DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2010/11

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**

DO NOT OPEN THIS PAGE UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

Question 1

(a) A steel manufacturing company has three options with regard to production (i) produce commercially (ii) build pilot plant (iii) stop producing steel. Management has estimated that their pilot plant if built has a 0.8 chance of high yield and 0.2 chance of low yield. If the pilot plant does show a high yield, management assigns a probability of 0.75 that the commercial plant will also have a high yield. If the pilot plant shows a low yield, there is only 0.1 chance that the commercial plant will show high yield. Management's best assessment of the yield on a commercial-sized plant without first building a pilot plant has a 0.6 chance of high yield. A pilot plant will cost E300, 000. If company obtain high yield, E12, 000, 000 would be earned and if low yield results, company will suffer a loss of E1, 200, 000. Find the optimal decision for the company. **(20 marks)**

Question 2

A. Consider the simplified list of activities and predecessors that are involved in building a house. Table 1:

Activity	Description	Immediate predecessor	Duration (Days)
A	Build foundation	-	5
B	Build walls and ceiling	A	8
C	Build roof	B	10
D	Do electrical wiring	B	5
E	Put in windows	B	4
F	Put on siding	E	6
G	paint house	C, F	3

The project network has been drawn for you.

(a) Calculate

(i) the earliest and latest starting and finishing times

(ii) Determine project duration and identify the critical path. **(13 marks)**

(c) What is the probability of completing the house in 23 days? **(7 marks)**

Activity	Standard deviation
A	**0.70**
B	**0.90**
C	**0.62**
D	**1.90**
E	**0.5**
F	**0.9**
G	**0.7**

OR

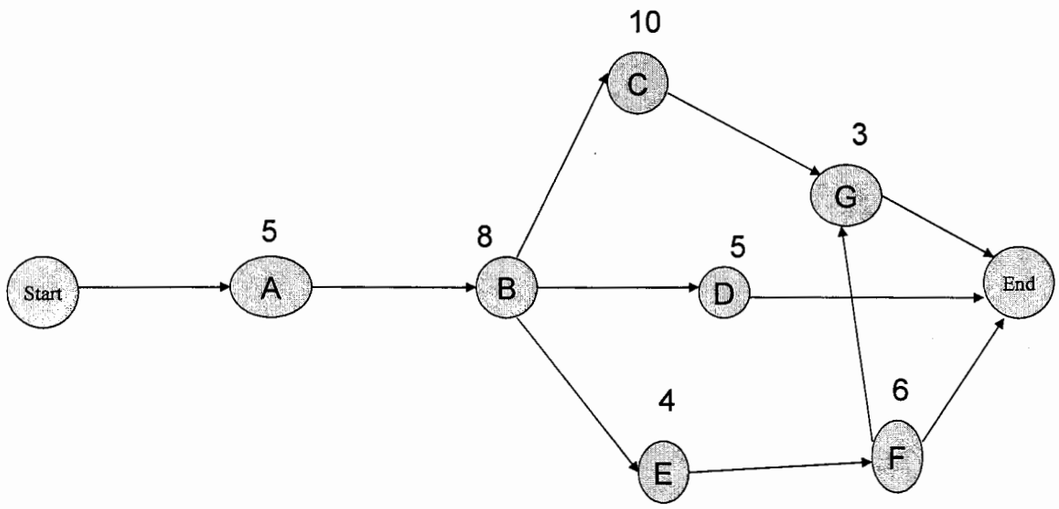
B. Suppose that by hiring additional workers, the duration of each activity can be reduced. The costs per day of reducing the duration of the activities are given in the Table 2 below.

Prepare a crash schedule and state the total cost of completing the house within 20 days? **Indirect costs are $70 per day**.

(20 marks)

Table 2:

Activity	Cost per day of reducing duration of activity ($)	Maximum possible reduction in duration of activity (days)
A (Build foundation)	30	2
B (Build walls & ceiling)	15	3
C (Build roof)	20	1
D (Electrical wiring)	40	2
E (Put in windows)	20	2
F (Put on siding)	30	3
G (Paint house)	40	1



Question 3

(a) Buhle Betfu Corporation is both a producer and user of brass couplings. The firm operates 220 days a year and uses coupling at a steady rate of 50 per day. Couplings can be produced at a rate of 200 per day. Annual storage cost is $1.00 per coupling, and machine setup cost is $35 per run.

(i) Determine the economic run size. **(3 marks)**
(ii) Approximately how many runs per year will there be? **(3 marks)**
(iii) Compute the maximum inventory level. **(3 marks)**

(b) Nhlangano Health Centre stocks a "code blue" resuscitation kit that has a normally distributed demand during the reorder period. The average demand during reorder period is 350 kits, and the standard deviation is 10 kits. The administrator wants to follow a policy that results in stockouts only 5% of the time.

(i) What is the appropriate Z-value? **(2 marks)**
(ii) How much safety stock should the centre maintain? **(2 marks)**
(iii) What reorder point should be used? **(2 marks)**

(c) The average daily demand for Apple iPods at a Circuit Town store is 15, with a standard deviation of 5 units. The lead time is constant at 2 days. Find the reorder point if management wants a 90% service level. How much of this is safety stock? **(5 marks)**

Question 4

(a) An L&G distributor currently employs one worker whose job is to load bricks on outgoing company trucks. An average of 24 trucks per day or 3 per hour, arrive at the loading bay, according to a Poisson distribution. The worker loads them at a rate of 4 trucks per hour, following an approximately exponential distribution in his service times.

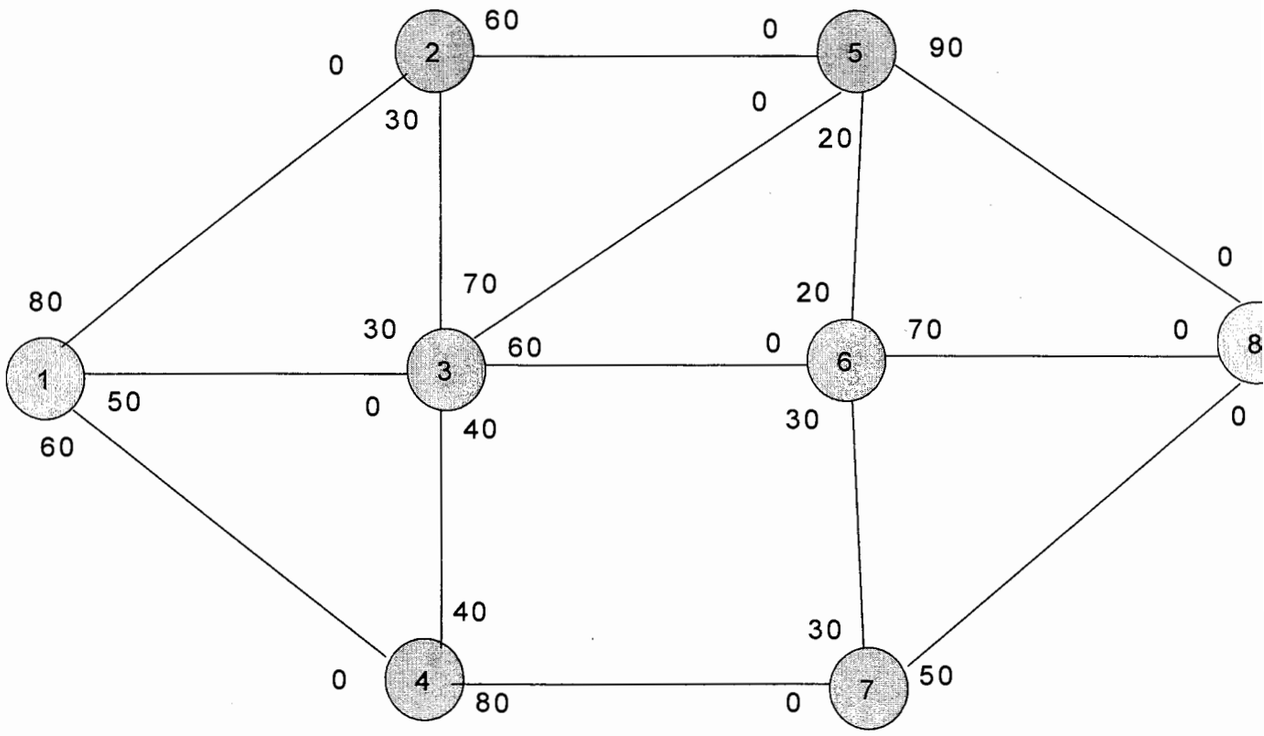
L&G believes that adding a second brick loader will substantially improve the firm's productivity. He estimates that a two-person crew at the loading Bay will double the loading rate from 4 trucks per hour to 8 trucks per hour.

(i) Analyse the effect on the queue of such a change and compare the results to those achieved with one worker. **(15 marks)**

(b) Truck drivers working for L&G earn an average of $10 per hour. Brick loaders receive about $6 per hour. Truck drivers waiting in the queue or at the loading bay are drawing a salary but are productively idle and unable to generate revenue during that time. What would be the hourly cost savings to the firm if it employs 2 loaders instead of 1? **(5 marks)**

Question 5

The network represents streets of a city with the indicated number of cars per hour that can travel these streets. Find the maximum number of cars that could travel per hour though this system. How many cars would travel on each street (arc) to allow this maximum flow? **(20 marks)**



END OF EXAM!!

Table E The Standard Normal Distribution

z	*.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.