UNIVERSITY OF ESWATINI
Faculty of Health Sciences
Department of Environmental Health Science

B.Sc. DEGREE IN ENVIRONMENTAL HEALTH SCIENCE

MAIN EXAMINATION PAPER DECEMBER 2019

TITLE OF PAPER	: RESEARCH METHODS
COURSE CODE	: EHS 309
DURATION	: 2 HOURS
MARKS	: 100
INSTRUCTIONS	: READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
	: ANSWER ANY FOUR QUESTIONS
	: EACH QUESTION **CARRIES 25** MARKS.
	: WRITE NEATLY & CLEARLY
	: NO PAPER SHOULD BE BROUGHT INTO THE EXAMINATION ROOM.
	: BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION ONE (5 marks each)

1A. Prepare a factorial design table for the following experimental research:

An experiment was conducted to evaluate the effectiveness of three different chemicals (A, B, C) used for coagulation. In addition, the chemicals are to be combined with other two different concentrations of coagulant aid (D, E). The test is to be repeated at three different pH values (F, G, H).

1B. Which of the following is/are true?

i. Construct validity is the extent to which a measuring instrument covers a representative sample of the domain of behaviors to be measured.
ii. Criterion validity is the extent to which a measuring instrument accurately predicts behavior or ability in a given area
iii. Content validity is the degree to which a measuring instrument accurately measures the theoretical trait that it is designed to measure.
iv. Face validity is a measure of the truthfulness of a measuring instrument.

1C. State the type of reliability test a researcher is employing in each of the following cases:

i. A researcher carrying out metal analysis did 5 sample repetition analyses.
ii. A researcher carrying out metal analysis used two different methods (method A and method B) to analyze the metals and compared the results.
iii. A researcher asked another laboratory researcher to analyze a replicate of the sample he is analyzing and compared the results with his own.

1D. State the type of study in each of the following cases:

i. Socio-economic characteristics of people such as their age, education, marital status, number of children and income;

ii. Socio-economic, physical, political variables that influence the availability of food;

iii. a doctor treats a patient with a skin condition with different creams to see which is most effective;

1E. List the advantages and disadvantages of cohort types of study

QUESTION TWO (5 marks each)

2A. Describe briefly the following forms of reliability:

i. Test-retest reliability
ii. Split half reliability
iii. Alternate forms reliability
iv. Inter-rater reliability

2B. A researcher wishes to undertake a research to determine whether inhalation or oral administration of medicine was appropriate for children suffering from asthma. The researcher is working in a rural region that is provided with a local hospital. The researcher needs to provide the study report in one year time. Discuss in detail the research approach that is appropriate in this case and what the research needs to do to carry out this research.

2C. State the type of research study followed in the following:

In a classic study, Doll and hill compared the smoking habits of two groups of patients in London hospitals: Those with carcinoma of the lungs and those with other cancers. Several aspects of smoking behavior were investigated as potential antecedent events, including the number of cigarettes smoked, history of smoking and whether smoked or inhaled. Although both groups contained a great proportion of smokers, evidence for an association between cigarette smoking and lung cancer was obtained from the study.

2D. List and define the different types of triangulation used in research.

2E. List and define the six ethical principles that must be followed in the course of conducting research.

QUESTION THREE (5 marks each)

3A. An occupational health officer wishes to estimate the mean rate of accident per year in a factory with a population of worker of 3000. From previous national level studies a standard deviation of 20 accidents/per year was reported. If the researcher is willing to tolerate a marginal error of up to 4 accidents/year in his estimate, how many subjects should be included in his study? α = 5% two-sided. Assume also that 10% of the subjects will fail to participate in the survey.

3B. A research study was conducted in a community to determine if members of the community who abstract water from a nearby river were exposed to water borne illnesses. The total population of households is 2000 and the households were randomly selected and a representative sample size was selected using statistical criteria. State the possible error that exists in this sampling approach.

3C. List and define the three types of interviews used in data collection. Discuss also their advantages and disadvantages.

3D. An environmental science researcher carried out air temperature measurements at two locations and found out that at location A, the temperature was 15 degree Celsius and at location B it was 30 degree Celsius. He then reported that location B was twice as warm as location A. Discuss if this report by the researcher was accurate or not and give reasons for your answer.

3E. List and explain three sources of errors that may arise when conducting interview.

QUESTION FOUR (5 marks each)

4A. Prepare a coding table and coding to the following data.

Name of respondents	Question	Answer (please tick)
Alexandra Hudson	How do you rate the value of the training you have undertaken	-Excellent -Very good -Good -Average -Poor -Very poor - I do not know
Mark Grummel		

4B. A lecturer of a certain subject plotted the stem and leaf diagram of a test result for a certain class. The plot is shown below. Answer the following questions:

i) What is the median score?
ii) What is the range?
iii) Does the plot follow a normal distribution?

```
VAR00006 Stem-and-Leaf Plot

 Frequency     Stem &  Leaf

     3.00        4 .  223
     3.00        4 .  689
    18.00        5 .  011122222233334444
    10.00        5 .  5577778899
    16.00        6 .  0011223333344444
    11.00        6 .  55566677789
    13.00        7 .  0012222333334
     3.00        7 .  557
     2.00        8 .  02
     1.00        8 .  8

Stem width:     10.00
Each leaf:       1 case(s)
```

4C. A researcher believes that the percentage of people who smoke in a certain location is greater than the national average. The national rate is 15%. The researcher gathers a random sample of 110 individuals who live in the region and finds that the number who smoke is 21 out of 110.

i) What statistical test should be used to analyse the data?
ii) Identify the null and alternative hypothesis for the study?
iii) What should the researcher conclude from the statistical test (give the calculation in detail)?

4D. A researcher is interested in analyzing the correlation between being a member of a social club and drinking habit (explained by the number of alcoholic drinks taken per week). What type of correlation coefficient should be used for the study?

4E. Describe the relationship between acceptance/rejection of the null hypothesis with increase or decrease of:

i. Type I error
ii. Type II errors.

In other words explain what will happen to the correctness of the decision either to accept or reject the null hypothesis if i) if type I error is to large or too small and ii) if type II error is too large or too small.

QUESTION FIVE (5 marks each)

5A. The mean score and standard deviation of Test #1 for a given subject for two of the degree programme students (labeled as I and II in the table) are given in the following table.

Programme	I	II
Mean score	61.33	61.83
Standard deviation	6.93	11.22
Number of students	18	20

Determine whether there is a significant difference in the mean between the two sections. A normality test for the data revealed that the data follow normal distribution.

Note that for two independent sets of data the pooled standard deviation (s_p) and t test statistics (t*) will take the following form

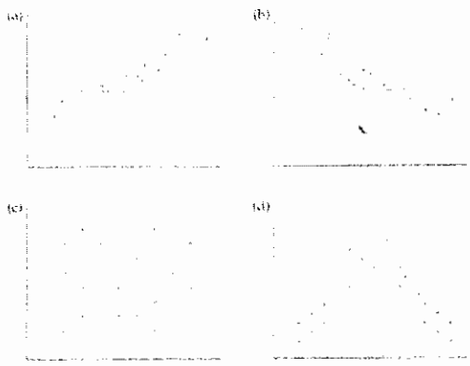
$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

$$t^* = \frac{\bar{x}_1 - \bar{x}_2}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where the x_1 and x_2 values are the mean values for the two data, the s1 and s_2 are standard deviation, n_1 and n_2 are number of samples, s_p is the pooled standard deviation and t* is the t test statistic.

5B. For each of the scatter plot shown in the figure below labeled a, b, c and d, answer the following.

i) Indicate the possible close value for correlation coefficient
ii) From this correlational values is it possible to determine the presence or absence of correlation? State the reason.
iii) State for which part of the scatter plot linear correlation formula can be applied. State the reason for your choice.



5C. The concentration of dust in the air was measured at to different points in a city A and B whereby A is a low latitude location whereas B was a high altitude location. The measurements were made in summer season (C) and winter season (D) . The following results were obtained.

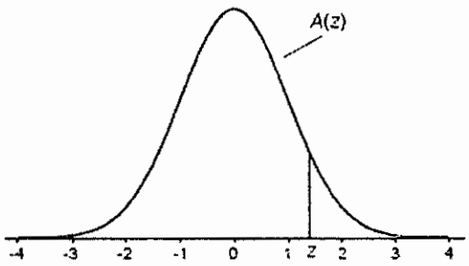
	Low altitude (A)	High altitude (B)
Summer measurement (C)	25 $\mu g/m^3$	40 $\mu g/m^3$
Winter measurement (D)	30 $\mu g/m^3$	35 $\mu g/m^3$

Determine if altitude and seasons can be taken as independent variables in determining the concentration of dust in the air for the city.

5D. A researcher conducting an interview to a group of respondents received complaints from the respondents that the interview was too long and it make them tired. The researcher responded that he knew that the interview would be too long and would make them tired but that he needs the data for the research and apologized for the inconvenience. State the type of ethical principle that the researcher violated.

5E. To assess the reliability of a data collecting instrument a researcher uses a split half test in whereby both halves involve questionnaire consisting of questions that used ordinal ranking scales. To assess the reliability of this instrument which type of correlation should the researcher use?

Cumulative Standardized Normal Distribution



$A(z)$ is the integral of the standardized normal distribution from $-\infty$ to z (in other words, the area under the curve to the left of z). It gives the probability of a normal random variable not being more than z standard deviations above its mean. Values of z of particular importance:

z	$A(z)$	
1.645	0.9500	Lower limit of right 5% tail
1.960	0.9750	Lower limit of right 2.5% tail
2.326	0.9900	Lower limit of right 1% tail
2.576	0.9950	Lower limit of right 0.5% tail
3.090	0.9990	Lower limit of right 0.1% tail
3.291	0.9995	Lower limit of right 0.05% tail

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999							

t Distribution: Critical Values of t

		Significance level					
Degrees of freedom	*Two-tailed test:* 10% / *One-tailed test:* 5%	5% / 2.5%	2% / 1%	1% / 0.5%	0.2% / 0.1%	0.1% / 0.05%	
1		6.314	12.706	31.821	63.657	318.309	636.619
2		2.920	4.303	6.965	9.925	22.327	31.599
3		2.353	3.182	4.541	5.841	10.215	12.924
4		2.132	2.776	3.747	4.604	7.173	8.610
5		2.015	2.571	3.365	4.032	5.893	6.869
6		1.943	2.447	3.143	3.707	5.208	5.959
7		1.894	2.365	2.998	3.499	4.785	5.408
8		1.860	2.306	2.896	3.355	4.501	5.041
9		1.833	2.262	2.821	3.250	4.297	4.781
10		1.812	2.228	2.764	3.169	4.144	4.587
11		1.796	2.201	2.718	3.106	4.025	4.437
12		1.782	2.179	2.681	3.055	3.930	4.318
13		1.771	2.160	2.650	3.012	3.852	4.221
14		1.761	2.145	2.624	2.977	3.787	4.140
15		1.753	2.131	2.602	2.947	3.733	4.073
16		1.746	2.120	2.583	2.921	3.686	4.015
17		1.740	2.110	2.567	2.898	3.646	3.965
18		1.734	2.101	2.552	2.878	3.610	3.922
19		1.729	2.093	2.539	2.861	3.579	3.883
20		1.725	2.086	2.528	2.845	3.552	3.850
21		1.721	2.080	2.518	2.831	3.527	3.819
22		1.717	2.074	2.508	2.819	3.505	3.792
23		1.714	2.069	2.500	2.807	3.485	3.768
24		1.711	2.064	2.492	2.797	3.467	3.745
25		1.708	2.060	2.485	2.787	3.450	3.725
26		1.706	2.056	2.479	2.779	3.435	3.707
27		1.703	2.052	2.473	2.771	3.421	3.690
28		1.701	2.048	2.467	2.763	3.408	3.674
29		1.699	2.045	2.462	2.756	3.396	3.659
30		1.697	2.042	2.457	2.750	3.385	3.646
32		1.694	2.037	2.449	2.738	3.365	3.622
34		1.691	2.032	2.441	2.728	3.348	3.601
36		1.688	2.028	2.434	2.719	3.333	3.582
38		1.686	2.024	2.429	2.712	3.319	3.566
40		1.684	2.021	2.423	2.704	3.307	3.551
42		1.682	2.018	2.418	2.698	3.296	3.538
44		1.680	2.015	2.414	2.692	3.286	3.526
46		1.679	2.013	2.410	2.687	3.277	3.515
48		1.677	2.011	2.407	2.682	3.269	3.505
50		1.676	2.009	2.403	2.678	3.261	3.496
60		1.671	2.000	2.390	2.660	3.232	3.460
70		1.667	1.994	2.381	2.648	3.211	3.435
80		1.664	1.990	2.374	2.639	3.195	3.416
90		1.662	1.987	2.368	2.632	3.183	3.402
100		1.660	1.984	2.364	2.626	3.174	3.390
120		1.658	1.980	2.358	2.617	3.160	3.373
150		1.655	1.976	2.351	2.609	3.145	3.357
200		1.653	1.972	2.345	2.601	3.131	3.340
300		1.650	1.968	2.339	2.592	3.118	3.323
400		1.649	1.966	2.336	2.588	3.111	3.315
500		1.648	1.965	2.334	2.586	3.107	3.310
600		1.647	1.964	2.333	2.584	3.104	3.307
∞		1.645	1.960	2.326	2.576	3.090	3.291

TABLE A.4

χ^2 (Chi-Squared) Distribution: Critical Values of χ^2

	Significance level		
Degrees of freedom	5%	1%	0.1%
1	3.841	6.635	10.828
2	5.991	9.210	13.816
3	7.815	11.345	16.266
4	9.488	13.277	18.467
5	11.070	15.086	20.515
6	12.592	16.812	22.458
7	14.067	18.475	24.322
8	15.507	20.090	26.124
9	16.919	21.666	27.877
10	18.307	23.209	29.588