AFRICA UNIVERSITY

(A United Methodist-Related Institution)

"Investing in Africa's Future"

FACULTY OF MANAGEMENT AND ADMINISTRATION

COURSE TITLE: **MMS202 Quantitative Analysis 1**

SEMESTER 1: **Final Examination September - October 2014**

LECTURER: **Dr. S. Murairwa**

TIME: **3 Hours**

SECTION A: ANSWER ALL QUESTIONS

1. Find the sample space:
   a) A six sided die is rolled once [**1 Mark**]
   b) Two coins are flipped once [**1 Mark**]
   c) A coin is tossed until a head is observed and the number of flips is recorded [**1 Mark**]
   d) Suppose staff members for a certain company weigh between 100 and 200 kilograms, inclusive. An employee of this company is selected at random and his or her weight is noted [**1 Mark**]

2. One objective of the ATFV treatment for vocal fold scar is to increase mean phonation time (MPT). The following data show pre-operation (preop) and post-operation (postpostop) MPT values for five patients.

Preop	10	7	10.2	5	13.8
Postop	17	5	18	14	15

   Is the MPT for patients after surgery greater than the MPT for patients before surgery at 5% significance level? Find the *p*-value [**10 Marks**]

3. Assume X is normally distributed with a mean of 200 and a variance of 900. Find
   a) the probability that X is
      i) between 160 and 210 [**4 Marks**]
      ii) equal to 160 [**2 Marks**]
      iii) from 160 to 210 [**2 Marks**]
   b) a number c such that $(\ <\ ) = 0.4$ [**4 Marks**]
   c) numbers *a* and *b* such that $(\ <\ <\ ) = 0.68$ [**4 Marks**]

4. Given the following events:
   S = {list of number from 1 to 13}
   P = {getting an odd number when tossing a fair die}
   Q = {getting an even number when tossing a fair die}
   R = {list of number from 2 to 12}
   T = {list of prime number less than 12}

   a. Show the events in a Venn diagram [**4 Marks**]
   b. Find
      i) $P(\mathrm{S} \cap \mathrm{P} \cap \mathrm{R})$ [**2 Marks**]
      ii) $P(Q \cap R) \cap \overline{P}$ [**2 Marks**]
      iii) $P(T \cup Q \cap \overline{R})$ [**2 Marks**]

SECTION B: ANSWER ANY THREE QUESTIONS

5. The bureau of Labour Statistics has sampled 30 communities in Zimbabwe and explained prices in each community at the beginning and end of August 2014 in order to find out approximately how the Consumer Price Index has change during the month. The percentage change in prices for the communities at the beginning of the month are given below:

0.8	0.2	-0.1	0.1	-0.2
0	0.6	0.3	0.2	1.0
-0.5	-0.2	0	0.4	0.6
0.2	0.3	0.5	-0.1	-0.2
-0.4	0	0.1	0.3	0.1
0	0.1	0.2	0.1	0.3

a) What is the variable of interest? **[1 Mark]**
b) Construct a frequency table for the data **[5 Marks]**
c) Based on the frequency table you obtained in (b),
   i) determine the relationship of the measures of central location. Sketch the graph of the relationship **[9 Marks]**
   ii) calculate the coefficient of skewness and interpret **[5 Marks]**

6. Attempt the following questions

a) In a university, 20 percent of the students fail the Algebra test. If 20 students from the university are interviewed, what is the probability of getting
   i) less than 3 students who fail the test **[2 Marks]**
   ii) more than 3 students who fail the test **[2 Marks]**
   iii) exactly 4 students who fail the test **[2 Marks]**

b) The customers enter shop ABC at an average rate of forty-two customers per hour. Find the probability that
   i) no customer enters the shop during a particular 1 minute interval **[2 Marks]**
   ii) at least 4 customers enter the shop during a particular 5 minutes interval **[4 Marks]**
   iii) between 2 and 6 customers enter the shop during a particular 10 minutes interval **[4 Marks]**
c) Explain the four possible outcomes of hypothesis testing **[4 Marks]**

7. In a factory,

a) a researcher wants to test the claim that the average cost of production is greater than $5 700. The researcher selected a random sample of 36 special universities and found the mean and population standard deviation to be $5 950 and $659 respectively.
   i) Is there enough evidence to support the claim at 5% significance level? Use the *p*-value method **[5 Marks]**

ii) Explain the relationship between statistic and parameter [**6 Marks**]

b) a certain brand of chocolates is packed into boxes on four different production lines, A, B, C and D. The records show that a small percentage of boxes are not packed properly for sale; 1% from A, 3% from B, 2.5% from C and 2% from D. If the total output from the production lines are 0.35 from A, 0.20 from B, 0.24 from C and 0.21 from D, what is the probability that

i) the box selected at random from the total output is faulty? [**4 Marks**]

ii) the faulty box came from the production line? [**3 Marks**]

iii) a faulty box came from the production line D? [**2 Marks**]

8. The data show

a) the method of payment by 16 customers in a supermarket checkout point: C = cash, CK = cheque, CC = credit card, D = debit and O = other.

C	CK	CK	C	CC	D	O	C
CK	CC	D	CC	C	CK	CK	CC

i) Calculate the relative frequencies and percentages for all categories [**5 Marks**]

ii) Draw a pie chart for the frequency table and state four disadvantages of the graph [**7 Marks**]

b) that 163 smoke cigarettes in a sample of 700 participants.

i) Find a 90% confidence interval for the proportion of participants who smoke cigarettes [**4 Marks**]

ii) Based on this confidence interval, does it appear that the percentage of participants who smoke is greater than 22%? [**2 Marks**]

iii) Explain what you do before conducting a hypothesis test for a single proportion [**2 Marks**]

End of paper

ADDITIONAL INFORMATION

1. Sturge's Rule:

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

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

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

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

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

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

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

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

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

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

10. Binomial Distribution: $(=) =$ –

11. Poisson Distribution: $(=) = \dfrac{}{!}$

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. $=$ ——

15. Weighted Mean: $\bar{X}_w = \frac{\Sigma xw}{\Sigma w}$

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

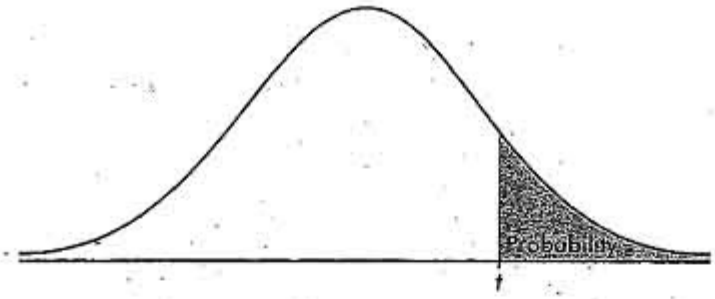


TABLE B: *t*-DISTRIBUTION CRITICAL VALUES

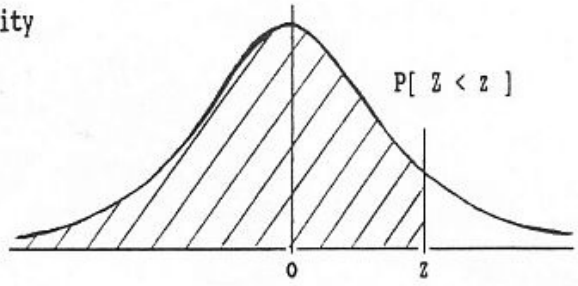
	Tail probability p											
df	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	.765	.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	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