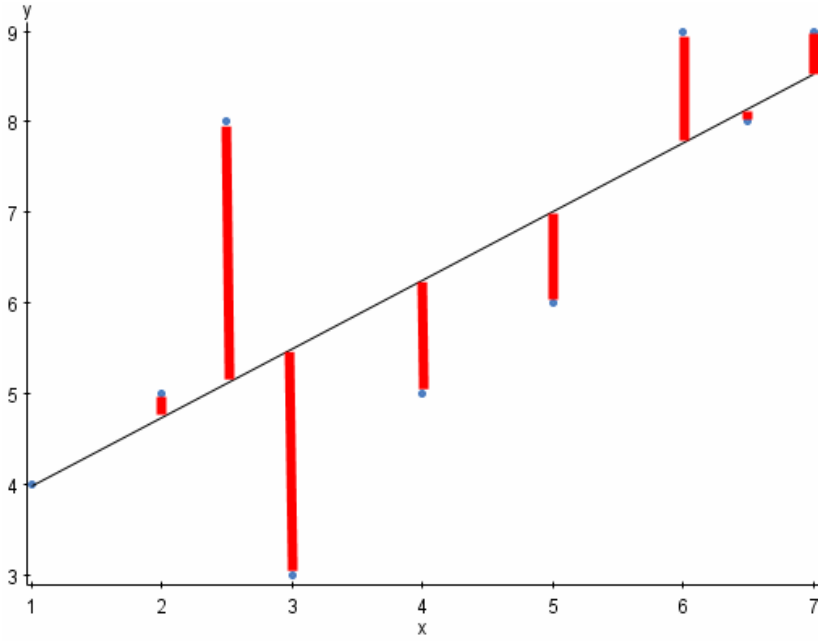
# Regression Line

- Residuals
- Least Squares Regression Line
- Prediction Interval

# Residuals

The residual is the difference between the $y$-value of the point and the $y$-value of the line.



# Least Squares Regression Line

- The Least Squares Regression Line is the line that has the smallest sum of the squares of the residuals. $\hat{y} = b_0 + b_1 x$
- The Slope is the rise over the run so if $x$ changes by 1 then $y$ tends to change by the slope.
- The y-intercept is the value of $y$ when $x$ is 0.

# Example

A study was done to look at the relationship between packs of cigarettes smoked per day and how long a person lives. The equation of the regression line is: $\hat{y} = 84 - 3x$

- Use the regression line to predict how long a person who smokes 4 packs a day will live.
- Interpret the slope.
- Interpret the y-intercept.

# Example

A realtor is looking at the relationship between the year and the population (in thousands) of South Lake Tahoe . The equation of the regression line is:

$$\hat{y} = -975 + \frac{1}{2}x$$

- Use the regression line to predict the population in 2000.
- Interpret the slope.
- Interpret the y-intercept.

# Prediction Interval

We can use the regression line to make a prediction for $y$ given an $x$. This is just a prediction and has error. We can form a confidence interval for the this $y$ given $x$. If $r^2$ is large, then it is useful to use the value of $x$ to predict $y$. Otherwise it is not useful.

# Finding a Prediction Interval

Data was taken to see the relationship between the price that a motel charges and the number of rooms that are filled. The data is shown below. Find a prediction interval for the number of rooms filled when the motel charges $80 per room.

| **Price** | 40 | 40 | 50 | 50 | 60 | 65 | 70 | 75 |
|---|---|---|---|---|---|---|---|---|
| **Rooms** | 92 | 80 | 85 | 81 | 78 | 75 | 80 | 65 |

| **Price** | 85 | 85 | 90 | 95 | 100 | 100 | 105 | 110 |
|---|---|---|---|---|---|---|---|---|
| **Rooms** | 50 | 55 | 60 | 49 | 45 | 50 | 52 | 35 |

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# Finding a Prediction Interval

Data was taken to see the relationship between the age when a person has their first kiss and the age when virginity is lost. Find a prediction interval for the age of lost virginity for a person who experienced his/her first kiss at age 15.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Kiss** | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 14 |
| **Virginity** | 14 | 17 | 20 | 19 | 16 | 17 | 18 | 21 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Kiss** | 15 | 16 | 16 | 17 | 17 | 18 | 18 |
| **Virginity** | 15 | 19 | 17 | 22 | 21 | 20 | 23 |

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