Bake Sale Example

: profit = \$30 per batch

: profit = \$60 per batch

The bakery is running low on flour, chocolate, sugar and eggs

	Flour	Choc.	Sugar	Eggs
	1 c.	9 oz.	1 c	1
	4 c.	6 oz.	1 c	1
Total Avail.	20 c	63 oz.	8 c.	10

① Define Decision Variables - "What are we trying to decide?"
  - How many batches of brownies + cookies should we make?

$$X_1 = \# \text{ of batches of}$$

$$X_2 = \# \text{ of batches of}$$

② Objective Function - "What is our goal?"
  - Maximize Profit

$$\text{Profit} = 30X_1 + 60X_2$$

③ Constraints - "What is restricting the set of feasible decisions?"

Flour

$1x_1 + 4x_2 \le 20$

Chocolate

$9x_1 + 6x_2 \le 63$

Sugar

$1x_1 + 1x_2 \le 8$

Eggs

$1x_1 + 1x_2 \le 10$

Can I produce negative batches?

Non-negativity

$x_1 \ge 0, \quad x_2 \ge 0$

So here is how we combine everything...

$\max \ 30x + 60x_2 \quad \leftarrow$ "Objective Function"

subject to

(s.t.)
$$\left.\begin{array}{l} x_1 + 4x_2 \le 20 \\ 9x_1 + 6x_2 \le 63 \\ x_1 + x_2 \le 8 \\ x_1 + x_2 \le 10 \\ x_1, x_2 \ge 0 \end{array}\right] \leftarrow \text{"Constraints"}$$

(change to 2nd slide)

The process:

1. Defining the problem
   - typically ill-defined
   - define objective
   - identify stakeholders > Ask what these were for bakesale example

2. Formulate the model (Translate into math)
   - decision variables
   - obj. function
   - constraints
   - parameters (external values you assume fixed) => DATA
   - simplifying assumptions - what were our simplifying assumptions for the bake sale?

3. Solve (Sometimes hard to do)
   - algorithms to find an optimal solution: Simplex
   - heuristics to find a feasible sol'n that's "good enough".