

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2016/17

**COURSE TITLE: OPERATIONS RESEARCH II**

**COURSE CODE: ST 408**

**TIME ALLOWED: THREE (3) HOURS**

**INSTRUCTION: ANSWER SECTION A AND ANY THREE QUESTIONS IN SECTION B**

**SPECIAL REQUIREMENTS: SCIENTIFIC CALCULATORS AND STATISTICAL TABLES**

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**SECTION A**

**Question 1**

(a) Building a backyard swimming pool consists of nine major activities. The activities and their immediate predecessors are shown. Develop the project network.

Activity	A	B	C	D	E	F	G	H	I
Immediate Predecessor	-	-	A, B	A, B	B	C	D	D, F	E, G, H

(5 marks)

(b) Assume that the activity time estimates (in days) for the swimming pool construction project are as follows:

ACTIVITY	OPTIMISTIC	MOST PROBABLE	PESSIMISTIC
A	3	5	6
B	2	4	6
C	5	6	7
D	7	9	10
E	2	4	6
F	1	2	3
G	5	8	10
H	6	8	10
I	3	4	5

Determine the following:

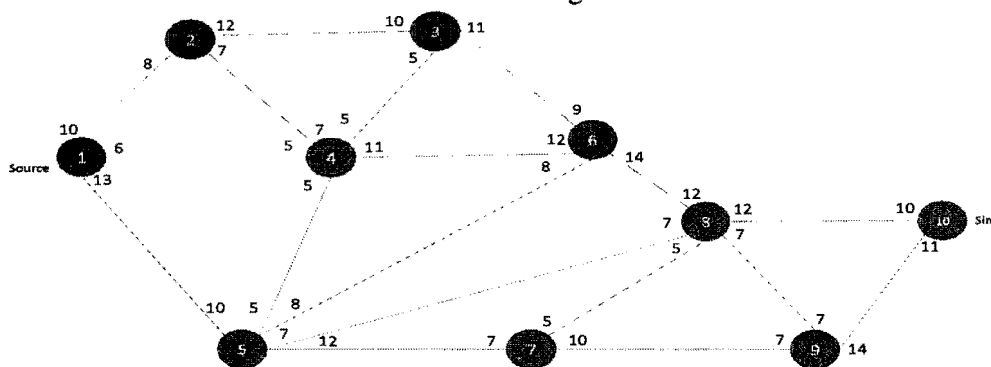
- The expected activity time and variance of the expected activity time for each activity.
- The ES, LS, EF and LF values for each activity.
- The slack for each activity and the critical path for the project
- The probability that the project will be completed in 25 days or fewer days.

(12+12+6+5 marks)

**SECTION B**

**Question 2**

Determine the maximum flow for the following network.



(20 marks)

**Question 3**

(a) Larry is considering investing some money that he inherited. The following payoff table gives the profits that would be realised during the next year for each of three investment alternatives considered:

Decision Alternative	State of Nature	
	Good Economy	Poor Economy
Stock market	80,000	-20,000
Bonds	30,000	20,000
CDs	23,000	23,000
Probability	0.5	0.5

- (i) What is the maximax decision?
  - (ii) What is the maximin decision?
  - (iii) What is the minimax regret decision?
  - (iv) What decision would maximise expected profits?
  - (v) What is the maximum amount that should be paid for a perfect forecast of the economy?
- (2+2+3+2+2 marks)**

(b) In the past few years, the traffic problems in a certain town have gotten worse. Now Dlovunga street is congested about half of the time. The normal travel time to work for Musa is only 15 minutes when Dlovunga street is used and there is no congestion. With congestion, however, it takes Musa 40 minutes to get to work. If Musa decides to take the Highway, it takes him 30 minutes regardless of the traffic conditions. Musa's utility for travel time is:  $U(15 \text{ minutes}) = 0.9$ ,  $U(30 \text{ minutes}) = 0.7$  and  $U(40 \text{ minutes}) = 0.2$ .

- (i) Which route will minimise Musa's expected travel time?
  - (ii) Which route will maximise Musa's utility?
  - (iii) When it comes to travel time, is Musa a risk seeker or a risk avoider?
- (3+3+3 marks)**

**Question 4**

(a) The following information is available on a particular item:

Annual usage = 12, 000 units; Ordering costs = \$60 per order; item unit cost = \$10; carrying cost is 10% of unit cost of the item and lead time = 10 days. Assuming that there are 300 working days a year; Determine:

- (i) The economic order quantity and number of orders per year? **(8 marks)**
- (ii) In the past two years, the usage rate has gone as high as 70 units per day. For a reordering system based on the inventory level, what should be the safety stock? What should be the reorder level at this safety stock? **(2 marks)**

(b) Trucks arrive at the loading dock of a wholesale grocery at the rate of 1.2 per hour. A single crew consisting of two workers can load a truck in about 30 minutes. Crew members receive \$50 per hour in wages and fringe benefits, and trucks drivers reflect an hourly cost of \$60. The manager is thinking of adding another member to the crew. The service rate would then be 2.4 trucks per hour. Assume rates are Poisson.

- (i) Would the third crew member be economical?
  - (ii) Would a fourth member be justifiable if the resulting service capacity were 2.6 trucks per hour?
- (10 marks)**

**Question 5**

A wholesale manager sells packets of snacks at the following prices:

<u>Quantity</u>	<u>Unit Price</u>
Less than 1000 packets	E5.00
1 000 – 3 999	E4.95
4 000 – 5 999	E4.90
6 000 or more	E4.85

Ordering costs are E50, annual holding cost is 40 percent of the purchase price and monthly usage is 6 000 packets. Determine an order quantity that will minimize total cost and determine the minimum total cost. (20 marks)

**END OF EXAM!!**



## Standard Normal Probabilities

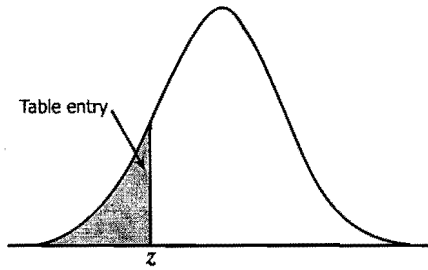


Table entry for  $z$  is the area under the standard normal curve to the left of  $z$ .

$z$	.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	.0018	.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	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.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