies. **(8 marks)**

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

v) Test the null hypothesis at 5% significance level. **(5 marks)**

4. Age (in years) of 5 people and their cholesterol ratios are given in the following table.

x (Age)	y (Cholesterol Ratio)
60	3.1
61	3.6
62	3.8
63	4
65	4.1

i) Complete the following table

x Value	y Value	$x \times y$	$x \times x$	$y \times y$
60	3.1			
61	3.6			
62	3.8			
63	4			
65	4.1			

(5 marks)

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

(5 marks)

iii) Calculate the correlation coefficient (r).

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

(2 marks)

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

(3 marks)

v) Fit a least square linear regression equation to predict cholesterol ratio of the participants based on their age.

You may use

$$b = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2} \quad and$$

$a = \bar{y} - b\bar{x}$, to estimate the coefficients.

Write down the fitted regression equation.

(5 marks)

vi) Estimate the cholesterol ratio of a 64 -year old person.

(5 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

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

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

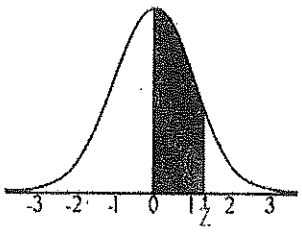
$$z = \frac{(P_1 - P_2)}{\sqrt{p(1-p)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$\chi^2 = \sum_{i=1}^{n} \frac{(f_o - f_e)^2}{f_e}$$

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

P.T.O.



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.

	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