

MATH 4-5794: Optimization Modeling - Spring  
Semester 2005  
Assignment 4

**Date Due:**

Note: The word solve means, "Use MATLAB (or Excel or GAMS or Lindo or another mathematical programming software) to find the solution. What you turn in will be the source followed by the solution (in sequence corresponding to the problems given below).

**Undergraduates (12 points total) and Graduates**

1. Suppose  $\max x_1^3 + 2x_2, x_1, x_2 \in [0, 3]$ . Set up the separable programming problem that linearizes  $x_1^3$  using points at 0, 1, 2, 3. You should obtain an Integer Program like that on page 138.  
\*\*\*\* For the next four problems, use 0–1 variable(s) to set up the models. You do NOT have to solve the model, just set them up.
2. The cost of a product is  $10x_1$  if  $0 \leq x_1 \leq 500$ ,  $9x_1$  if  $500 < x_1 \leq 1000$  and  $8x_1$  for amounts greater than 1000.
3. If  $x_1$  is in the blend, then we must have  $x_2$  and  $x_3$  in the blend as well.
4. Detect whether or not  $5x_1 + 3x_2 \geq 2$ .
5. If  $x_1$  and  $x_2$  are produced (greater than zero), then  $x_3$  or  $x_4$  must also be produced (be at levels greater than zero).
6. Solve the set covering problem (1)-(5) on page 176.
7. Solve the set packing problem (6)-(11) on page 178.
8. Solve the set partitioning problem (12)-(16) on page 179.
9. Take one of the problems from chapters 13 and solve it.
10. Given

$$\begin{aligned} \max f(x_1, x_2) &= 100(x_2 - x_1^2)^2 + (1 - x_1)^2 & (1) \\ x_1, x_2 &\in [-2, 2] \end{aligned}$$

start at the point (-2,-2).

- (a) Use Genetic Algorithms to solve (1).
- (b) Use Simulated Annealing to solve (1).
- (c) Use Interval Analysis and INTLAB to solve (1).

**Note:** You might want to graph the function (3-d plot). Also, for half the points, you can do 2 iterations of Genetic Algorithms and 3 iterations of Simulated Annealing by hand.

**Graduates (13 points total)**

1. Solve the model on page 138 using Integer Programming. You can transform the problem using (5), (6) on page 141. Make sure that (4) or (7) are enforced.