UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

MAIN EXAMINATION PAPER

MAY, 2011

(FULL TIME / IDE STUDENTS).

TITLE OF PAPER : MANAGEMENT SCIENCE

COURSE CODE : BA 412

TIME ALLOWED : THREE (3) HOURS

TOTAL MARKS : 100 MARKS

INSTRUCTIONS :
(1) TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS SIX (6)

(2) THE PAPER CONSISTS OF SECTION A AND SECTION B.

(3) ANSWER ALL THE QUESTIONS IN SECTION A WHICH ARE COMPULSORY AND ANY TWO (2) QUESTIONS IN SECTION B.

(4) THE MARKS ALLOCATED 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 CLEARLY 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.

SECTION A (COMPULSORY) - 50 MARKS

Q1. The UNISWA Foundation has just purchased a small hotel for conversion to condominium apartments. The building, in a popular area in Mbabane will be highly marketable, and each condominium sale is expected to yield good profit. The conversion process, however, includes several options. Basically, four types of condominiums can be designed out of the former hotel rooms. They are deluxe one-bedroom apartments, regular one-bedroom apartments, deluxe studios, and efficiency apartments. Each will yield a different profit, but each type also requires a different level of investment in carpeting, painting, appliances, and carpentry work. Bank loans dictate a limited budget that may be allocated to each of these needs. Profit and cost data, and cost of conversion requirements, for each apartment are shown in the accompanying table.

Zoning regulations dictate that the building contains no more than 50 condominiums when the conversion is completed; and no less than 25 units. The development company also decides that to have a good blend of owners, at least 40% but no more than 70% of the units should be one-bedroom apartments. Not all money budgeted in each category need to be spent, although profit is not affected by cost savings; but since the money represents a bank loan, under no circumstances may it be exceeded or even shifted from one area, such as carpeting, to another, such as painting.

| Renovation Rqts | Type of Apartment | | | | Total |
	Deluxe One-Bedroom	Regular One-Bedroom	Deluxe Studio	Efficiency	Budgeted
	(E)	(E)	(E)	(E)	(E)
New Carpeting	1,100	1,000	600	500	35,000
Painting	700	600	400	300	28,000
New Appliances	2,000	1,600	1,200	900	45,000
Carpentry	1,000	400	900	200	19,000
Profit per unit	8,000	6,000	5,000	3,500.	

(i). Formulate UNISWA Foundation's decision as a linear programming equation.

(10marks).

(ii). Covert your objective function and constraints to a form containing the appropriate slack, surplus, and artificial variables. (10marks).

Q2. Gillette is thinking about producing a new type of electric razor for men. If the market were favourable, he would get a return of E200,000, but if the market for this new type of razor were unfavourable, he would lose E120,000. Since Phillip is a good friend of Gillette, Gillette is considering the possibility of using Phillip Marketing Research to gather additional information about the market for the razor. Phillip has suggested that Gillette either use a survey or a pilot study to test the market. The survey would be a sophisticated questionnaire administered to a test market. It will cost E10,000. Another alternative is to run a pilot study. This would involve producing a limited number of the new razors and trying to sell them in two cities that are typical of American cities. The pilot study is more accurate but is also more expensive. It will cost E40,000. Phillip has suggested that it would be a good idea for Gillette to conduct either the survey or the pilot before Gillette makes the decision concerning whether to produce the new razor; but Gillette is not sure if the value of the survey or the pilot is worth the cost.
Gillette estimates that the probability of a successful market without performing a survey or pilot study is 50%. Furthermore, the probability of a favourable survey result given a favourable market for razors is 70%, and the probability of a favourable survey result given an unsuccessful market for razors is 20%. In addition, the probability of an unfavourable pilot study given an unfavourable market is 90%, and the probability of an unsuccessful pilot study result given a favourable market for razors is 20%.

(a). Draw the decision tree for this problem without the probability values.   (10marks).

(b). Compute the revised probabilities (i.e. Bayesian probability) needed to complete the decision, and place these values in the decision tree.   (10marks).

(c). What is the best decision for Gillette? Use expected monetary value as the decision criterion.   (10marks).

SECTION B (ANSWER ANY TWO QUESTIONS) - 50 MARKS

Q3. After six months of study, much political arm wrestling, and some serious financial analysis; Prof. Lawrence martins, Vice Chancellor of Global University (GU), had reached a decision. To the delight of its students, and to the disappointment of its athletic boosters, GU would not be relocating to a new football site but would expand the capacity at its on-campus stadium.
Adding 21,000 seats, including dozens of luxury skyboxes, would not please everyone. The influential football coach, Jo Bonfere, had long argued the need for a first class stadium, one with built-in hostel rooms for his players and a palatial office appropriate for the coach of a future Africa Universities' Champion team. The job now was to get construction going immediately after the 2008/2009 season ended. This would allow exactly 270 days until the 2010/2011 season opening game. The contractor, Duvan Construction, signed the contract; with a guarantee that the team will be able to take the field on schedule next year. The Chairman of Duvan said "The contract penalty of E10,000 per day for running late is nothing compared to Global stand to loose if the

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opening game is cancelled". Back in his office, the Chairman of Duvan again reviewed the data (See the data below). He then gathered his foremen and said "people, if we're not 75% sure we'll finish this stadium in less than 270 days, I want this project crashed". "Give me the cost figures for a target date of 250 days and also for 240 days. I want to be *early*, not just on time!"

Activity:	A	B	C	D	E	F	G	H	I	J	K	L
Predecessors:	-	A	A	C	B	E	D,E	G	H	H	J	I,K
Pessimistic time:	40	80	100	100	35	1	35	30	60	12	1	60
Most Likely time:	30	65	60	50	30	1	30	20	25	10	1	25
Optimistic time:	20	20	50	30	25	1	25	10	20	8	1	20

(i). Develop a network drawing for Duvan Construction and determine the critical path. How long is the project expected to take?   (14marks).

(ii). What is the probability of finishing in 270 days?   (4marks).

(iii). If it were necessary to crash to 250 or 240 days, how would Duvan do so, and at what costs? As noted in the case, assume that optimistic time estimates can be used as crash times.   (7marks).

Q4. The maize harvesting season in Swaziland is short, and most farmers deliver their truckloads of maize to a giant central storage bin within a two-week span. Because of this, maize-filled trucks waiting to unload and return to the fields have been known to back up for a block at the receiving bin. The central bin is owned cooperatively, and it is to every farmer's benefit to make the unloading/storage process as efficient as possible. The cost of grain deterioration caused by unloading delays, the cost of truck rental, and idle driver time are significant concerns to the cooperative members. Although farmers have difficulty quantifying crop damage, it is easy to assign a waiting and unloading cost for truck and driver of E18 per hour. The storage bin is open and operated 16hours per day, 7 days per week, during the harvest season and is capable of unloading 35 trucks per hour according to an exponential distribution. Full trucks arrive all day long (during the hours the bin is open) at a rate of about 30 per hour, following a Poisson pattern.
To help the cooperative get a handle on the problem of lost time, while trucks are waiting in line or unloading at the bin, find the:

(a). average number of trucks in the unloading system.   (3marks).

(b). average time per truck in the system.   (3marks).

(c). utilization rate for the bin area.   (3marks).

(d). probability that there are more than three trucks in the system at any given time.
                                                                              (5marks).

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(e). total daily cost to the farmers of having their trucks tied up in the unloading process.
(5marks).

(f). The cooperative, as mentioned, uses the storage bin only two weeks per year. Farmers estimate that enlarging the bin would cut unloading costs by 50% next year. It will cost E9,000 to do so during the off-season. Would it be worth the cooperative's while to enlarge the storage area? (6marks).

Q4. Government Hospital, Mbabane operates a blood bank to meet the day to day demands of its patients. Blood is collected from donors by a team and a vehicle travelling to places such as factories, colleges and offices. The cost of collection is E100 per visit per day. The quantity collected per visit varies considerably as shown in table 2 below. On returning to the hospital, the blood, after testing and dating, is transferred into refrigerated storage until it is required. The holding cost for a week is E0.10 per pint.

If there is a sudden rush of demand or some major accident, then there is an emergency collection system which costs E150 irrespective of the quantity of blood required. This procedure is also initiated whenever the hospital runs out of blood. The present policy of the hospital is to plan a visit as soon as the stocks of blood at the hospital fall to 500 pints. Visits take two weeks to set up. (*Note: Supply is available for use in the following week even though it has been delivered to allow for screening exercise*).

Table 1: Weekly demands for blood

Number of Pints	Frequency
50	30 .
150	80
250	50
350	10
450	30
Total	**200**

Table 2: Blood collected per visit

Number of Pints	Frequency
300	10
400	20
500	50
600	15
700	5
Total	**100**

Random Numbers Demands

34 58 21 12 71
89 63 27 17 43

Random Numbers Supplies

73 47 26 91 33 ˙
14 09 65 39 50

Required:

Using the random numbers as given and starting stock of 600 pints, simulate the system for 10 weeks and estimate the annual cost of the current policy. (25marks).

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Q6. IDM has been given the responsibility of managing a training and development programme. He knows the earlier start time (EST), the latest start time (LST), and the total costs for each activity. This information is given in the following table:

Activity:	A	B	C	D	E	F	G	H	I	J	K	L	M
EST:	0	1	3	4	6	14	12	14	18	18	22	22	18
LST:	0	4	3	9	6	15	18	14	21	19	22	23	24
Time (t):	6	2	7	3	10	11	2	11	6	4	14	8	6
Total Cost (E'000s):	10	14	5	6	14	13	4	6	18	12	10	16	18.

Required:

Using latest start times, determine IDM's total monthly budget. (25marks).

TABLE 7S.1
Learning curve coefficients

Unit Number	70% Unit Time	70% Total Time	75% Unit Time	75% Total Time	80% Unit Time	80% Total Time	85% Unit Time	85% Total Time	90% Unit Time	90% Total Time
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	.700	1.700	.750	1.750	.800	1.800	.850	1.850	.900	1.900
3	.568	2.268	.634	2.384	.702	2.502	.773	2.623	.846	2.746
4	.490	2.758	.562	2.946	.640	3.142	.723	3.345	.810	3.556
5	.437	3.195	.513	3.459	.596	3.738	.686	4.031	.783	4.339
6	.398	3.593	.475	3.934	.562	4.299	.657	4.688	.762	5.101
7	.367	3.960	.446	4.380	.534	4.834	.634	5.322	.744	5.845
8	.343	4.303	.422	4.802	.512	5.346	.614	5.936	.729	6.574
9	.323	4.626	.402	5.204	.493	5.839	.597	6.533	.716	7.290
10	.306	4.932	.385	5.589	.477	6.315	.583	7.116	.705	7.994
11	.291	5.223	.370	5.958	.462	6.777	.570	7.686	.695	8.689
12	.278	5.501	.357	6.315	.449	7.227	.558	8.244	.685	9.374
13	.267	5.769	.345	6.660	.438	7.665	.548	8.792	.677	10.052
14	.257	6.026	.334	6.994	.428	8.092	.539	9.331	.670	10.721
15	.248	6.274	.325	7.319	.418	8.511	.530	9.861	.663	11.384
16	.240	6.514	.316	7.635	.410	8.920	.522	10.383	.656	12.040
17	.233	6.747	.309	7.944	.402	9.322	.515	10.898	.650	12.690
18	.226	6.973	.301	8.245	.394	9.716	.508	11.405	.644	13.334
19	.220	7.192	.295	8.540	.388	10.104	.501	11.907	.639	13.974
20	.214	7.407	.288	8.828	.381	10.485	.495	12.402	.634	14.608
21	.209	7.615	.283	9.111	.375	10.860	.490	12.892	.630	15.237
22	.204	7.819	.277	9.388	.370	11.230	.484	13.376	.625	15.862
23	.199	8.018	.272	9.660	.364	11.594	.479	13.856	.621	16.483
24	.195	8.213	.267	9.928	.359	11.954	.475	14.331	.617	17.100
25	.191	8.404	.263	10.191	.355	12.309	.470	14.801	.613	17.713
26	.187	8.591	.259	10.449	.350	12.659	.466	15.267	.609	18.323
27	.183	8.774	.255	10.704	.346	13.005	.462	15.728	.606	18.929
28	.180	8.954	.251	10.955	.342	13.347	.458	16.186	.603	19.531
29	.177	9.131	.247	11.202	.338	13.685	.454	16.640	.599	20.131
30	.174	9.305	.244	11.446	.335	14.020	.450	17.091	.596	20.727

Areas under the standardized normal curve, from − ∞ to + z

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7703	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9991	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998