We are going to be able to:

~ Build Linear Models from Data
~ Build Linear Models using Direct Variation
~ Straight Line Depreciation

REVIEW: What are our steps for problem solving?

1. *Identify* the question being asked.
2. *Define* variables.
3. *Translate* into a mathematical equation.
4. *Solve* the equation and check the reasonableness of the answer.
5. *Answer* the question in a sentence form.

BUILDING MODELS FROM VERBAL DESCRIPTIONS:

If we are talking about linear functions, slope is an important part of the equation. Keep in mind that we can assign a dependent variable (Y) and an independent variable (X), and look at the changes in x and y. This average rate of change of the dependent variable given a constant change in the independent variable describes our slope.

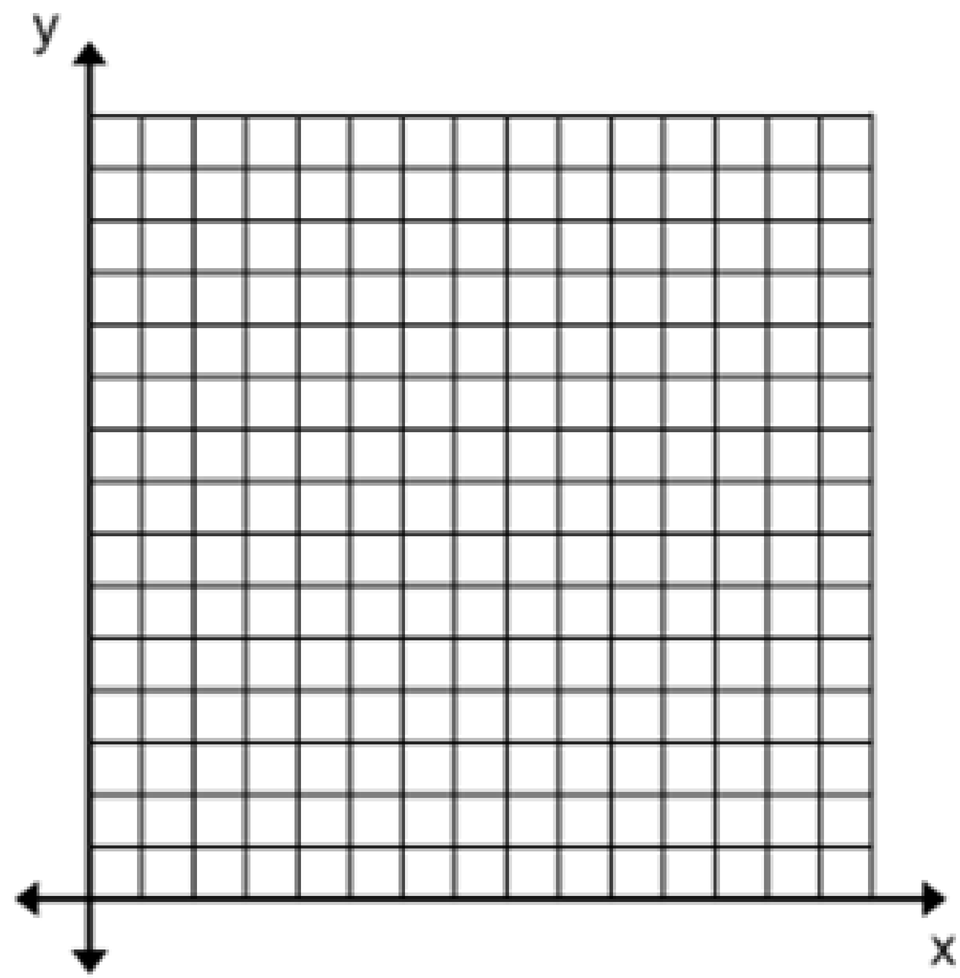
For example, if your cell phone company charges you $ .05 a minute to talk, the slope of the function would be $m=.05/1$

EXAMPLE: Cost function: A simple cost function can be described as $C(x) = ax + b$, where b represents the fixed costs of a business, and a represents the variable cost (like the cost for each item manufactured). Suppose a small bicycle factory has daily fixed costs of $2000, and each bicycle costs $80 to manufacture.

A) Write a linear function the expresses the cost of manufacturing x bicycles in a day.

B) Graph the linear function.

(Label the horizontal axis as number of bikes, the vertical axis as cost).



C) What is the cost of manufacturing 12 bikes in one day? (Plug 12 in for x)

D) How many bicycles can be manufactured for $3520? (Solve for x)

Depreciation:

Depreciation is a reduction in value over time on a specific item, like cars. Many companies use a linear model to model depreciation of assets.

EXAMPLE 2: Suppose that a publishing company purchased a new fleet of cars for their sales people, and each car cost $29,400. The company will depreciate the cars over 7 years using a straight-line model, so that each car depreciates by

$29,400/7 = $4200 per year.

A) Write the linear function that expresses the book value V of each car as a function of its age, x.

B) What is the implied domain of the function?

C) What is the book value of each car after 3 years?

D) When will the book value of the car be $21,000?

Buildin Linear Models Involving

Direct Variation

Variation refers to how one quantity varies in relation to some other quantity.

Supposed X and Y represent two quantities. We say that Y varies DIRECTLY with X, or Y is directly proportional to X, if there is some number, k, such that

$$y = kx$$

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The number ***k*** is called the constant of Proportionality.

Think about what this means.

- If we're looking for a constant proportion in the rate of change, this means <u>k is the slope of the line, and there is no y-intercept</u>.

So to find k, find the rate of change as a proportion of y/x.

EXAMPLE 3: **Car payments:** Suppose that Jeff just bought a used car for \$10,000. He decides to put \$1000 down on the car and borrow the rest. The bank lends Jeff the \$9000 he needs at 4.9% interest for 48 months. His payments are \$206.86. The monthly payment p on a car always varies directly with the amount borrowed (b).

A) Find a function that relates the monthly payment (p) to the amount borrowed (b) for any car loan with the same terms.

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B) If Jeff put down $2000, what would his payment be?

BUILDING LINEAR MODELS FROM DATA

We often try to determine if data can be predicted using a linear model. One way to do this is to make a ***scatter diagram*** or ***scatter plot***. We do this by plotting data points based on the value of the x and it's y.

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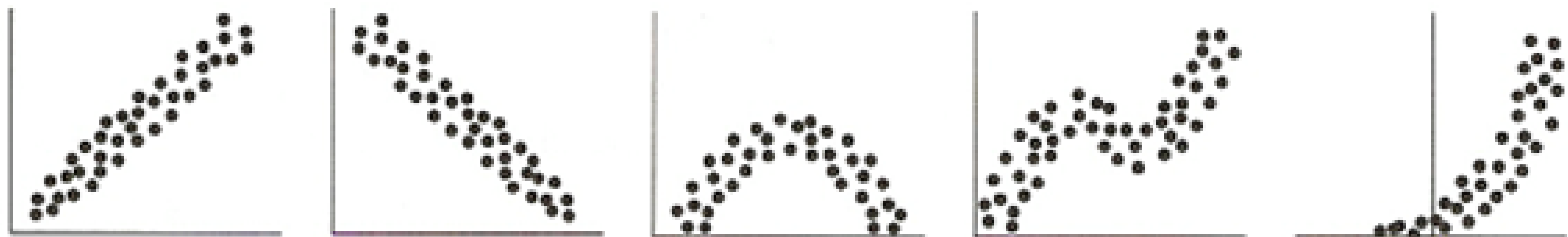
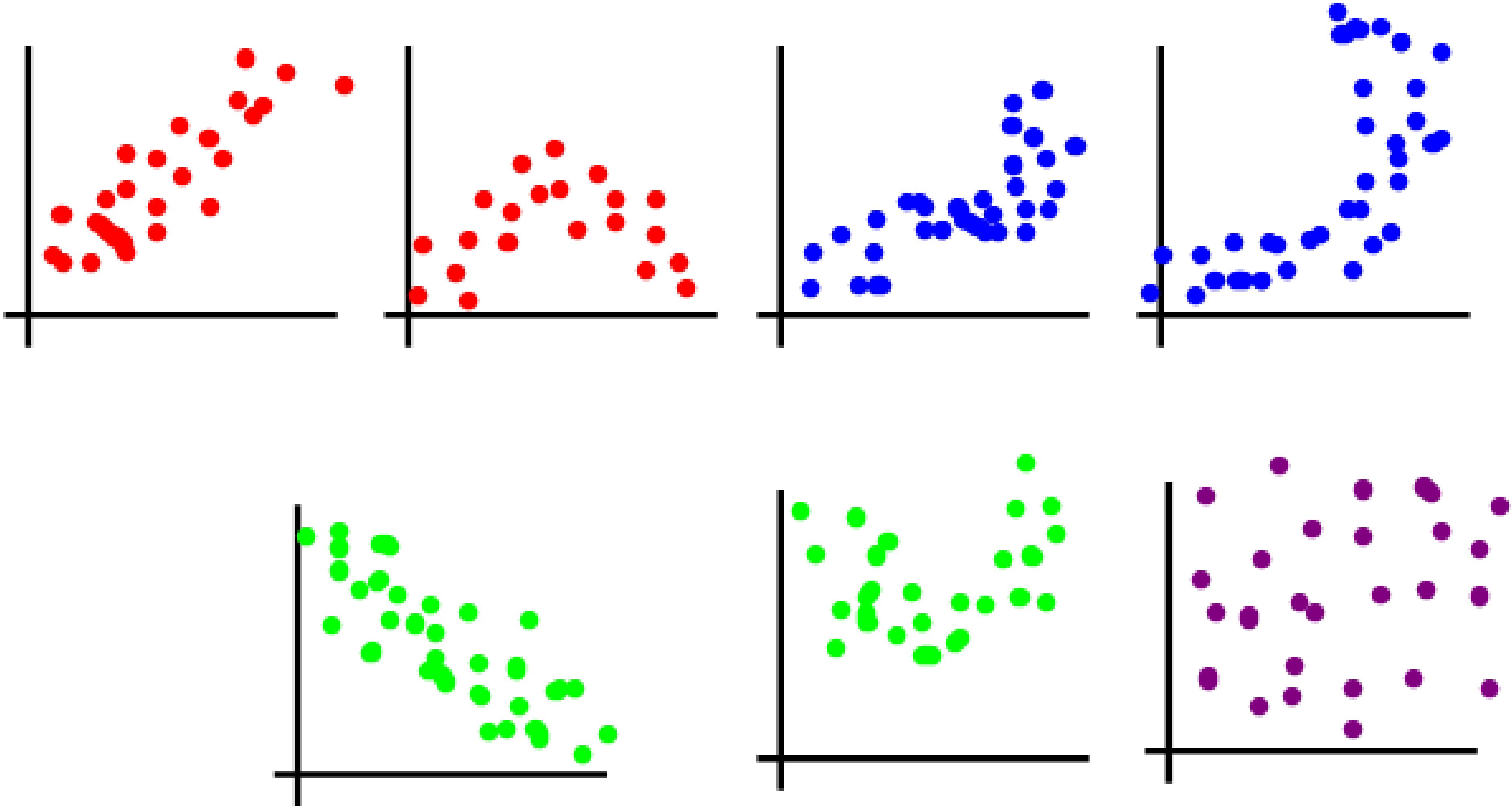


(a) Linear $y = mx + b, m > 0$ (b) Linear $y = mx + b, m < 0$ (c) Nonlinear (d) Nonlinear (e) Nonlinear

The following are Scatter plots. What kind of relationship can you see?



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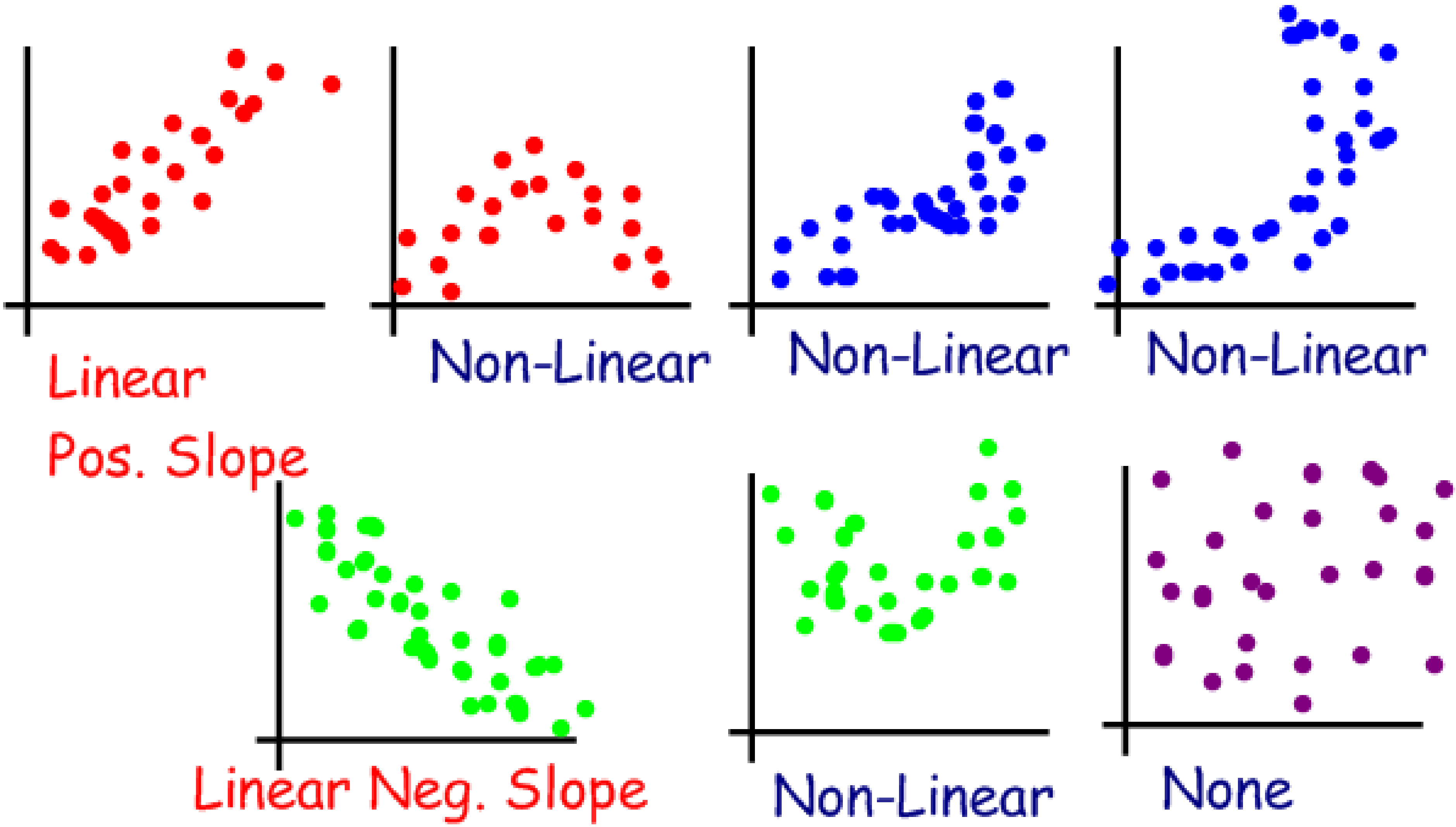
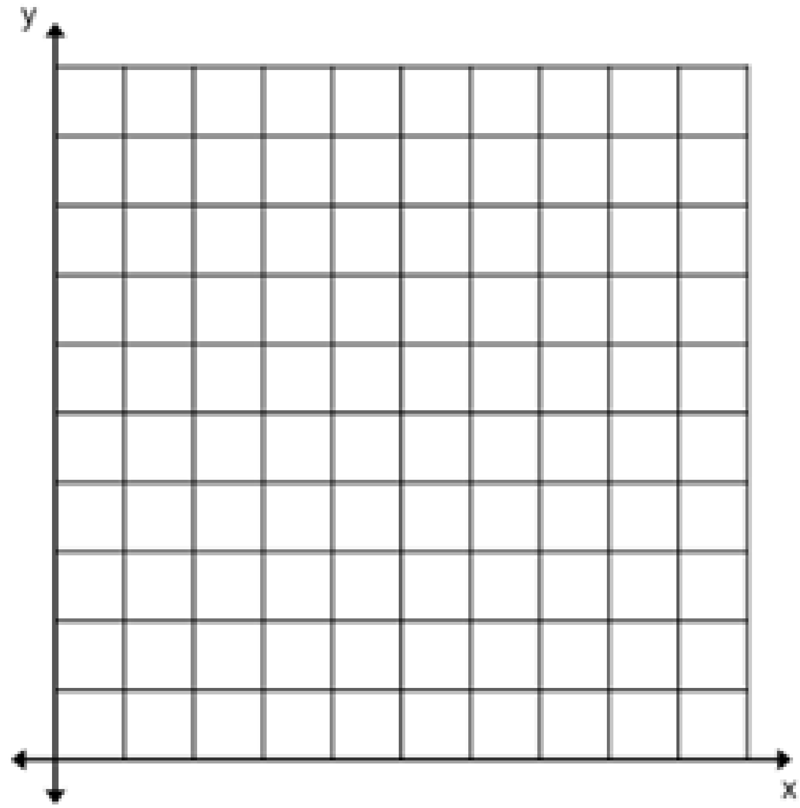


EXAMPLE 4: A company looked at the age of their employees (x) and the number of sick days (y) they took in a year to see if there was a relationship.

Age	20	28	40	47	50
Sick days	15	10	9	4	3

A) Draw the Scatter Diagram using age as the independent variable



FITTING A LINE TO THE DATA:

(Finding a line of Best Fit)

Step 1: Choose 2 points that look fairly central, and find the equation of the line containing the points (use the point-slope form).

Step 2: Graph the line on your scatter diagram.

Step 3: Use the graph to predict data based on your line of best fit (or prediction line).

Step 4: Interpret your slope. Does the y-intercept make sense?

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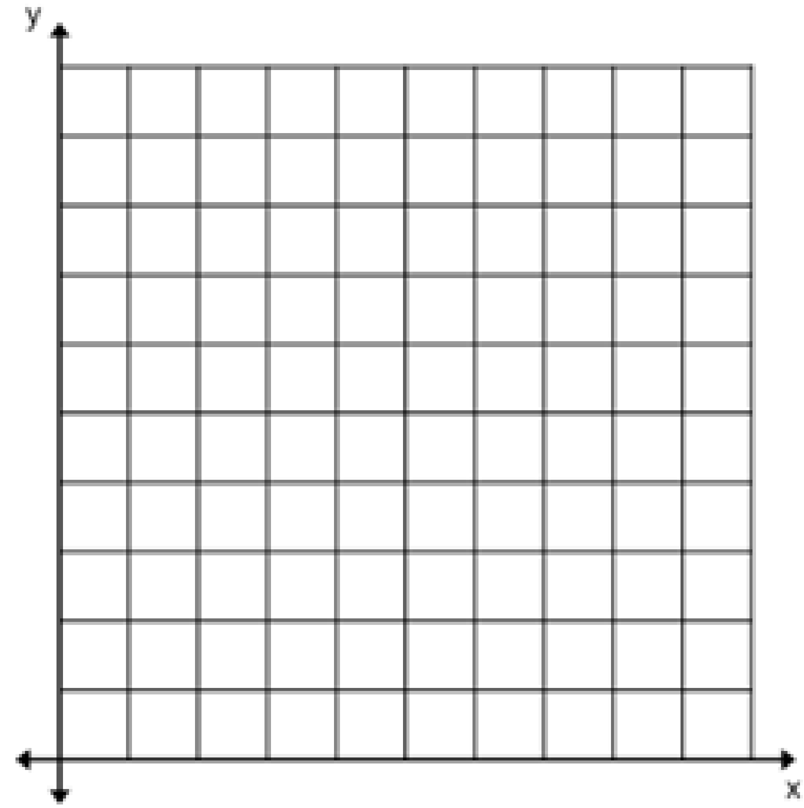

B) Find the equation for a line of best fit.

C) Predict the number of sick days for someone 45 years old.

B) Find the equation for a line of best fit.

Choose (28, 10) and (47, 4) $m = \frac{10-4}{28-47} = \frac{6}{-19} = -.3158$

$y - 10 = -.3158(x - 28) \rightarrow y - 10 = -.3158x + 8.8424 \rightarrow y = -.3158 + 18.8424$

C) Predict the number of sick days for someone 45 years old.

Predict the number of sick days for someone 45 years old.

Three ways:
1. See if the value is in the original data set.
2. Graph the line and find y when x=45
3. plug in x=45 and solve.

$y = -.3158(45) + 18.8424 = 13.4738$ *or between* 13 *and* 14 *days*

NOTE:

Everyone's line of prediction will be different depending on which two points they choose, or how they round values.

When looking at a test with multiple answers, choose the one that is closest to yours.

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Can you?

Homework:

Pg. 239: #'s 1-6 all, 7, 9, 13,
15, 21, 23, 25, 29

*Remember "Average Rate of Change" is Slope.