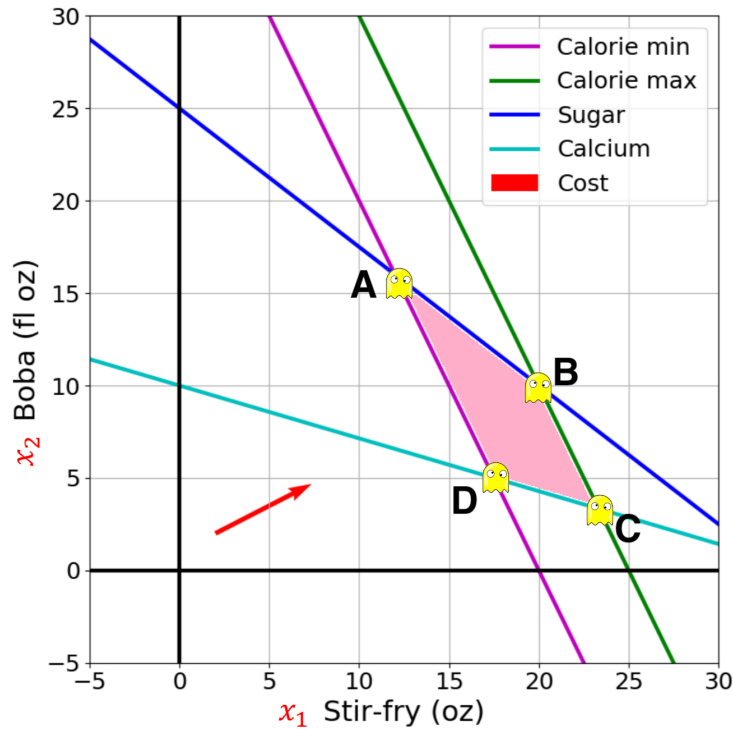


# 1 Warmup

In Tuesday's lecture, we went through two algorithms for solving linear programming programs - vector enumeration and the simplex algorithm.

Recall the "Healthy Squad Goals" example from Thursday's lecture. The goal is to minimize the cost, and the cost vector (red) is perpendicular to the purple and green lines.



- Briefly describe both algorithms and explain how they differ. (hint: use terms such as vertices, intersections and neighbors).
- Run simplex algorithm starting from point B. Now try running the algorithm starting from point C. How do their solutions differ?

## 2 Baymax's Factory

Baymax and the 281 TAs have opened a factory to produce special medicine and bandages. These are really difficult to produce and require the collaboration of robots and humans.

To produce an ounce of medicine, it takes 0.2 hours of human labor and 4 hours of robot labor. To produce an inch of bandage, it takes 0.5 hours of human labor and 2 hours of robot labor. An ounce of medicine sells for \$30 and an inch of bandages sells for \$30. Medicine and bandages can be sold in fractions of an ounce or inch.

We want to maximize our profit so we can buy gifts for all the students. However, the TAs are really busy so they can only devote 90 human hours. In addition, Baymax can only devote 800 robot hours because he has other obligations to tend to. How can we maximize our profit?

(a) Is this a linear, mixed or integer programming problem? Formulate and solve it.

Now suppose the items can only be sold in whole units (by ounce/inch).

(b) Is this a linear, mixed, or integer programming problem? Perform branch and bound for one branch level. You do not have to evaluate; writing out the constraints will suffice.

(c) Now assume medicine can be sold in fractions but bandages can only be sold in whole units. What kind of a programming problem would this be, and how would our evaluation process differ from the problem type in part b?

(d) How many optimal solutions can a LP have? How about IP?

### 3 4-Queens

Recall the 4-Queens problem. The goal is to place 4 chess queens on a 4x4 chess board such that no two queens are in the same row, column and diagonal.

Formulate the 4-Queens problem as an integer programming problem.