

CS635 – Problem Set #1

Due Date: January 30, 2009

Formulate the following problems as linear programming (LP) models in GAMS and solve them. Useful sources of information about linear programming can be found at:

- <http://www-unix.mcs.anl.gov/otc/Guide/faq/linear-programming-faq.html>
- http://en.wikipedia.org/wiki/Linear_programming

Instructions for Handing In Homework

When you execute `gams` on your model file a corresponding `.lst` file is produced automatically. If using the IDE, this file is automatically loaded into a window. For each problem to turn in, use an editor to extract the required lines of output to a text file. *Please* use a text editor, or if using word, save the file as text. Non-text files will be returned without being graded.

For this assignment, the only information required in the text file is the GAMS “Solution report”, that contains the solver and model status, and the objective function value. Ensure you use self-explanatory variable names.

Submit the assignment electronically using the instructions on the course web page. You should hand in exactly 8 files with the following names: `hw1-1.gms`, `hw1-1.txt`, `hw1-2.gms`, `hw1-2.txt`, `hw1-3.gms`, `hw1-3.txt`, `hw1-4.gms`, `hw1-4.txt`.

1 Warm-Up Problem

1.1 Problem

Enter and solve the following linear program in GAMS

$$\begin{aligned} \min_{x_1, x_2, x_3} \quad & 3x_1 + 2x_2 - 33x_3 \\ \text{subject to} \quad & x_1 - 4x_2 + x_3 \leq 15 \\ & 9x_1 + 6x_3 = 12 \\ & -5x_1 + 9x_2 \geq 3 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

Use the statement “option limrow=0, limcol=0;” to suppress some of the compiler output (not needed in this exercise) from the “lst” file. Also use the expression “positive variables” to get the lower bounds on the variables instead on setting the lower bounds with “lo”. You should enter the model into the file hw1-1.gms, and then create the file “hw1-1.txt” as explained above.

2 Index sets and bounds

2.1 Problem

Use an appropriate set J and declare variables $x(J)$ along with upper and lower bound statements to formulate and solve:

$$\begin{aligned} \max_{x_1, x_2, x_3} \quad & 5(x_1 + 2x_2) - 11(x_2 - x_3) \\ \text{subject to} \quad & 3x_1 \geq x_1 + x_2 + x_3 \\ & 0 \leq x_j \leq 3, j = 1, \dots, 3 \end{aligned}$$

You can enter the problem as written above - there is no need to do arithmetic to simplify the objective or constraints.

In addition to the solution values, extract into “hw1-2.txt” the portion of the solution listing that displays the lower and upper bounds.

3 Pig Valve Production

U.S. labs manufactures mechanical heart valves from the heart valves of pigs. Different heart operations require valves of different sizes. U.S. Labs purchases pig valves from three different suppliers. The cost and size mix of the valves purchased from each supplier are given as:

Supplier	Cost (\$)	% large	% medium	% small
1	5	40	40	20
2	4	30	35	35
3	3	20	20	60

Each month, U.S. Labs places one order with each supplier. At least 500 large, 300 medium and 300 small valves must be purchased each month. Due to limited availability of pig valves, at most 700 valves per month can be purchased from each supplier.

3.1 Problem

Write a GAMS model to determine how you should acquire the needed pig valves while minimizing cost?

4 Madison Schools

Madison contains three school districts. The number of minority and non-minority students in each district is given below:

District	Minority	Non-minority
1	50	200
2	55	245
3	100	150

The local court has decided that East and West High Schools must have approximately the same percentage of minorities (within $\pm 5\%$) as the whole city. The distances (in miles) between the school districts and the high schools are given below:

District	East	West
1	1.2	2.1
2	1.9	1.1
3	1.3	0.9

Each high school must have an enrollment of 300 – 500 students.

4.1 Problem

Determine the percentage of students from each district assigned to schools that minimizes the total distance students must travel to school.