Unit 3b Day 18: Finding Linear Equations from Multiple Representations

Focus Question: What strategies do you use in writing equations for linear functions?

A. Two Points Practice

Yesterday when Shirts R Us gave you two pieces of data, you found the equation from two points (10, 50) and (20, 70).

1. What was the first thing you had to find? Slope $\dfrac{70-50}{20-10} = \dfrac{20}{10}$ $\boxed{m=10}$

2. Then what did you find?

y int (fee) ← not needed to do pointslope

3. Find the equation of the line that passes through the following pairs of points. (You can write it in whatever form you like.) yint!

a. (-6, 4) and (2, 8)

$\dfrac{\Delta y}{\Delta x}\ \dfrac{8-4}{2--6} = \dfrac{4}{8}\ \boxed{m=\frac{1}{2}}$

$\boxed{y-8=\frac{1}{2}(x-2)}$

b. (0, 5) and (-2, 6)

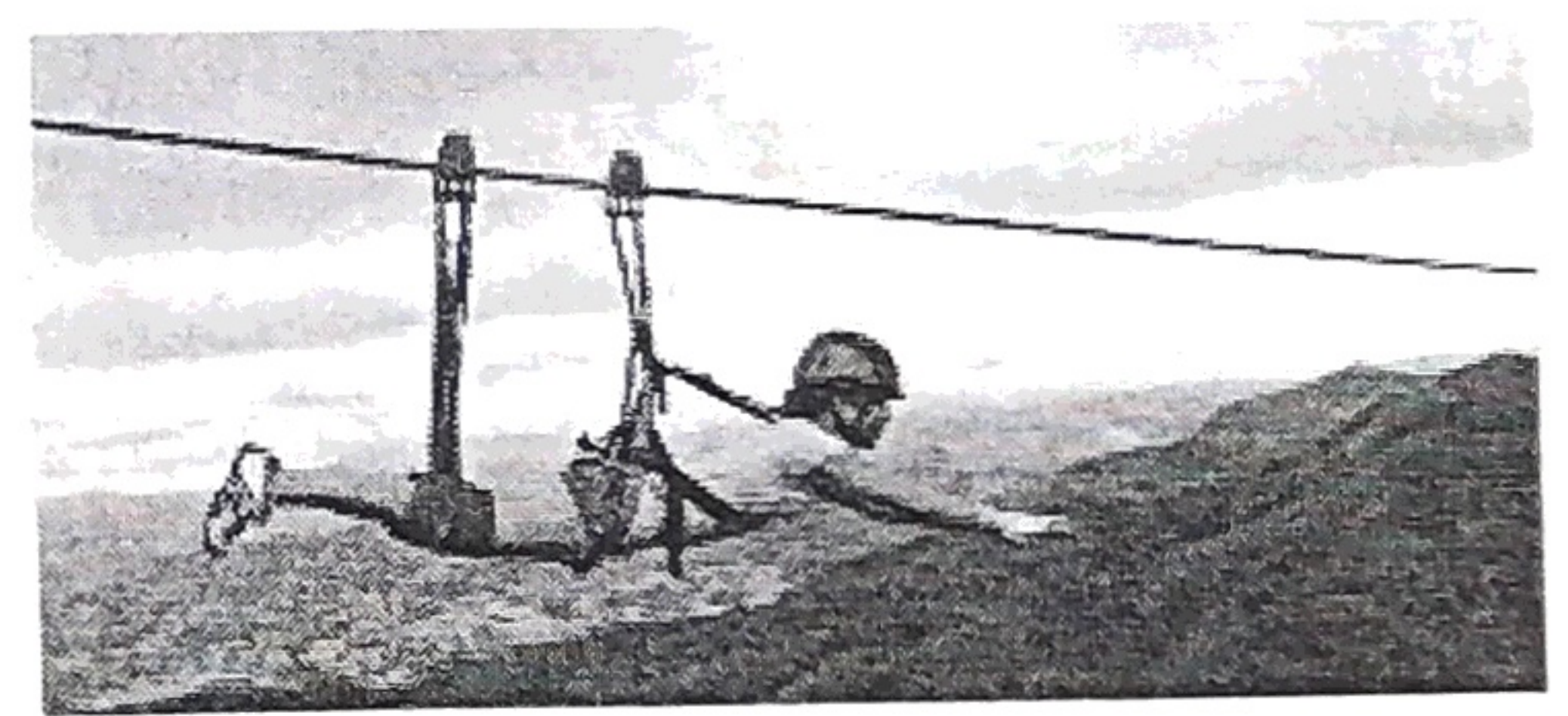$\dfrac{\Delta y}{\Delta x}\ \dfrac{6-5}{-2-0} = \dfrac{1}{-2}\ \boxed{m=-\frac{1}{2}}$

$\boxed{f(x)=-\frac{1}{2}x+5}$

c. (-1, 4) and (8, -12)

$\dfrac{\Delta y}{\Delta x}\ \dfrac{-12-4}{8--1} = \boxed{\dfrac{-16}{9}}$

$\boxed{y-4=\frac{-16}{9}(x+1)}$

B. Tree-Top Fun (TTF) runs adventure sites with zip lines, swings, rope ladders, bridges, and trapezes. The company uses mathematical models to relate the number of customers, prices, costs, income, and profit at its many locations.

m = 25

1. The standard charge per customer at TTF is $25. Write an equation that relates the daily income I to the number n of customers.
   ↑ I.V.   D.V. ↑

   $\boxed{I(n)=25n}$

They also have a group admission fees in the table below.

+1's   5's

Number in Group	0	1	2	3	4	5	10	15	20
Admission (dollars)	60	75	90	105	120	135	210	285	360

+15's   75's

2. What is the slope of the table?
   $\dfrac{15}{1}\qquad \dfrac{75}{5}\qquad \boxed{m=15}$

3. Write a function that relates A, the admission fee, to n, the number of people in the group.
   ↑ D.V.   ↑ I.V. $\boxed{A(n)=15n+60}$

4. How many people need to be in your group to make the group admission rate cost effective?

   group admission is less than regular admis.

   $A(n) < I(n)$

   $15n+60 < 25n$

   $\underline{-15n \qquad\qquad -15n}$

   $\dfrac{60}{10} < \dfrac{10n}{10}$

   $6 < n \quad$ or $\quad n > 6$

   when you have more than 6 people

The owners of Tree Top Adventures opened a snack bar at one site. The graph below shows the income from snack sales for six different days.

$r \approx .8$ or $.9$
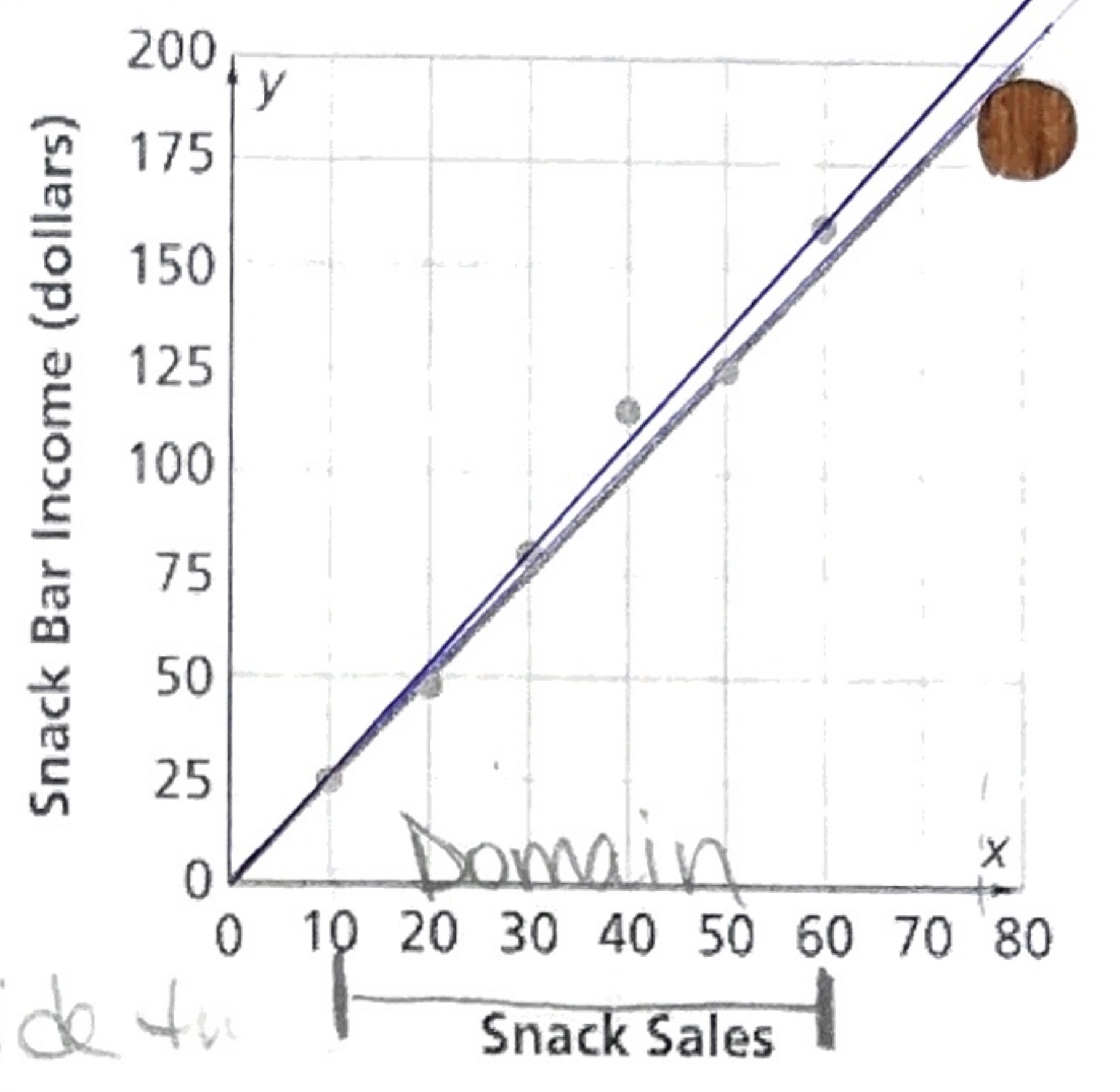
5. Why does the line not hit every single point?
B/c its a line of best fit & the correlation is not perfect.

6. What is the equation of the linear model on the graph?

$m = \dfrac{25}{10}$ $b = 0$ $\boxed{f(x) = \dfrac{5}{2}x}$

$m = \dfrac{5}{2}$

7. If the snack bar had 75 sales, what would be the predicted income?

$f(75) = \dfrac{5}{2}(75)$

$= \$187.50$

8. Did question 7 ask you to interpolate or extrapolate? Explain.
b/c 75 is outside the domain

Graph: y-axis labeled "Snack Bar Income (dollars)" from 0 to 200 in increments of 25. x-axis labeled "Snack Sales" from 0 to 80 in increments of 10. A line of best fit with data points. "Domain" labeled on x-axis.

9. Is that a good line of best fit? Explain.
No all the dots are above the line

10. Draw your own line of best fit. Then compare it to 3 other people. Did you all draw the exact same line? No
11. Who's line is best? Is there a best? Yes
    ???

C. The BEST line of Best Fit: Linear Regression
    There is a process for finding the line of best fit that involves **residuals**. Remember a **residual** is the distance between the line and the data point. The process called **regression** minimizes the residuals.

$$y = Bx + A \quad \text{or} \quad y = Ax + b$$

Where

$$B = \dfrac{n\,\Sigma xy \;-\; \Sigma x\,\Sigma y}{n\,\Sigma x^2 \;-\; (\Sigma x)^2}$$

$$A = \dfrac{\Sigma y \;-\; B\Sigma x}{n}$$

The correlation coefficient

$$r = \dfrac{n\,\Sigma xy \;-\; \Sigma x\Sigma y}{\sqrt{n\,\Sigma x^2 - (\Sigma x)^2 \;\; n\,\Sigma y^2 - (\Sigma y)^2}}$$

1. What does B represent in the linear regression formula? Slope

2. While it is NOT the slope formula, there are some similarities. How is the linear regression formula (B) similar to the slope formula?
Subtraction
y's only in the top

3. What does A represent in the linear regression formula? y int.

Don't worry, your calculator will do it for you!!!!
(See calculator instructions) Your calculator just switches the B and A