

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2009/10

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)

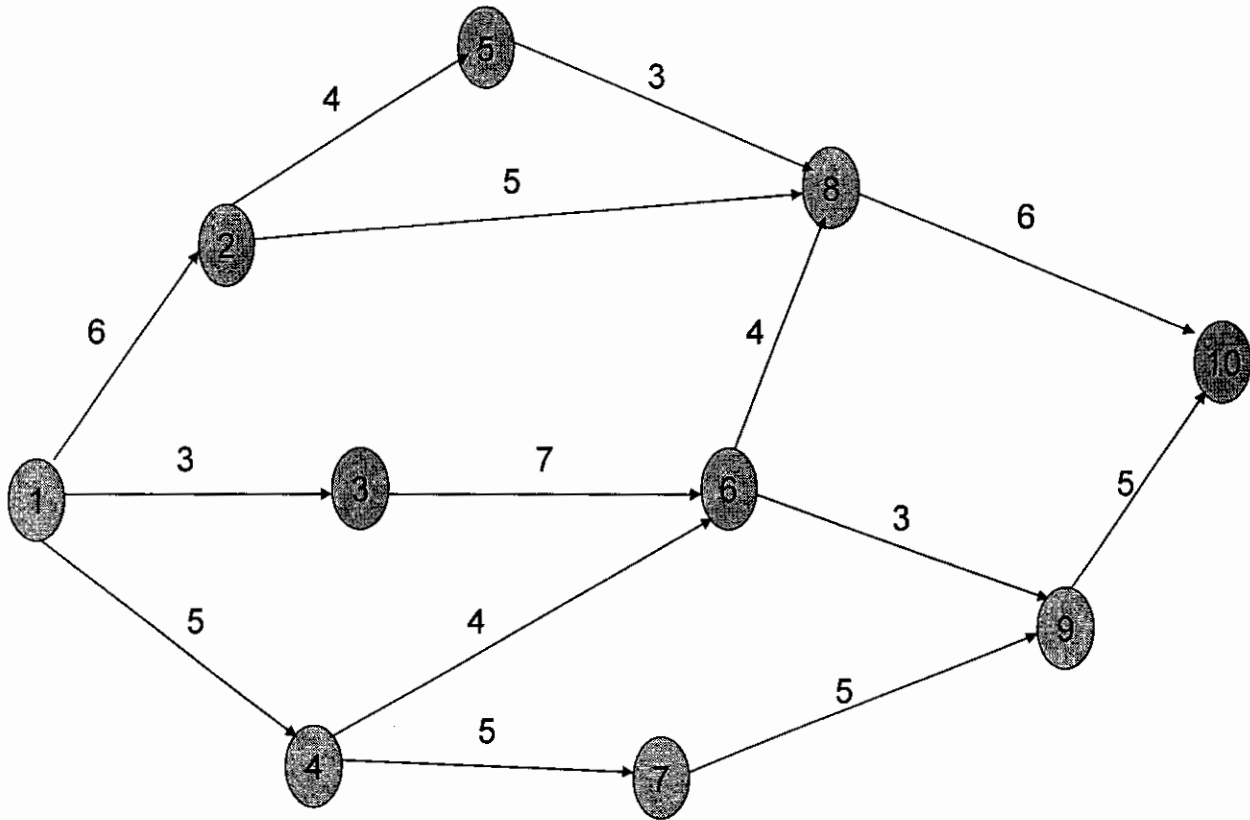
SPECIAL REQUIREMENTS: SCIENTIFIC CALCULATORS AND STATISTICAL TABLES

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INVIGILATOR**

Question 1

(a) Consider the network shown in the figure below. The activity times in days are given along the arrows. Calculate:

- (i) The earliest starting and finishing times
- (ii) The latest starting and finishing times
- (iii) The slack for the events and determine the critical path. Put the calculations in tabular form.



(15 marks)

(b) The project described below has just begun and is scheduled to be completed in 11 weeks. If there is a penalty of E5 000 for each week that the project is late, what is the probability of incurring a penalty of at least E5 000?

<u>Activity</u>	<u>Estimated time (weeks)</u>	<u>Standard deviation (weeks)</u>
1-2	4	0.7
1-3	3	0.62
2-4	6	0.9
3-4	9	1.9

(5 marks)

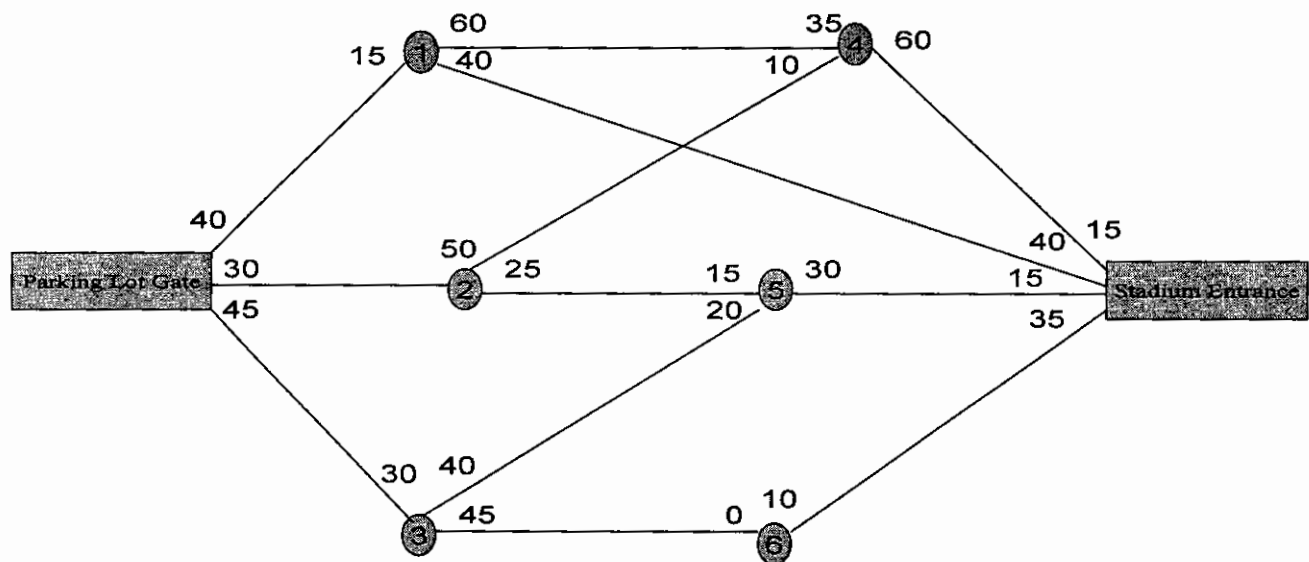
Question 2

Farm Chemicals is developing a new fertilizer. If the company markets the product and it is successful, the company will earn \$50, 000 profit; if it is unsuccessful, the company will lose \$35, 000. In the past, similar products have been successful 60% of the time. At a cost of \$5, 000, the effectiveness of the new fertilizer can be tested. If the test result is favourable, there is an 80% chance that the fertilizer will be successful. If the test result is unfavourable, there is only a 30% chance that the fertilizer will be successful. There is a 60% chance of a favourable test result and 40% chance of an unfavourable test result.

- (a) Determine Farm Chemicals's optimal strategy. (12 marks)
- (b) Find Expected Value of Sample Information (EVSI) and the Expected Value of Perfect Information (EVPI) (8 marks)

Question 3

City Planning and Architectural Associates of South Africa have been commissioned to design the new soccer stadium for a soccer team. Their design has the parking lot separated from the stadium with a single gate leading to the stadium for security reasons. Within the gate, there a number of possible routes through landscaped gardens to the single stadium entrance. The network through the gardens looks the one shown below (the numbers show capacity in thousands of persons per hour):



- (a) Using the maximal-flow algorithm, find the hourly capacity of the system to move spectators into the stadium. a
- (b) Charlie Willis, the owner of the team, phoned to say that if the system couldn't accommodate 100,000 fans coming into the stadium during 1 hour, the architects should start redesigning. Will City Planning have to redesign?

(20 marks)

Question 4

A wholesale manager sells packets of ginger biscuits 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)**

Question 5

(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? **(6 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? **(5 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? **(9 marks)**

END OF EXAM!!

Table E The Standard Normal Distribution

<i>z</i>	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Note: Use 0.4999 for *z* values above 3.09.

Source: Frederick Mosteller and Robert E. K. Rourke, *Sturdy Statistics*, Table A-1 (Reading, Mass.: Addison-Wesley, 1973). Reprinted with permission of the copyright owners.

