

UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

FINAL EXAMINATION PAPER

MAY 2006

FULL TIME & I.D.E STUDENT

TITLE PAPER : MANAGEMENT SCIENCE

COURSE TITLE : BA 412

TIME ALLOWED : THREE (3) HOURS

- INSTRUCTIONS :**
- (1) TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS SIX (6)**
 - (2) THE PAPER CONSISTS OF SECTION A AND SECTION B.**
 - (3) ANSWER ANY TWO QUESTIONS FROM EACH SECTION.**
 - (4) THE MARKS AWARDED FOR A QUESTION /PART OF A QUESTION ARE INDICATED AT THE END OF EACH QUESTION / PART OF QUESTION.**
 - (5) WHERE APPLICABLE, ALL WORKINGS / CALCULATIONS MUST BE CLERLY SHOWN.**

NOTE: MAXIMUM MARKS WILL BE AWARDED FOR GOOD QUALITY LAYOUT, ACCURACY, AND PRESENTATION OF WORK.

THIS PAPER MUST NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

GOOD LUCK!!!

SECTION A (ANSWER ANY TWO QUESTIONS)

Q1. Government Hospital, Mbabane is concerned that the control of medical supplies is unsatisfactory resulting in high carrying costs for some items and high stock-out costs for others. It has been decided to conduct an investigation into the demand for the ordering of a number of items.

The past *demand* and *order lead time patterns* for one of the items are given below:

<u>Daily Demand</u> <u>Units</u>	<u>Probability</u>	<u>Lead time*</u> <u>Days</u>	<u>Probability</u>
4	0.07	3	0.14
5	0.12	4	0.41
6	0.14	5	0.26
7	0.19	6	0.19
8	0.18		
9	0.13		
10	0.09		
11	0.05		
12	0.03		

**Note: A lead time of, e.g., 3 days, means the order is placed at the end of the day that stock runs out and is received after 3 full days.*

A proposal has been made that a policy of ordering a basic 38 units should be adopted whenever stock falls below 30 units. To the order of 38 units there should be added the number of units necessary to bring stock up to the re-order point of 30 units at the time the order is made.

A stock of 60 units is in hand. Ordering costs amount to E10 per order, carrying costs are 50 cents per day and stock-out costs are E2 per unit.

The hospital administrators decided to carry out a Monte Carlo simulation of the demand for this item.

Random Numbers for 24 days of the demand sequence are given below:

*Demand: 03, 97, 16, 12, 55, 16, 84, 63, 33, 57, 18, 26, 23, 52, 37, 70, 56,
99, 16, 31, 68, 74, 27, 00.*

Lead time: 47, 74, 76, 56, 59, 22, 42, 01, 21, 60.

You are required to:

- (i). Carry out the simulation of the 24 days' demand on stock levels. (20marks).
- (ii). Calculate the average daily stock cost and average demand. (5marks).

Q2. XYZ Pharmaceutical Company uses a particular chemical in many of its products. The chemical being stored in special refrigerated units which are provided by the supplier at a nominal rental of E40 per month. The demand for the chemical is reasonably constant from month to month and averages about 1000 litres per month. The company currently rents one storage unit which has a capacity of 1000 litres, so that replenishment takes place every month when stock falls to zero. The process of stock replenishment involves cleaning and sterilising the unit each time at a cost of E50.

As a result of an expansion of the company's product range, the demand for this chemical is expected to increase to 2500 litres per month and the company Operations Manager has been asked to recommend an appropriate purchasing and storage policy. Additional storage units could be obtained but this would involve a further rental cost of E40 per month for each additional unit. However, there would be some economies in the cleaning and sterilising costs as these would only increase by E25 for each additional unit involved.

The cost of the chemical is E5 per litre and the company's cost of capital is 24% per annum.

Required:

- (a). Show that the present policy of ordering 1000 litres every month is the most economical ordering policy in the current demand situation with just the one storage unit. What is the total annual cost associated with the storing of this chemical? (8marks).
- (b). Given the projected increase in demand, advise the company on whether an additional storage unit should be rented if the objective is to minimise the storage costs involved. (9marks).
- (c). Show that demand has to increase to 7200 litres per month before it becomes economical to rent a second storage unit. (8marks).

Q3. The following information on a job has been provided:

Tasks:	A	B	C	D	E	F	G	H	I	J	K	L
Preceding Tasks:	-	-	A	A	C, D	B	-	E, F	H, G	I	J	K
Time (weeks):	8	4	4	2	3	2	1	2	3	4	3	4

Required:

- (a). Draw the network diagram for this job and determine how long it will take for the job to be completed. (10marks).
- (b). Calculate the free float which is available for each of the non-critical activities (5marks).

(c). The time taken to complete tasks A, B, D, K, and L is somewhat uncertain and the following additional information is provided:

Task:	A	B	D	K	L
Pessimistic time (days):	91	42	28	42	56
Optimistic time (days):	35	14	7	14	14

What is the expected time for the completion of this job and is the probability of the time exceeding 245 days? (10marks).

SECTION B (ANSWER ANY TWO QUESTIONS)

Q4 (a). Lorries enter a cold store unloading area randomly throughout the week, 24 hours, 7 days a week, at a mean rate of 2.5 per hour. If it takes exactly 15 minutes to unload each lorry, for what number of hours in a week will the unloading bay be unable to cope? (7marks).

(b). The demand for a stores item is Poisson with a mean number of 5 per 5 working days. What is the probability that the time between requests is:

(i). greater than 2 days? (3marks).

(ii). between 3 and 4 days? (3marks).

(iii). less than 1 day? (3marks).

(c). New clients visit a solicitor's office at random throughout the week. One solicitor is designated to deal with the initial interviews. The office is open from 9am to 5pm. The mean arrival rate is 2 per hour, and it takes an average of 20 minutes to deal with each client. Assume Poisson processes for both arrival and service times.

Calculate:

(i). how many clients on average will be waiting to see the solicitor? (3marks).

(ii). how long will they have to wait on average? (3marks).

(iii). what is the probability that no one will be waiting when a client arrives? (3marks).

Q5. Z plc, a market research bureau, expects to be able to expand its business by providing personal computers for its data collection staff. The company has to decide whether to buy or lease these machines. The growth of the business over the next four years cannot be predicted exactly, but it can be classified as high, average, or low.

In the first year after installation of the computers, it is estimated that the probability of the growth being high is 0.6. The corresponding probabilities for average and low growth in this first year are 0.3 and 0.1 respectively. In the following three year period, the prediction of expected growth is reduced to just two categories – high and low. It is estimated that, if the growth is high in the first year, there is a 0.75 probability of the growth remaining high over the next three year period. A first year average growth has a 0.5 chance of deteriorating to low in years 2 to 4. An initial low growth has a 0.9 chance of remaining low throughout the period.

The net cash revenues generated have been estimated as:

<i>Growth</i>	<i>Net cash revenue, E/year arising at year end</i>
High	E20,000
Average	E14,000
Low	E11,000

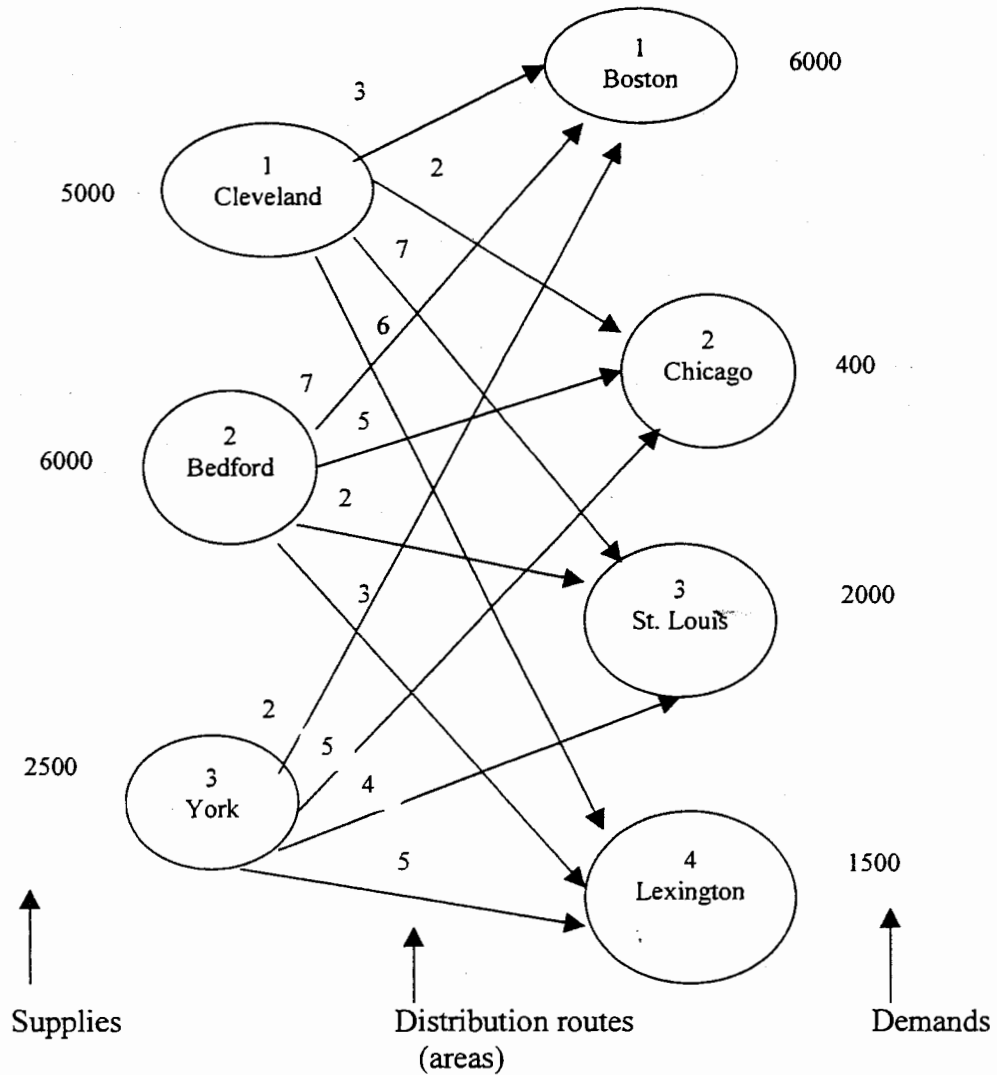
The initial purchase cost of the machine is E35,000. Z's alternative leasing arrangement is an immediate payment of E15,000 plus 25% of the net cash revenue paid at the end of each year. The company expects 12% per annum return on capital.

Use decision tree to advise Z plc whether or not it should buy or lease the computers.
(25marks).

Question 6

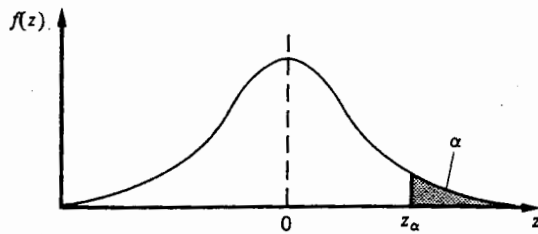
Foster Generators has production operations in Cleveland, Bedford, and York. The firm distributes its generators through four regional distribution centers located in Boston, Chicago, St. Louis, and Lexington. Production capacity and forecast of demand for the next three (3) months are shown by the network below:

Formulate the problem in a transportation table and advise the management how much of its production should be shipped from each plant to each distribution center. Use both Minimum cost method and MODI to obtain optimal solution.



(25 marks).

Normal distribution (areas)



Area (α) in the tail of the standardised Normal curve, $N(0, 1)$, for different values of z . Example: Area beyond $z = 1.96$ (or below $z = -1.96$) is $\alpha = 0.02500$. For Normal curve with $\mu = 10$ and $\sigma = 2$, area beyond $x = 12$, say, is the same as area beyond $z = \frac{x - \mu}{\sigma} = \frac{12 - 10}{2} = 1$, i.e. $\alpha = 0.15866$.

$z \rightarrow$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414
0.1	.46017	.45620	.45224	.44828	.44433	.44038	.43644	.43251	.42858	.42465
0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	.19215	.18943	.18673
0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
1.0	.15866	.15625	.15386	.15150	.14917	.14686	.14457	.14231	.14007	.13786
1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08692	.08534	.08379	.08226
1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07214	.07078	.06944	.06811
1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
2.2	.01390	.01355	.01321	.01287	.01254	.01222	.01191	.01160	.01130	.01101
2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00509	.00494	.00480
2.6	.00466	.00453	.00440	.00427	.00415	.00403	.00391	.00379	.00368	.00357
2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00263
2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
3.0	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
3.1	.00097	.00094	.00090	.00087	.00085	.00082	.00079	.00076	.00074	.00071
3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00009	.00008	.00008	.00008
3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00004	.00003
4.0	.00003	.00003	.00003	.00003	.00003	.00002	.00002	.00002	.00002	.00002

α	0.4	0.25	0.2	0.15	0.1	0.05	0.025	0.01	0.005	0.001
z_α	.2533	.6745	.8416	1.0364	1.2816	1.6449	1.9600	2.3263	2.5758	3.0902