

Activity

Extension 3.3 Exploring Linear Programming

STEP 1 Read the problem

Your class plans to raise money by selling T-shirts and caps. The plan is to buy the T-shirts for \$8 and sell them for \$12 and to buy the caps for \$4 and sell them for \$7. The planning committee estimates that you will not sell more than 120 items. Your class can afford to spend as much as \$800 to buy the articles.

STEP 2 Write inequalities

Let c be the number of caps and let t be the number of T-shirts.

Write an inequality using c and t to represent selling at most 120 items.

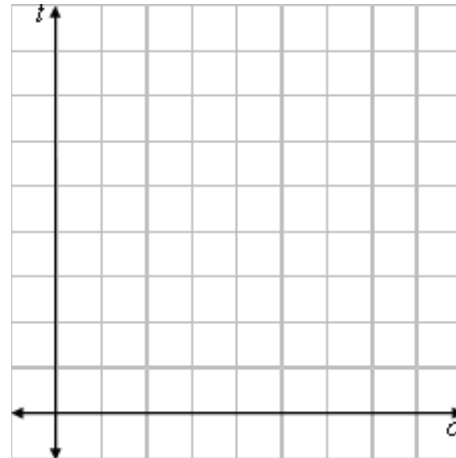
Write an inequality to represent spending up to \$800 dollars.

Write an inequality comparing c to 0.

Write an inequality comparing t to 0.

STEP 3 Graph inequalities

Graph the system of four inequalities that you wrote in Step 2. Use the horizontal axis for the number of caps and the vertical axis for the number of T-shirts.



DRAW CONCLUSIONS Use your observations to complete these exercises

1. If you buy the caps for \$4 and sell them for \$7, what is your profit for one cap?
2. If you buy the T-shirts for \$8 and sell them for \$12, what is your profit for one T-shirt?
3. Write a function for the profit P in terms of c and t .
4. The shaded region in your graph from Step 3 represents all possible combinations of caps and T-shirts that satisfy the system of inequalities. What are the coordinates of all the vertices of the region that lie on one or both of the x - and y -axes?
5. How can you find the coordinates of the vertex of the solution region that does *not* lie on either the x - or y -axis? What are the coordinates?

EXPLORE 2 Find the maximum

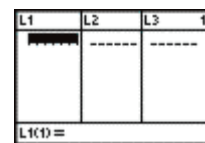
STEP 1 Choose points

Choose 10 points in the solution region of your graph in Explore 1, including all the vertices. Do not fill in the profit row at this time.

Number of caps, c										
Number of T-shirts, t										
Profit										

STEP 2 Enter data

Enter the data from Step 1 into your calculator in the form of lists by pressing **STAT** and selecting Edit. Enter the number of caps in L1 and the number of T-shirts in L2.



STEP 3 Find the profit

You can have your calculator table display the profit P in L3. To do this, first rewrite your profit function from Exercise 3 of the Explore 1 section below by substituting L3 for P , L1 for c , and L2 for t .

$$L3 = \underline{\hspace{2cm}}$$

Using the calculator's arrow keys, highlight L3 on the screen. Then key in the expression above (press **2ND** 1 to enter "L1" and **2ND** 2 to enter "L2"), and press **Enter**. The calculator will display the results in L3.

STEP 4 Record results

Record the resulting profits displayed in L3 in your table from Step 3.

DRAW CONCLUSIONS Use your observations to complete these exercises

6. For which combination of caps and T-shirts did you find the maximum profit? What was the maximum profit?
7. Look at the point on the graph corresponding to the combination of caps and T-shirts from Exercise 6. What is the geometrical relationship of this point to the solution region?
8. For which combination of caps and T-shirts did you find the minimum profit? What was the minimum profit?
9. Look at the point on the graph corresponding to the combination of caps and T-shirts from Exercise 8. What is the geometrical relationship of this point to the solution region?