Graphing in Mathematica

AM121

This is the Mathematica version of the graphing guide. Mathematica is another great piece of software for performing common operations in AM121: graphing linear inequalities, performing pivot operations and other matrix manipulations, etc. Here we will show you just how simple it is to graph something.

Consider the following linear program:

$$\begin{aligned} \max \quad & x_1 + 1.5x_2 \\ & x_1 + 2x_2 \leq 4 \\ & 3x_1 + 4x_2 \leq 10 \\ & x_1 \geq 0, x_2 \geq 0 \end{aligned}$$

We can graph this in Mathematica with the `RegionPlot` and the `ContourPlot` commands. First we'll prepare the plot of the feasible region using `RegionPlot` providing our set of constraints and a range for each variable:

```
FeasibleRegion = RegionPlot[
     x1 + 2 x2 <= 4 &&
     3 x1 + 4 x2 <= 10 &&
     x1 >= 0 &&
     x2 >= 0, {x1, 0,10}, {x2, 0, 15}]
```

Okay, so since we left off a semicolon at the end, we'll be able to see how our plot looks:

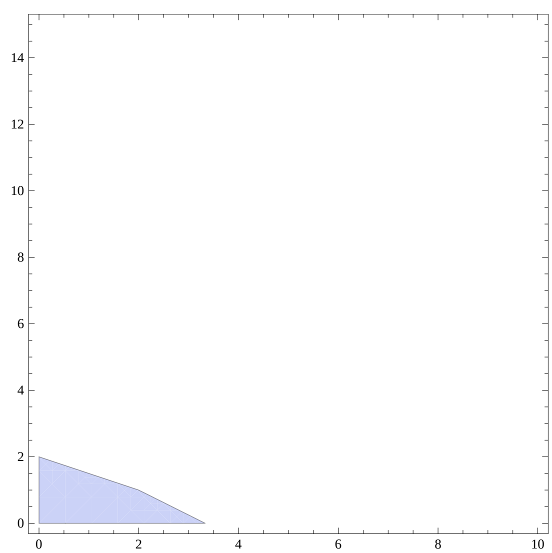

Figure 1: graphing feasible region

See Figure 1. Not bad. The ranges are too long though, so let's just redefine domain:

```
FeasibleRegion = RegionPlot[
     x1 + 2 x2 <= 4 && 3 x1 + 4 x2 <= 10 && x1 >= 0 && x2 >= 0, {x1, 0, 4}, {x2, 0, 3}]
```

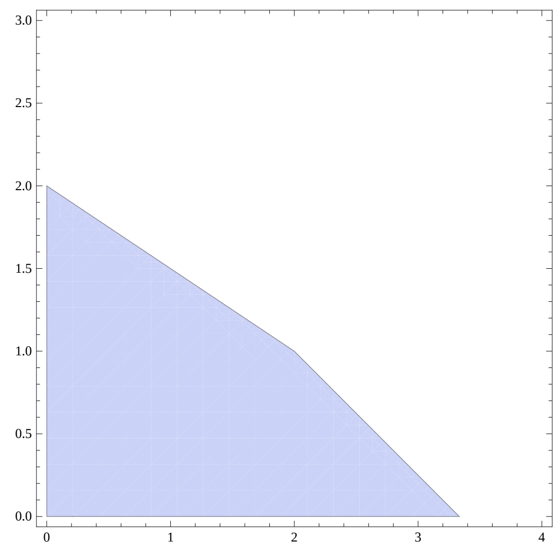

Figure 2: graphing feasible region

That's better. Okay, now let's add our objective function. Here we like to use contour lines to see the line move out to the right. Let's define it this way, and display both the feasible region and objective (and some nice labels of our possible solutions, depending on if we wanted a minimum or a maximum):

```
ObjectiveLines = ContourPlot[x1 + 1.5 x2, {x1, 0, 5}, {x2, 0, 10},
     Contours -> 10, ContourStyle -> {Red}, ContourShading -> None, ContourLabels -> True];
Show[FeasibleRegion, ObjectiveLines,
     Graphics[Text["A", {0.1, 0.1}]], Graphics[Text["B", {2.1, 1.1}]], FrameLabel -> {x1, x2}]
```

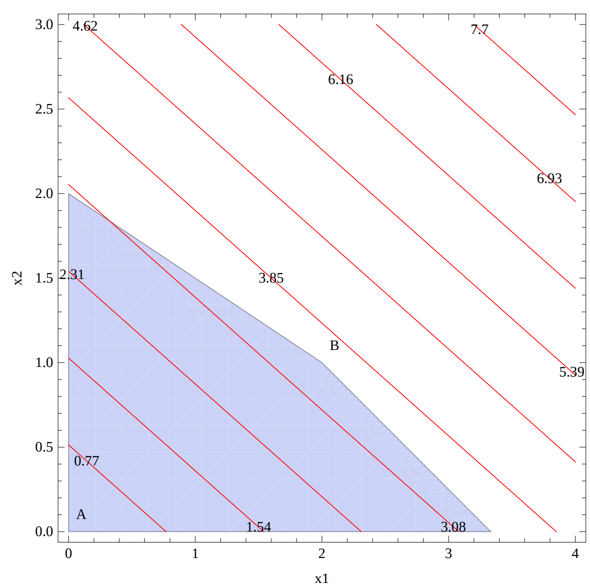

Figure 3: graph with contour lines

See Figure 3, which shows us the contour line moving out. The contour lines may not hit the intersection of the lines where the optimal solutions lie, but it does give you and idea of how the objective works out. Finding the actual point of intersection would just be solving the system of two equations, but as we just want a nice graph here, we will leave the rest to you :).