UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION

Monday, April 23, 2000

First Year - Program 03, 04

MIE 165S – MODELLING INTEGRATED SYSTEMS

Exam Type: A

Examiner - M. W. Carter

Examination is worth a total of 55 marks
and counts for 55% of final grade

Marks

1. Robert Stevenson from Giffels Engineering Management talked to the class about project management. He explained that one of the key tools for tracking a project involves tracking Budget vs Actual vs Earned Hours. Briefly explain what these terms mean and describe the typical S-curve. 5

2. Professor Li Shu talked about her research in the area of "Design for End-of-Life for Durable Products". She described four options for what can be done with a product after the customer is finished with it. Briefly describe each of these four options. 4

3. We discussed the use of control charts in Statistical Process Control. Briefly describe the steps that you would have to perform to construct an X-bar chart. 5

4. Suppose you have the following table of TV sales for a small store: 4

Month	Sales
January	40
February	47
March	50
April	49
May	56
June	53

Use the methods of "Moving-Average" with N=3 to estimate the sales for July. Use the Mean Absolute Deviation (MAD) measure the forecast error.

5. Joe is considering placing a bet on the College Basketball playoff game between Purdue and Indiana. He believes that each team has a equal chance of winning. If he wins the bet, he will win $10,000; if he loses, he will lose $11,000. Before betting, he may pay Mark $1,000 for his inside prediction of the game; 60% of the time, Mark will predict that Indiana will win. When Mark says that Indiana will win, Indiana has a 70% chance of winning, and when Mark says Purdue will win, Indiana has only a 20% chance of winning. Determine how Joe can maximize his expected profit. 5

Marks

6. During each 4-hour period, the Smalltown police force requires the following number of on-duty police officers every day of the week: **5**

Hours	Officers
12:00 midnight – 4:00 A.M.	8
4:00 A.M. – 8:00 A.M.	7
8:00 A.M. – 12:00 noon	6
12:00 noon – 4:00 P.M.	6
4:00 P.M. – 8:00 P.M.	5
8:00 P.M. – 12:00 midnight	4

Each police officer works two consecutive 4-hour shifts. Formulate an LP that can be used to minimize the number of police officers needed to meet Smalltown's daily requirements. Do not solve this problem.

7. a. Solve the following Linear Programming problem graphically: **5**

$$\begin{aligned} \text{maximize} \quad & z = x + y \\ \text{subject to:} \quad & x - y \le 1 \\ & x + 2y \le 4 \\ & 2y \le 3 \\ & x, y \ge 0 \end{aligned}$$

b. Graphically do a sensitivity analysis on the following entries: **6**
- How much can you change the coefficient of y in the objective function (up and down) without changing the basis?
- If you increase the right hand side of the first constraint, how much does this change the objective function value?
- How much can you increase the right hand side of the first constraint without changing the basis?

8. Consider the problem in question 6a above. Set up a simplex tableau, and perform ***one iteration*** of the simplex method. In other words, find an initial basic solution, and use the simplex method to find a new basic solution with a higher value of z. **6**

Marks

9. Consider the set of activities shown in the following table:

Activity	Immediate Predecessors	Duration (days)
A	-	3
B	-	4
C	-	1
D	A, B	3
E	A, B	3
F	B, C	2
G	D	4
H	E, F	3

a) Draw the project network, and determine critical path for the network. the free float and the total float for each activity. **6**

b) Unfortunately, there is some uncertainty about how long each activity will really take. The designers have made the following estimates of the most likely completion time (m), the earliest possible (a), and the latest possible (b) completion times in days. Use the PERT method to determine the probability that the project will be completed in 13 days. Recall that, for each activity, $\mu = (a+4m+b)/6$ and $\sigma = (b-a)/6$. (I have also included a table of z scores for a cumulative standard normal distribution with mean 0, and standard deviation 1. You can use these to obtain an approximate answer.) **4**

Activity	Earliest possible (a)	Latest possible (b)	Most Likely Duration (m)
A	2	4	3
B	4	10	4
C	1	3	1
D	1	5	3
E	2	7	3
F	2	2	2
G	2	6	4
H	3	5	3

z	-3	-2.5	-2	-1.5	-1	-.5	0	.5	1	1.5	2	2.5	3
F	.0	.01	.02	.07	.16	.31	.5	.69	.84	.93	.98	.99	1.0