SA305 – Linear Programming Spring 2014
Asst. Prof. Nelson Uhan

Exam 1 – Information

1 Information

- When: **Friday February 14** in class
- What: Lessons 1 – 15
- No outside materials allowed
- No calculators
- GMPL clinic on Tuesday February 11, 1900 – 2000, CH348
- Review on Wednesday February 12 in class
- Exam EI on Thursday February 13, 1900 – 2000, CH348

2 Review Problems

Note: make sure to review all the different types of modeling problems we've studied so far this semester.

Problem 1. Consider the following feasible region of a linear program:

$$\begin{aligned} x - 2y &\leq 4 \\ x - y &\geq -2 \\ x &\geq 0 \\ y &\geq 0 \end{aligned}$$

a. Graph the feasible region.
b. Give a *maximizing* objective function such that $(2, 0)$ and $(0, 0)$ are optimal in the feasible region above.
c. Give a *maximizing* objective function such that $(2, 2)$ is optimal in the feasible region above.
d. Add a constraint that makes the feasible region infeasible.

Problem 2. Dantzigbank is attempting to determine where its assets should be invested during the current year. At present, $500,000 is available for investment in bonds, home loans, auto loans, and personal loans. The annual rate of return on each type of investment is known to be

Investment	Rate of return
Bonds	10%
Home loans	16%
Auto loans	13%
Personal loans	20%

To ensure that its portfolio is not too risky, Dantzigbank's investment manager has placed the following three restrictions on the bank's portfolio:

- The amount invested in personal loans cannot exceed the amount invested in bonds.

- The amount invested in home loans cannot exceed the amount invested in auto loans.
- No more than 25% of the total amount invested may be in personal loans.

The bank's objective is to maximize the annual return on its investment portfolio. Formulate a linear program that will enable Dantzigbank to meet this goal. Be sure to briefly

- define any symbolic input parameters you use,
- define the decision variables that you use,
- explain the objective function, general constraints, and variable bounds that you write.

Problem 3. The Fulkerson Company manufactures ski jackets. Their business is highly seasonal: next year, the expected demand in week t is d_t, for all $t \in \{1, \dots, 52\}$. The company can produce K ski jackets per week, but inventories must be built up to meet larger demands at a holding cost of h per jacket per week. Fulkerson wants to meet demand while minimizing inventory cost. Formulate a linear program that determines an optimal production plan for next year. Be sure to briefly

- define any symbolic input parameters you use,
- define the decision variables that you use,
- explain the objective function, general constraints, and variable bounds that you write.

Problem 4. ShinyBrite makes two brands of toothpaste: normal and tartar control. ShinyBrite uses three ingredients to make toothpaste: sweetened paste, silica gel, and sodium fluoride solution. To make 100 g of normal toothpaste requires 60 g of paste, 30 g of gel and 10 g of solution. To make 100 g of tartar control toothpaste requires 50 g of paste, 45 g of gel and 15 g of solution. ShinyBrite has 5000 g of paste, 3500 g of gel, and 1000 g of solution available. ShinyBrite receives a profit of $1 for every 100 g of normal toothpaste made and $1.20 for every 100 g of tartar control toothpaste made.

Write a linear program that helps ShinyBrite determine how much of each toothpaste to make in order to maximize profits with the paste, gel, and solution they have available. Assume fractional solutions are acceptable. Be sure to briefly

- define any symbolic input parameters you use,
- define the decision variables that you use,
- explain the objective function, general constraints, and variable bounds that you write.