Hey Guys,
Great class today. The applications in section 2.4 provide a great way to apply everything that we learned about slope, writing equations of lines, intercepts, etc. The problems give meaning to an otherwise abstract concept. I wish we had more time to dive into this topic. I would like to do an actual experiment, collect some data, and analyze the data points. We can do this with distance. Remember, the formula for distance (not the distance formula on the coordinate plane) is rate times time, or \( D = r \times t \), or just \( D = rt \). Notice here that this represents a direct variation equation because there is no y-intercept. We could take data here fairly easily. It would not require much. This would be a great experiment, though.

I have included the solutions to the HW problems form 2.4. Look over those and try to understand the problems. Next week we will roll on to section 2.5, which is more graphing so don’t forget your graph paper.

Also guys, I want to remind everyone that in order for the classroom to function, we have GOT TO raise our hands if we want to ask a relevant question or otherwise. I want everyone to feel comfortable asking questions, but it is disruptive when students just blurt out question. As I said at the beginning of the year, I love the dialogue, and if it was just you and me or a small group, it would work. But, in a classroom setting that does not work.

Have a great weekend!!
Algebra 2
Warm-Up
Thursday, Jan 19

Pg 69 #69

a. Which student(s) moved at a constant rate? Which student(s) did not? Justify your reasoning.
b. Which student(s) moved away from the motion detector?
c. Which student started farthest from the motion detector?

HINT: THINK SLOPE
Using Linear Models

Section 2.4

**Learning Objective**
To write linear equations that model real-world data
To make predictions from linear models

SG Questions #11,12,13
Writing Linear Models

\[ h(t) = 50 \frac{ft}{\text{min}} t + 12 \frac{ft}{\text{min}} \]

\[ t \quad h(t) \]
\[ 1 \text{ min} \quad 62 \]
\[ 2 \text{ min} \quad 114 \]

Check Your Understanding 1a.

\[ h(t) = -2 \cdot 10 \frac{ft}{\text{min}} t - 1350 \ ft \]

\[ t \quad h(t) \]
\[ 1 \text{ min} \quad -1330 \]
\[ 2 \text{ min} \quad -1310 \]
\[ 3 \text{ min} \quad -1290 \]

Multiply thru by a (-)

\[ h(t) = -20t + 1350 \]
Candle Burning

$h \rightarrow$ dependent
$t \rightarrow$ independent

\[(x_i, y_i) (\text{indept, dept})\]
\[(1h, 6\text{in}) (3h, 5\frac{1}{2}\text{in})\]
\[(1h, 6\text{in}) (3h, \frac{1}{2}\text{in})\]
\[m = \frac{6\text{in} - \frac{1}{2}\text{in}}{1\text{h} - 3\text{h}} = \frac{\frac{11}{2}\text{in}}{-2\text{h}} = -\frac{11}{4\text{h}} = -\frac{1}{\frac{4}{2}} = -\frac{1}{2} \cdot \frac{1}{2} = -\frac{1}{4}\]

\[(1h, 6\text{in})\]
\[y - y_1 = m(x - x_1)\]
\[y - 6\text{in} = -\frac{1}{4}(x - 1\text{h})\]
\[y - 6\text{in} = -\frac{1}{4}x + \frac{1}{4}\text{in}\]
\[y = -\frac{1}{4}x + \frac{1}{4}\text{in} + 6\text{in}\]
\[y = -\frac{1}{4}x + 6\frac{1}{4}\text{in}\]
\[y = -\frac{1}{4}x + 6.25\text{in}\]
\[y = -0.25x + 6.25\text{in}\]

\[h(t) = -0.25t + 6.25\text{in}\]
Write a linear equation given data points:

\[(1h, 6in) \quad (3h, 5\frac{1}{2}in)\]

General Convention:

\[m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6in - 5\frac{1}{2}in}{1h - 3h} = \frac{1}{2} \quad \text{in} = \frac{1}{2} \quad \text{in} \]

Write the equation of the line:

\[y - y_1 = m(x - x_1)\]

\[y - 6in = -0.25\text{in/h} (x - 1h) \quad \rightarrow \quad y = 6in - 0.25\text{in/h}x + 0.25\text{in} + 6in\]

\[y = 0.25\text{in/h}x + 6.25\text{in}\]

\[h(t) = 0.25t + 6.25\]

"Units": \[2\text{in}/\text{h}\]

\[\begin{align*}
\hat{y} &\approx 6.78 \\
1 & 2 3 4 5 6 7 8 \\
\end{align*}\]
Predicting With Linear Models

If we are given data points that approximate real-world events, then we can plot those data points (or ordered pairs) on a coordinate plane. Most of the time, the data points will not form a linear relationship. We like linear relationships because we can easily make predictions using the linear equation.

For example, in the grade equation, g(z), we can easily calculate a final grade for a given final exam score. All we would need to do is evaluate g(z) at z, the final exam score. Once we have the linear equation written, we can make predictions about future events.

One way to do this is to find a trend line which approximates the data. If all of the data points look like they follow a general straight line, then we can draw an approximate linear graph through them. Refer to some of the diagrams in the previous pages.
Predicting With Linear Models

Scatter Plot: a graph that relates two different sets of data by plotting the data as ordered pairs.

\[ y_1 = -2x + 10 \]

\[ y_2 = -\frac{17}{11}x + 14.27 \]

The green line represents the best approximation of the data. Choose 2 points from the green line to find its equation.

Trend Line: a line that approximates the relationship between data sets from a scatter plot.

Now use pts A & B to write the equation of the green line:

1) Slope: \[ m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 15}{2 - (-2)} = \frac{-6}{4} = -\frac{3}{2} \]

2) Point: \((2,9)\) \[ y - y_1 = m(x - x_1) \]

\[ y - 9 = -\frac{3}{2}(x - 2) \]

\[ y - 9 = -\frac{3}{2}x + 3 \]

\[ y = -\frac{3}{2}x + 12 \]

\[ d(t) = -\frac{3}{2}t + 12 \]
2.4: Using Linear Models

Friday, Jan 20

Homework/Classwork

Pg. 81 #3, 5, 7, 8, 14, 15, 17, 19, 20, 21, 23, 25
HOMEWORK PROBLEMS
3) A tree 5 ft tall grows an average of 8 in. each year. Write and graph an equation to model the tree's height $h$ after $x$ years.

For each situation, find a linear model and use it to make a prediction.

5) An empty 5-gal water jug weighs 0.75 lb. With 3 c of water inside, the jug weighs 2.25 lb. Predict the weight of the jug with 5 c of water inside.

7) A 2-mi cab ride costs $5.25. A 5-mi cab ride costs $10.50. How much does a 3.8-mi cab ride cost?

Graph each set of data. Decide whether a linear model is reasonable. If so, draw a trend line and write its equation.

8) \{(0,11), (2,8), (3,7), (7,2), (8,0)\}
14) Suppose you manufacture and sell tarps. The table displays your current sizes and prices.
a. Draw a scatter plot showing the relationship between a tarp’s area and its cost. Use area as the independent variable.
b. Use your scatter plot to develop a model relating the area of a tarp to its cost.
c. How good of a model do you feel you have? Explain.
d. Is $7.00 a reasonable price for a tarp that measures 10 ft by 15 ft? Explain.
e. Using your model and the prices in the table, determine which tarp size varies the most from your predicted price. How great is the discrepancy between your model and the actual price?

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 X 7 ft</td>
<td>$1.39</td>
</tr>
<tr>
<td>6 X 8 ft</td>
<td>$1.99</td>
</tr>
<tr>
<td>8 X 10 ft</td>
<td>$3.19</td>
</tr>
<tr>
<td>10 X 12 ft</td>
<td>$4.79</td>
</tr>
<tr>
<td>12 X 16 ft</td>
<td>$7.69</td>
</tr>
<tr>
<td>10 X 20 ft</td>
<td>$7.99</td>
</tr>
<tr>
<td>16 X 20 ft</td>
<td>$12.79</td>
</tr>
</tbody>
</table>

HINT: This question gives several data points, the prices for each size of tarp. First, give the two things that we are talking about (area & price where the area is equal to the length times the width, or the product of the size dimensions) a letter or variable. Then, identify your independent and dependent variables. Which variable, depends on the other?
Write an equation for each line.

15) through (2,2), y-intercept 10
17) y intercept $\frac{5}{2}$, x-intercept $-\frac{1}{3}$

HINT: Remember, we can write the intercepts as an ordered pair. Still need slope and a point to write the equation of the line.

19) Suppose you are trying to decide whether to subscribe to cable service or just rent videos.

a. Write an equation to model the cost $y$ of the cable service for 1 month.
b. Write a second equation to model the cost $y$ of renting $x$ movies from the video store. What is the slope? What is the y-intercept?
c. Suppose you currently rent 8 to 12 movies each month. Graph the two equations from (a) and (b). Interpret the graph. Use your interpretation to choose between the alternatives. Explain your reasoning.

<table>
<thead>
<tr>
<th>Village Cable Cable Service</th>
<th>24-hour Video Rentals</th>
</tr>
</thead>
<tbody>
<tr>
<td>$$29.95 per month</td>
<td>$$2.95 each</td>
</tr>
</tbody>
</table>
20) The table below shows the relationship between Calories and fat in various fast-food hamburgers.

<table>
<thead>
<tr>
<th>Hamburger</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>720</td>
<td>530</td>
<td>510</td>
<td>500</td>
<td>410</td>
<td>440</td>
<td>320</td>
<td>598</td>
<td></td>
</tr>
<tr>
<td>Fat (g)</td>
<td>46</td>
<td>30</td>
<td>27</td>
<td>26</td>
<td>13</td>
<td>20</td>
<td>25</td>
<td>13</td>
<td>26</td>
</tr>
</tbody>
</table>

a. Develop a model for the relationship between Calories and fat.
b. How much fat would you expect a 330-Calorie hamburger to have?
c. A student reports these estimates: 10 g of fat for a 200-Calorie hamburger and 36 g of fat for a 660-Calorie hamburger. Which estimate is not reasonable. Explain?
21) Is the population of a state related to the number of licensed drivers in that state? The table shows population and licensed-driver statistics from a recent year.

<table>
<thead>
<tr>
<th>State</th>
<th>Population (millions)</th>
<th>Licensed Drivers (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>4.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Florida</td>
<td>14.7</td>
<td>11.6</td>
</tr>
<tr>
<td>Louisiana</td>
<td>4.4</td>
<td>2.7</td>
</tr>
<tr>
<td>South Carolina</td>
<td>3.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Virginia</td>
<td>6.7</td>
<td>4.7</td>
</tr>
<tr>
<td>West Virginia</td>
<td>1.8</td>
<td>1.3</td>
</tr>
</tbody>
</table>

a. Which variable should be the independent variable?
b. Draw a scatter plot.
c. Draw a trend line.
d. The population of Oregon was approximately 3 million that year. About how many licensed drivers lived in Oregon that year?
e. Is the correlation between population and number of licensed drivers strong or weak? Explain. Or said another way, does the linear model do a good job of approximating the data?
A linear model for each situation passes through the origin (y-intercept is zero). Find each missing value. Round your answer to the nearest tenth.

23. 8.5 gal of gas to drive 243.1 mi, 3 gal of gas to drive ___ mi

25. $9.45 to buy 7 lb of apples, $17.55 to buy _____ lb
SOLUTIONS

3. \( h = 8x + 60 \)

5. \( y = 0.5x + 0.75; \ 3.25 \text{ lb} \)

7. \( y = 1.75x + 1.75; \ \$8.40 \)

8. Linear model is reasonable; models may vary. Sample: \( y = -1.3x + 11. \) SEE GRAPH

14. a. SEE GRAPH
   b. \( \text{cost (c)} = 0.04 \times \text{Area (A)} \) or \( c = 0.04A \)
   c. The model fits the data very closely.
   d. No; the area of the tarp is 150 square feet so the price should be \$6.00

15. \( y = -4x + 10 \)

17. \( y = -7.5 - 2.5 \)

19. a. \( y = 29.95 \)
   b. \( y = 2.95x; \ \text{slope} = 2.95; \ \text{y-intercept} = 0 \)
   c. Answers may vary. Sample: Either way, you will average the same costs over the long run. SEE GRAPH.

20. a. Answers may vary. Sample: \( y = 0.068x - 7.7 \)
   b. about 15 g
   c. 200 Cal; a 200-Cal hamburger has about 6 g of fat

21. a. population
   b, c, e. SEE GRAPH
   d. 2 milion
19c) $y = 2.95x$

$y = 29.95$
21) The graph shows the relationship between population (in millions) and licensed drivers (in millions). The trend line indicates a linear relationship. The x-axis represents the population in millions, and the y-axis represents the number of licensed drivers in millions.