THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. /B.Ed. Degree Programme, Continuing Education Programme

APPLIED MATHEMATICS-LEVEL 05

ADU5318/PCU1142/ /PCU3141/PSU1182 – Biostatistics

FINAL EXAMINATION 2019/2020

Duration: Two Hours.

Date: 09th February 2021	Time: 1.30pm – 3.30pm

Instructions:

- **This question paper consists of 06 questions. Answer only four questions.**
- **Statistical Tables are attached. You may use the closest degrees of freedom given in the table, where appropriate.**
- **In all tests, use the significance level as 0.05.**
- **If the random number table is to be used, you are required to clearly indicate how to read the values and as an illustration present three values that you read.**
- **Non-programmable calculators are permitted.**

1. A researcher is interested in finding out the fertilizer and the method of fertilizer application that gives the highest root length of a certain medicinal plant. The study involves three fertilizers (F1, F2, F3) and two methods of fertilizer application (M1, M2). The researcher has access to medicinal plants in 80 plots, of which 60 are in a sloping land and the rest are on a plane land. Each plot has five plants, planted close to each other, and all plants are of similar age and appearance at the start of the experiment. The root lengths of the plants in these plots are to be measured, two months after fertilizer application. The researcher suspects differences in the root lengths in the two land types.

   Suppose the researcher seeks your advice to design this study.

   i) Clearly describe how you advise. If you use the random number table, clearly state how you read the values.

   ii) Explain the following terms in relation to this study:
      a) replicate
      b) interaction
      c) confounding

2. A researcher sampled 46 pods from a population of 150 pods of a particular cowpea variety and counted the number of seeds in each of the sampled pods. The results are summarized in the following table.

Number of seeds in the pod	Number of pods
0 – 2	2
3 – 5	6
6 – 8	16
9 - 11	14
12 - 14	7
15 – 17	1

i) Calculate the sample mean of the data.

ii) Estimate the number of cowpea seeds in the population.

iii) Calculate the relative frequency corresponding to the third-class interval.

iv) Calculate the first quartile of the data and clearly explain what it measures in relation to this study.

v) Suppose the researcher decided to use only those pods in the sample with more than 10 seeds to estimate the seed weight of this cowpea variety. Estimate the number of pods he plans to use to estimate the seed weight.

3. A manufacturer claims that the dried weights of curry powder packeted by his company has the weight labeled in the packet. A sample of 30 packets labeled 100g were measured (grams) and the sample mean, and the standard deviation of the measured packets were found to be 97.2g and 2g respectively.

i) Write down the null and the alternative hypotheses that you examine to test the validity of the manufacturer's claim.

ii) Clearly describing the notation, write down the test statistic that you use to examine the validity of the manufacturer's claim.

iii) Clearly state the assumptions needed to carry out the proposed test.

iv) Test the hypothesis at a 5% significance level and clearly state the findings in relation to this study.

4. Among the 130 students registred for a Statistics course, 58 students had attended the first day school. A researcher plans to classify the student population according to the attendance at the dayschool and take simple random samples, each of size 20, from the two groups. Based on the data collected on selected students, the researcher wants to study the effect of day school attendance on the performance of the 130 students at the final examination.

i) If the researcher seeks your advice on how to select the sample from the group who had attended the first day school, clearly describe how you advise. Using the random number table given below and reading values downwards starting from the top left corner of the table, identify the serial numbers of the first three students who will be selected for the sample.

60	00	35	14	40	32	13	51	70	88	32	24	76	63	34
55	62	84	12	93	28	14	84	00	17	85	73	77	41	73
09	44	99	67	18	69	29	88	48	01	66	24	78	36	31
53	15	61	18	57	11	75	93	36	18	68	54	06	03	61
95	02	41	71	12	68	44	61	36	09	84	53	62	43	53

ii) State whether each of the following statements is true or false in relation to the study described in part (i). Give reasons for each answer.

a) The researcher plans to do cluster sampling to select the sample.

b) The population referred in this study is an infinite population.

c) Each student in the population has the same chance to be included into the sample.

d) Since researcher will be taking samples of the same size from the two groups, there will be no sampling error.

e) Since everyone in the population has a chance to be included into the sample, there will be no non-sampling error.

5. The variables that a researcher recorded on each of the 70 visits to a site to observe a particular rare bird species are listed below.

V_1: type of weather recorded as 1: sunny; 2: cloudy; 3: rainy

V_2: Group size of birds (i.e. total number of birds seen together as a group)

Some of the birds were sampled and following variables were also recorded.

V_3: gender of the bird

V_4: wing length (measured to the nearest decimal in centimeters)

V_5: tail length measured to the nearest centimeter and recorded as 1: less than 4; 2: 5 to 6; 3: more than 6

a) Classify the five variables as qualitative or quantitative.

b) Classify the quantitative variables as discrete or continuous.

c) Classify the five variables as nominal, ordinal, interval, or ratio.

d) A student found that the mode of the data collected on V_2 is 5 and concluded that the biggest group size of birds seen by the researcher on the visits to the site is 5. Do you agree with this conclusion? Give reasons for your answer.

Wing lengths of birds sampled for further observations are summarized below.

Wing length (cm)	Number of birds	
	Male	Female
6.0 – 6.9	4	8
7.0 – 7.9	6	12
8.0 – 8.9	14	16
9.0 – 9.9	20	6
10.0 – 10.9	20	6
11.0 – 11.9	4	6
12.0 – 12.9	2	0

The researcher is interested in examining the differences in the birds of the two gender groups with respect to the wing length and the dispersions of the wing lengths within each gender group.

i) Construct a suitable graph that will meet the objective of the researcher.

ii) Clearly state the findings from the graphical summary constructed in part (i).

4

6. The following table gives the discriptive statistics calculated from the heights (cm) and weights (Kg) of 80 boys sampled from the population of 15 year old boys in an urban school in Sri Lanka.

Description	Mean	Median	5% trimmed mean	First quartile	Third quartile	Standard deviation
Height	150.1	150.7	150.03	150.18	151.0	3.82
Weight	49.2	49.0	49.4	47.8	51.2	2.93

i) State three measures of dispersion for the heights of the boys in the sample, which can be calculated based on the given information.

ii) Calculate the value of each of the measures stated in part (i) and give the unit of measurement in each of these values.

iii) The researcher is interested in finding out whether students differ more with respect to the height or with respect to the weight. Using a suitable measure, compare the variables and clearly state what you conclude with regards to the researcher's objective.

iv) Based on the information presented in the table, a student made the following conclusions. In each case, state whether you agree with the conclusion drawn. Give reasons for your answer.

   a) There are no extreme observations in the heights that were used to calculate the given statistics.

   b) The heights used to calculate the given statistics are symmetrically distributed.

   c) Weights of 50% of the students in the sample exceed 49 kilograms.

5

Table A4: Random Number Tables

Row No.	Column Nos. 1 - 10	Column Nos. 11 - 20	Column Nos. 21 - 30	Column Nos. 31 - 40
1	13 50 63 04 23	25 47 57 91 13	52 62 24 19 94	91 67 48 57 10
2	78 66 28 55 80	47 46 41 90 08	55 98 78 10 70	49 92 05 12 07
3	51 57 32 22 27	12 72 72 27 77	44 67 32 23 13	67 95 07 76 30
4	66 86 65 64 60	56 59 75 36 75	46 44 33 63 71	54 50 06 44 75
5	19 83 52 47 53	65 00 51 93 51	30 80 05 19 29	56 23 27 19 03
6	51 78 57 26 17	34 87 96 23 95	89 99 93 39 79	11 28 94 15 52
7	79 68 96 26 60	70 39 83 66 56	62 03 55 86 57	77 55 33 62 02
8	73 52 93 70 50	48 21 47 74 63	17 27 27 51 26	35 96 29 00 45
9	63 99 25 69 02	09 04 03 35 78	19 79 95 07 21	02 84 48 51 97
10	86 28 30 02 35	71 30 32 06 47	93 74 21 86 33	49 90 21 69 74
11	97 96 47 59 97	56 33 24 87 36	17 18 16 90 46	76 27 28 52 13
12	93 41 69 96 07	97 50 81 79 59	42 37 13 81 83	92 42 85 04 31
13	40 24 74 36 42	40 33 04 46 24	35 63 02 31 61	34 59 48 36 96
14	06 05 16 25 98	17 78 80 36 85	26 41 77 63 37	71 63 94 94 33
15	97 81 26 03 89	39 46 67 21 17	98 10 39 33 15	61 63 00 25 92
16	65 99 59 97 84	90 14 79 61 55	56 16 88 87 60	32 15 99 67 43
17	16 91 21 32 41	60 22 66 72 17	31 85 33 69 07	68 49 20 43 29
18	62 03 89 26 32	35 27 99 18 25	78 12 93 09 70	50 93 19 35 56
19	92 27 73 40 38	37 11 05 75 16	98 81 99 37 29	62 20 32 39 67
20	45 51 94 69 04	00 84 14 36 37	95 66 39 01 09	21 68 40 95 79
21	00 81 06 28 48	12 08 05 75 26	03 35 63 05 77	13 81 20 67 58
22	05 06 42 24 07	60 60 29 99 93	73 93 78 04 36	25 76 01 54 03
23	12 68 46 55 89	60 09 71 87 89	70 81 10 95 91	83 79 68 20 66
24	07 79 26 69 61	67 85 72 37 41	85 79 76 48 23	61 58 87 08 05
25	52 16 16 23 56	62 95 80 97 63	32 25 34 03 36	48 84 60 36 56
26	16 01 92 58 21	48 79 74 73 72	08 64 80 91 38	07 28 66 61 59
27	89 84 05 34 47	88 09 31 54 88	97 96 86 01 69	46 13 95 65 96
28	51 99 98 44 39	12 45 10 60 36	80 66 39 94 97	42 36 31 16 59
29	08 12 60 39 23	61 73 84 89 18	26 02 04 37 95	96 18 69 06 30
30	69 99 47 26 52	48 06 30 00 18	03 30 28 55 59	66 10 71 44 05
31	88 91 28 79 50	71 42 14 95 55	98 59 96 01 36	88 77 90 45 59
32	59 45 27 08 51	85 64 23 85 41	64 72 08 59 55	67 98 36 65 56
33	84 27 17 30 37	48 69 49 02 58	98 02 50 58 11	95 39 06 35 63
34	65 45 53 41 07	14 83 46 74 11	76 66 63 60 08	90 54 33 65 84
35	48 28 01 83 84	09 11 21 91 73	97 28 44 74 06	22 30 95 69 72

Table A2: Student's t - Distribution
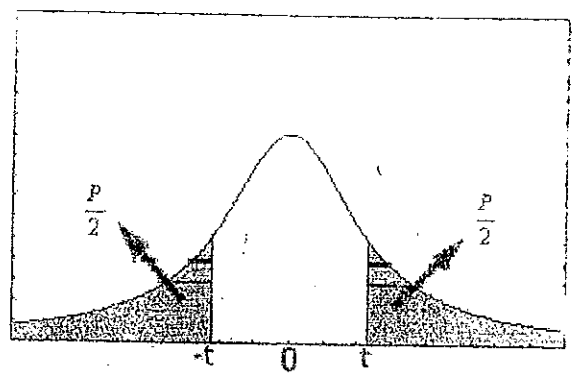
P	50	20	10	5	2	1	0.2	0.1
Degrees of freedom								
1	1.00	3.08	6.31	12.7	31.8	63.7	318	637
2	0.82	1.89	2.92	4.30	6.96	9.92	22.3	31.6
3	0.76	1.64	2.35	3.18	4.54	5.84	10.2	12.9
4	0.74	1.53	2.13	2.78	3.75	4.60	7.17	8.61
5	0.73	1.48	2.02	2.57	3.36	4.03	5.89	6.87
6	0.72	1.44	1.94	2.45	3.14	3.71	5.21	5.96
7	0.71	1.42	1.89	2.36	3.00	3.50	4.79	5.41
8	0.71	1.40	1.86	2.31	2.90	3.36	4.50	5.04
9	0.70	1.38	1.83	2.26	2.82	3.25	4.30	4.78
10	0.70	1.37	1.81	2.23	2.76	3.17	4.14	4.59
12	0.70	1.36	1.78	2.18	2.68	3.05	3.93	4.32
15	0.69	1.34	1.75	2.13	2.60	2.95	3.73	4.07
20	0.69	1.32	1.72	2.09	2.53	2.85	3.55	3.85
24	0.68	1.32	1.71	2.06	2.49	2.80	3.47	3.75
30	0.68	1.31	1.70	2.04	2.46	2.75	3.39	3.65
40	0.68	1.30	1.68	2.02	2.42	2.70	3.31	3.55
60	0.68	1.30	1.67	2.00	2.39	2.66	3.23	3.46
∞	0.67	1.28	1.64	1.96	2.33	2.58	3.09	3.29