University of Ruhuna

Master of Arts in Economics

1st Semester Examination - September 2017

MAE 5102 – Economic Statistics

(Answer **four (04)** Questions only, selecting one (01) question **from each section.**)

Time: 3 Hours

Part I

01. (a) "Measures of central tendency are not adequate to explain the characteristics of a data set." Criticize this statement using examples/figures (diagrams) wherever necessary.

(06 marks)

(b) 220 students were asked to report the number of hours per week they spent watching television and the summary of the data are presented below in a format of a frequency distribution. Calculate the mean and the standard deviation of hours spent watching television.

Hours	Number of students
10 – 14	02
15 – 19	12
20 – 24	23
25 – 29	60
30 – 34	77
35 – 39	38
40 – 44	08

(09 marks)

02. (a) Discuss the Pearson's correlation coefficient under following heading.

(i) Definition
(ii) Usage
(iii) Interpretation

(06 marks)

(b) Briefly describe the following situations using suitable diagrams.

(i) Strong negative correlation
(ii) Weak positive correlation

(04 marks)

(c) Following table summarizes the data on age and blood glucose level of six individuals. Calculate the person's correlation coefficient and comment it.

Subject	Age	Glucose level
1	43	99
2	21	65
3	25	79
4	42	75
5	57	87

Part II

03. (a). LED bulbs produced by The Sigma Company were found to be defective. There are th factories (A, B, C) where such bulbs are manufactured. Quality Control Manager (QC found that 4% of A's bulbs are defective, that 6% of B's bulbs are defectives, and t 3% of C's bulbs are defective. 55% of the company's bulbs are produced from A facto and 30% are produced from B factory and remains are from C factory.

(i). What is the probability that the Sigma Company's LED bulbs defective when the produced the factory?

(ii). What is the probability that an LED bulb came from the A factory given that it w defective?

(iii). What is the probability that an LED bulb came from the B factory given that it w defective?

(iv). What is the probability that an LED bulb came from the C factory given that it w defective?

(10 Mark

(b). An Economics class has 13 boys and 15 girls. The teacher wants to form a committee o 4 students to plan a farewell party.

(i). How many different committees can be formed if there are no restrictions?

(ii). How many different committees can be formed if there must be at least one boy an one girl on the committee?

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04. (a). Fifth grade students in a school, the average IQ is 80. A team of teachers wants to test new teaching method to see if it has either a positive or negative effect on intelligence or no effect at all. A sample of 30 participants who have participated to the new teachin method class has a mean of 95 with a standard deviation of 10. Teachers need to buil hypothesis and test the sample using 0.05 significant level. Answer for followin questions.

(i) Define Null and Alternative Hypotheses
(ii) State Alpha
(iii) State Decision Rule
(iv) Calculate Test Statistic
(v) State Results
(vi) State Conclusion

(07 Mark

(b). In order to determine daily staffing needs of a retail store, the manager may wish to kno whether there are an equal number of customers each day of the week. The manag asked to an officer to counts the number of customers of each day that are visited in week. Following table shows observed values.

Day of the Week	No. of Customers
Sunday	145
Monday	170
Tuesday	140
Wednesday	120
Thursday	160
Friday	175
Saturday	190

To check whether the mean number of customers per day is equal with 10% of significant level:

(i) Define Null and Alternative Hypotheses
(ii) Calculate test statistics
(iii) State degrees of freedom
(iv) State conclusion

(08 Marks)

Part III

05. (a) A salesman makes a sale on the average to 40% of the consumers he contact. If four consumers are contacted today, what is the probability he makes sales to exactly two?

(03 Marks)

(b) What are the required assumptions to your answer in (a)?

(03 Marks)

(c) State the probability distribution function of X, if X is a Poisson random variable whose variance is 1.25.

(01 Marks)

(d) Since $X \sim P(2.2)$ Find $P(X = 3)$ and $P(X \geq 3)$

(03 Marks)

(a) If X is a continuous random variable which has a normal distribution. The expected value of X is 45 and the standard deviation is 4.

(i) Find $P(X > 42)$
(ii) Find $P(48 \leq X \leq 51)$
(iii) Find the value of X_o when $P(X \leq X_o) = 0.025$

(05 Marks)

06. (a) Differentiate simple linear regression and multiple linear regression.

(03 Marks)

(b) Consider the following multiple linear regression equation.
$\hat{Y} = 17.33 + 1.19X_1 + 2.91X_2$

State the following statements are 'true' or 'false', and justify your answer.

(i) Y is and independent variable of this model.
(ii) There is a strong negative relationship between X_1 and Y
(iii) X_2 has a stronger relationship with Y than X_1
(iv) When X_1 and X_2 values are zero, Y has a value greater than zero
(v) When $X_1 = 45$ and $X_2 = 15$ the predicted value of Y is approximately 115.

(05 marks)

(c) The following table shows that sales of a commodity within the period of 20 2009.

Year	Sales ('000)	Year	Sales ('000)
2000	43.1	2005	49.5
2001	50.1	2006	60.2
2002	38.1	2007	53.6
2003	45.1	2008	47.7
2004	44.3	2009	50.3

(i) Estimate the trend line by using semi – average method and sketch it.

(ii) Estimate the trend value for the year 2003 by using method of mov averages of order 03.

(iii) Estimate the trend value for the year 2007 by using method of mov averages of order 02.

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MAE5102 - List of Equations

1.

$$\bar{X} = \frac{X_1 + X_2 + \cdots + X_n}{n}$$

2.

$$\bar{X} = \frac{f_1X_1 + f_2X_2 + \cdots + f_KX_K}{f_1 + f_2 + \cdots + f_K} = \frac{\sum_{j=1}^{K} f_jX_j}{\sum_{j=1}^{K} f_j} = \frac{\sum fX}{\sum f} = \frac{\sum f_X}{N}$$

3.

$$\bar{X} = A + \frac{\sum_{j=1}^{N} d_j}{N} = A + \frac{\sum d}{N}$$

4.

$$\bar{X} = A + \frac{\sum_{j=1}^{K} f_jd_j}{\sum_{j=1}^{K} f_j} = A + \frac{\sum fd}{N}$$

5.

$$\text{Median} = L_1 + \left(\frac{\frac{N}{2} - (\sum f)_1}{f_{\text{median}}}\right)c$$

6.

$$\text{Mode} = L_1 + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2}\right)c$$

7. $$MD = \frac{1}{n}\sum_{i=1}^{n}|x_i - \bar{x}|$$

8. $$MD = \frac{1}{n}\sum_{i=1}^{n} f|x_i - \bar{x}|$$

9. $$\sigma^2 = \frac{\sum_{i=1}^{N}(X-\bar{X})^2}{N}$$

10. $$S^2 = \frac{\sum_{i=1}^{n}(X-\bar{X})^2}{n}$$

11. $$S^2 = \frac{\sum_{i=1}^{n} f(X-\bar{X})^2}{n}$$

12. $$Q_1 = l + \frac{h}{f}\left(\frac{n}{4} - CF\right)$$

13. $$Q_3 = l + \frac{h}{f}\left(\frac{3n}{4} - CF\right)$$

14. $$Sk_1 = \frac{\bar{X}-Mode}{S}$$

15. $$Sk_2 = \frac{3(\bar{X}-Median)}{S}$$

16. $$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{[\sum(x-\bar{x})^2][\sum(y-\bar{y})^2]}}$$

17. $$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

18. $$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

19. $$R = 1 - \frac{6\left\{\sum D^2 + \frac{1}{12}(m_1^3 - m_1) + \frac{1}{12}(m_1^3 - m_2)\right\} + \cdots}{n\left(n^2-1\right)}$$

20. $P(B_i|\,A) = \frac{P(A\,|B_i)P(B_i)}{\sum_{i=1}^{n} P(A\,|\,B_i)P(B_i)}$.

21. $\bar{\boldsymbol{X}} \mp \boldsymbol{Z}\frac{S}{\sqrt{n}}$

22. $\hat{p} \pm z^*\left(\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\right)$

23. $Z^* = \frac{\hat{p}-p}{\sqrt{\frac{p_0(1-p_0)}{n}}}$

24. $t^* = \frac{\bar{x}-\mu_0}{\frac{S}{\sqrt{n}}}$

25. $\chi^2 = \sum\left[\frac{(O_i - E_i)^2}{E_i}\right]$

Standard Normal Probabilities

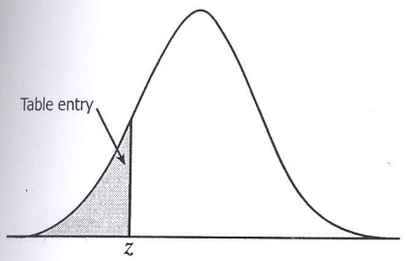
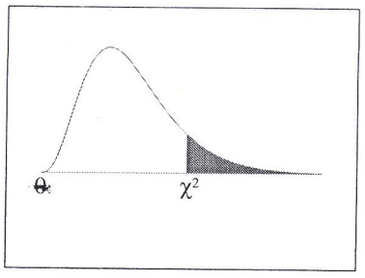


Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	*.5000*	*.4960*	*.4920*	*.4880*	*.4840*	*.4801*	*.4761*	*.4721*	*.4681*	*.4641*

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

Table

$= \chi^2_\alpha$.

$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	
3.841	5.024	6.635	
5.991	7.378	9.210	
7.815	9.348	11.345	
9.488	11.143	13.277	
1.070	12.833	15.086	
2.592	14.449	16.812	
4.067	16.013	18.475	
5.507	17.535	20.090	
6.919	19.023	21.666	
8.307	20.483	23.209	
9.675	21.920	24.725	
.026	23.337	26.217	
2.362	24.736	27.688	
.685	26.119	29.141	
.996	27.488	30.578	
.296	28.845	32.000	
.587	30.191	33.409	
869	31.526	34.805	
144	32.852	36.191	
410	34.170	37.566	
671	35.479	38.932	
924	36.781	40.289	
172	38.076	41.638	
415	39.364	42.980	
652	40.646	44.314	
885	41.923	45.642	
113	43.195	46.963	
337	44.461	48.278	
557	45.722	49.588	
773	46.979	50.892	
958	59.342	63.691	
095	71.420	76.154	
232	83.298	88.379	
351	95.023	100.425	1
479	106.629	112.329	1
515	118.136	124.116	1
642	129.561	135.807	1

Standard Normal Probabilities

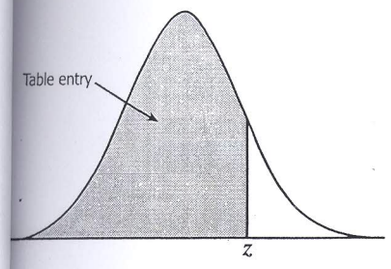


Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998