Operations Research I: Models & Applications

Using Excel to Solve Linear Programs

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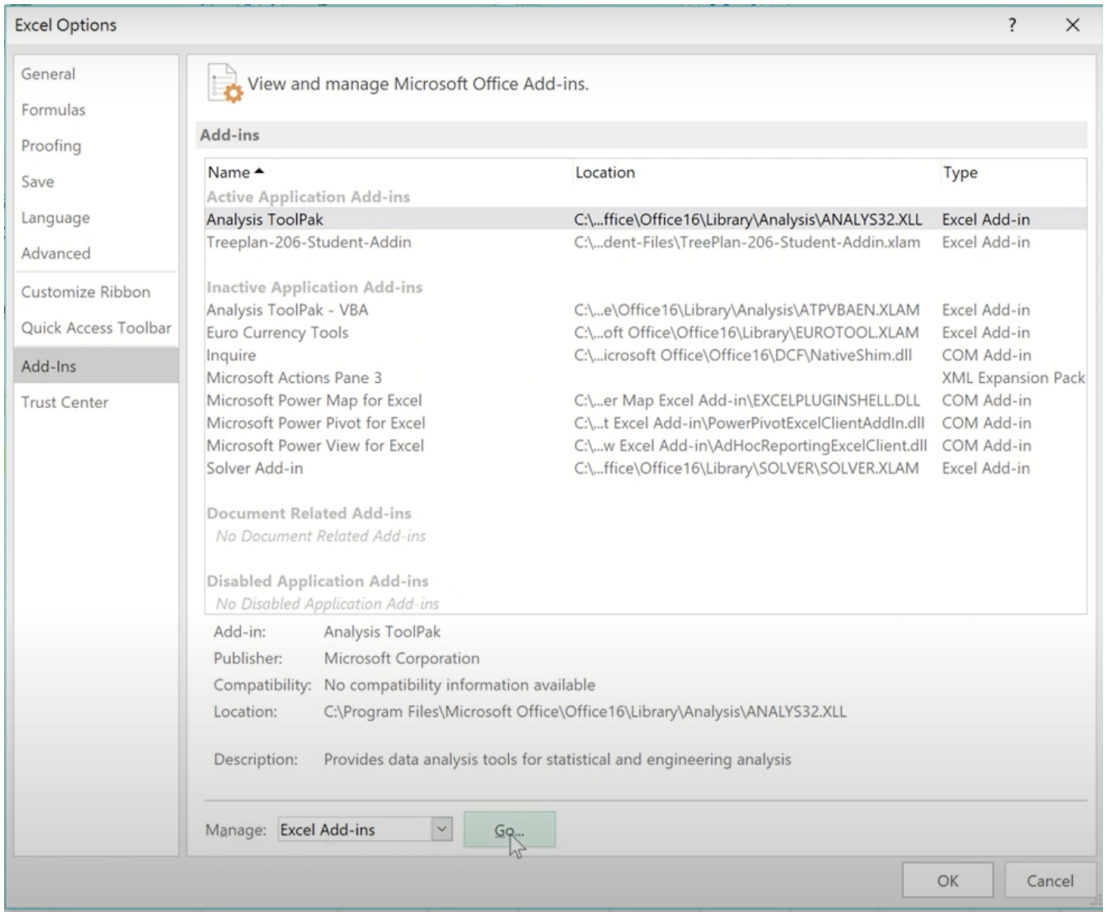
Road map

- **The Solver add-in**.
- Example 1: producing desks and tables.
- Example 2: personnel scheduling.

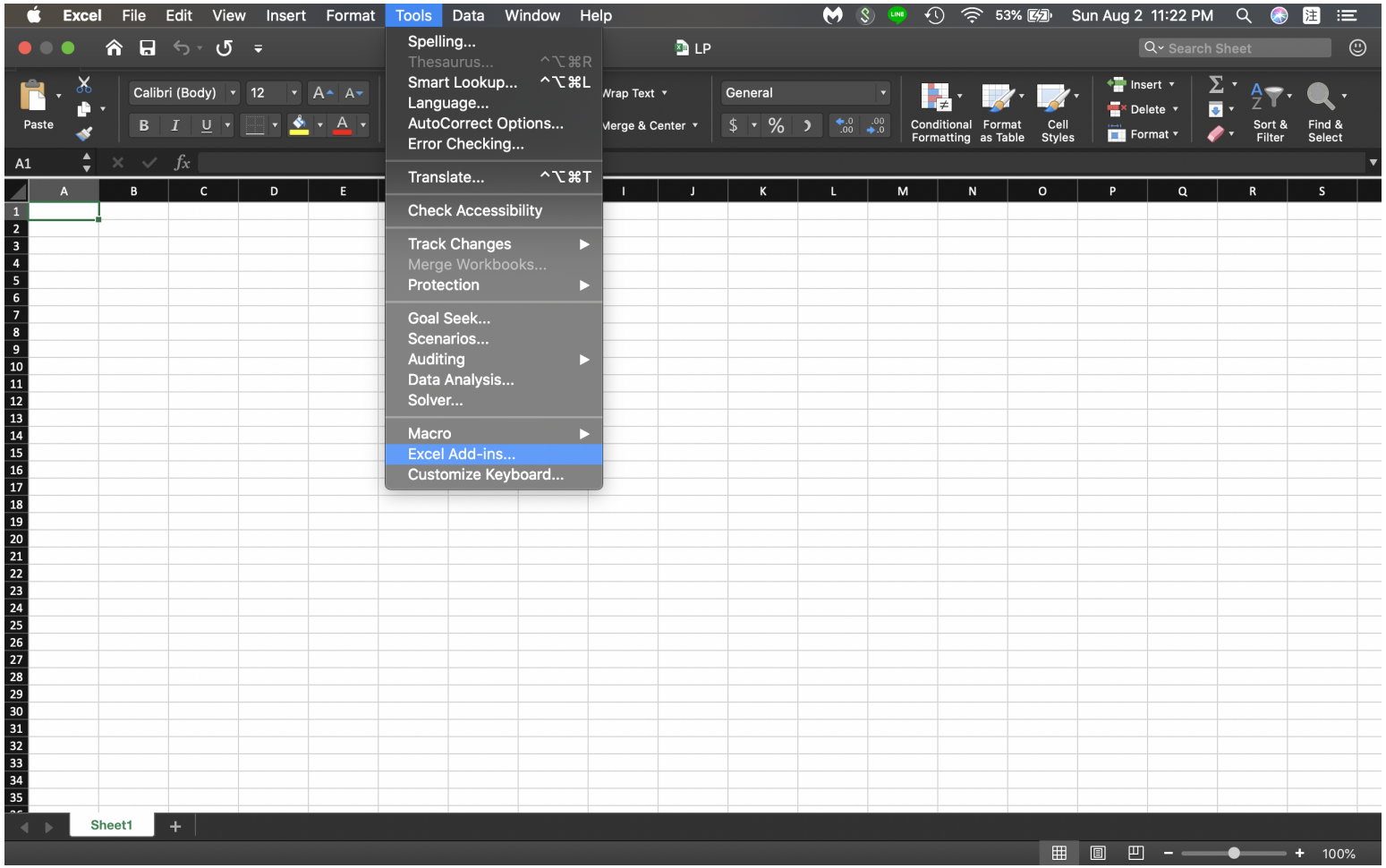
Excel Solver add-in

- "Solver" is a Microsoft Excel add-in program for solving linear programs, integer programs, and nonlinear programs.
- Solver adjusts the values of the decision variables in your model.
  - To satisfy all the constraints.
  - Maximize or minimize the objective value.

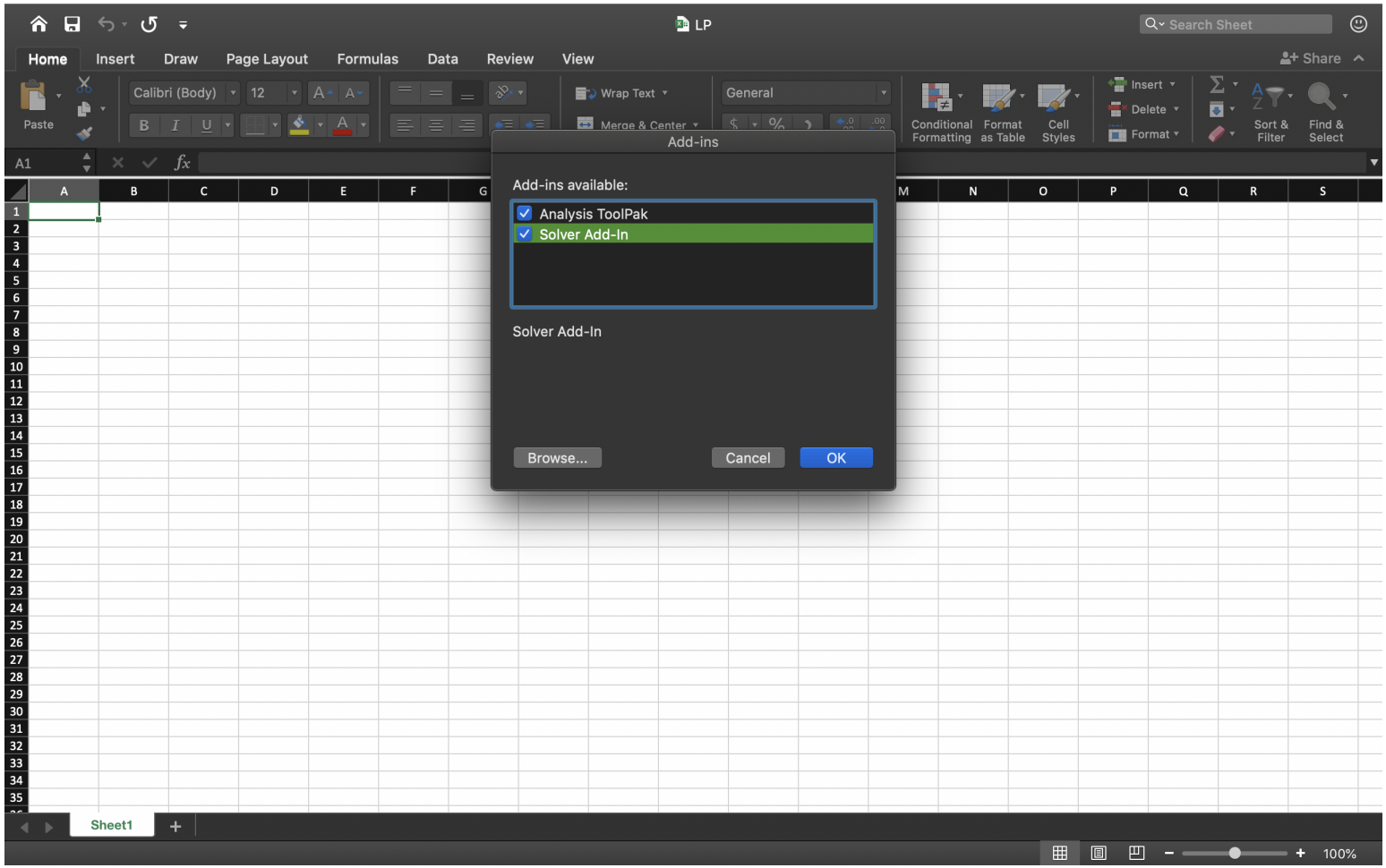
Install Solver add-in for Windows 2019



Install Solver add-in for Mac 2019 (1)



Install Solver add-in for Mac 2019 (2)



Road map

- The Solver add-in.
- **Example 1: producing desks and tables**.
- Example 2: personnel scheduling.

Complete formulation

- According to the previous videos, let

$$x_1 = \text{number of desks produced in a day and}$$
$$x_2 = \text{number of tables produced in a day.}$$

- The formulation of this example is

$$\begin{array}{rrcrcll} \max & 700x_1 & + & 900x_2 & & & \\ \text{s.t.} & 3x_1 & + & 5x_2 & \leq & 3600 & \text{(wood)} \\ & x_1 & + & 2x_2 & \leq & 1600 & \text{(labor)} \\ & 50x_1 & + & 20x_2 & \leq & 48000 & \text{(machine)} \\ & x_1 & & & \geq & 0 & \\ & & & x_2 & \geq & 0 & \end{array}$$

- Let's use the Solver add-in to find an optimal solution!

Solve by the Solver add-in

- An optimal solution of this LP is $(884.2, 189.5)$. $z^* = 789473.7$.

Constraints				
	Desk (x_1)	Table (x_2)		
Wood	3	5	<=	3600
Labor hours	1	2	<=	1600
Machine	50	20	<=	48000
Objective values				
max	700	900		
Linear Programing				
	x_1	x_2		
Decision variables	884.2	189.5		
Objective value	789473.7			
Constraint 1	3600.0			
Constraint 2	1263.2			
Constraint 3	48000.0			

Road map

- The Solver add-in.
- Example 1: producing desks and tables.
- **Example 2: personnel scheduling**.

Complete formulation

- According to the previous videos, let x_i be the number of people who start to work on day i for five consecutive days.
- The formulation of this example is

$$
\begin{array}{lccccccccccccccc}
\min & x_1 & + & x_2 & + & x_3 & + & x_4 & + & x_5 & + & x_6 & + & x_7 & & \\
\text{s.t.} & x_1 & + & & & & & x_4 & + & x_5 & + & x_6 & + & x_7 & \geq & 110 \\
 & x_1 & + & x_2 & + & & & & & x_5 & + & x_6 & + & x_7 & \geq & 80 \\
 & x_1 & + & x_2 & + & x_3 & + & & & & & x_6 & + & x_7 & \geq & 150 \\
 & x_1 & + & x_2 & + & x_3 & + & x_4 & + & & & & & x_7 & \geq & 30 \\
 & x_1 & + & x_2 & + & x_3 & + & x_4 & + & x_5 & & & & & \geq & 70 \\
 & & & x_2 & + & x_3 & + & x_4 & + & x_5 & + & x_6 & & & \geq & 160 \\
 & & & & & x_3 & + & x_4 & + & x_5 & + & x_6 & + & x_7 & \geq & 120
\end{array}
$$

$$x_i \geq 0 \quad \forall i = 1, ..., 7.$$

- Let's use the Solver add-in to find an optimal solution!

Solve by the Solver add-in

- An optimal solution is $(3.3, 0, 53.3, 0, 13.3, 93.3, 0)$. $z^* = 163.3$.

Constraints									
	x_1	x_2	x_3	x_4	x_5	x_6	x_7		
Mon	1			1	1	1	1	>=	110
Tue	1	1			1	1	1	>=	80
Wed	1	1	1			1	1	>=	150
Thu	1	1	1	1			1	>=	30
Fri	1	1	1	1	1			>=	70
Sat		1	1	1	1	1		>=	160
Sun			1	1	1	1	1	>=	120
Objective values									
min	1	1	1	1	1	1	1		
Linear Programing									
	x_1	x_2	x_3	x_4	x_5	x_6	x_7		
Decision variables	3.3	0.0	53.3	13.3	0.0	93.3	0.0		
Objective value	163.3								
Constraint 1	110.0								
Constraint 2	96.7								
Constraint 3	150.0								
Constraint 4	70.0								
Constraint 5	70.0								
Constraint 6	160.0								
Constraint 7	160.0								