

**The lab is due by 4pm on November 30, 2017.**

The Excel solver is extremely useful when solving linear programming problems. First make sure that the excel solver is accessible by the spreadsheet.

New version of Excel:

Start the program and click on the **data** tab. In the section **Analysis**, you should see the solver option.

If there is not a section called **Analysis**, then search the help for "solver add-in" or see my webpage for directions on installing the solver.

A spreadsheet on my webpage shows how to set up the linear programming problem given below. The formula page shows how the formulas were entered. The solution for the linear programming problem is  $x = 3$ ,  $y = 0$ ,  $z = 15$ ,  $s_1 = 2$ ,  $s_2 = 0$ ,  $s_3 = 0$  and  $P = 78$ .

$$P = 6x + 5y + 4z \text{ max}$$

$$x + y + z \leq 20$$

$$4x + 3y + 2z \leq 42$$

$$3y + 2z \leq 30$$

$$x, y, z \geq 0$$

Once the spreadsheet is constructed, click the **Data** tab and then click on **solver** found in the **analysis** section. Now set/adjust the solver parameters. The solver parameters can be found on my webpage by clicking on the link **solver-parameters** located next to the lab assignment.

Solve these linear programming problems with the excel.

**Problem 1.** Solve this linear programming problem.

Objective function:

$$J = 6x + 8y + 1z \text{ minimize}$$

Constraints:

$$3x + 5y + 3z \geq 20$$

$$x + 3y + 2z \geq 9$$

$$6x + 2y + 5z \geq 30$$

$$x + y + z \leq 10$$

$$x \geq 0, y \geq 0, z \geq 0$$

Give the solution to all of the variables for this problem.

**Problem 2.** A contractor is planning to build a new housing development. Let  $x$ ,  $y$ , and  $z$  be the number of colonial, split-level, and ranch-style houses that are built in the housing development, respectively. The linear programming problem that maximizes profit, while staying within the available resources is:

Maximize:

$$P = 20,000x + 25,000y + 24,000z$$

Constraints:

$$\begin{aligned} 60,000x + 64,000y + 80,000z &\leq 3,200,000 && \text{dollars of capital} \\ 4,000x + 3,000y + 4,000z &\leq 180,000 && \text{labor-hours} \\ .5x + .75y + z &\leq 30 && \text{acres} \\ x, y, z &\geq 0 && \end{aligned}$$

**Question 1:** How many of each house should be built in order to achieve a maximum profit?

Answer:  $x =$  \_\_\_\_\_  $y =$  \_\_\_\_\_  $z =$  \_\_\_\_\_

**Question 2:** Are there any resources left over when the maximum profit is achieved? If so, list all resources left over and the quantities of each.

**Question 3:** Use the sensitivity report to figure out the maximum increase that is allowable for the profit of these houses that will not change the solution.

colonial house = \_\_\_\_\_ split-level house = \_\_\_\_\_ ranch-style house = \_\_\_\_\_

**Question 4:** If the number of Labor hours increased by 12000, predict the the maximum profit by using shadow variables. (show how you calculate this answer ).

**Question 5:** Find the new solution for this problem when the number of labor hours is increased by 12000 hours.

Answer:  $x =$  \_\_\_\_\_  $y =$  \_\_\_\_\_  $z =$  \_\_\_\_\_

**Problem 3.** A confectioner makes three types of candy: Sweet Tooth, Sugar Dandy, and Dandy Delite. Each box of candy has the following requirements. The current inventory of each ingredient is also listed in the table.

	Sweet Tooth	Sugar Dandy	Dandy Delite	inventory
chocolate	3 lbs	4 lbs	5 lbs	700 lbs
nuts	1 lb	0.5 lbs	0.75 lbs	140 lbs
fruit	1 lb		1 lb	125 lbs

Each box of Sweet Tooth sells for \$9, Sugar Dandy sells for \$7, and Dandy Delite sells for \$8.

**Question 1:** How many boxes of each type of candy should be made from the available inventory in order to maximize the revenue?

Answer:  $x = \underline{\hspace{2cm}}$      $y = \underline{\hspace{2cm}}$      $z = \underline{\hspace{2cm}}$

**Question 2:** After maximizing the revenue, is there any inventory left over? If yes, then list the left over ingredient(s) and their amounts.

**Question 3:** Use the sensitivity report to figure out the maximum increase that is allowable for the profit of these boxes candy that will not change the solution.

Sweet Tooth =                           Sugar Dandy =                           Dandy Delite =                     

**Question 4:** Use shadow values to determine how much revenue will the company make if its supply of chocolate increases to 730 lbs and its supply of nuts increased to 180 lbs.

**Problem 4.** Solve this linear programming problem.

Objective function:  
 $C = 7x + 5y + 6z$  minimize

Constraints:  
 $x + y + z = 10$   
 $x + 2y + 3z \leq 19$   
 $2x + 3y \geq 21$   
 $x \geq 0, y \geq 0, z \geq 0$

Give the solution to all of the variables for this problem.

Answer:  $x = \underline{\hspace{2cm}}$      $y = \underline{\hspace{2cm}}$      $z = \underline{\hspace{2cm}}$      $C = \underline{\hspace{2cm}}$

E-mail a spreadsheet that contains all parts to the solution to either problem 2 or problem 3. The spreadsheet does not have to have all 4 problems in it.