CS325: Linear programming project

Prof. Glencora Borradaile

Due: Tuesday, December 2, in class (10 AM)

For this project, you will model the following problems as linear programs and solve them using a language and linear programming solver of your choice. For a (non-comprehensive) list of freely available LP solvers, see this wikipedia page: `http://en.wikipedia.org/wiki/Linear_programming`

Problem 1: mmmm ... tofu

Modified from a problem in Linear Programming *by Chvátal (70 points)*

A soy producer grows enough edamame (raw soy beans) to produce 480 blocks of tofu, 400 bags of edamame and 230 blocks of tempeh every day during harvest season; each of these products can be sold either plain or flavored. The total units of edamame, tofu and tempeh that can be flavored during a normal working day is 420; in addition up to 250 units can be flavored on overtime at a higher cost. The *net* profits are as follows:

	plain	flavored on regular time	flavored on overtime
edamame (1 bag)	\$4	\$12	\$7
tofu (1 block)	\$8	\$14	\$11
tempeh (1 block)	\$4	\$13	\$9

For example, the following plan yields a total net profit of \$9,965:

	fresh	flavored on regular time	flavored on overtime
edamame	295	70	35
tofu	165	280	35
tempeh	55	70	105

Your goal is to find a plan that maximizes the total net profit.

Your report must include:

- the linear program written (mathematically) as an objective and set of constraints
- the linear program in matrix form
- the optimal solution to the linear program
- a description of the environment/language/solver you used to solve the LP
- the code (as succinct as possible) that you used to solve the LP

(The presentation should be similar to that given for the bicycle problem.)

Problem 2: least squares isn't good enough for me

Modified from a problem in Algorithms *by Dasgupta, Papadimitriou and Vazirani (30 points)*

You are given a set of points $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$ in the plane. You want to find a line $ax+by = c$ that comes close to each point. You probably learnt the method of least squares to find a line of best fit in your past, but we want to find the line of best fit that minimizes the maximum absolute deviation. That is, you want to find the values of a, b, and c that minimizes:

$$\max_{1 \leq i \leq n} |ax_i + by_i - c|$$

Model this *general problem* as a linear program. Use the linear program to find the line of minimum-maximum-absolute-deviation for *the instance*:

$$(1, 3), (2, 5), (3, 7), (5, 11), (7, 14), (8, 15), (10, 19)$$

Note that $a = b = c = 0$ would minimize this expression, which is certainly not intended. What can you do to avoid this?

Your report must include:

- the linear program for the *general problem* written as an objective and set of constraints
- the best solution for the *specific problem* above
- a plot of the points and your solution for *the instance*
- the code (as succinct as possible) that you used to solve the LP