KASNEB

CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 26 May 2017.   **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE
(a)   Describe four types of sets as used in set theory.   (4 marks)

(b)   Explain the following terms as used in Markov analysis:

      (i)   Transition probability.   (1 mark)

      (ii)   Absorbing state.   (1 mark)

(c)   The average revenue and marginal cost functions of a certain company are given by:

$$AR = 650 - 15x$$

and

$$MC = 9x^2 - 14x + 180$$

Where: AR is the average revenue (in Sh. million).

              MC is the marginal cost (in Sh. million).

              x is the level of output (in units).

The fixed cost of production is Sh. 25 million.

Required:

(i)   The profit function.   (3 marks)

(ii)   The level of output that would maximise profit.   (3 marks)

(d)   Market Intelligence Research Limited carried out a study on nine households to determine the monthly income levels and the amount of expenditure incurred by the households.

The results of the study are as shown below:

Monthly Income (Sh. "000")	15	6	9	3	20	11	14	10	12
Expenditure (Sh.)	2,000	200	500	500	2,500	800	1,500	1,500	1,600

Required:

(i)   The least squares regression function relating the monthly income and expenditure incurred by the households. Interpret your results.   (7 marks)

(ii)   The expenditure incurred by a household whose monthly income is Sh.30,000.   (1 mark)

                                                  (Total: 20 marks)

QUESTION TWO

(a) Highlight four properties of a binomial experiment. (4 marks)

(b) Viwanda Limited is a company that operates in the printing industry. The company has a total of 30 machines that operate a 24 hour cycle. The probability of a machine breaking down on any given day is 0.015.

Required:

(i) The probability that exactly four machines break down in a given day, using poisson distribution. (3 marks)

(ii) The probability that exactly four machines break down in a given day, using binomial distribution. (2 marks)

(iii) Comment on the results obtained in (b)(i) and (b)(ii) above. (2 marks)

(c) ABC Limited has recently developed a new product named "Exe". The demand for "Exe" is expected to be low, medium or high with probabilities of 0.25, 0.45 and 0.30 respectively.

The product is to be manufactured at small or large scale production with the following annual profit estimates:

		Small scale production		Large scale production	
		Profit (Sh. million)	Probability	Profit (Sh. million)	Probability
Demand	Low	40	0.25	5	0.25
	Medium	140	0.45	90	0.45
	High	180	0.30	280	0.30

Required:
Advise ABC Limited on the best course of action based on the following approaches:

(i) Expected profit. (3 marks)

(ii) Minimising risk. (6 marks)

(Total: 20 marks)

QUESTION THREE

(a) Mwangaza Limited deals in the production of electric bulbs. A random sample of 10 electric bulbs produced by the company yielded the following results on the lifetime of the bulbs:

Lifetime (hours)   4,400   4,800   3,700   3,900   5,500   4,000   3,700   4,100   4,000   5,400

The hypothetical population mean of the lifetime of the electric bulbs is given as 4,000 hours.

Required:
Test at a 5 per cent level of significance, whether there is a significant difference between the sample mean and the population mean. (8 marks)

(b) Green Furniture Limited manufactures two models of plastic chairs, C_1 and C_2 from plastic waste, using two automated machines, X and Y. The following information relates to the production of the two models of chairs for the coming year:

		C_1	C_2
Maximum sales (units)		8,000	12,000
Selling price (Sh.)		1,000	900
Machine time (hours):	X	0.5	0.3
	Y	0.4	0.45

The maximum operating hours of machines X and Y are 3,400 and 3,840 respectively. The maximum quantity of plastic waste available is 34,000 kilogrammes and each chair requires 4 kilogrammes of plastic waste. The company purchases plastic waste at Sh.50 per kilogramme. Variable machine overheads are estimated to be Sh.250 and Sh.300 per machine hour for machines X and Y respectively. All chairs produced are expected to be sold during the period. A computer generated print out of the linear programming model is as given below:

Objective function value 4,441,250.

Variable	Value	Reduced values	Objective coefficient	All increase	All decrease
C_1	4,250	0	555	261.70	65.00
C_2	4,250	0	490	65.00	157.00

Constraints	Value	Shadow Price	Right hand side constraint	Allowable increase	Allowable decrease
Plastic waste	34,000	98.125	34,000	1,733.33	6,800
Machine X	3.400	325.000	3,400	850.00	850
Machine Y	3,612.5	0	3,800	-	227.5

Required:

(i) Formulate the mathematical model for the linear programming problem. (4 marks)

(ii) The maximum contribution of C_1 and C_2. (2 marks)

(iii) Explain the effect on contribution of the availability of additional plastic waste and machine time. (2 marks)

(iv) Explain the sensitivity of the model to changes in contribution per unit of C_1 and C_2. (2 marks)

(v) The increase in contribution of Green Furniture Limited assuming that the management overcomes the plastic waste constraint. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Outline five assumptions of game theory. (5 marks)

(b) The table below shows marks scored by 8 students in Mathematics and English subjects:

Student:	1	2	3	4	5	6	7	8
Marks scored in Mathematics:	31	36	44	28	56	76	36	96
Marks scored in English:	56	46	66	46	36	26	46	76

Required:
The rank coefficient of correlation. Interpret your result. (5 marks)

(c) Pure Grain Society is considering the planting of wheat on a piece of land it recently acquired.

The data below relate to the estimated selling prices, yield and cost of planting the wheat:

Selling price per tonne (Sh."000")	Probability	Yield per acre (tonne)	Probability	Cost per acre (Sh."000")	Probability
240	0.18	70	0.09	12,000	0.14
250	0.29	75	0.16	14,000	0.22
260	0.31	80	0.24	16,000	0.36
270	0.14	85	0.38	18,000	0.26
280	0.08	90	0.13	20,000	0.02

You are provided with the following random numbers:

03 91 38 55 17 46 32 43 69 72 24 22 61 96 30 32

Required:
Using eight trials, simulate the average profit of Pure Grain Society. (10 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Enumerate five characteristics of a simple queuing system. (5 marks)

(b) Two companies, A and B, are competing for business whereby one company's gain is the other company's loss. The pay-off matrix is given as follows:

<table>
<tr><td colspan="2"></td><td colspan="3" align="center">Company B's strategies</td></tr>
<tr><td colspan="2"></td><td>B₁</td><td>B₂</td><td>B₃</td></tr>
<tr><td>Company A's strategies</td><td>A₁</td><td>7</td><td>4</td><td>1</td></tr>
<tr><td></td><td>A₂</td><td>4</td><td>2</td><td>0</td></tr>
<tr><td></td><td>A₃</td><td>3</td><td>-1</td><td>-2</td></tr>
<tr><td></td><td>A₄</td><td>1</td><td>5</td><td>-3</td></tr>
</table>

Required:
The optimal strategy for each company. (4 marks)

(c) Ujenzi Limited has been awarded a contract to build an office block. The tasks of the building project have been analysed as follows:

Activity	Preceding activity	Duration (months)	Total cost (Sh. million)
A	-	8	100
B	-	2	75
C	A	3	135
D	A	7	70
E	B	5	160
F	C, D	9	255
G	D	2	30
H	D, E	4	90
I	G, H	3	55

The overhead costs of the project amount to Sh.5 million per month.

Required:

(i) A network diagram for the project. (5 marks)

(ii) The minimum cost of the project. (2 marks)

(iii) Ujenzi Limited has been offered a bonus of Sh.25 million if they complete the project within a period of 20 months or less. The table below shows activities that would require to be crashed and their respective total costs:

Activity	Duration (months)	Total cost (Sh. million)
A	6	125
B	1	90
D	5	85
E	3	200
F	7	275
H	2	95

Determine whether or not Ujenzi Limited should accept the bonus offer. (4 marks)

(Total: 20 marks)

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
						Confidence Level					