# Carpenter's Problem

*Example.* Suppose that a carpenter makes tables and bookcases.

- Tables require 20 units of lumber and 5 hours of labor.
- Bookcases require 30 units of lumber and 4 hours of labor.
- She makes a profit of \$25 per table and \$30 per bookcase.
- She has on hand 690 units of lumber and 120 units of labor.

Determine the optimal number of tables and bookcases to build.

*Formulation.* Let $x$ be the number of tables and $y$ be the number of bookcases she builds in a week. We have the following LP.

$$\begin{aligned} \text{maximize} \quad & z = 25x + 30y && \text{(objective function)} \\ \\ \text{subject to} \quad & 20x + 30y \leq 690 && \text{(lumber constraint)} \\ & 5x + 4y \leq 120 && \text{(labor constraint)} \\ & x, y \geq 0 && \text{(nonnegativity constraints)} \end{aligned}$$

—Worksheet—

# Carpenter's Problem

The worksheet helps us to understand the idea of **sensitivity analysis**.

Given a linear program and its solution,

- How sensitive is the solution to changes in the objective function or the constraints?

The economic interpretation of the results is that the equilibrium cost of lumber is about 71.4 cents per unit and that of labor is \$2.14 per hour.

- So if we can buy our lumber for less or hire labor cheaper than that, we should (up to a point)
- And, if we can sell our lumber for more or contract out labor for more, we should (up to a point)

This "point" occurs when the constraint becomes redundant.