ACTIVITY
# 3.1 The Residual Effect

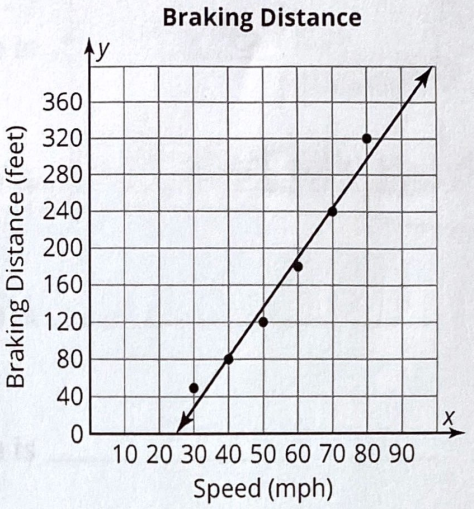
In addition to the shape of the scatter plot and the correlation coefficient, one additional method to determine whether a linear model is appropriate for the data is to analyze the *residuals*. A **residual** is the vertical distance between an observed data value and its predicted value using the regression equation.

$y = 5.4x - 133.9$

1. **Complete the table to determine the residuals for the braking distance data.**

| Speed (mph) | Observed Braking Distance (feet) | | Predicted Braking Distance (feet) | | Residual Value Observed Value – Predicted Value | |
|---|---|---|---|---|---|---|
| 30 | 48 | − | 28 | = | 20 | $5.4(30) - 133.9$ |
| 40 | 80 | − | 82 | = | −2 | $5.4(40) - 133.9$ |
| 50 | 120 | − | 136 | = | −16 | $5.4(50) - 133.9$ |
| 60 | 180 | − | 190 | = | −10 | $5.4(60) - 133.9$ |
| 70 | 240 | − | 244 | = | −4 | $5.4(70) - 133.9$ |
| 80 | 320 | − | 298 | = | 22 | $5.4(80) - 133.9$ |

Now, let's analyze the relationship between the observed braking distances and the predicted braking distances using graphs. The graph of the line of best fit for the observed braking distances is shown.




The vertical distance from each observed data point to the line is called the residual for that *x*-value.

**2. Examine the scatter plot and the residual values.**

**a. Show the residual values on the scatter plot by connecting each observed value to its predicted value using a vertical line segment.**

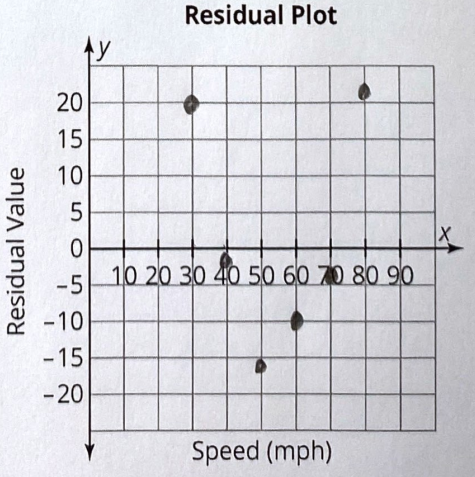
**b. When does a residual have a positive value?**

**c. When does a residual have a negative value?**

The residual data can now be used to create a *residual plot*. A **residual plot** is a scatter plot of the independent variable on the *x*-axis and the residuals on the *y*-axis.

The residual plot displays the residual values you calculated in the table.

**3. Construct a residual plot of the speed and braking distance data.**



4. **Interpret each residual in the context of the problem situation.**

- **At 30 mph, the braking distance is** 20 ft greater than predicted.
- **At 40 mph, the braking distance is** 2 ft less than predicted.
- **At 50 mph, the braking distance is** 16 ft less than predicted.
- **At 60 mph, the braking distance is** _____.
- **At 70 mph, the braking distance is** _____.
- **At 80 mph, the braking distance is** _____.

A residual plot cannot tell you whether a linear model is appropriate. It can only tell you that there may be a model other than linear that is more appropriate.

5. **What pattern, if any, do you notice in the residuals?**