

## Worthing Outreach Program Summary: November 16, 2005

### Linear Programming with Constraints

Today we solve a linear program with constraints. Let's start with an example:

**Problem:** A woman wants to purchase crackers and cheese for lunch. She'd like to keep the total cost as low as possible. Crackers cost 1 cent and cheese costs 3 cents. She also must have at least 150 calories. Each cracker is 14 calories and each piece of cheese 40 calories. However, at most, she can only have 11 crackers and 4 pieces of cheese. The minimum amount of each she can have is 0 crackers and 0 pieces of cheese. How many crackers and pieces of cheese should she buy?

**Solution:** We can use linear programming to solve this problem. The first step in solving a linear program is to list the constraints. Let's start with the easy ones. We know she can only eat at least 0 and less than 11 crackers. We can represent that by the following:

$$\begin{aligned}(\text{no. crackers}) &\geq 0 \\(\text{no. crackers}) &\leq 11.\end{aligned}$$

The number of cheese pieces she can eat is less than 4, but greater than 0:

$$\begin{aligned}(\text{no. cheese}) &\geq 0 \\(\text{no. cheese}) &\leq 4.\end{aligned}$$

The final constraint is that the total amount of calories is less than 150. Each cracker contains 14 calories, while each piece of cheese contains 40 calories. So the total amount of calories of crackers and cheese is

$$14 * (\text{no. crackers}) + 40 * (\text{no. cheese}).$$

So we can represent this constraint by

$$14 * (\text{no. crackers}) + 40 * (\text{no. cheese}) \geq 150.$$

A linear program can be used with MATLAB to solve this problem.