3.2 Solving Systems of Linear Equations
3.3 Using Systems to Model Data

Study 3.2 # 1, 5, 9, 17, 21,
23, 25, 29, 35, 39, 41, 45

check answers with
on-line geogebra:
Systems of 2 Linear Eq.

Study 3.3 # 11, 13, 15

Class Notes: Prof. G. Battaly, Westchester Community College, NY

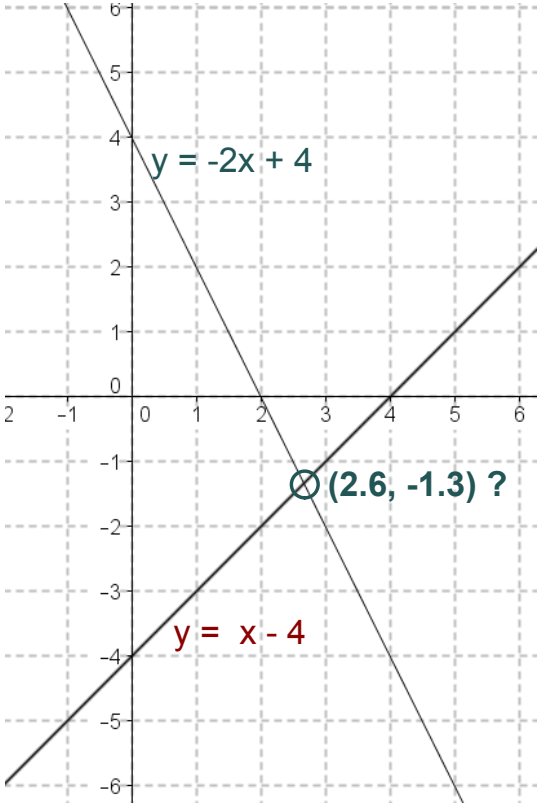
College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

Graphing provides overview of a system of equations:

- Increasing or decreasing
- Shallow or steep changes
- Intersect or not



To obtain precision in solving the system, need an analytical approach.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

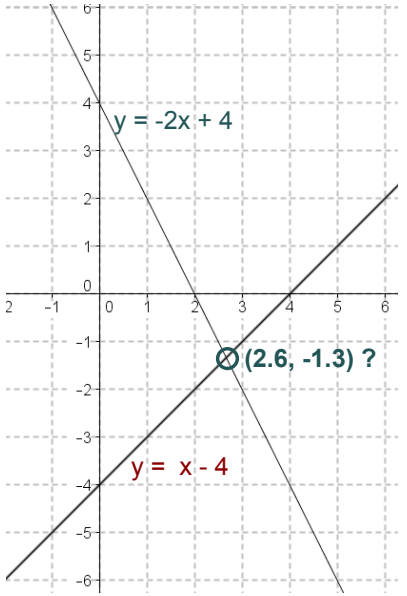
3.2 Solving Systems of Linear Equations

Analytic Solution Overview

Goal:

Find values of the variables that satisfy both equations

(2 equations in 2 variables)



How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

e.g. $2x + 3 - x = 10$

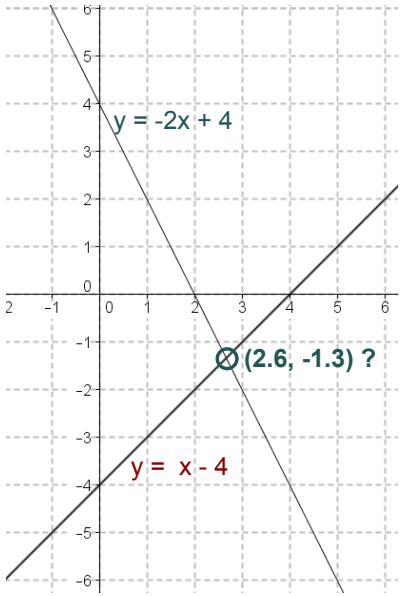
Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)



A: $y = -2x + 4$

B: $y = x - 4$

$-2x + 4 = x - 4$

$-x - 4 = -x - 4$

$-3x + 0 = 0 - 8$

$-3x = -8$

$x = \frac{-8}{-3} = 8/3 = 2.67$

B: $y = \frac{8}{3} - 4 = \frac{8}{3} - \frac{12}{3}$

$y = \frac{-4}{3}$

(8/3, -4/3)

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

A: $3(x - 1) - y = 3$
B: $7x - 3y - 10 = 0$

How do we "eliminate 1 of the 2 variables"?

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

Have 2 options:
SUBSTITUTION or ELIMINATION

SUBSTITUTION

a) Select either of the 2 equations.
b) Solve for one variable in terms of the other.
c) Substitute in the other equation.

ELIMINATION - add opposites to eliminate a variable

a) Arrange each equation in the form: $ax + by = c$
b) Use multiplication (MPE) to get opposite coefficients for one of the variables.
c) Use addition (APE) to eliminate that variable.

MPE: Multiplication Property of Equality
APE: Addition Property of Equality

3.2 Solving Systems of Linear Equations

How do we
"eliminate 1 of the 2 variables"?

SUBSTITUTION

a) Select either of the 2 equations.
b) Solve for one variable in terms of the other.
c) Substitute in the other equation.

A: 3(x -1) -y =3
B: 7x - 3y - 10 = 0

A: 3x - 3 -y = 3 DP
A: 3x - 6 = y APE
B: 7x - 3y = 10 APE
7x - 3(3x - 6) = 10 substitute for y
7x - 9x + 18 = 10 simplify, DP
-2x = - 8 APE
x = 4 MPE

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

B: 7x - 3y = 10
7(4) - 3y = 10 substitute for x
28 - 3y = 10 simplify
- 3y = -18 APE
y = -18/(-3) = 6 MPE

(4, 6) Answer

check answers with
on-line geogebra:
Systems of 2 Linear Eq.

MPE: Multiplication Property of Equality
APE: Addition Property of Equality

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

How do we
"eliminate 1 of the 2 variables"?

ELIMINATION - add opposites to eliminate a variable
a) Arrange each equation in the form: ax + by = c
b) Use multiplication (MPE) to get opposite coefficients for one of the variables.
c) Use addition (APE) to eliminate that variable.

A: 3(x -1) -y =3
B: 7x - 3y - 10 = 0

Simplify A

A: 3x - 3 -y = 3 DP
A: 3x - y = 6 APE

A: 3x - y = 6
B: 7x - 3y = 10

To eliminate y,
Multiply A by -3 and add to B:

-3A: -9x + 3y = -18
B: 7x - 3y = 10

-2x + 0 = - 8
-2x = -8
x = 4

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

B: 7x - 3y = 10
7(4) - 3y = 10 substitute for x
28 - 3y = 10 simplify
- 3y = -18 APE
y = -18/(-3) = 6 MPE

(4, 6) Answer

MPE: Multiplication Property of Equality
APE: Addition Property of Equality

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

A: $y = 2x - 1$ $3 = 4 - 1$ ✓

B: $x + y = 5$ $2 + 3 = 5$ ✓

$x + (2x - 1) = 5$

$3x - 1 = 5$

$3x = 6$

$x = 2$

$(2, 3)$

A: $y = 2x - 1$

$= 2(2) - 1 = 4 - 1 = 3$

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

check answers with on-line geogebra: Systems of 2 Linear Eq.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

A: $3x - y = 10$

B: $2x + 5y = -16$

$5A: \quad 15x - 5y = 50$

$17x + 0y = 34$

$17x = 34$

$x = 2$

$(2, -4)$

$A: \quad 3x - y = 10$

$3(2) - y = 10$

$6 - y = 10$

$-y = 4$

$y = -4$

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

check answers with on-line geogebra: Systems of 2 Linear Eq.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

A: $2x + 3y = -2$

B: $x + 3y = 2$

Subtract B from A, or
multiply B by (-1) and add

A: $2x + 3y = -2$

B: $-x - 3y = -2$

$x + 0y = -4$

$x = -4$ $\quad (-4, 2)$

B: $x + 3y = 2$

$-4 + 3y = 2$

$3y = 6$

$y = 2$

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

check answers with
on-line geogebra:
Systems of 2 Linear Eq.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

3.2 Solving Systems of Linear Equations

$\frac{1}{4}$ (A: $20x - 8y = 16$)

$\frac{1}{2}$ (B: $-15x + 6y = 18$)

A: $5x - 2y = 4$

B: $-5x + 2y = 6$

$0x + 0y = 10$

$0 = 10$

inconsistent

parallel lines.

How?	Get
1. Eliminate 1 of the 2 variables	equation in 1 variable
2. Solve for the remaining variable	1st value in answer
3. Substitute the value	equation in 1 variable
4. Solve for the other variable	2nd value in answer
5. State solution	(a,b)

check answers with on-line geogebra: Systems of 2 Linear Eq.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

A: $\frac{1}{4}x + \frac{5}{2}y = 2$

B: $\frac{5}{6}x - \frac{1}{3}y = -2$

F: solve.

$6 \cdot \frac{5}{6}x - 6 \cdot \frac{1}{3}y = 6(-2)$

4A: $\frac{4}{4}x + \frac{20}{2}y = 8$

4A $x + 10y = 8$

6B: $5x - 2y = -12$

$-5(4A)$ $-5x - 50y = -40$

$0x - 52y = -52$

$-52y = -52$

$y = 1$

$x + 10y = 8$

$x + 10(1) = 8$

$x + 10 = 8$

$x = -2$

MPE

$(-2, 1)$

check answers with on-line geogebra: Systems of 2 Linear Eq.

3.3 Using Systems to Model Data

Apply Solving Systems to word problems.

Given: Visitors to Yellowstone in winter
(in thousands)

Vehicle	2001	after 2001
Snow**M**obile	84.5	decr 15.1/year
Snow**C**oach	11.7	incr. 12.3/year

Find: When did the number of visitors by snowmobile equal the number of visitors by snowcoach?

Let t = number of years since 2001

Visitors by snow**M**obile started at 84.5 and decreased 15.1 / year:

$$M = 84.5 - 15.1\,t$$

Visitors by snow**C**oach started at 11.7 and increased 12.3 / year:

$$C = 11.7 + 12.3\,t$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

check answers with
on-line geogebra:
Systems of 2 Linear Eq.

3.3 Using Systems to Model Data

Given: Visitors to Yellowstone in winter
(in thousands)

Vehicle	2001	after 2001
Snow**M**obile	84.5	decr 15.1/year
Snow**C**oach	11.7	incr. 12.3/year

Find: When did the number of visitors by snowmobile equal the number of visitors by snowcoach?

Let t = number of years since 2001

Visitors by snow**M**obile started at 84.5 and decreased 15.1 / year:

$$M = 84.5 - 15.1\,t$$

Visitors by snow**C**oach started at 11.7 and increased 12.3 / year:

$$C = 11.7 + 12.3\,t$$

Visitors by snowMobile equals the visitors by snowCoach when M = C.

$$84.5 - 15.1t = 11.7 + 12.3t$$

t = 2.66 years 2001 + 2.66 = 2003.7

Therefore, the visitors by snowmobile equaled the visitors by snowcoach during the year 2003.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra Home Page

Homework Problems

check answers with on-line geogebra: Systems of 2 Linear Eq.