TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam	New Regular		
Level	BE	Full Mark	80
Program	BME	Pass Mark	32
Year/Part	IV/II	Time	3 hrs

Subject: - Operations Research *(Elective II)* **(ME 76507)**

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **_All_** questions.
✓ All questions carry equal marks.
✓ Assume suitable data if necessary.

Examination must be conducted in a computer lab. Each student has to be provided with a PC or is to be allowed to use his laptop, which must have Microsoft Office and CRYSTAL BALL Pro. The Microsoft Office must have EXCEL with SOLVER and Analysis Tool Pack. Each student must be provided with a CD to attempt the questions and save them or his answers to be copied in a pen drive. If the PC has some problem, the student should be provided with another usable PC and the time elapsed should be considered. Time series formula sheet should be allowed.

1. Implement the following LP problem in a spreadsheet. Use Solver to solve the problem and create a Sensitivity Report. Use this information to answer the following questions:

$$\text{MAX:} \quad 4X_1 + 2X_2$$
$$\text{Subject to:} \quad 2X_1 + 4X_2 \le 20$$
$$3X_1 + 5X_2 \le 15$$
$$X_1, X_2 \ge 0$$

   a. What range of values can the objective function coefficient for variable X_1 assume without changing the optimal solution?
   b. Is the optimal solution to this problem unique, or are there alternative optimal solutions?
   c. How much does the objective function coefficient for variable X_2 have to increase before it enters the optimal solution at a strictly positive level?
   d. What is the optimal objective function value if X_2 equals 1?
   e. What is the optimal objective function value if the RHS value for the second constraint changes from 15 to 25?
   f. Is the current solution still optimal if the coefficient for X_2 in the second constraint changes from 5 to 1? Explain.

2. A new airport is being built will have three terminals and two baggage pickup areas. An automated baggage delivery system has been designed to transport the baggage from each terminal to the two baggage pickup areas. This system is depicted graphically in the figure given below where nodes 1, 2 and 3 represent the terminals, and nodes 7 and 8 represent the baggage pickup areas. The maximum number of bags per minute that can be handled by each part of the system is indicated by the value on each arc in the network.
   a. Formulate an LP model to determine the maximum number of bags per minute that can be delivered by this system.
   b. Use Solver to find the optimal solution to this problem.
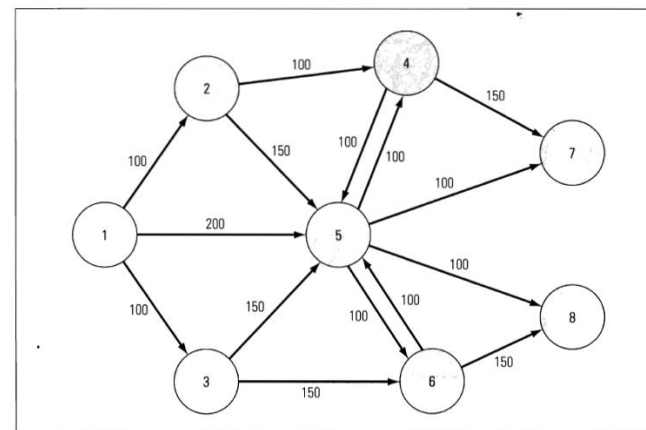
3. Morley Properties is planning to build a condominium development on St. Simons Island, Georgia. The company is trying to decide between building a small, medium, or large development. The payoffs received for each size of development will depend on the market demand for condominiums in the area, which could be low, medium, or high. The payoff matrix for this decision problem is:

	Market Demand		
Size of development	**Low**	**Medium**	**High**
Small	400	400	400
Medium	200	500	500
Large	-400	300	800
	(Payoffs in $1000s)		

The owner of the company estimates a 21.75% chance that market demand will be low, a 35.5% chance that it will be medium, and a 42.75% chance that will be high.
   a. What decision should be made according to the maximax decision rule?
   b. What decision should be made according to the maximin decision rule?

c. What decision should be made according to the minimax regret decision rule?
d. What decision should be made according to the EMV decision rule?
e. What decision should be made according to the EOL decision rule?

4. Based on the following information, use Crystal Ball and run simulation for 5,000 iterations. Find the mean NPV, its descriptive statistics and the probability distribution. What is the certainty level that the project will be feasible?

Project life = 10 years

Initial investment = $1,50,000; Uniform distribution (minimum = $1,00,000 and maximum = $1,80,000)

Unit price = $40; Normal distribution (mean $40 and standard deviation $1)

Demand = 2,000; Triangular distribution (minimum = 1,200 and maximum = 2,400)

Unit variable cost = $20; Uniform distribution (minimum = $16 and maximum = $24)

Fixed cost = $10,000; Lognormal distribution (location = $8,000, mean = $10,000 and standard deviation = $1,000)

Depreciation = Straight line depreciation

Salvage value = $30,000; Normal distribution (mean $30,000 and standard deviation $4,000)

Interest rate = 12%, Income tax rate = 40%

5. An analyst for Phidelity Investments want to develop a regression model to predict the annual rate of return for a stock based on the price-earnings (PE) ratio of the stock and measure of the stock's risk. The data given below were collected for a random sample of stocks.
   a. Prepare scatter plots for each independent variable versus the dependent variable. What type of model do these scatter plots suggest might be appropriate for the data?
   b. Let Y = Return, X_1 = PE Ratio, and X_2 = Risk. Obtain the regression results for the following regression model:
   $$\hat{Y}_i = b_0 + b_1 X_{1i} + b_2 X_{2i}$$
   Interpret the value of R^2 for this model
   c. Obtain the regression results for the following regression model:
   $$\hat{Y}_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{3i} + b_4 X_{4i}$$
   Where $X_{3i} = X_{1i}^2$ and $X_{4i} = X_{2i}^2$. Interpret the value of R^2 for this model.
   d. Which of the previous two models would you recommend that the analyst use?

PE Ratio	Risk	Return
7.4	1.0	7.6
11.1	1.3	13.0
8.7	1.1	8.9
11.2	1.2	10.9
11.6	1.7	12.1
12.2	1.3	12.8
12.5	1.2	11.3
12.5	1.3	14.1
13.0	1.6	14.8
13.4	1.4	16.7