IEMS 310 Quiz

4/28/2009

Solutions are due by 11am on Wednesday. Turn in a hard copy of your solutions at the beginning of class on Wednesday and email me your spreadsheet. Have the spreadsheet file name be `Lastname.xls`.

You may use your notes, Excel, your book, and material posted on the course website. You may not communicate with other people (except with me) about the exam. Best of luck.

1) Consider the following optimization problem:

$$\begin{aligned} \max\ & 44x_1 - 3x_2 + 16x_3 + 56x_4 \\ s.t.\ & x_1 + x_2 + x_3 + x_4 = 20 \\ & x_1 - x_2 \le 0 \\ & 9x_1 - 3x_2 + x_3 - x_4 \ge 24 \\ & x_1 \ge 0,\ x_2 \ge 0,\ x_3 \ge 0,\ x_4 \ge 0. \end{aligned}$$

a) Use Excel to determine it's solution and the optimal objective function value.
b) Use the sensitivity analysis to describe what would happen to the optimal objective function value if the right hand side of the first constraint increased to 23.
c) Write the dual problem.

2) Your division of a clothing company manufactures swim suits. The demand is highly seasonal with the expected demand being 1200, 10200, 33600, and 6000 over the four quarters of the next year. The company can produce 14400 suits per quarter but inventories must be built up to meet larger demands at a holding cost of \$1.25 per suit per quarter. Your goal is to meet demand while minimizing the inventory costs. Assume the initial inventory is 0.
a) Define the decision variables. What are the constraints? What is the objective function?
b) Formulate a linear program that determines the optimal production plan. Write it in mathematical notation. Then solve it and explain it's solution.
c) The average quarterly demand is 12750. The company wants to keep the quarterly production close to this average and will impose a charge on your division if the production deviates from this average. If you produce x suits in a quarter, then they will impose (i) a charge of \$0.50$(12750 - x)$ if you produce less than the average ($x < 12750$); (ii) a charge of \$1$(x - 12750)$ if you produce more than average ($x > 12750$); and (iii) an additional charge of \$2$(x - 14400)$ for any production involving overtime ($x > 14400$) — this allows you to violate the limit on production capacity, at a cost. Charge (iii) is an addition to (ii). Find the production schedule that minimizes these charges and the inventory costs. Formulate this as an LP (write it in mathematical notation) and then solve it.
d) (Ignore part c for this part.) Instead of assuming the initial inventory is 0, assume the production plan is periodic: the inventory at the beginning of the year equals the inventory at the end of the year. How does that change your LP from part b? Solve it.