How Many

ID: 10256

Time required
45 minutes

Activity Overview

Students will be presented a situation in which they must use linear programming to determine the optimum production level to maximize profits.

Topic: Linear Algebra: Vectors & Matrices

- *Graph a system of linear inequalities and identify the solution set.*
- *Apply the minimax theorem to solve problems in linear programming.*

Teacher Preparation and Notes

- *Linear programming, or a form of it, is used by many different industries in the world to analyze the effects of the variables involved in a business as well as to determine which values of these variables will result in maximizing profit. For example the airline industry uses a form of linear programming to maximize profits. It does this by determining all the various factors involved with the industry (demand by people for a certain airline route between cities, type of aircraft, time of flights, number of flights, competitors flights as well, etc). The industry's linear programming application is so powerful and fast that if a competing airline were to add an additional route at a certain time between two cities, that new route could be entered and within a half hour, its effect known.*
- *Students should already be familiar with graphing inequalities and be aware that the shaded region is the solution.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter "10256" in the keyword search box.***

Associated Materials

- *HowMany_Student.doc*
- *HowMany.tns*

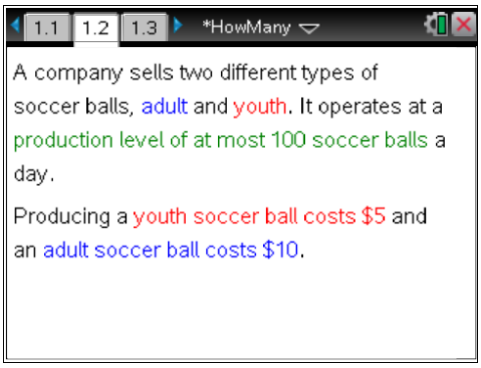
Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Linear Programming-Cookie Dough Kits (TI-84 Plus family) — 6570*
- *Linear programming (TI-Nspire technology) — 9637*
- *Linear Inequalities (TI-Nspire technology) — 8477*

Problem 1 – Soccer Balls

On pages 1.2 and 1.3, students are introduced to the first linear programming problem, a company that wants to maximize profits selling two types of soccer balls.



Students will need to determine the profit function and constraints of the problem.

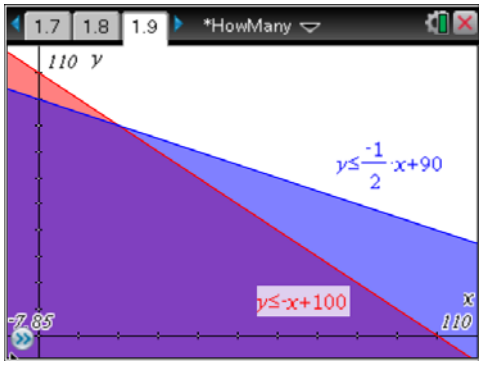
The profit function is $P(x, y) = 14x + 20y$
Production Level Constraint: $x + y \leq 100$
Daily operating budget constraint: $5x + 10y \leq 900$

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

One of the common mistakes for students when working with a linear programming problem is mistakenly putting the function that is being maximized or minimized into the constraints. If the students write this function out first, then they can avoid this common pitfall.

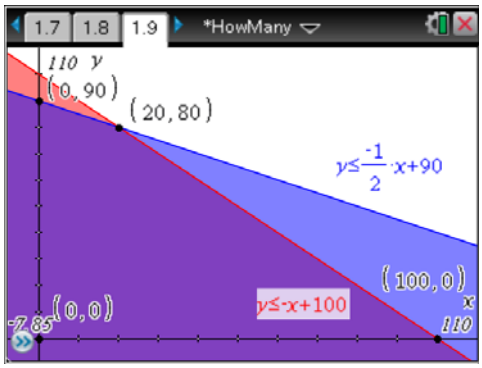
On page 1.9, students are to graph the constraints, or inequalities.



The inequality signs can entered by pressing ↵ to remove the "=" sign. Then select the needed inequality form the pop-up menu that appears.

Note: Students do not need to graph $x \geq 0$ and $y \geq 0$ because they are the axes.

The constraints form the fundamental region and 4 vertices. Students can use the **Intersection Point(s)** tool to find the coordinates of the vertices. If the coordinates do not appear automatically, students can use the **Coordinates and Equations** tool to display the locations.



(0, 90), (20, 80), (100, 0), (0,0)

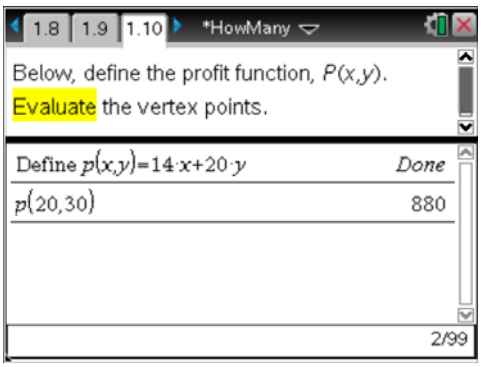
TI-Nspire Navigator Opportunity: *Screen Capture and Live Presenter*

See Note 2 at the end of this lesson.

On page 1.10, students will define the profit function they found on page 1.4.

Then students can substitute in the coordinates of the vertices to determine which one produces the highest profit.

Maximum profit, occurs when 20 youth soccer balls and 80 adult soccer balls are produced each day.

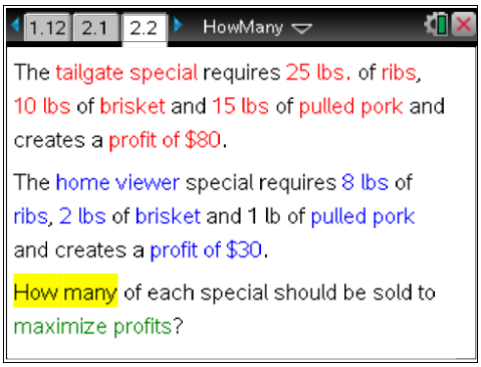


TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 3 at the end of this lesson.

Problem 2 – Barbeque Catering

On pages 2.1 and 2.2, students are introduced to the second linear programming problem, a catering business that wants to maximize profits selling two specials.

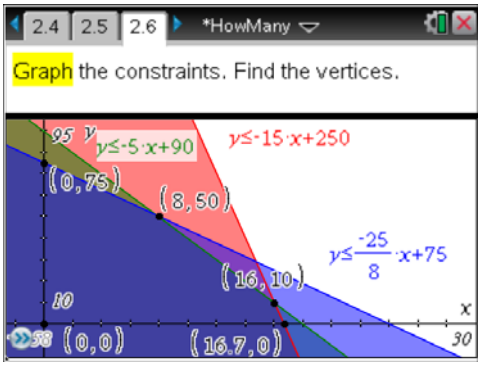


Students will need to determine the profit function and constraints of the problem.

The profit function is $P(x, y) = 80x + 30y$

Smoked meat inequalities

Ribs:	$25x + 8y \leq 600$
Brisket:	$10x + 2y \leq 180$
Pork:	$15x + y \leq 250$

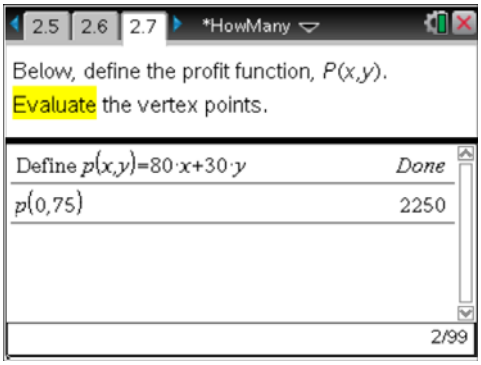


On page 2.6, students are to graph the constraints, or inequalities, and find the coordinates of the vertices of the region.

(0, 75), (8, 50), (16, 10), (16.667, 0)

On page 2.7, students will define the profit function they found on page 2.3.

Then students can substitute in the coordinates of the vertices to determine which one produces the highest profit.



The maximum profit occurs when 0 tailgate specials and 75 home viewer specials are sold.

Students are also asked about whether this choice is good for the company or not. They should think about the amount of meat left over after making the specials.

TI-Nspire Navigator Opportunities

Note 1
Problem 1, *Quick Poll*

Send *Quick Polls* for the questions on pages 1.6 and 1.7. Then use the results to guide the class discussion over the constraints.

Note 2
Problem 1, *Screen Capture and Live Presenter*

Use *Screen Capture* to monitor student progress as they graph the inequalities and find the vertices. Consider using *Live Presenter* to help those students who are having difficulty.

Note 3
Problem 1, *Quick Poll*

Send *Quick Polls* for the questions on pages 1.11 and 1.12. Then use the results to guide the class discussion over the determined maximum values.