DLT on Nonlinear Systems

*15 minutes

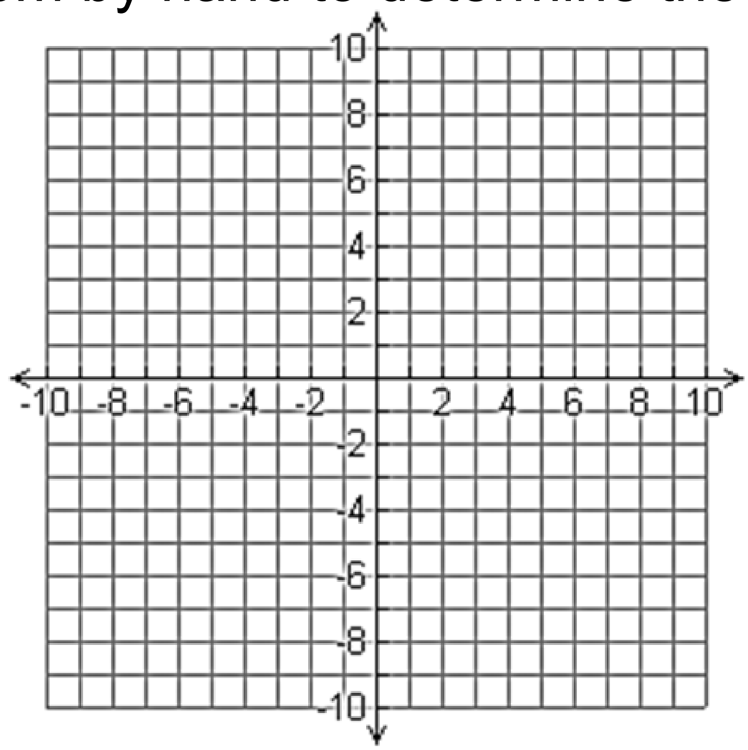
Dec 5-8:05 AM

Warm Up

1) Graph the system by hand to determine the solution(s).

$y=2(x+3)(x-1)$

$y=-2x-6$



2) Solve the system algebraically.

$x^2-2x+y^2=1$

$2x+y=5$

Linear Programming

What is it?
A mathematical technique for maximizing (revenue) or minimizing (costs) of a linear function of several variables

Who uses it?
Computer Programmers

Restaurants (menu planning - optimizes meal production and increases restaurant profits)

Coca - Cola (optimal production in bottling plants while keeping costs as low as possible = more money in their pocket)

Economics & Business (planning, routing, scheduling, assignments, and design)

Cell Phone Companies (network flow problems and fixing them)

Nov 20-6:45 AM

Objective Quantity

-a value to be optimized

-looking for its maximum or minimum value

Constraints

-restrictions on the objective quantity

Feasible Region

-the set of all points that make all of the constraints "true" k

Nov 23-2:19 PM

1) Define Variables

x:

y:

2) Objective Function

(Cost or Profit)

3) Constraint Equations

4) Graph

5) Find Intersection Points

6) List Points

7) Plug Points into Constraint Function

Magician Linear Programming

Your school has contracted with a professional magician to perform at the school. The school has guaranteed an attendance of at least 1000 with total ticket receipts of at least \$4800. The tickets are \$4 for students and \$6 for non-students, of which the magician receives \$2.50 and \$4.50 respectively. How many student and non-student tickets are needed to determine a minimum amount of money for the magician?

1) Define your variables:

x = student
y = nonstudent

2) The Objective Function:

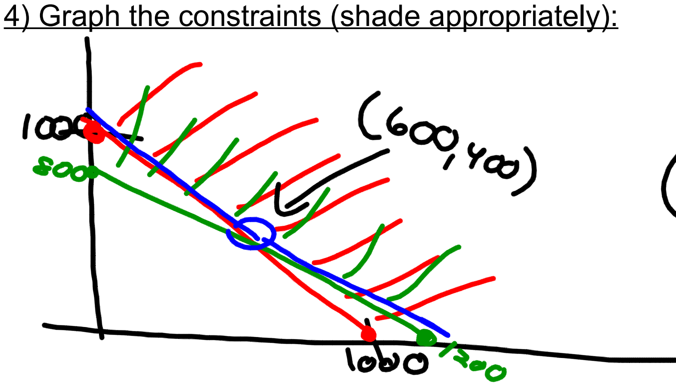
$c = 2.5x + 4.5y$ MIN

3) The Constraints (find intercepts):

$x + y \geq 1000$ (1000, 0) (0, 1000)

$4x + 6y \geq 4800$ (1200, 0) (0, 800)

4) Graph the constraints (shade appropriately):



5) Find any points of intersection:

$-4(x + y = 1000)$

$4x + 6y = 4800$
$-4x - 4y = -4000$
$2y = 800$
$y = 400$

(600, 400)

$x + 400 = 1000$ $x = 600$

6) List the vertices of the feasible region:

(0, 1000) (1200, 0)
(600, 400)

7) Plug vertices into the Objective Function to find the Max or Min:

$2.5x + 4.5y$

(0, 1000)
$2.5(0) + 4.5(1000) = 4500$

(600, 400)
$2.5(600) + 4.5(400) = 3300$

$\boxed{(1200, 0) \quad 2.5(1200) + 4.5(0) = 3000}$

1200 student tickets
0 NON-student tickets

Storage Space Linear Programming

An office manager is purchasing file cabinets and wants to maximize storage space. The office has 60 square feet of floor space fo rthe cabinets and $600 in the budget to purchase them. Cabinet A requires 3 square feet of floor space, has a storage capacity of 12 cubic feet and costs $75. Cabinet B requires 6 square feet of floor space, has a storage capacity of 18 cubic feet, and costs $50. How many of each cabinet should the office manager buy to maximize storage space?

1) Define your variables:

x = cabinet A
y = cabinet B

2) The Objective Function:

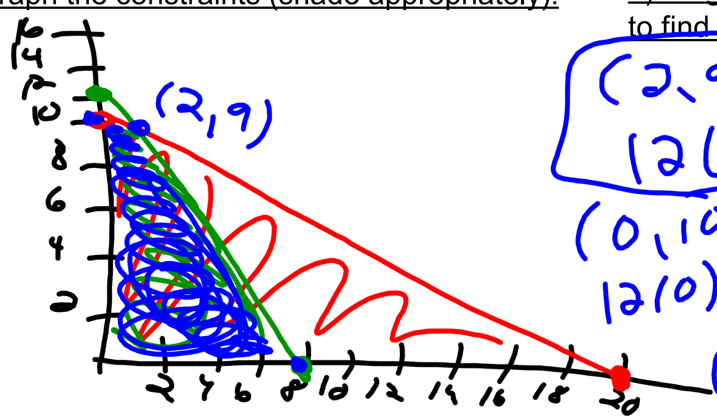
$12x + 18y$ MAX

3) The Constraints (find intercepts):

$3x + 6y \le 60$ (20,0) (0,10)

$75x + 50y \le 600$ (8,0) (0,12)

4) Graph the constraints (shade appropriately):



5) Find any points of intersection:

$3x + 6(9) = 60$

$-25(3x + 6y = 60)$

$75x + 50y = 600$

$-75x - 150y = -1500$

$-100y = -900$

$y = 9 \quad x = 2$

(2,9)

6) List the vertices of the feasible region:

(2,9) (0,10) (8,0)

7) Plug vertices into the Objective Function to find the Max or Min:

(2,9)
$\boxed{12(2) + 18(9) = 186}$

(0,10)
$12(0) + 18(10) = 180$

(8,0)
$12(8) + 18(0) = 96$

2 cabinet A
9 cabinet B

*Your turn to try the back of the first two pages!

Dec 5-8:07 AM

Patio Sets Linear Programming

You own a factory that makes metal patio sets using two processes. The hours of unskilled labor, machine time, and skilled labor per patio set are given in the table. You can use up to 4000 hours of unskilled labor, up to 1500 hours of machine time, and up to 2300 hours of skilled labor. Process A earns a profit of $80 per set and Process B earns profit of $40 per set. How many patio sets should you make by each process to maximize profits?

	Assembly Hours		
	Process A	Process B	
Unskilled Labor	$10x$ +	$1y$	≤ 4000
Machine Time	$1x$ +	$3y$	≤ 1500
Skilled Labor	$5x$ +	$2y$	≤ 2300

1) Define your variables:

x = Process A

y = Process B

2) The Objective Function:

$80x + 40y$ $\boxed{\text{MAX}}$

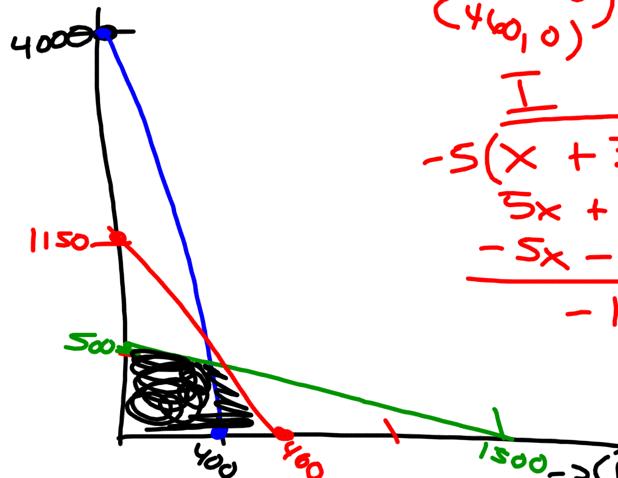
3) The Constraints (find intercepts):

$10x + y \leq 4000$ (0, 4000) (400, 0)

$1x + 3y \leq 1500$ (0, 500) (1500, 0)

$5x + 2y \leq 2300$ (0, 1150) (460, 0)

Graph the constraints (shade appropriately):



I 2 + 3

$-5(x + 3y = 1500)$

$5x + 2y = 2300$

$-5x - 15y = -7500$

$-13y = -5200$

$y = 400$

$x + 3(400) = 1500$ 1200

$x = 300$

(300, 400)

I 1 + 3

$-2(10x + 1y = 4000)$

$5x + 2y = 2300$

$-20x - 2y = -8000$

$-15x = -5700$

$x = 380$

$10(380) + 1y = 4000$

$y = 200$

(380, 200)

5) Find any points of intersection:

6) List the vertices of the feasible region:

(0, 500)

(300, 400)

(380, 200)

(400, 0)

7) Plug vertices into the Objective Function to find the Max or Min:

$80(0) + 40(500) = 20{,}000$

$80(300) + 40(400) = 40{,}000$

$80(380) + 40(200) = 38{,}400$

$80(400) + 40(0) = 32{,}000$

Homework

-Complete Linear Programming WS

Green

(Blue and ~~Purple~~)

-Review Packet due test day!

*Test Tuesday/Wednesday!

Nov 23-2:35 PM