THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES DEGREE PROGRAMME - LEVEL 5
FINAL EXAMINATION – 2014
QUANTITATIVE TECHNIQUES FOR MANAGEMENT II- MCU3209
DURATION: 03 HOURS

DATE: 21.06.2014	**TIME: 1.30pm - 4.30 pm**

Instructions:

- ***Answer any five (05) questions. All questions carry equal marks (20 marks).***
- ***Use of a non-programmable calculator is allowed.***
- ***A Standard Normal table is attached.***

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(1)

(a) State the differences between Normal distribution and Standard Normal Distribution.

(b) A machine is set to produce ball-bearings with mean diameter 2 cm when the production process is in control. Each day a random sample of 50 ball-bearings are selected and the diameters are accurately measured. If the sample mean diameter lies outside the range 1.9cm to 2.1cm then it will be taken as evidence that mean diameter of the ball bearing produced is not 2 cm. The machine will then be stopped and adjustments are made to it. The diameter of the ball-bearings has a standard deviation of 0.1 cm. Assume diameter of a randomly selected ball-bearing follows a normal distribution.

(i) Find the probability that diameter of a randomly selected product is greater than 1.8cm when production process is in control.

(ii) One particular morning production manager claims that the probability of the diameter of a randomly selected ball-bearing exceeding 2.2cm on that day is 0.0228. If the manager's clam is true, what should be the mean diameter of a randomly selected ball-bearing on the particular day?

(iii) Find the distribution of sample mean diameter. Clearly sate the distribution and the necessary parameters.

(iv) Suppose the process is in control, find the probability that machine is being stopped unnecessarily for adjustments.

(v) Suppose production process is out of control and mean diameter is 2.03cm. Find the probability that machine is not being stopped for adjustments.

(2) The zinc-phosphate coating on the threads of steel tubes used in oil and gas wells is critical for their performance. To monitor the coating process, uncoated metal samples with known outside area is weighted and treated along with the lot of tubing. The samples are then stripped and weight is measured again. From this, it is possible to determine whether or not the proper amount of coating was applied to the tube.

Assume that the probability of a given lot is unacceptable is 0.05. Let X denotes the number of unacceptable lots out of 20 testing runs. Assume that the testing runs are independent, i.e., the outcome of a testing run has no effect on that of any other.

(i) Find the probability that the number of unacceptable lots is at most 3 out of 20 testing runs.

(ii) What is the expected number of unacceptable lots out of 20 testing runs?

(iii) Find the variance of unacceptable lots out of 20 testing runs.

(iv) Suppose that first ten testing runs have produced acceptable lots. Find the probability that the number of unacceptable lots out of 20 testing runs is at most 2.

(3)

(a) A restaurant kitchen has two food mixing machines A and B. The average number of times Machine A breakdowns per week is 0.3 and the average number of times Machine B breakdowns per week is 0.2. Find the probability that more than 4 total break downs of both machines per month assuming that month has four weeks.

(b) A factory packs bulbs in boxes of 200. The probability of a bulb of poor quality is 0.008. What is the probability that box contains 5 bulbs of poor quality.

(c) The number of bacteria on a plant follows a Poisson distribution with parameter 20. Find the probability of there being 10 to 30 bacteria on a plant.

(4) During the first three months of 2013, a technician was timed for the repair of an electronic instrument on 12 separate occasions. In the same period, a trainee technician was timed for the repair of a similar instrument on 14 occasions. These times, in minutes, are given in the table below.

Technician	314	296	300	324	255	242	374	250	307	215	317	334		
Trainee	279	351	282	280	258	267	312	357	322	249	228	315	311	341

Assume that these observations may be regarded as independent random samples from normal populations with equal standard deviation.

(i) Construct a 95% confidence interval for the mean time difference taken to repair the instrument by technician and trainee. Interpret your answer.

(ii) Does the data provide evidence to justify the claim "The time taken to repair the instrument is the same by the technician and the trainee"? Justify your answer.

(iii) Subsequently it was learned that the times for the trainee and the technician were incorrectly recorded and that each of the values above is 30 minutes less than the actual. What, if any difference does this make to the result of the part (i).

(5) An inventor has developed a new, energy-efficient lawn mower engine. He claims that the engine will run continuously for 5 hours (300 minutes) on a single gallon of regular gasoline. To test inventor's claim a randomly selected sample of 25 engines are tested. The engines run for an average of 295 minutes, with a standard deviation of 20 minutes. Assume that run times for the population of engines are normally distributed.

(a) Construct 95% confidence interval for the mean runtime of the engine on a single gallon of regular gasoline. Comment on the inventor's claim.

(b) Suppose you are asked to conduct a statistical test to test the inventor's claim;

(i) Clearly sate the null hypothesis and the alternative hypothesis that you should test.

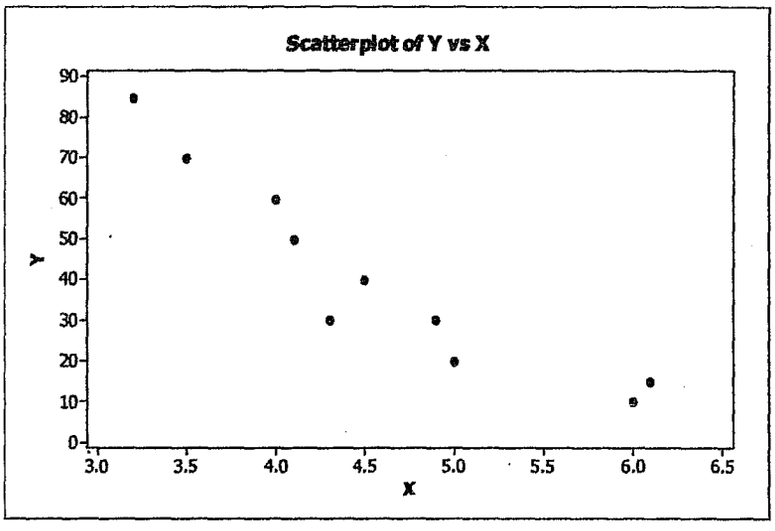
(ii) Conduct a suitable statistical test to test the inventors claim. What is your conclusion at 0.5 level of significance?

(c) State the assumptions if any that you have made answering part (a) and (b).

(6) In studying the effect of air quality on a lake, an experimenter takes observations on the pH of the water and the air quality as measures on the air quality index. The index goes from 0 to 100, where large index numbers represent high pollution. These data are shown below.

pH(X)	4.5	4.1	4.3	4	5	6	3.5	4.9	3.2	6.1
Air Quality index(Y)	40	50	30	60	20	10	70	30	85	15

(a) Scatter plot for the above data is given below. Comment on the scatter plot.



(b) The ANOVA table for linear regression model for the above data is given below.

Regression Analysis: Y versus X

The regression equation is
Y = 151 - 24.0 X

Predictor	Coef	SE Coef	T
Constant	150.62	15.40	9.78
X	-24.039	3.311	-7.26

S = 9.55125 R-Sq = 86.8%

Analysis of Variance

Source	DF	SS	MS	F
Regression	1	4810.2	4810.2	52.73
Residual Error	8	729.8	91.2	
Total	9	5540.0		

(i) Comment on the variation explained by the fitted model.

(ii) Conduct a suitable test to test whether the fitted linear model significant at 5% level of significance. Comment on your results.

(iii) What is the change of the index of air pollution for increasing unit change of pH value in water?

(iv) Estimate the index of air pollution when the water of the lake has pH =3.8.

(7)

(a) Briefly explain the Components of a time series data.

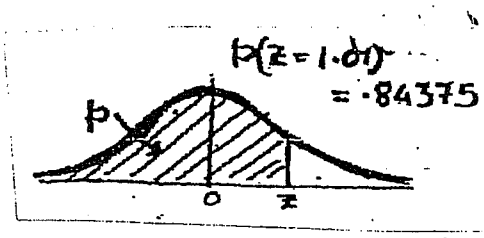
(b) The following table provides monthly sales (in Rs. 1000s) at a bookstore.

Year	Quarter	Sales
2010	1	576
2010	2	424
2010	3	412
2010	4	560
2011	1	580
2011	2	426
2011	3	452
2011	4	558
2012	1	610
2012	2	470
2012	3	464
2012	4	616
2013	1	678
2013	2	612
2013	3	564
2013	4	738

(i) Plot the data and comment on the graph.

(ii) Calculate the seasonal effects.

(iii) Calculate the forecasted sales for the first quarter in the year 2014.



STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997