COLLEGE OF BUSINESS, PEACE, LEADERSHIP AND GOVERNANCE

NMMS202: QUANTITATIVE ANALYSIS 1

END OF FIRST SEMESTER FINAL EXAMINATION

NOVEMBER-DECEMBER 2022

LECTURER: MUGWAGWA T. M

DURATION: 3 HOURS

INSTRUCTIONS

ANSWER ALL QUESTIONS FROM **SECTION A**

CHOOSE **ONLY TWO** QUESTIONS FROM **SECTION B**

Credit will be awarded for logical, systematic and neat presentations

SECTION A(50 MARKS)

Answer all questions from this section

QUESTION ONE

(a) For the following data, identify whether or not they are

1. Categorical [nominal or ordinal], or

2. Numerical [interval/ratio] [discrete or continuous]

Give examples of possible values for each random variable.

Copy and complete the following table with the required information in your answer script.

An example has been done for you.

Data	Measurement scale	Examples
Number of children living in a given home	Interval data(discrete)	0,1,2,3, 4….
(i) marital status		
(ii) Number of students who drop this statistics course		
(iii) Time student spends studying for their first statistics test		
(iv) The weight loss over the first week of a "fad" diet		
(v) The part on a new computer that breaks during the first year of ownership		

(10 Marks)

QUESTION TWO

Given that the following data set is a sample of the delivery times (in hours) for

Chibuku Breweries;

68 82 95 51 59 39 50 21 44 71 49 65 32 49 64 56 86 50 74 51
54 63 33 64 43 42 45 37 55 62 45 38 50 60 66 76 34 36 61 43

i. Determine an appropriate class interval and show the data in a grouped frequency table showing the tally and the frequency [12 marks]

ii. Show the data on a suitable sketch graph. [10 marks]

iii. Comment on the distribution of the deliveries. [3 marks]

QUESTION THREE

(a)Suppose 15% of a population has flu and the researcher takes a random sample of 6 people from the population. If X is the number of people in the sample with flu, then the probability density function for X is

x	0	1	2	3	4	5	6
$P(x)$	0.3771	0.3993	0.1762	0.0415	0.0055	0.0004	0.0000
F(x)							

Find the probability that

(i) a person chosen from the sample does not have flue [2 marks]

(ii) at least 2 people in the sample have flu [3marks]

(iii) Find the expected value ($\overline{X}$) [3marks]

(iv) Find the variance of X [3marks]

(v) Copy and Complete the probabilities for the cumulative distribution function F(x) [4marks]

SECTION B (50 MARKS)

Choose ONLY two questions from this section. Each question has 25 marks

QUESTION FOUR

A source of interest to your management is whether the net weights of boxes of biscuits coming from three packaging machines are the same. A random sample was taken from each with the following results: (weights in grams)

Machine A	249	257	252	256	253	257	258	253	248
Machine B	251	245	247	250	248	246	250	250	246
Machine C	250	254	251	248	257	256	248	250	251

i) Calculate a 95% confidence interval for the mean net weight of all the packets coming from machine A. [15 marks]

ii) You are given that the 95% confidence interval for the mean net weight of all the packets coming from machine B is: 286.4 to 249.8 g

(a) Does this interval support the claim that the mean net weight is 250g?

Explain. [5 marks]

((b) Is there a difference in the net weights of boxes of biscuits coming from A and B packaging machines? [5 marks]

QUESTION FIVE

A researcher wants to see whether there is a relationship between amount spent on clothing per year and IQ. The Excel printout on the relationship between the two variables is below:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.891086
R Square	0.794034
Adjusted R Square	0.778190
Standard Error	950.357399
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	45264753.9	45264753.9	50.117	0.0000083
Residual	13	11741329.4	903179.2		
Total	14	57006083.3			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	13296.3	1499.81674	8.865296	0.0000007	10056.163	16536.4760
X Variable 1	-99.443	14.04691	-7.079346	0.0000083	-129.789	-69.0964

Using the given summary output, answer the following questions:

(i) Identify the independent(x) and the dependent variable(y) [2marks]

(ii) The sample size consists of how many people? [2marks]

(iii) Compute the correlation coefficient r. Using this value, how would you interpret the correlation between the two variables being compared [3marks]

(iv) Write down the regression equation in terms of the amount spent on clothing and IQ [4marks]

(v) According to the regression model, an individual with an IQ of zero should spend about how much on clothing [4marks]

(vi)According to the regression model, an individual with a 100 IQ should spend about how much on clothing [4marks]

(vii) What is the coefficient of determination R^2 equal to and what does it mean? [3 marks]

(viii)What is the standard error of estimate? What does it mean [3 marks]

QUESTION SIX

1. The followings data shows the information of serving time (in minutes) for 40 customers in a post office:

2.0	4.5	2.5	2.9	4.2	2.9	3.5	2.8
3.2	2.9	4.0	3.0	3.8	2.5	2.3	3.5
2.1	3.1	3.6	4.3	4.7	2.6	4.1	3.1
4.6	2.8	5.1	2.7	2.6	4.4	3.5	3.0
2.7	3.9	2.9	2.9	2.5	3.7	3.3	2.4

(a) Construct a frequency distribution table. [5 Marks]

(b) Using the frequency table, you constructed in (a): Calculate

(i) The mode [4Marks]

(ii) The median [4Marks]

(iii) The mean [3Marks]

(a) Determine the skewness of the data and interpret [3Marks]

(b) Find the

(i) lower quartile [2Marks]

(ii) the upper quartile [2Marks]

(iii) the interquartile range [2Marks]

QUESTION SEVEN

(a) Given that a data set consisting of 75 data values and has 109 as the highest value and 29 as the lowest value, construct the class intervals, showing the class limits of all the classes. [10Marks]

(b) The number falling into the different categories are shown in the following table. A student is randomly selected from the group.

	Opinion	
Gender	For	Total
Femal	30	70

e		
Male	50	130
Total	80	200

Find the probability that a student selected is

(c) a female and is against the issue [3 Marks]

(d) a male or is for the issue [4 Marks]

(e) for the issue given that the student is male [3 Marks]

(f) against the issue [2 Marks]

QUESTION EIGHT

Use the following information to answer the next three questions (a to c).

10; 11; 15; 15; 17; 22

(a) Compute the mean and standard deviation for this data; use the sample formula for the standard deviation. [10 Marks]

(b) What number is two standard deviations above the mean of this data? [5 Marks]

(c) In a biology class, the scores on the final exam were normally distributed,

with a mean of 85, and a standard deviation of five. Susan got a final exam score

of 95. Express her exam result as a *z*-score, and interpret its meaning. **[**10 Marks]

End of Examination

ADDITIONAL INFORMATION

1. Sturge's Rule:

Number of class, $C = 1 + 3.3 \log n$

Class width, $i > \frac{range}{C}$

2. Mean of grouped data $= \frac{\sum_{i=1}^{n} fx_i}{n}$

3. Mean of ungrouped data = $\frac{\sum_{i=1}^{n} x_i}{n}$

. Mode = $L_{mo} + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2} \right) i$

4

5 Median = $L_{me} + \left(\frac{\frac{n}{2} - F}{f_m} \right) i$

6. Standard deviation: $S = \sqrt{\frac{\sum_{i=1}^{n} fx_{i^2} - \frac{\left(\sum_{n=1}^{n} fx_i \right)^2}{n}}{n-1}}$

7. Standard Deviation of ungrouped data: $S = \sqrt{\frac{\sum_{i=1}^{n} x_{i^2} - \frac{\left(\sum_{i=1}^{n} x_i \right)^2}{n}}{n-1}}$

8. Coefficient of skewness: $S_k = \frac{3(mean - median)}{s} = \frac{mean - \mathrm{mod}\, e}{s}$

9. Conditional probability: $P(A¿) = \frac{P(A \cap B)}{P(A)}$

10. Binomial Distribution

- $P(X = x) = nC_x p^x q^{n-x}$

11. Poisson Distribution

- $P(X = x) = \frac{e^{-\lambda} \lambda^x}{x!}$

12. Hypothesis testing (single mean)

- $Z=\dfrac{\overline{X}-\mu}{\dfrac{\sigma}{\sqrt{n}}}$
- $t=\dfrac{\overline{X}-\mu}{\dfrac{s}{\sqrt{n}}}$, df = n – 1

13. Hypothesis testing (single proportion)
- $Z=\dfrac{p-\pi}{\sqrt{\dfrac{\pi(1-\pi)}{n}}}$

14. Hypothesis testing (difference of two means)
- $Z=\dfrac{\overline{X}_1-\overline{X}_2}{\sqrt{\dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}}}$
- $t=\dfrac{\overline{X}_1-\overline{X}_2}{\sqrt{\dfrac{S_1^2}{n_1}+\dfrac{S_2^2}{n_2}}}$, df = smaller $(n_1-1; n_2-1)$
- $t=\dfrac{\overline{X}_1-\overline{X}_2}{\sqrt{\dfrac{S_p^2}{n_1}+\dfrac{S_p^2}{n_2}}}$

  Where $S_p^2=\dfrac{S_1^2(n_1)+S_2^2(n_2)}{n_1+n_2-2}$, $df=n_1+n_2-2$
- $t=\dfrac{\overline{D}-\mu_D}{\dfrac{S_D}{\sqrt{n}}}$, df = n – 1

15. Hypothesis testing (difference of two proportions)
- $Z=\dfrac{p_1-p_2}{\sqrt{\overline{p}\,\overline{q}\left(\dfrac{1}{n_1}+\dfrac{1}{n_2}\right)}}$

16. Confidence Interval (Single mean)
- $\overline{X}-Z_{\frac{\alpha}{2}}\dfrac{\sigma}{\sqrt{n}}\le\mu\le\overline{X}+Z_{\frac{\alpha}{2}}\dfrac{\sigma}{\sqrt{n}}$
- $\overline{X}-t_{\frac{\alpha}{2}}\dfrac{S}{\sqrt{n}}\le\mu\le\overline{X}+t_{\frac{\alpha}{2}}\dfrac{S}{\sqrt{n}}$

17. Confidence Interval (Difference of two means)
- $(\overline{X}_1-\overline{X}_2)-Z_{\frac{\alpha}{2}}\sqrt{\dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}}\le(\mu_1-\mu_2)\le(\overline{X}_1-\overline{X}_2)+Z_{\frac{\alpha}{2}}\sqrt{\dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}}$
- $(\overline{X}_1-\overline{X}_2)-t_{\frac{\alpha}{2}}\sqrt{\dfrac{S_1^2}{n_1}+\dfrac{S_2^2}{n_2}}\le(\mu_1-\mu_2)\le(\overline{X}_1-\overline{X}_2)+t_{\frac{\alpha}{2}}\sqrt{\dfrac{S_1^2}{n_1}+\dfrac{S_2^2}{n_2}}$

  df = smaller $(n_1-1; n_2-1)$
- $(\overline{X}_1-\overline{X}_2)-t_{\frac{\alpha}{2}}\sqrt{\dfrac{S_p^2}{n_1}+\dfrac{S_p^2}{n_2}}\le(\mu_1-\mu_2)\le(\overline{X}_1-\overline{X}_2)+t_{\frac{\alpha}{2}}\sqrt{\dfrac{S_p^2}{n_1}+\dfrac{S_p^2}{n_2}}$

Where $S_p^2 = \frac{S_1^2(n_1) + S_2^2(n_2)}{n_1 + n_2 - 2}$, $df = n_1 + n_2 - 2$

18. Confidence Interval (Single proportion)

- $p - Z_{\frac{\alpha}{2}}\sqrt{\frac{pq}{n}} \le \pi \le p + Z_{\frac{\alpha}{2}}\sqrt{\frac{pq}{n}}$

19. Confidence Interval (Difference of two proportions)

- $(p_1 - p_2) - Z_{\frac{\alpha}{2}}\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} \le (\pi_1 - \mu_2) \le (p_1 - p_2) + Z_{\frac{\alpha}{2}}\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}}$

20. $Z = \frac{X - \mu}{\sigma}$

21. Weighted Mean: $\overline{X}_w = \frac{\sum xw}{\sum w}$

$$P(B_i/C) = \frac{P(C/B_i)P(B_i)}{\sum_{i=1}^{n} P(C/B_i)P(B_i)},$$

22.

23. $y = \beta_0 + \beta_1 x + e,$

$$\beta_1 = \frac{n\sum xy - \sum x \sum y}{n\sum y^2 - \left(\sum y\right)^2}$$

$$\beta_0 = \overline{y} + \beta_1 \overline{x}$$

$$r = \frac{n\sum xy - \sum x \sum y}{\left\{\left(n\sum x^2 - \left(\sum x\right)^2\right)\left(n\sum y^2 - \left(\sum y\right)^2\right)\right\}}$$

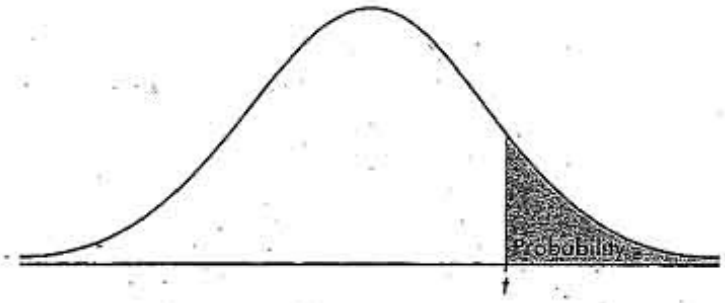


TABLE B: *t*-DISTRIBUTION CRITICAL VALUES

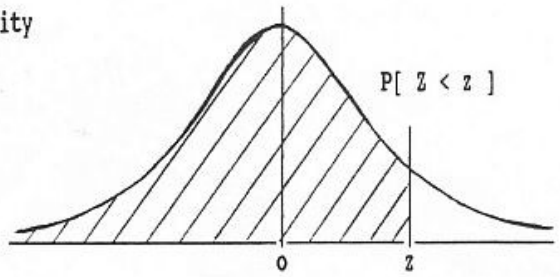
	Tail probability p											
df	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	.765	.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	.741	.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	.727	.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	.718	.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	.711	.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	.706	.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	.703	.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	.700	.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	.697	.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	.695	.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	.694	.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	.692	.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	.691	.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	.690	.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	.689	.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	.688	.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	.688	.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	.687	.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	.686	.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	.686	.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	.685	.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	.685	.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	.684	.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	.684	.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	.684	.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	.683	.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	.683	.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	.683	.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	.681	.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	.679	.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	.679	.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	.678	.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	.677	.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	.675	.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
∞	.674	.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%
	Confidence level C											

STANDARD STATISTICAL TABLES

1. Areas under the Normal Distribution

The table gives the cumulative probability up to the standardised normal value z

i.e. $$P[\ Z < z\ ] = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp(-\tfrac{1}{2}Z^2)\ dZ$$



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	0.5159	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	0.7854
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	0.8804	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	0.9773	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	0.9865	0.9868	0.9871	0.9874	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	0.9924	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	0.9980	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
z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000