Linear Optimization - Tutorial 2

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Excel Solver

- Excel has a built in solver module that can solve Linear Programs (and IPs/NLPs)

- This tutorial will show how to enable the solver add-in and how to use it to solve a LP

Load the Solver Add-in in Excel

- https://support.office.com/en-us/article/load-the-solver-add-in-in-excel-612926fc-d53b-46b4-872c-e24772f078ca

- Windows:
  - File − > Options − > Add-ins − > Manage − > Excel Add-ins
  - Select Solver Add-in, then OK.
- Mac:
  - Tools − > Excel Add-ins
  - Select Solver Add-in, then OK.
- Solver button is available in the Data tab.

Example 1 - Excel Solver

$$
\begin{aligned}
\text{max} \quad & z = 2x_1 - x_2 + 2x_3 \\
\text{subject to} \quad & 2x_1 + x_2 \leq 10 \\
& x_1 + 2x_2 - 2x_3 \leq 20 \\
& x_2 + 2x_3 \leq 5 \\
& x_j \geq 0 \text{ for } j = 1 \text{ to } 3
\end{aligned}
$$

Example 2 - Media Selection

The advertising alternatives for a company include Youtube, radio, and newspaper advertisements. The costs and estimates for audience coverage are:

	Youtube	Newspaper	Radio
Cost per Advertisement	$2000	$600	$300
Audience per Advertisement	100000	40000	18000

The local newspaper limits the number of weekly advertisements from a single company to ten. Moreover, in order to balance the advertising among the three types of media, no more than half of the total number of advertisements should occur on the radio, and at least 10% should occur on Youtube. The weekly advertising budget is $18, 200. How many advertisements should be run in each of the three types of media to maximize the total audience?

Example 3 - Production Planning

- Ontario Corporation needs to determine how many sailboats can be produced during each of the next four quarters (one quarter three months). The demand during each of the next four quarters is: first quarter, 40 sailboats; second quarter, 60 sailboats; third quarter, 75 sailboats; fourth quarter, 25 sailboats. Sailco must meet demands on time. At the beginning of the first quarter, Sailco has an inventory of 10 sailboats. At the beginning of each quarter, Sailco must decide how many sailboats should be produced during that quarter. For simplicity, we assume that sailboats manufactured during a quarter can be used to meet demand for that quarter.

Example 3 - Production Planning

- During each quarter, Ontario Corporation can produce up to 40 sailboats with regular-time labor at a total cost of $400 per sailboat. By having employees work overtime during a quarter, Ontario Corporation can produce additional sailboats with overtime labor at a total cost of $450 per sailboat. At the end of each quarter (after production has occurred and the current quarter's demand has been satisfied), a carrying or holding cost of $20 per sailboat is incurred. Use linear programming to determine a production schedule to minimize the sum of production and inventory costs during the next four quarters.

Example 4 - Transportation Problem

- A company manufacturing widgets has two factories located
  at cities F_1 and F_2 and three retail centers located at C_1, C_2
  and C_3. The monthly demand at the retail centers are (in
  thousands of widgets) 8, 5 and 2 respectively while the
  monthly supply at the factories are 6 and 9 respectively.
  Notice that the total supply equals the total demand. We are
  also given the cost of transportation of 1 widget between any
  factory and any retail center.

	C_1	C_2	C_3
F_1	5	5	3
F_1	6	4	1

In the transportation problem, the goal is to determine the
quantity to be transported from each factory to each retail
center so as to meet the demand at minimum total shipping
cost.

- Simplex Method