

Linear Programming

using

EXCEL

An Example LP Problem

Blue Ridge Hot Tubs manufactures and sells two models of hot tubs: the Aqua-Spa and the Hydro-Lux. Howie Jones, the owner and manager of the company needs to decide how many of each type of hot tub to produce during his next production cycle. Howie buys prefabricated fiberglass hot tub shells from a local supplier and adds the pump and tubing to the shells to create his hot tubs. (The supplier has the capacity to deliver as many hot tub shells as Howie needs.) Howie installs the same type of pump into both hot tubs. He will have only 200 pumps available during his next production cycle. From a manufacturing standpoint, the main difference between the two models of hot tubs is the amount of tubing and labor required. Each Aqua-Spa requires 9 hours of labor and 12 feet of tubing. Each Hydro-Lux requires 6 hours of labor and 16 feet of tubing. Howie expects to have 1,566 production labor hours and 2,880 feet of tubing available during the next production cycle. Howie earns a profit of \$350 on each Aqua-Spa he sells and \$300 on each Hydro-Lux he sells. He is confident that he can sell all the hot tubs he produces. The question is, how many Aqua-Spas and Hydro-Luxes should Howie produce if he wants to maximize his profits during the next production cycle? [Ragsdale, Spreadsheet Modeling and Decision Analysis, p.

Getting organized -- understanding the problem

Decision variables: number of aqua-spas (A) to produce and the number of hydro-luxes (H) to produce.

Objective function: Max: Profit = 350 A + 300 H

Constraints:

pump $1A + 1H \# 200$

labor $9A + 6H \# 1566$

tubing $12A + 16H \# 2800$

Implementing an LP Model in a Spreadsheet

1. Organize the data for the model on the spreadsheet.
2. Reserve separate cells in the spreadsheet to represent each decision variable.
3. Create a formula in a cell in the spreadsheet that corresponds to the objective function.
4. For each constraint create a formula in a cell in the spreadsheet that corresponds to the relationship expressed in the constraint. (This is the left-hand-side in an algebraic model.)

| | A | B | C | D | E |
|----|-----------------|-----------|-------------|---------------|-----------|
| 4 | | Aqua Spas | Hydro Luxes | | |
| 5 | Number to make | B | | Total Profit | |
| 6 | Unit profits | \$ 350 | \$ 300 | \$ - | A |
| 7 | | | | | |
| 8 | Constraints | | | Used | Available |
| 9 | Pumps required | 1 | 1 | \$ - | 200 |
| 10 | Labor required | 9 | 6 | \$ C - | 1566 |
| 11 | Tubing required | 12 | 16 | \$ - | 2880 |

C

Constraints

$$D9 = B5 * B9 + C5 * C9$$

$$D10 = B5 * B10 + C5 * C10$$

$$D11 = B5 * B11 + C5 * C11$$

B

cells for **decision variables**

B5 and C5


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A


Objective function

$$D6: = B5 * B6 + C5 * C6$$


Step 5: Select: Tools | Solver

A Set Target Cell: 

Equal To: Max Min Value of:

By Changing Cells: 

B

Subject to the Constraints: 

C

In the Solver menu box we need to enter the following:

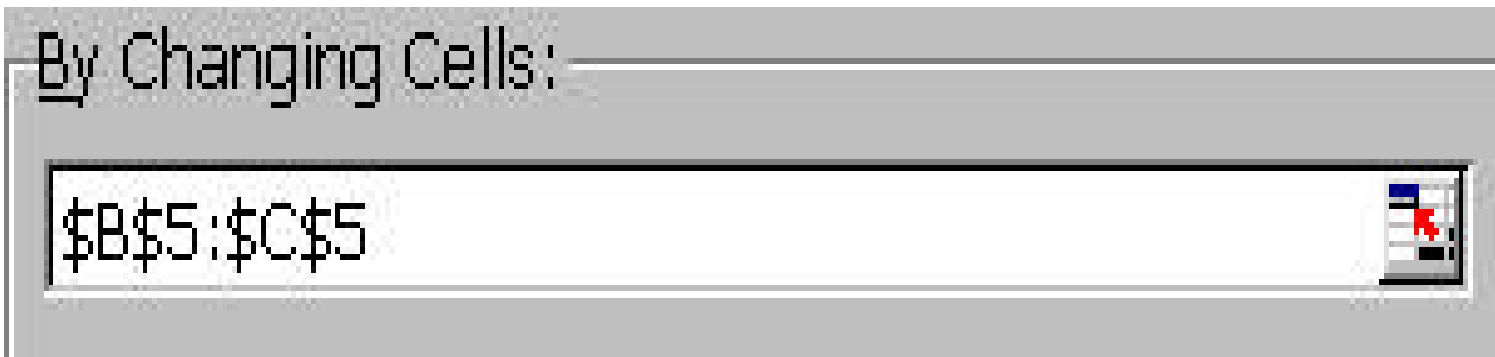
| | |
|-------------------------------------|---|
| Objective function (target cell) | A |
| Decision variables (changing cells) | B |
| Constraints (constraints) | C |

A



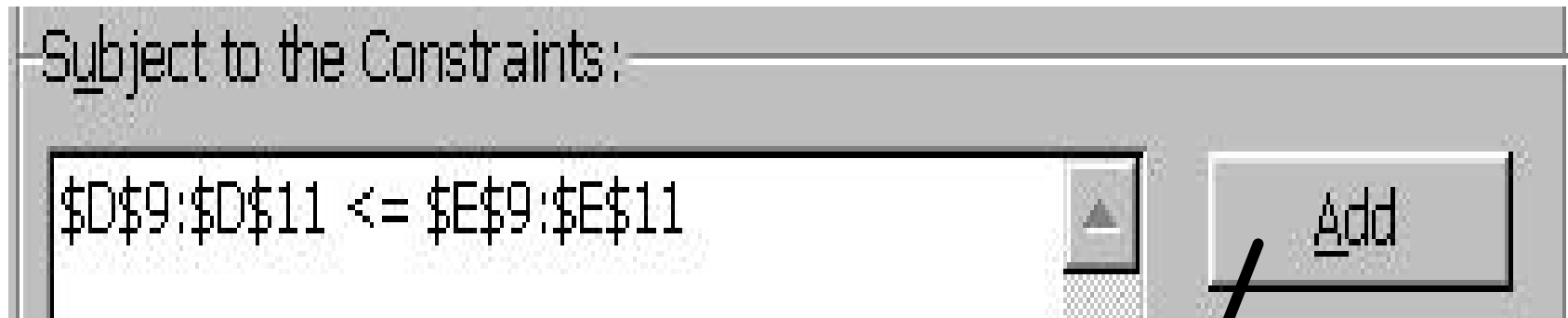
Cell D6 has the objective function formula.

B

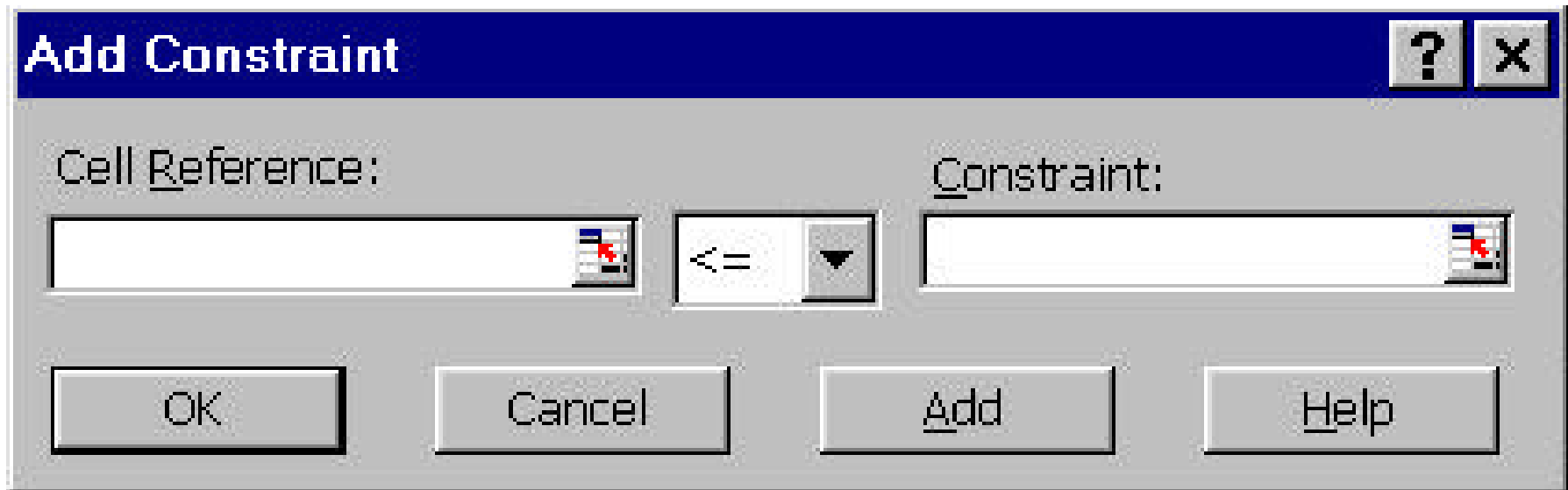


Cells B5 to C5 are the decision variables.

C

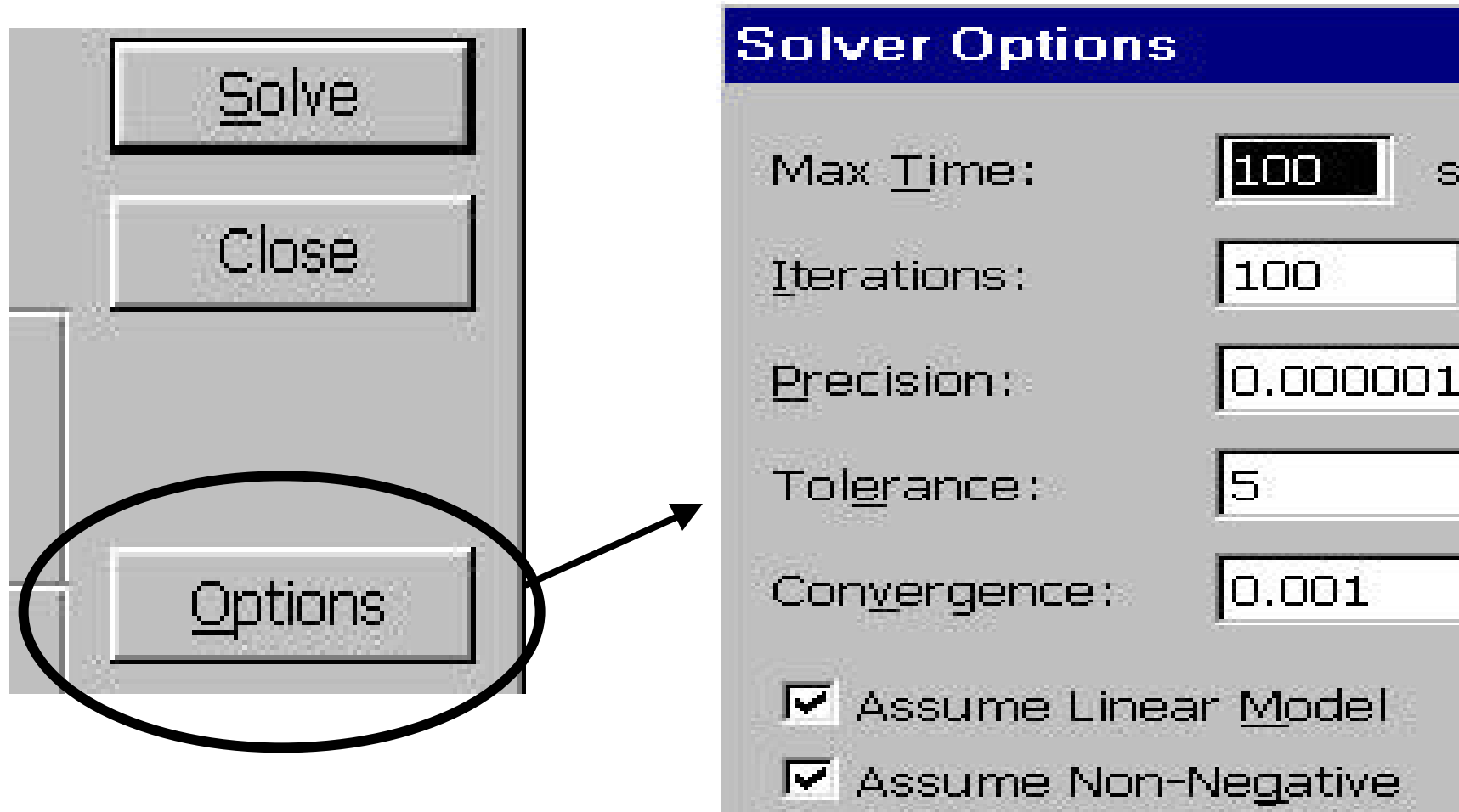


Select **Add** to enter each constraint.



Enter LHS formula in Cell Reference and RHS value in Constraint.

Before solving we must set some Options.



Select Assume Linear Model and Assume Non-Negative.

Solution:

**Decision
variables:**

**Objective
function:**

| | Aqua Spas | Hydro Luxes | | |
|------------------------|------------------|--------------------|---------------------|------------------|
| Number to make | 122 | 78 | Total Profit | |
| Unit profits | \$ 350 | \$ 300 | \$ 66,100 | |
| | | | | |
| Constraints | | | Used | Available |
| Pumps required | 1 | 1 | \$ 200 | 200 |
| Labor required | 9 | 6 | \$ 1,566 | 1566 |
| Tubing required | 12 | 16 | \$ 2,712 | 2880 |