

**Homework #3**  
**Engineering Optimization (ISyE 4231) - Spring 2001**  
**Due January 29, 2001**

Show all your steps to get full credit.

**Reading assignment:** Read Chapters 1 and 2.

1. A small manufacturer is producing two types of steel products on two machines. Product 1 requires 2 hours of processing on machine 1 and 1 hour of processing on machine 2. Product 2 requires 5 hours of processing on machine 1 and 1 hour of processing on machine 2. Product 1 uses 3 units of raw material and product 2 uses 1 unit of raw material. Total number of machine hours available on machines 1 and 2 are 60 and 12, respectively. There are 30 units of raw material available. Marketing restricts the quantity of product 2 to be sold to 10 units or less. The selling price of products 1 and 2 are \$200 and \$100, respectively. The company wants to maximize its revenues from these two products.

- (a) Model this problem as a linear program.  
(b) Solve this LP graphically. Indicate the feasible region, draw at least one objective function contour and indicate the optimum solution. Also, mark all the extreme points in your drawing using letters A, B, ... How many extreme points are there?

2. An investor has a total of \$10,000 to invest at the beginning of year 1. She has the following investment options:

- Type A CD account: Each dollar invested in this account at the beginning of year 1 returns \$1.30 (profit of \$0.30) 2 years later (in time for immediate reinvestment).
- Type B CD account: Each dollar invested in this account at the beginning of year 1 returns \$1.50 (profit of \$0.50) 3 years later (in time for immediate reinvestment).
- One time investment opportunity C: A dollar invested at the beginning of year 2 returns \$1.70 at the end of year 5.
- One time investment opportunity D: A dollar invested at the beginning of year 5 returns \$1.20 at the end of year 5.
- Regular savings account: A dollar invested in this account at the beginning of a year returns \$1.05 at the end of that year.

Since the one time investment opportunity C is somewhat risky, the investor wants to limit the amount invested in that fund to no more than twice the amount invested in a regular savings account in that year. Also, for diversification purposes, the amount invested in a type A CD account should not exceed the amount invested in a type B CD account by more than \$2000 in any year.

The investor wants to know which investment plan maximizes the amount of money she can accumulate by the beginning of year 6.

3. A paper company produces large rolls of papers, called “reels”, which are then cut into smaller rolls to satisfy customer demand. The width of each reel is 120”, and the reels are cut into smaller rolls according to the following patterns:

Pattern 1: 40-40-30. This pattern produces two rolls of 40” width, and one roll of 30” width from one reel. Note that it also produces 10” of waste.

Pattern 2: 25-25-30-40

Pattern 3: 40-40-40

Pattern 4: 30-30-30-30

Pattern 5: 25-25-25-40

Current demand calls for 75 40” rolls, 60 30” rolls and 45 25” rolls.

The company wants to decide how many reels to produce and how to cut them in order to satisfy the demand with minimum number of reels. Formulate this company’s problem as a mathematical program.

Consider the alternative objective of minimizing waste. How would your model change? How do you think the solution would compare to the solution of your previous model? Explain.

4. Solve Exercise 2-12 on page 67.

5. Solve Exercise 2-29, all parts except (h), on page 70.