Linear Programming

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October 2, 2023

1 Word Problems

For word problems, your goal is to read the problem, and write down the objective function and constrains like this:

Maximize 300,000*T + 54,000*R + 120,000*O

Subject to
$2,000 * T + 300 * R + 600 * O \leq 27,400$
$T \leq 10$
$R \leq 20$
$O \leq 10$
$R \leq \frac{1}{2}(T + R + O)$
$T \geq \frac{1}{10}(T + R + O)$

1.1 Explanation

This is how we interpreted the problem's rules to get the constrains:

Objective Function   The goal was to maximize audience, so we simple add the total audience for each add type together by multiplying the number of ads (T, R, or O) by the audience for each ad, and then sum them togehter.

Budget   A budget means the cost of each variable R, T, O must be $\leq$ our spending budget.

Limits   The question stated that we aren't allowed for our answer to have more than 10 TV ads for example, so we add $T \leq 10$ so that our answer does not break the rules

Other Rules   The question stated, in english, "The number of radio ads can not be more than half of the total number of ads". Can not be more means there can be that many or less, which means $\leq$, just like a budget. Simply read left to right and convert to math as shown above in the constraint.

2 Problems with 2 variables

2.1 Setup

When given sets of equations such as
Max $2A + 1B$

Subject to
$A + 3B \leq 15$
$0.5B - 10A \geq 12$
...

2.2 Solving

Your goal is to graph it by converting to $B = mA + C$, graph each line, and shade above / to the right if it says $B \geq$ and below and to the left if it says $B \leq$.

1. Convert the equation to $B = mA + C$, or $y = mx + b$. If the graph is given, your new equations can help you identify which line is which by looking at the constant all the way to the right. if this constant is 51, the graph will cross the vertical axis at height 51. The other number is the slope of the line

   Note that when converting if you divide both sides of the equation by a negative number (happens when B has a negative coefficient) you have to reverse the inequality sign.

2. Shade the regions above or below based on the rules stated above.

3. Now you have the feasable region, and you want to write down the coordinate points at the corners of this region: That is, where lines intersect and that intersection point is within your shaded region.

4. Plug all of these points (A,B) into the objective function. If your asked to maximize, The optimal value is the greatest result of the objective function, and the optimal A and B are the values from the point that you plugged in which gave you this optimal value.

5. Beware you may be asked to minimize, in which you are looking for the smallest result instead.

2.3 Tips for single variable constraints

If you have a constraint like $A \leq 10$ that you need to graph to find the feasible region / optimal points, it's simply a straight line that crosses the A axis at 10, and youd shade to the left in this case. A = will be a vertical line, B = will be a horizontal line.

3 Tips using the online solver

Steps

1. Visit Online Solver (Click Here)

2. For all of your variables, replace the default variables on the first two lines with your variables. For example for a problem with variables T, R, O, you want

   - var $T >= 0$;
   - var $O >= 0$;
   - var $R >= 0$;

3. Be sure if you make a variable capital here, you always refer to it as capital.

4. Replace the function after 'maximize z:' with your objective function. Note that for multiplication, you must use *, and no commas in numbers! For example write 3000*T instead of 3,000T

5. if your goal is to minimize, change maximize to minimize.

6. Ensure each line is ended with a semicolon ;

7. For the constrains, copy and paste the given line that looks like 'subject to c11: ...;' so that you have one copy of the line for each of your constraints.

8. Change the dumb default constraint IDs from c11, c12 etc to c1, c2, c3, c4... for each of your constraints.

9. I highly recommend do not copy and paste into the code window on this website. If you have errors, it is probably because of this. Ensure you follow the format that is provided, type equations the way they do, keep your semi colons, initialize variables correctly at the start and you should be fine.

10. Press solve in the bottom left, then click on the Variables tab to view the results.