4 Excel and Solver.

4.1 Spreadsheets.

There are many computer programs to solve optimization problems. The most widely available is Microsoft Excel. Excel is an all-purpose spreadsheet-based program. Think of a spreadsheet as a grid of cells where each cell has a pre-defined address. The cells hold data or formulas acting on the data. A cell displays its content in a variety of formats. If a cell holds a formula, then the current value of the formula is displayed. As values change in a spreadsheet, affected cells are continually updated unless this mechanism is suppressed. For instance, if cell A1 holds the value 2 and cell B1 the formula =A1*A1, then B1 displays 4. If the value in A1 is changed to 3, then B1 right away changes its value to 9 without any user-intervention.

4.2 Solver.

As expected, Excel can be programmed to solve a variety of optimization problems. The good news is that there is a Tools Add-In called Solver, which has several useful optimization algorithms. The examples given here refer to Microsoft Excel 2000 (Version 9.0). When Excel is started it creates a new document called Book 1. Sheet 1 of Book 1 is displayed with the current cell A1 highlighted by a dark black rectangle. To solve the primal problem

$$\max 2x + 3y \text{ when } \begin{cases} 5x + 7y \leq 11 \\ x, y \geq 0 \end{cases},$$

take the following steps.

1. Enter the text “x” in A1, “y” in A2, “2x+3y” in A4, and “5x+7y” in A6.
2. Enter the formula “=2*B1+3*B2” in B4, and “=5*B1+7*B2” in B6.
3. Enter the number 11 in C6.
4. Start Solver.
5. Highlight B4 and observe how the “Set Target Cell” edit control changes.
6. Click in the “By Changing Cells” edit control.
7. Highlight B1:B2 by clicking holding and dragging. Observe the change in the edit control.
8. Click on Add.
9. Highlight B6 and observe the change in the edit control “Cell Reference”.
10. Click in the “Constraint” edit control.
11. Highlight C6 and observe the change in the edit control.
12. Click Add.
13. Click Cancel.
14. Click Options.

15. Check “Assume Non-Negative” and click OK.
16. Click Solve and observe how the values change on Sheet 1.
17. Click the “Answer Report” and click OK.
18. Click the “Answer Report 1” tab next to the “Sheet 1” tab.

The report, without the heading, should look like this:

Target Cell (Max)

Cell	Name	Original Value	Final Value
B4	2x+3y	0	4.714285714

Adjustable Cells

Cell	Name	Original Value	Final Value
B1	x	0	0
B2	y	0	1.571428571

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
B6	5x+7y	11	B6<=C6	Binding	0

Exercise

Use Excel to find the solution of

$$\min 2\lambda_1 + 3\lambda_2 + 5\lambda_3 \text{ when } \begin{cases} 7\lambda_1 + 11\lambda_2 + 13\lambda_3 \geq 17 \\ \lambda_1, \lambda_2, \lambda_3 \geq 0 \end{cases}.$$