COLLEGE OF BUSINESS, PEACE, LEADERSHIP AND GOVERNANCE

NMMS202: QUANTITATIVE ANALYSIS 1

END OF FIRST SEMESTER EXAMINATIONS

APRIL-MAY 2022

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DURATION: 3 HOURS

INSTRUCTIONS

Answer all questions in Section A and any **one** question Section B

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Credit will be awarded for logical, systematic and neat presentations

Section A

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. [Example: number of children living in a given home – "interval data [discrete], (0, 1, 2, 3, …)"

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

[5 marks]

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

SECTION B

Question Two

A quality control manager takes a random sample of 100 packets of biscuits from a production line in order to check the mean weight of the whole production. The net weights he found are tabulated below:

Weight in grams	Frequency
247 and less than 248	4
248 and less than 249	21
249 and less than 255	40
255 and less than 258	27
258 and less than 259	7
259 and less than 262	1

Estimate the mean, mode, median, standard deviation (sd), and skewness of the production.

[35 marks]

Question Three

Practical and theory marks for a random sample of 10 chemistry students were as follows:

Student	A	B	C	D	E	F	G	H	I	J
Practical	63	83	54	63	71	45	68	68	62	52
Theory	50	75	60	56	63	32	55	69	67	43

i) Calculate a 95% confidence interval for each type of assessment separately. **[30 marks]**

ii) Use these two intervals to investigate whether there is a difference between the mean marks produced by the different types of assessment. **[5 marks]**

Question Four

The data given below pertain to a random sample of disbursements of state highway funds

(in millions of dollars), to different states.

1188	1050	2882	2802	780	1171	685
537	519	2523	316	1117	1578	261

(a) Find the mean, variance, and range for these data and interpret.

(b) Find lower and upper quartiles, median and interquartile ranges. Check for any outliers and interpret.

(c) Construct a box plot and interpret.

[35 marks]

Question Five

Use the following information to answer the next four questions (B1 to B4).

10; 11; 15; 15; 17; 22

B1. Compute the mean and standard deviation for this data; use the sample formula for the standard deviation. **[10 marks]**

B2. What number is two standard deviations above the mean of this data? **[5 marks]**

B3. Express the number 13.7 in terms of the mean and standard deviation of this data. **[5 marks]**

B4. 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. **[15 marks]**

End of Examination

LIST OF FORMULAE

8. Coefficient of skewness: $S_k = \dfrac{3(mean - median)}{s} = \dfrac{mean - mode}{s}$

12. Test statistic: $t = \dfrac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$ or $Z = \dfrac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}}$

13. Proportion Test Statistics $= Z = \dfrac{\hat{p} - p}{\sqrt{pq/n}}$

14. $Z = \dfrac{X - \mu}{\sigma}$

16. $CV = \dfrac{s}{\bar{x}} \times 100$

17. $\hat{p} - z_{\alpha/2}\sqrt{\dfrac{\hat{p}\hat{q}}{n}} < p < \hat{p} + z_{\alpha/2}\sqrt{\dfrac{\hat{p}\hat{q}}{n}}$

18. $E(X) = \sum X.P(x)$

19. $\sigma = \sqrt{\sum x^2 P(x) - \mu^2}$

20. $\bar{X} - z_{\alpha/2}\left(\dfrac{\sigma}{\sqrt{n}}\right) < \mu < \bar{X} + z_{\alpha/2}\left(\dfrac{\sigma}{\sqrt{n}}\right)$

21. $z = \dfrac{\left(\bar{X}_1 - \bar{X}_2\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$ or $t = \dfrac{\left(\bar{X}_1 - \bar{X}_2\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$

22. $\left(\bar{X}_1 - \bar{X}_2\right) - z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}} < \left(\mu_1 - \mu_2\right)$

$$< \left(\bar{X}_1 - \bar{X}_2\right) + z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}$$

23. $t = \dfrac{\bar{D} - \mu_D}{s_D/\sqrt{n}}$

24. $z = \dfrac{\left(\hat{p}_1 - \hat{p}_2\right) - \left(p_1 - p_2\right)}{\sqrt{\bar{p}\bar{q}\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}}$

where

$\bar{p} = \dfrac{X_1 + X_2}{n_1 + n_2}$ $\hat{p}_1 = \dfrac{X_1}{n_1}$

$\bar{q} = 1 - \bar{p}$ $\hat{p}_2 = \dfrac{X_2}{n_2}$
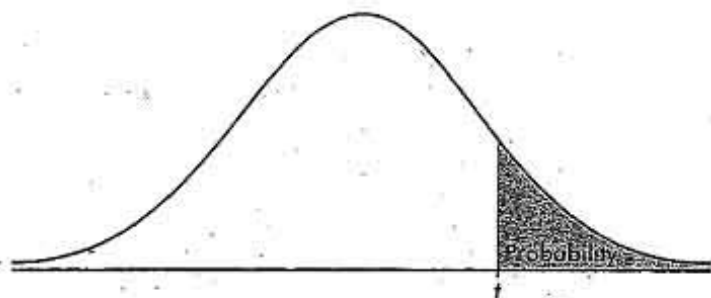
TABLE B: *t*-DISTRIBUTION CRITICAL VALUES

						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.

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

P[Z < z]
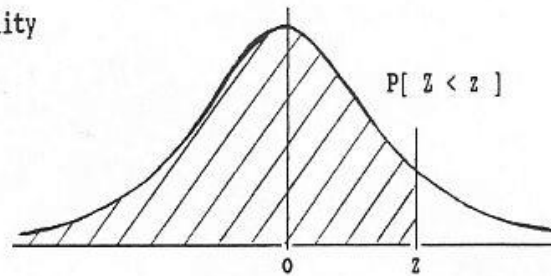
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	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