UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

SUPPLEMENTARY EXAMINATION PAPER

JULY, 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 FIVE (5)**
		(2) THE PAPER CONSISTS OF SECTION A AND SECTION B.
		(3) ANSWER THE QUESTION IN SECTION A WHICH IS 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. Toyota Leites Pty is a large motor dealer with 12 showrooms in Southern Africa. In recent months, problems have arisen with the supply of new cars to customers as unanticipated delays have been occurring in the pre-delivery inspection stage. The system operated by Toyota Leites Pty is that all stocks of new cars are held in a central compound and, when a sale is made at any one of the showrooms, the order is telephoned through to the compound and the car in question is taken from stock and submitted for pre-delivery inspection at the company's main workshop. After the car has been inspected and any faults repaired, the car is delivered to the appropriate showroom for collection by the customer.

In recent months, the company has been selling new cars at a rate of about 38 per week with no significant seasonal variation. Furthermore it seems reasonable to assume that sales are occurring randomly throughout the week as no regular patterns are discernible. Pre-delivery inspection is carried out on a 'first-come-first-serve' basis and takes on average about 2 hours for all models. The workshop has 2 inspection bays and the engineers who carry out the pre-delivery inspections work a 40-hour week. When the inspection is completed, delivery to the showroom usually takes 1 working day. You may assume that inspection engineers work a 5 day week and you should ignore the effects of weekends.

Required:

(a). Show that P_0 (the proportion of time that the workshop is idle) is 0.0256 and determine the average time which elapses between an order being placed and the car being delivered to the showroom. (25marks).

(b). In view of the delays which have been occurring, the company production manager has been asked to advise whether it would be worthwhile employing 2 extra engineers in the workshop at a total cost of E220 per week. It has been estimated that this would reduce the average inspection time to 1½ hours and the resulting earlier delivery would produce a saving of E2 per day for an average car as a result of earlier payment by the customer. Would you recommend that the 2 extra engineers should be employed?

You are reminded that, with an arrival rate of λ and a service rate of μ in each of 'c' channels:

$$\text{Average time in queue} = \frac{(\rho c)^c P_o}{c!(1-\rho)^2 c\mu}$$

$$\text{Average time in system} = \frac{(\rho c)^c P_o}{c!(1-\rho)^2 c\mu} + \frac{1}{\mu}$$

UNISWA: Faculty of Commerce; Dept. Of Business Administration. BA412- Management Science Supplementary Examination Paper July, 2011.

Where: $$P_o = \left\{ \sum_{i=0}^{c-1} \frac{(\rho c)^i}{i!} + \frac{(\rho c)^c}{c!(1-\rho)} \right\}^{-1}$$

And $$\rho = \frac{\lambda}{c\mu}$$ (25marks).

SECTION B (ANSWER ANY TWO QUESTIONS) - 50 MARKS

Q2. The following activities have been identified as those necessary for the development and launch of a new product by XYZ plc. Additional information on activity costs and possible reductions are given below:

	Immediate preceding	*NORMAL*		*CRASH*	
Activity	*Activity*	*Times, days*	*Cost (E)*	*Time, day*	*Cost (E)*
A	-	8	7,500	4	9,000
B	-	10	8,500	8	11,000
C	-	6	6,000	5	7,000
D	A,B	8	13,000	5	16,000
E	B,C	9	14,000	6	16,500
F	C	14	14,500	11	18,000
G	D,E	14	13,500	10	18,750
H	F,G	6	5,500	4	6,500

The crash information represents the minimum time in which the activity could be completed and the total cost of completing the activity within this shorter time. The choice is between normal time and cost, or crash time and cost. It is not possible to save one day on a particular activity for a proportionate increase in cost. In addition to the costs for each activity, there is a site cost of E1000 per day.

Required:

(a). What is the maximum and minimum time in which the project can be completed? (18marks).

(b). What is the associated minimum additional cost? (7marks).

Q3. A machine manufactures parts at the rate of 2000 per month. A second machine uses these parts at the rate of 500 per month; and the remainder being put into stock. It costs E1000 to set up the first machine. The company estimate their stock holding costs as 20% per annum of the average stock value. Each part costs E2.50 to make.

Required:

(a). What batch size should be produced on the first machine and at what frequency? What is the total annual variable cost of production? (13marks).

(b). If the set up costs could be reduced to E500, how would the change affect the answers in (a)? (6marks).

(c). If a further reduction in set up costs to E250 is possible, how would the answers in (a) be changed? (6marks).

Q4. From this LP equation:

$$\text{Min C: } 630x_1 + 600x_2 + 708x_3 + 135x_4$$

s.t.

$$\tfrac{7}{10}x_1 + \tfrac{1}{2}x_2 + x_3 + \tfrac{1}{10}x_4 \leq 10$$

$$x_1 + \tfrac{5}{6}x_2 + \tfrac{2}{3}x_3 + \tfrac{1}{4}x_4 \leq 9$$

$$x_1, x_2, x_3, x_4 \geq 0$$

(a). Formulate the duality of this LP equation. (7marks).

(b). Use the simplex method to solve the answer to ***part a*** (18marks).

Q5. The Manager of ABC Ltd thinks that the growth in sales will continue into the future. Sales records for the past 10 years have been accumulated as follows:

Year	*Annual Sales ('000units)*	*Year*	*Annual Sales ('000units)*
1	1,000	6	2,000
2	1,300	7	2,200
3	1,800	8	2,600
4	2,000	9	2,900
5	2,000	10	3,200

Required:

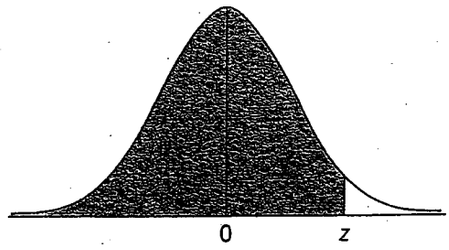
Develop a long range forecast to be used to plan facility requirements for the next three years. (25marks).

UNISWA: Faculty of Commerce; Dept. Of Business Administration. BA412- Management Science Supplementary Examination Paper July, 2011.

TABLE 7S.1
Learning curve coefficients

	70%		75%		80%		85%		90%	
Unit Number	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time	Unit Time	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 $-\infty$ 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