DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2007/8

COURSE TITLE:	**OPERATIONS RESEARCH II**
COURSE CODE:	**ST 408**
TIME ALLOWED:	**TWO (2) HOURS**
INSTRUCTION:	**ANSWER ANY THREE QUESTIONS** **ALL QUESTIONS CARRY EQUAL MARKS (20 MARKS)**
SPECIAL REQUIREMENTS:	**SCIENTIFIC CALCULATORS AND STATISTICAL TABLES**

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Question 1

The following table gives details of eight activities of a certain project.

		Duration		Direct costs	
Activity	Precedence	Normal time (weeks)	Crash time (weeks)	Normal($)	Crash($)
A	-	4	2	800	1800
B	A	3	2	400	500
C	A	7	4	800	1100
D	B	3	2	500	700
E	C, D	4	4	1000	1000
F	-	6	4	800	1000
G	F	7	3	400	1200
H	E,G	5	4	1000	1600

(a) Draw the project network **(4 marks)**

(b) Find the early dates, late dates and critical activities given that all activities take their normal time. **(8 marks)**

(c) Given that the indirect costs amount to $500 per week, determine which activities should be crashed and by how much. What is the final cost of the network? **(8 marks)**

Question 2

(a) In a motorway service area you can eat either in the restaurant or in the self-service cafeteria. There is never any queue for tables in the restaurant, and it takes 25 minutes to eat your meal. In the self-service cafeteria, the time for collecting your food and paying for it is exponentially distributed with mean 2 minutes, and it takes 10 more minutes to eat your food. If people arrive at the cafeteria at the rate of 25 per hour, and each one cannot be served until the previous one has paid for his food, how many would you expect to find in the queue when you arrive? Hence decide which is a quicker way of getting a meal.

(b) A car service station has facilities for a maximum of four cars to be filled or waiting for service in their premises. Past experience indicates that no potential customers join the queue once these four places are filled. The arrival rate of customers is 24 per hour and the input process is approximately Poisson. The service times are exponential with a mean of 3 minutes.

(i) What is the s ystem utilisation? What is the average idle time of the attendant? **(3 marks)**

(ii) What is the fraction of customers lost? **(5 marks)**

(iii) If the average profit per customer is $100, what is the lost profit per hour? **(6 marks)**

(iv) What is the average waiting time on arrival? **(6 marks)**

Question 3

A manufacture's purchasing agent must decide to accept or reject an incoming shipment of machine parts. The agent wishes to use either of the following two acts for this situation:

a_1: accept the shipment
a_2: reject the shipment

The fraction of defective parts in the shipment is either 0.1 or 0.5 with a prior likelihood of each occurring being 0.5. The costs associated with the possible decisions are \$1000 if a 0.1 shipment is rejected and \$1500 if a 0.5 shipment is accepted. No costs are incurred if a 0.1 shipment is accepted or a 0.5 shipment is rejected. There is a sample cost of \$10 per part tested.

(a) What is the optimal action without sampling? **(4 marks)**
(b) What is the EVPI? **(6 marks)**
(c) Determine the optimal strategy, that is, what actions to take in response to the sample outcomes. Show all your work and indicate results on your decision tree. **(10 marks)**

Question 4

Consider a project consisting of 7 jobs (A,B,C,D,E,F,G) with the following precedence relationships and time estimates:

Job	Predecessors	Optimistic time	Most probable time	Pessimistic time
A	-	2	5	8
B	A	6	9	12
C	A	5	14	17
D	B	5	8	11
E	C, D	3	6	9
F	-	3	12	21
G	E, F	1	4	7

(a) Draw the project network for the above problem. **(4 marks)**
(b) Determine the expected duration and variance for each job **(4 marks)**
(c) What is the expected length of the project, and its variance? **(6 marks)**
(d) Compute the probabilities of completing the project:
  (i) 3 days earlier than expected **(3 marks)**
  (ii) no more than 5 days than expected **(3 marks)**

Question 5

(a) What is lead-time and why is it important? **(4 marks)**

(b) Explain the difference between a periodic review system and a continuous review system. Is one better than the other? Why or why not? **(4 marks)**

(c) A cafeteria uses up paper napkins at a rate of 12 boxes per week. They are so bulky that it is nuisance to store many boxes. For accounting purposes, the company figures that the space costs $20.00 per box per week. The cost of placing an order and the handling that is involved when it arrives, regardless of the size of the order, is $100. How frequent should the orders be placed, and for how many boxes? **(12 marks)**

END OF EXAM!!

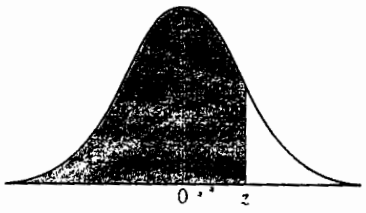

TABLE 3 Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0017	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0722	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.0156	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

TABLE 3 *(continued)*

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8328	.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	.9278	.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	.0808	.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	.9992	.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