00331

(18)

THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES HONORS DEGREE PROGRAMME
LEVEL 05
FINAL EXAMINATION – 2020
QUANTITATIVE TECHNIQUES FOR MANAGEMENT II – MCU 3209/ MSU 5509
DURATION THREE (03) HOURS

DATE: 22nd January 2020	TIME: 1.30 pm – 4.30 pm

Answer 5 questions only.
Use of a non-programmable calculator is allowed.

Question 1

a. A manufacturer of metal pistons finds that on an average, 10% of his pistons are rejected because they are either oversize or undersize. What is the probability that a batch of 10 pistons will contain at least 2 rejects? (5 marks)

b. A website receives hits at a rate of 300 per hour. Find the probability of 10 hits in a given minute. (5 marks)

c. A company pays its employees an average wage of Rs 585/- per day with a standard deviation of Rs 108/-. If the wages are approximately normally distributed, determine the proportion of the workers getting wages between Rs 495/- and Rs 664/- per day. (5 marks)

d. The probability that a new restaurant in a particular city fails in the first year of operation is 0.1. If 15 new restaurants are sampled, use Normal approximation to calculate the probability that more than 5 out of the 15 restaurants fail. (5 marks)

(Total 20 Marks)

Question 2

a. The target thickness for silicon wafers used in a certain type of integrated circuit is 245 μm. A sample of 50 wafers is obtained and the thickness of each one is determined, resulting in a sample mean thickness of 246.18 μm and a sample standard deviation of 3.60 μm.

i. Is this a sufficient evidence to indicate that the true thickness has varied from the original value? Use a level of significance of 0.01. (6 marks)

ii. Develop a 95% confidence interval to estimate the mean thickness. (4 marks)

b. Two different areas of a large city are being considered as sites for day-care centers. Of 200 households surveyed in one section, the proportion of which the mother worked full time was 0.52. In another section, 40% of the 150 households surveyed had mothers working at full time

jobs. At the 0.05 level of significance, is there any significant difference in the proportions of working mothers in the two areas of the city? (10 marks)

(Total 20 marks)

Question 3

A scientist wants to know if the highest education level and marital status are related for all people in the country. He collects data on a simple random sample of n = 300 people.

Marital status	Highest education level				Total
	Ordinary level	Advanced level	Degree	Masters or above	
Single	18	36	21	15	90
Married	12	36	45	57	150
Divorced	6	9	9	6	30
Widowed	3	9	9	9	30
Total	39	90	84	87	**300**

Can we infer at 5% significance level that the highest education level is associated with marital status?

(Total 20 marks)

Question 4

A researcher wishes to investigate the relationship between calcium intake and knowledge about calcium in sports science students. The sample data is given in the table below.

Respondent Number	Knowledge score (out of 100)	Calcium intake (mg/ day)
1	20	450
2	84	1050
3	76	900
4	30	525
5	44	710
6	64	854
7	80	800
8	28	493
9	52	730
10	64	894

a. Plot the data on a scatter diagram and interpret the relationship you can observe. (5 marks)
b. Calculate the correlation between knowledge score and Calcium intake. Interpret the correlation between the two factors? (6 marks)

c. Calculate the regression equation. (Use knowledge score to predict Calcium intake) (5 marks)

d. If the knowledge score is 28, what amount of Calcium intake would you predict? Compare that result with the values in the table. Why doesn't the regression equation predict the exact value? (4 marks)

(Total: 20 marks)

Question 5

a. A juice company is planning an expansion. The management wishes to predict which sites are likely to be profitable. Several areas, where predictors of profitability can be identified, are: number of hotel rooms within 3km from the site (Number), distance to the nearest juice stall (Nearest), number of offices (Office Space), number of colleges (Enrollment), median annual household income (Income) and distance to town (Distance). The data was analysed using SPSS. The outputs are as follows:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.725[a]	.525	.494	5.5121

a. Predictors: (Constant), Distance, Office Space, Enrollment, Nearest, Number, Income

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3123.832	6	520.639	17.136	.000[a]
	Residual	2825.626	93	30.383		
	Total	5949.458	99			

a. Predictors: (Constant), Distance, Office Space, Enrollment, Nearest, Number, Income

b. Dependent Variable: Margin

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	38.139	6.993		5.454	.000
	Number	-.008	.001	-.440	-6.089	.000
	Nearest	1.646	.633	.188	2.601	.011
	Office Space	.020	.003	.422	5.796	.000
	Enrollment	.212	.133	.115	1.587	.116
	Income	.413	.140	.216	2.960	.004
	Distance	-.225	.179	-.091	-1.260	.211

a. Dependent Variable: Margin

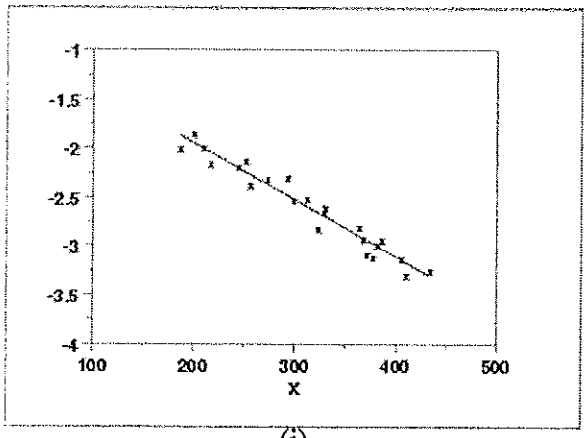
i. Determine the regression equation based on the given outputs. (3 marks)

ii. The management of the company claims that the profit margin increases with the distance to town. Is this statement correct? Justify your answer. (2 marks)

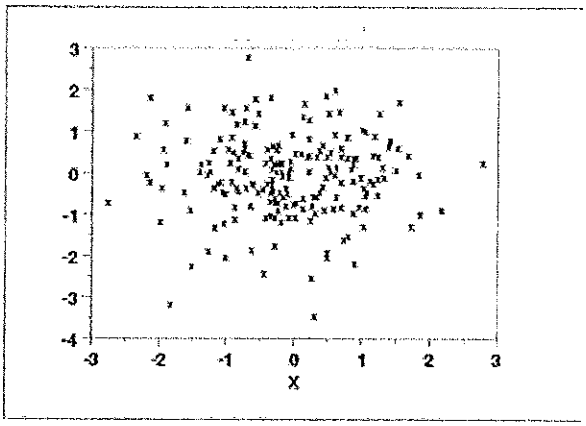
iii. Interpret the coefficient of the variable of 'median household income'. (Its strength and how it may affect the profit margin) (3 marks)

iv. Estimate the profit margin with 23 number of hotel rooms within 3km from the site (Number), 4km distance to the nearest juice stall (Nearest), 10 offices (Office Space), 3 colleges (Enrollment), Rs 350,000/- of median annual household income (Income) and 1.5km distance to town (Distance). (2 marks)

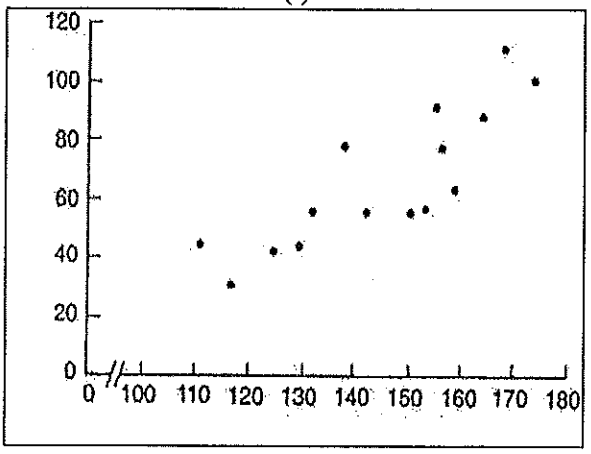
b. Comment on the following scatter plots. (i.e. the relationship and its strength) (10 marks)



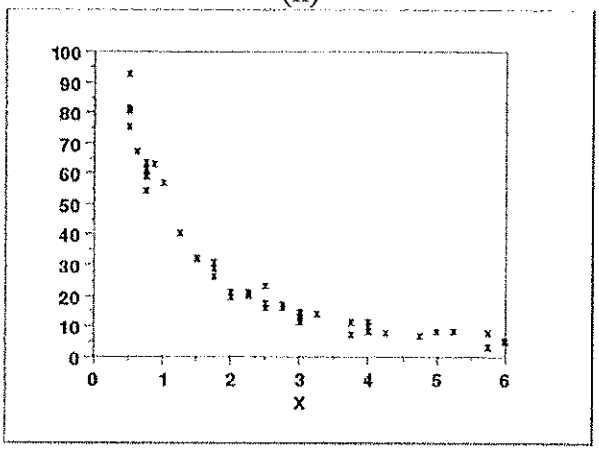
(i)



(ii)



(iii)



(iv)

(Total: 20 marks)

Question 6

a. The quarterly sales of a company have to be analysed to develop a forecast. The data are as follows:

Period	Year	Quarter	Sales	Centered Moving Averages (CMA)	Sales/ CMA
1	2016	1	211		
2		2	274		
3		3	235	235.625	1.00
4		4	227	236.375	0.96
5	2017	1	202	244.75	0.83
6		2	289	252.375	1.15
7		3	287	258.375	1.11
8		4	236	261	0.90
9	2018	1	241	254.75	0.95
10		2	271	258.125	1.05
11		3	255	265.125	0.96
12		4	295	265.875	1.11
13	2019	1	238	270.125	0.88
14		2	280	265.25	1.06
15		3	280		
16		4	231		

i. Find the seasonal index values using the moving averages. (8 marks)

ii. If the trend line equation is, Sales = 237.83+1.8*Period, find the forecasted sales for the four quarters of year 2020. (4 marks)

b. Explain the components of time series using suitable illustrations or examples? (8 marks)

(Total: 20 marks)

Cumulative Binomial Probabilities

e. n = 9

k	0.01	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95	0.99
0	0.914	0.630	0.387	0.134	0.040	0.010	0.002	0.000	0.000	0.000	0.000	0.000	0.000
1	0.997	0.929	0.775	0.436	0.196	0.071	0.020	0.004	0.000	0.000	0.000	0.000	0.000
2	1.000	0.992	0.947	0.738	0.463	0.232	0.090	0.025	0.004	0.000	0.000	0.000	0.000
3		0.999	0.992	0.914	0.730	0.483	0.254	0.099	0.025	0.003	0.000	0.000	0.000
4		1.000	0.999	0.980	0.901	0.733	0.500	0.267	0.099	0.020	0.001	0.000	0.000
5			1.000	0.997	0.975	0.901	0.746	0.517	0.270	0.080	0.008	0.001	0.000
6				1.000	0.996	0.975	0.910	0.768	0.537	0.262	0.053	0.008	0.000
7					1.000	0.996	0.980	0.929	0.804	0.564	0.225	0.071	0.003
8						1.000	0.998	0.990	0.960	0.866	0.613	0.370	0.086
9							1.000	1.000	1.000	1.000	1.000	1.000	1.000

f. n = 10

k	0.01	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95	0.99
0	0.904	0.599	0.349	0.107	0.028	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1	0.996	0.914	0.736	0.376	0.149	0.046	0.011	0.002	0.000	0.000	0.000	0.000	0.000
2	1.000	0.988	0.930	0.678	0.383	0.167	0.055	0.012	0.002	0.000	0.000	0.000	0.000
3		0.999	0.987	0.879	0.650	0.382	0.172	0.055	0.011	0.001	0.000	0.000	0.000
4		1.000	0.998	0.967	0.850	0.633	0.377	0.166	0.047	0.006	0.000	0.000	0.000
5			1.000	0.994	0.953	0.834	0.623	0.367	0.150	0.033	0.002	0.000	0.000
6				0.999	0.989	0.945	0.828	0.618	0.350	0.121	0.013	0.001	0.000
7				1.000	0.998	0.988	0.945	0.833	0.617	0.322	0.070	0.012	0.000
8					1.000	0.998	0.989	0.954	0.851	0.624	0.264	0.086	0.004
9						1.000	0.999	0.994	0.972	0.893	0.651	0.401	0.096
10							1.000	1.000	1.000	1.000	1.000	1.000	1.000

g. n = 15

k	0.01	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95	0.99
0	0.860	0.463	0.206	0.035	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.990	0.829	0.549	0.167	0.035	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	1.000	0.964	0.816	0.398	0.127	0.027	0.004	0.000	0.000	0.000	0.000	0.000	0.000
3		0.995	0.944	0.648	0.297	0.091	0.018	0.002	0.000	0.000	0.000	0.000	0.000
4		0.999	0.987	0.836	0.515	0.217	0.059	0.009	0.001	0.000	0.000	0.000	0.000
5		1.000	0.998	0.939	0.722	0.403	0.151	0.034	0.004	0.000	0.000	0.000	0.000
6			1.000	0.982	0.869	0.610	0.304	0.095	0.015	0.001	0.000	0.000	0.000
7				0.996	0.950	0.787	0.500	0.213	0.050	0.004	0.000	0.000	0.000
8				0.999	0.985	0.905	0.696	0.390	0.131	0.018	0.000	0.000	0.000
9				1.000	0.998	0.966	0.849	0.597	0.278	0.061	0.002	0.000	0.000
10					0.999	0.991	0.941	0.783	0.485	0.164	0.013	0.001	0.000
11					1.000	0.998	0.982	0.909	0.703	0.352	0.056	0.005	0.000
12						1.000	0.996	0.973	0.873	0.602	0.184	0.036	0.000
13							1.000	0.995	0.965	0.833	0.451	0.171	0.010
14								1.000	0.995	0.965	0.794	0.537	0.140
15									1.000	1.000	1.000	1.000	1.000

$P(r) = {}^{n}C_r p^r q^{(n-r)}$

$P(x) = \frac{e^{-\lambda}\lambda^x}{x!}$ where, e = 2.718

$x - E < \mu < x + E$ where, $E = Z_{\alpha/2}\ \frac{\sigma}{\sqrt{n}}$ or $E = t_{\alpha/2}\ \frac{s}{\sqrt{n}}$

$p - E < p < p + E$ where, $E = Z\sqrt{\frac{p(1-p)}{n}}$

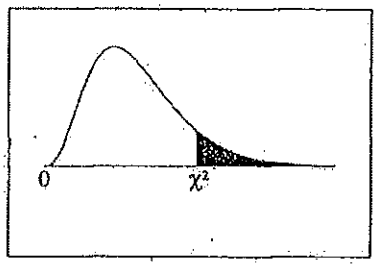
$$\chi^2_{STAT} = \sum_{\text{all cells}} \frac{(f_o - f_e)^2}{f_e}$$

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

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

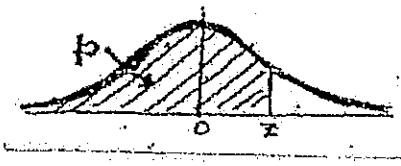
$$a = \frac{\sum y}{n} - b.\frac{\sum x}{n}$$

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



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