LINEAR PROGRAMMING

SOLVING SYSTEMS OF LINEAR INEQUALITIES

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Description of Activity

This packet is designed for students to complete after learning about solving systems of linear inequalities. The activity gives students a real-life perspective on systems of inequalities by using simple business models. After reading a few sentences about a business situation, students will determine the objective quantity (profit) equation. Then, they will develop a system of constraints by writing inequalities. Next, they will graph the system and determine what the points of intersection are. Finally, students will determine which option maximizes their profit.
Materials

- No other materials necessary! Just print a copy for each student.
- NOTE: I have included handy blank graphs for each problem in both PowerPoint and Promethean (ActivInspire) formats that allow the teacher to work through each problem using their LCD projector.

Disclaimers

- So Italian is my favorite local restaurant. Felipe, the owner, is happy for me to tell you to visit him. Even if you are nowhere near Indianapolis, it's worth the drive. Plan a nice vacation! www.soitalian.com
Teacher Preparation

I have done all of the work for you but the teaching. If I were you, I would definitely work through at least one example with the students. There are so many problems here that using up a few would not be a big deal. You may graph along with the students on your board if you have an LCD projector. Even if you don't, though, you could always print them off to transparencies and graph them on your overhead projector.
Linear Programming Word Problems

1. You run the Polka Cola bottling plant. You receive $20 per case of regular cola and $25 per case of vanilla cola. The table below shows the number of machine hours and man hours needed to produce one case of each type of cola. It also shows the maximum number of hours available.

<table>
<thead>
<tr>
<th></th>
<th>Regular Cola</th>
<th>Vanilla Cola</th>
<th>Maximum Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Hrs.</td>
<td>3</td>
<td>2</td>
<td>54</td>
</tr>
<tr>
<td>Man Hrs.</td>
<td>4</td>
<td>3</td>
<td>75</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ___________________     ___________________
___________________     ___________________

Find the number of each type of cola that can be produced in order to maximize profit. Then determine the profit.

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2. You own a small parking lot outside Yankee Stadium. You charge $25 per car and $100 per bus. Cars occupy 8$^2$ m and buses take up 32$^2$ m. New York has set a limit of 50 vehicles in your 1120$^2$ m parking lot.

<table>
<thead>
<tr>
<th></th>
<th>Cars</th>
<th>Buses</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>area</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ________________  ________________

Find the number of cars & buses you can park to maximize profit. Then determine the profit.
3. It costs $10 for So Italian to produce a deep-dish pizza, and they spend $2 per deep-dish in packaging. It costs them $7.50 to produce a thin-crust pizza, and they spend $1 per thin-crust in packaging. They can only spend $145 to make pizzas and $24 on packaging. So Italian makes $20 per deep-dish and $15 per thin-crust.

<table>
<thead>
<tr>
<th>Profit</th>
<th>Make</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>deep</td>
<td>thin</td>
<td>max.</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ___________________     ___________________

___________________     ___________________

Find the number of deep-dish and thin-crust pizzas you can make to maximize profit. Then determine the profit.
4. Señor Roberto opens a catering business with his wife. They sell quesadillas for $1.50 each and burritos for $3.50 each. The table below shows the number of minutes it takes Señor and Señora Roberto to assemble and cook each item, as well as the maximum number of minutes they can spend assembling and cooking.

<table>
<thead>
<tr>
<th></th>
<th>Quesadilla</th>
<th>Burrito</th>
<th>Maximum Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly</td>
<td>5</td>
<td>2</td>
<td>115</td>
</tr>
<tr>
<td>Cooking</td>
<td>10</td>
<td>15</td>
<td>450</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ____________________________________
__________________
__________________

Find the number of quesadillas and burritos you can make to maximize profit. Then determine the profit.
5. Baking a tray of corn muffins takes 4 c milk and 3 c wheat. A tray of bran muffins takes 2 c milk and 3 c wheat flour. A baker has 16 c milk and 15 c wheat flour. He makes $3 per tray of corn muffins and $2 per tray of bran muffins. How many trays of each type of muffin should the baker make to maximize his profit?

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>Bran</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ___________________     ___________________


Find the number of corn and bran muffins you can make to maximize profit. Then determine the profit.
6. You run the Wily Monka Chocolate Factory. You receive $20 per case of Everlasting Goobstoopers and $35 per case of Monka Bars. The table below shows the number of machine hours and man hours needed to produce one case of each case of candy. It also shows the maximum number of hours available.

<table>
<thead>
<tr>
<th></th>
<th>Goobstoopers</th>
<th>Monka Bars</th>
<th>Maximum Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Hrs.</td>
<td>4</td>
<td>5</td>
<td>410</td>
</tr>
<tr>
<td>Man Hrs.</td>
<td>5</td>
<td>10</td>
<td>700</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ___________________     ___________________
___________________     ___________________

Find the number of each type of candy that can be produced in order to maximize profit. Then determine the profit.
7. Your candy factory makes Stickers Bars and N&N’s. For each case of Snickers, you make $40 profit. For each case of N&N’s, you make $55 profit. The table below shows the number of machine hours and man hours needed to produce one case of each type of candy. It also shows the total number of hours available.

<table>
<thead>
<tr>
<th>Machine Hours</th>
<th>Stickers</th>
<th>N&amp;N's</th>
<th>Maximum Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man Hours</td>
<td>2</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>155</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ___________________     _____________

Find the number of each type of candy that can be produced in order to maximize profit. Then determine the profit.
8. Your factory makes purses and shoes. For each case of purses, you make $100 profit. For each case of shoes, you make $50 profit. The table below shows the number of machine hours and man hours needed to produce one case of each type of product. It also shows the total number of hours available.

<table>
<thead>
<tr>
<th>Machine Hours</th>
<th>Purses</th>
<th>Shoes</th>
<th>Maximum Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Man Hours</td>
<td>5</td>
<td>2</td>
<td>60</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: _______________________

System of Constraints: ___________________     ___________________

___________________     ___________________

Find the number of each type of item that can be sold in order to maximize profit. Then determine the profit.
1. You run the Coca Cola bottling plant. You receive $20 per case of regular Coke and $25 per case of Vanilla Coke. The table below shows the number of machine hours and man hours needed to produce one case of each type of Coke. It also shows the maximum number of hours available.

<table>
<thead>
<tr>
<th></th>
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<tr>
<td><strong>Man Hrs.</strong></td>
<td>4</td>
<td>3</td>
<td>75</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: \(20x + 25y = P\)

System of Constraints:

\[\begin{align*}
&x \geq 0 & y \geq 0 \\
&3x + 2y \leq 54 & 4x + 3y \leq 75 
\end{align*}\]

Find the number of each type of Cola that can be produced in order to maximize profit. Then determine the profit.

\((0, 0): 0 \quad (18,0): 360 \quad (0,25): 625 \quad (12,9): 465\)

0 regular & 25 vanilla = $625 profit
You own a small parking lot outside Yankee Stadium. You charge $25 per car and $100 per bus. Cars occupy $8m^2$ and buses take up $25m^2$. New York has set a limit of 50 vehicles in your 655m$^2$ parking lot.

<table>
<thead>
<tr>
<th></th>
<th>Cars</th>
<th>Buses</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$$</td>
<td>$25c$</td>
<td>$100b$</td>
<td>$P$</td>
</tr>
<tr>
<td>#</td>
<td>$1c$</td>
<td>$1b$</td>
<td>50</td>
</tr>
<tr>
<td>area</td>
<td>$8c$</td>
<td>$32b$</td>
<td>1120</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: $25c + 100b = P$

System of Constraints: 
\[ c \geq 0 \quad b \geq 0 \]
\[ c + b \leq 50 \quad 8c + 32b \leq 1120 \]

Find the number of cars & buses you can park to maximize profit. Then determine the profit.

- $(0, 0): 0$ 
- $(50, 0): 1250$ 
- $(0, 35): 3500$ 
- $(20, 30): 3500$ 

0 cars & 35 buses or 20 cars & 30 buses = $3500 profit
3. It costs $10 for So Italian to produce a deep-dish pizza, and they spend $2 per deep-dish in packaging. It costs them $7.50 to produce a thin-crust pizza, and they spend $1 per thin-crust in packaging. They can only spend $145 to make pizzas and $24 on packaging. So Italian makes $20 per deep-dish and $15 per thin-crust.

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>Profit</td>
<td>20</td>
<td>15</td>
<td>P</td>
</tr>
<tr>
<td>Make</td>
<td>10d</td>
<td>7.50t</td>
<td>145</td>
</tr>
<tr>
<td>Package</td>
<td>2d</td>
<td>1t</td>
<td>24</td>
</tr>
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Objective Quantity representing profit: \(20d + 15t = P\)

System of Constraints:

\[d \geq 0 \quad t \geq 0\]
\[10d + 7.50t \leq 145\]
\[2d + t \leq 24\]

Find the number of deep-dish and thin-crust pizzas you can make to maximize profit. Then determine the profit.

\[(0, 0): 0 \quad (12, 0): 240 \quad (0,19): 285 \quad (7,10): 290\]

7 deep dish & 10 thin crust = $290 profit
4. Señor Roberto opens a catering business with his wife. They sell quesadillas for $1.50 each and burritos for $3.50 each. The table below shows the number of minutes it takes Señor and Señora Roberto to assemble and cook each item, as well as the maximum number of minutes they can spend assembling and cooking.

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<td>15</td>
<td>450</td>
</tr>
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Objective Quantity representing profit: \(1.50q + 3.50b = P\)

System of Constraints:
\[q \geq 0\]
\[b \geq 0\]
\[5q + 2b \leq 115\]
\[10q + 15b \leq 450\]

Find the number of quesadillas and burritos you can make to maximize profit. Then determine the profit.

\((0, 0): 0\) \quad \((23, 0): 34.50\) \quad \((0, 30): 105\) \quad \((15, 20): 92.50\)

0 quesadillas & 30 burritos = $290 profit
5. Baking a tray of corn muffins takes 4 c milk and 3 c wheat. A tray of bran muffins takes 2 c milk and 3 c wheat flour. A baker has 16 c milk and 15 c wheat flour. He makes $3 per tray of corn muffins and $2 per tray of bran muffins. How many trays of each type of muffin should the baker make to maximize his profit?

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<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Wheat</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: \(3c + 2b = P\)

System of Constraints:
\[
\begin{align*}
    c &\geq 0 \\
    b &\geq 0 \\
    4c + 2b &\leq 16 \\
    3c + 3b &\leq 15
\end{align*}
\]

Find the number of corn and bran muffins you can make to maximize profit. Then determine the profit.

\((0, 0): 0 \quad (4,0): 12 \quad (0,5): 10 \quad (3,2): 13\)

3 corn & 2 bran = $13 profit
6. You run the Wily Monka Chocolate Factory. You receive $20 per case of everlasting goobstooppers and $35 per case of Monka Bars. The table below shows the number of machine hours and man hours needed to produce one case of each case of candy. It also shows the maximum number of hours available.

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<td>410</td>
</tr>
<tr>
<td>Man Hrs.</td>
<td>5</td>
<td>10</td>
<td>700</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: \(20x + 35y = P\)

System of Constraints:

\[
g \geq 0 \\
w \geq 0 \\
4g + 5w \leq 410 \\
5g + 10w \leq 700
\]

Find the number of each type of candy that can be produced in order to maximize profit. Then determine the profit.

\((0, 0): 0 \quad (102,0): 2040 \quad (0,70): 2450 \quad (40,50): 2550\)

\(40\) Goobstoopers & \(50\) Monka Bars = \$2550 profit
7. Your candy factory makes Stickers Bars and N&N’s. For each case of Stickers, you make $40 profit. For each case of N&N, you make $55 profit. The table below shows the number of machine hours and man hours needed to produce one case of each type of candy. It also shows the total number of hours available.

<table>
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<tbody>
<tr>
<td>Man Hours</td>
<td>2</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>155</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: \( 40s + 55m = P \)

System of Constraints:

\[
\begin{align*}
&s \geq 0 \\
&m \geq 0 \\
2s + 6m &\leq 150 \\
5s + 4m &\leq 155
\end{align*}
\]

Find the number of each type of candy that can be produced in order to maximize profit. Then determine the profit.

(0, 0): 0  (31, 0): 1240  (0, 25): 1375  (15, 20): 1700

15 Stickers & 20 N&N's = $1700 profit
8. Your factory makes purses and shoes. For each case of purses, you make $100 profit. For each case of shoes, you make $50 profit. The table below shows the number of machine hours and man hours needed to produce one case of each type of product. It also shows the total number of hours available.

<table>
<thead>
<tr>
<th></th>
<th>Purses</th>
<th>Shoes</th>
<th>Maximum Hours</th>
</tr>
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<tbody>
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<td>3</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Man Hours</td>
<td>5</td>
<td>2</td>
<td>60</td>
</tr>
</tbody>
</table>

Objective Quantity representing profit: $100p + 50s = P$

System of Constraints:

\[
p \geq 0 \\
s \geq 0 \\
3p + 4s \leq 50 \\
5p + 2s \leq 60
\]

Find the number of each item that can be produced in order to maximize profit. Then determine the profit.

(0, 0): 0  
(12,0): 1200  
(0,12): 600  
(10,5): 1250

10 purses & 5 shoes = $1250 profit
Thank you very much for your purchase. I hope you enjoy this activity! Please give me feedback & a rating! If you have any requests, comments, or corrections, please send me a message. At Teachers Pay Teachers, search for DAVID ROBERTSON or use this link:

http://www.teacherspayteachers.com/Store/David-Robertson

If you enjoyed this, you may also like some of my other activities:

**EQUATION-SOLVING ACTIVITY:** SELLING PIZZA!

**SLOPE ACTIVITY:** Ball Drop Lab

**SLOPE-INTERCEPT ACTIVITY:** Tower-Building Lab (with cups)

**POINT-SLOPE ACTIVITY:** Doing The Wave

**SCATTER PLOT ACTIVITY:** Celebrity Age-Guessing

**JEOPARDY REVIEW GAME:** GRAPHING LINES

**SYSTEMS OF EQUATIONS ACTIVITY:** Selling Burgers

**JEOPARDY REVIEW GAME:** SYSTEMS OF EQUATIONS

**GRAPHING SYSTEMS OF EQUATIONS MAZE REVIEW GAME**

**SYSTEMS OF INEQUALITIES:** REAL-WORLD PROBLEMS

**GRAPHING QUADRATIC FUNCTIONS ROCKET LAUNCH ACTIVITY**

**JEOPARDY REVIEW GAME:** QUADRATICS

**JEOPARDY REVIEW GAME:** EXPONENTS

**JEOPARDY REVIEW GAME:** POLYNOMIALS & FACTORING

**JEOPARDY REVIEW GAME:** MATRICES

Thanks again!