KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2017/2018

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF MASTER OF PUBLIC POLICY AND ADMINISTRATION

APP 801: QUANTITATIVE TECHNIQUES FOR PUBLIC POLICY

DATE: Monday 29th January 2018 **TIME: 5.30p.m-8.30p.m**

INSTRUCTIONS

This paper contains five questions.

Answer any four questions. All questions carry equal marks

Question One

Apex Ltd is planning to launch a new product next year. It has carried out a survey on the products prototype's colour, brand name and packaging. 200 potential customers were given questionnaires and were requested to indicate their liking or otherwise of each of the three attributes of the product. Their responses were as follows:-

24 persons liked the packaging and brand name
77 persons liked the brand name or the colour but not packaging
40 persons liked the colour only
120 persons liked the brand name or the colour
23 persons liked the colour and the packaging
43 persons liked at least two attributes
5 persons did not like any of the three attributes
25 of the customers did not return the questionnaires
The company accepted an attribute to be incorporated in the product if at least 50% of those who responded to the questionnaire liked it.

Required:-

i. Present the above information in a Venn diagram (5 Marks)
ii. The number of persons that liked all the three attributes (5 Marks)
iii. The proportion of persons that liked the colour (4 Marks)
iv. The proportion of persons that liked the brand name (4 Marks)

v. The proportion of persons that liked the packaging (4 Marks)
vi. Attribute(s) to be incorporated (3 Marks)

Question Two

Gatheru and Kabiru Certified Public Accountants have recently started to give business advice to their clients. Acting as consultants, they have estimated the demand curve of a client's firm to be:

$P = 200 - 8Q$

Where P is price in millions of shillings and Q is the output in units.

Investigations of the client firm's cost profile shows that marginal cost (TC) is given by:

$$TC = \frac{Q^3}{3} - 14Q^2 + 211Q + 10$$ (in millions of shillings)

Required:

(i) The equation of total revenue **(5 marks)**

(ii) The level of output that maximize revenues. **(5 marks)**

(iii) The level of output that minimize costs. **(5 marks)**

(iv) An expression for total profit **(5 marks)**

(v) The level of output that maximizes profit **(5 marks)**

Question Three

Four months ago, a Restoration team submitted a competitive bid to the Lake Basin Authority to revitalize Lake Victoria in Western Kenya. The team had developed a new technique to combat water pollution by increasing the basic amount of oxygen in a lake, called oxygenation.

Oxygenation of a lake is a very complex project involving specialized equipment and specially trained personnel. The contract was for a period of more than half of a year, a long enough period for significant changes to occur in the economy and in the availability of resources. The Authority wanted the project to be completed on time and therefore the contract contained a $2000 token clause for each week below the agreed – on 30-week completion time.

The team felt that planning, monitoring and controlling this job could be staggering.

The team approaches you having done a course in operations management. After consulting with the team, you came up with a list of activities with each activity clearly defined as below:

Activity	Activity Description	Duration in Weeks	Preceding Activities
a	Administrative Set-up	3	-
b	Hire Personnel	4	a
c	Obtain materials	4	a
d	Transport materials to the lake	2	c
e	Gather measuring team	4	a
f	Planning	6	c
g	Assemble equipment	3	d,b
h	Plan evaluation	1	e
I	Oxygenation	12	f,g
j	Measurement & Evaluation	2	i,h

Required:

a) Briefly explain three main functions in project management (3 Marks)
b) Set up the project network showing the various activities and durations. (5 Marks)
c) Determine the critical path of the project. (5 Marks)
d) What is the longest period that the project can take to complete? (2 Marks)

e) Just to be sure that they were on schedule; you sought to find the status of the project on the 10^{th} week. You established the following in terms of progress by the 10^{th} week: Is the project on schedule? (5 Marks)

Activity	Percentage completed
a	100
b	100
c	100
d	75
e	100
f	60
g	0
h	20
I	0
j	0

f) After completing the project, the Lake Basin Authority did not honor the token clause and hence the Restoration Team sued the Authority for breach of contract. How much would the Authority have to pay to the team if the case is in favour of the team? (5 Marks)

Question Four

(a) The government is concerned about the rising mortgage rates in the country and there has been a claim that the average mortgage rate is 12%. The Housing Finance Corporation of Kenya estimated the mean mortgage rate for savings and loan institutions across the nation. A sample of 100 institutions was taken under the assumption that rates were normally distributed. A mean and standard deviation of 10.3% and 2.1% were calculated respectively. Based on the sample results, is the government concern justified? $\alpha = 0.01$. (10 marks)

(b) It has been theorized that in the ideal balanced workforce in a certain industry, the rations of Managerial, Clerical & Professional employees will be around 1: 3: 6. A particular firm in the industry employs 7 managers, 30 clerical staff and 43 trained professional personnel. Test at the 10% significance level whether this company differs substantially from the ideal. (15 Marks)

Question Five

(a) Distinguish between simple and multiple regression analysis. (5 Marks)
(b) The data below shows the ages and pries of eleven Nyota Cars. The Age is in years while prices are in ten thousands shillings.

Age (yrs)	6	8	7	7	6	5	8	7	6	6	3
Prices (00,000)	32	22	23	22	28	35	17	24	27	25	47

Given that the relationship between price and Age of Nyota Cars is approximately given by a linear equation $y = a + bx$, where y is price and x is age, Appendix 1 is the summary output of the regression analysis.

i) Determine and interpret the correlation coefficient. **(3 Marks)**

ii) Write down the exact functional relationship between the price and Age of Nyota cars. **(5 Marks)**

iii) Interpret the value of b above. What is the price of a new Nyota Car? **(5 Marks)**

iv) How much of the variations in price would be explained by variations in the Age of Nyota Car? **(2 Marks)**

v) Would you conclude that Age indeed affects the price of a Nyota car? Explain your answer. **(5 Marks)**

Appendix 1: SUMMARY OUTPUT

Regression Statistics					
Multiple R	0.891374385				
R Square	0.794548294				
Adjusted R Square	0.771720327				
Standard Error	3.721605883				
Observations	11				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	482.0741196	482.0741196	34.80591518	0.00022917
Residual	9	124.6531532	13.85035035		
Total	10	606.7272727			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	
Intercept	57.2027027	5.316220593	10.76003181	1.93854E-06	
Age(X)	-4.887387387	0.828419351	-5.899653819	0.00022917	

Appendix 2: USEFUL FORMULAE

1. The quadratic equation:

   If $ax^2 + bx + c = 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

2. Z- scores:

   $$Z = \frac{x_i - \mu}{\delta}$$

3. Confidence Interval for the population mean:

   $\mu = \bar{x} \pm Z_{\alpha/2}\delta_{\bar{x}}$ where $\delta_{\bar{x}}$ is the standard error of the mean.

4. The standard error for the mean:

   $\delta_{\bar{x}} = \dfrac{\delta}{\sqrt{n}}$, where δ is the population standard deviation and n is the sample size.

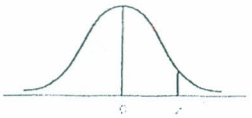
5. Calculated statistic for a single mean:

   $$Z_{cal} = \frac{\bar{x} - \mu}{\delta_{\bar{x}}}$$

6. Chi-square test statistic:

$\chi^2_{cal} = \sum \frac{(O-E)^2}{E}$, where O is the observed frequency and E is the expected frequency.

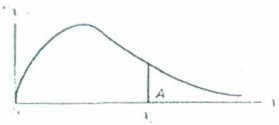
Table 3 Normal Probabilities



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

SOURCE: Abridged from Table 1 of A. Hald, *Statistical Tables and Formulas* (New York: Wiley & Sons, Inc.), 1952. Reproduced by permission of A. Hald and the publisher, John Wiley & Sons, Inc.

Table 5 Critical Values of χ^2



DEGREES OF FREEDOM	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.0000393	0.0001571	0.0009821	0.0039321	0.0157908	2.70554	3.84146	5.02389	6.63490	7.87944
2	0.0100251	0.0201007	0.0506356	0.102587	0.210720	4.60517	5.99147	7.37776	9.21034	10.5966
3	0.0717212	0.114832	0.215795	0.351846	0.584375	6.25139	7.81473	9.34840	11.3449	12.8381
4	0.206990	0.297110	0.484419	0.710721	1.063623	7.77944	9.48773	11.1433	13.2767	14.8602
5	0.411740	0.554300	0.831211	1.145476	1.61031	9.23635	11.0705	12.8325	15.0863	16.7496
6	0.675727	0.872085	1.237347	1.63539	2.20413	10.6446	12.5916	14.4494	16.8119	18.5476
7	0.989265	1.239043	1.68987	2.16735	2.83311	12.0170	14.0671	16.0128	18.4753	20.2777
8	1.344419	1.646482	2.17973	2.73264	3.48954	13.3616	15.5073	17.5346	20.0902	21.9550
9	1.734926	2.087912	2.70039	3.32511	4.16816	14.6837	16.9190	19.0228	21.6660	23.5893
10	2.15585	2.55821	3.24697	3.94030	4.86518	15.9871	18.3070	20.4831	23.2093	25.1882
11	2.60321	3.05347	3.81575	4.57481	5.57779	17.2750	19.6751	21.9200	24.7250	26.7569
12	3.07382	3.57056	4.40379	5.22603	6.30380	18.5494	21.0261	23.3367	26.2170	28.2995
13	3.56503	4.10691	5.00874	5.89186	7.04150	19.8119	22.3621	24.7356	27.6883	29.8194
14	4.07468	4.66043	5.62872	6.57063	7.78953	21.0642	23.6848	26.1190	29.1413	31.3193
15	4.60094	5.22935	6.26214	7.26094	8.54675	22.3072	24.9958	27.4884	30.5779	32.8013
16	5.14224	5.81221	6.90766	7.96164	9.31223	23.5418	26.2962	28.8454	31.9999	34.2672
17	5.69724	6.40776	7.56418	8.67176	10.0852	24.7690	27.5871	30.1910	33.4087	35.7185
18	6.26481	7.01491	8.23075	9.39046	10.8649	25.9894	28.8693	31.5264	34.8053	37.1564
19	6.84398	7.63273	8.90655	10.1170	11.6509	27.2036	30.1435	32.8523	36.1908	38.5822
20	7.43386	8.26040	9.59083	10.8508	12.4426	28.4120	31.4104	34.1696	37.5662	39.9968
21	8.03366	8.89720	10.28293	11.5913	13.2396	29.6151	32.6705	35.4789	38.9321	41.4010
22	8.64272	9.54249	10.9823	12.3380	14.0415	30.8133	33.9244	36.7807	40.2894	42.7956
23	9.26042	10.19567	11.6885	13.0905	14.8479	32.0069	35.1725	38.0757	41.6384	44.1813
24	9.88623	10.8564	12.4011	13.8484	15.6587	33.1963	36.4151	39.3641	42.9798	45.5585
25	10.5197	11.5240	13.1197	14.6114	16.4734	34.3816	37.6525	40.6465	44.3141	46.9278
26	11.1603	12.1981	13.8439	15.3791	17.2919	35.5631	38.8852	41.9232	45.6417	48.2899
27	11.8076	12.8786	14.5733	16.1513	18.1138	36.7412	40.1133	43.1944	46.9630	49.6449
28	12.4613	13.5648	15.3079	16.9279	18.9392	37.9159	41.3372	44.4607	48.2782	50.9933
29	13.1211	14.2565	16.0471	17.7083	19.7677	39.0875	42.5569	45.7222	49.5879	52.3356
30	13.7867	14.9535	16.7908	18.4926	20.5992	40.2560	43.7729	46.9792	50.8922	53.6720
40	20.7065	22.1643	24.4331	26.5093	29.0505	51.8050	55.7585	59.3417	63.6907	66.7659
50	27.9907	29.7067	32.3574	34.7642	37.6886	63.1671	67.5048	71.4202	76.1539	79.4900
60	35.5346	37.4848	40.4817	43.1879	46.4589	74.3970	79.0819	83.2976	88.3794	91.9517
70	43.2752	45.4418	48.7576	51.7393	55.3290	85.5271	90.5312	95.0231	100.425	104.215
80	51.1720	53.5400	57.1532	60.3915	64.2778	96.5782	101.879	106.629	112.329	116.321
90	59.1963	61.7541	65.6466	69.1260	73.2912	107.565	113.145	118.136	124.116	128.299
100	67.3276	70.0648	74.2219	77.9295	82.3581	118.498	124.342	129.561	135.807	140.169

SOURCE: From C. M. Thompson, "Tables of the Percentage Points of the χ^2-Distribution," *Biometrika* 32 (1941): 188–89. Reproduced by permission of the Biometrika Trustees.