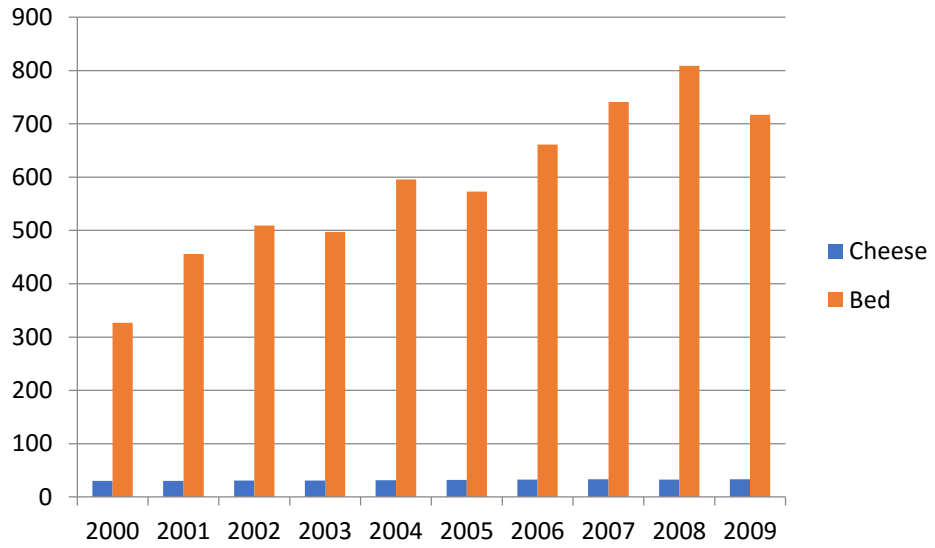
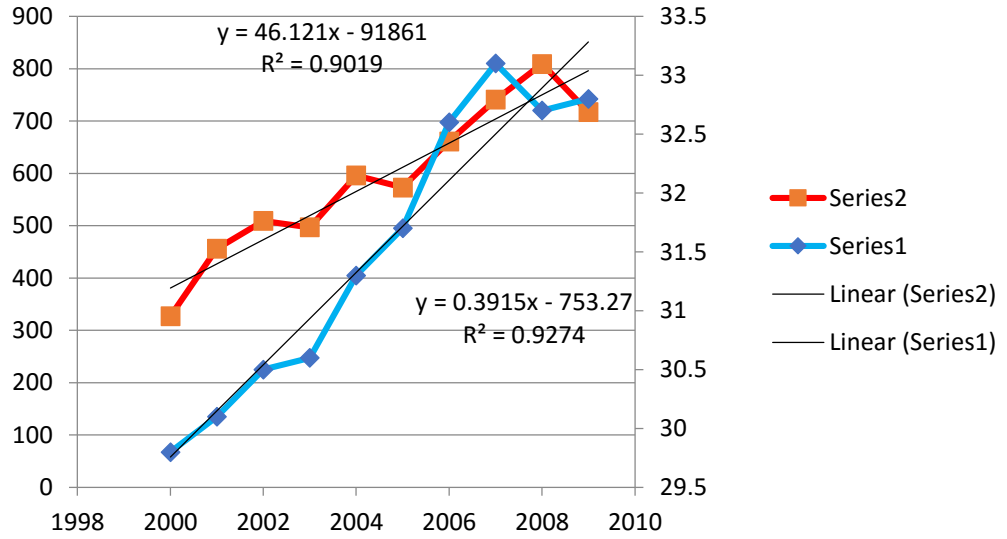
Graphical Relationships Handout

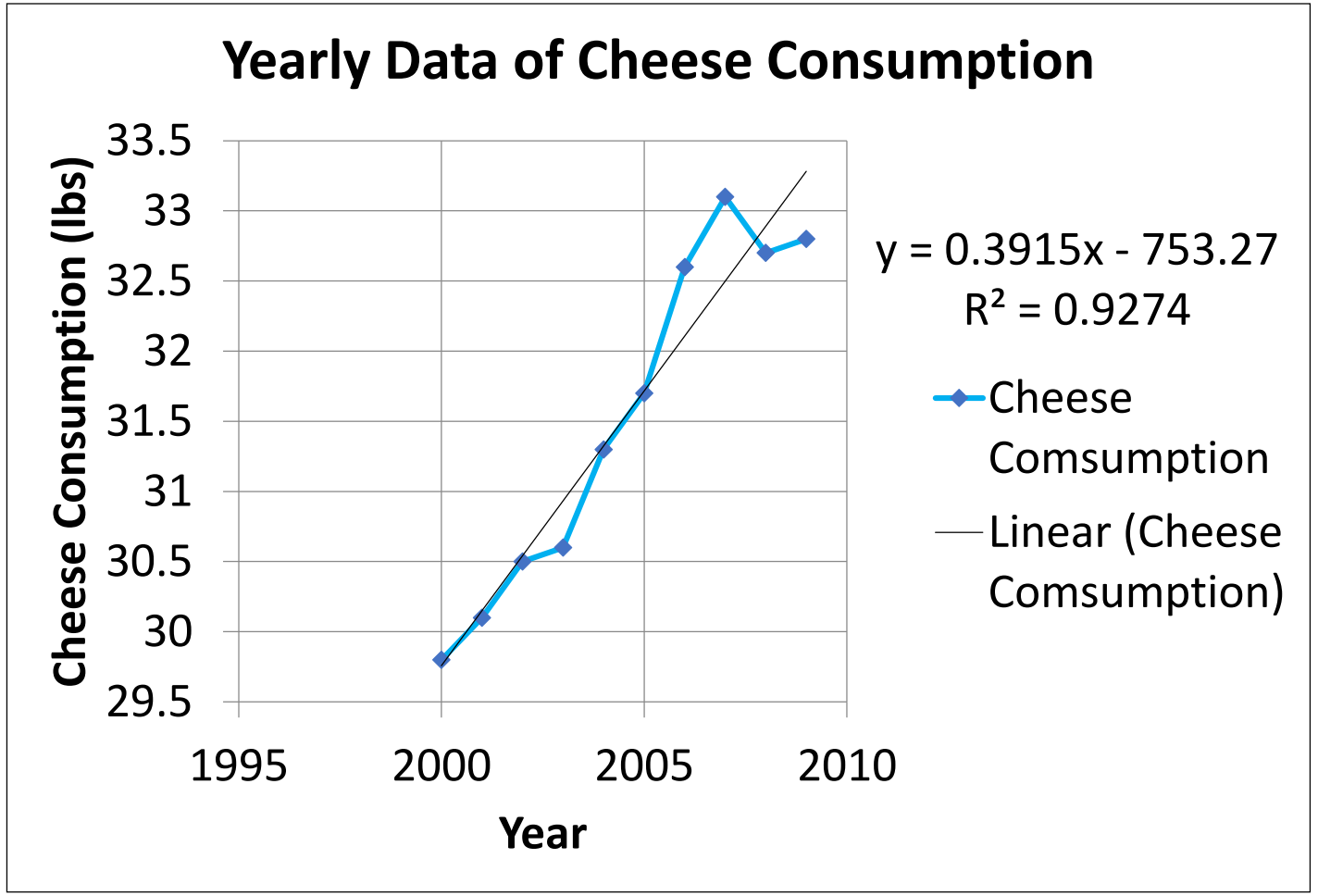




http://www.mrwaynesclass.com/labs/reading/index06.html

Analyzing Data Visually – Recognize Patterns

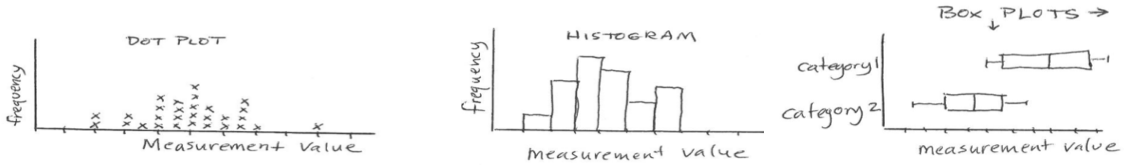
Year	Consumption of Cheese (lbs)
2000	29.8
2001	30.1
2002	30.5
2003	30.6
2004	31.3
2005	31.7
2006	32.6
2007	33.1
2008	32.7
2009	32.8



Graph Types – Depends on Question(s)

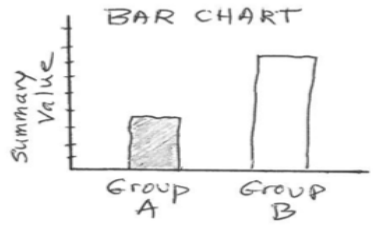
1. **Variability** within a group?

   → **frequency plot, PBC**

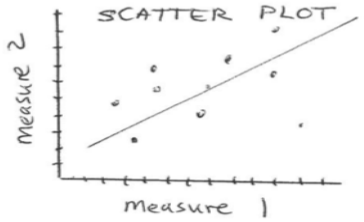


2. **Compare** groups?

   → **2 frequency plots or 1 bar graph**

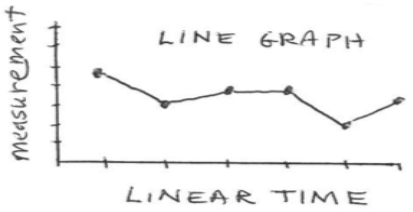


3. **Correlation** between two variables? → **scatter plot**



4. Change through **time**?

   → **line graph**



Slide From : "Practice 4". *Participatoryscience.org*. N.p., 2017. Web. 8 Mar. 2017.

Question Development: **Variability**

What is the measure of variability within a group?

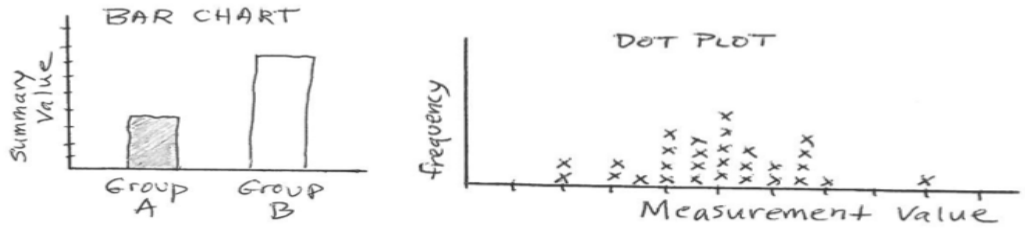
Sample Questions

1. How deep are the lakes in Connecticut?

2. How many red hawks are spotted at Sleeping Giant every month?

3. What are teachers paid in CT?

4. How old are deer in CT when hunted?



Graph Types:

Frequency Plots = Dot, Histogram, Box, Bar Plots

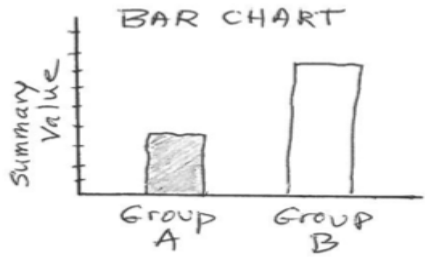
Process Behavior Chart - PBC

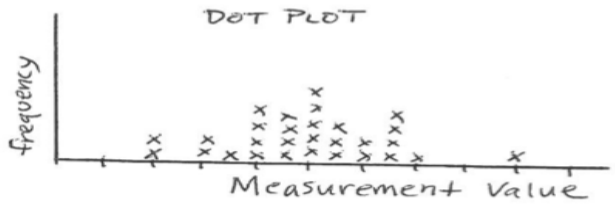
Question Development: **Comparison**

How do two/more groups compare using a single variable or measure?

Sample Questions

1. Do Cats and Dogs have the same average body temperature?
2. Which of the two car designs are consistently the fastest?





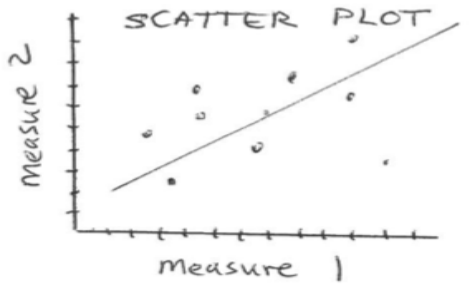
Graph Types:

One Variable – Bar Graph

Multiple Variables – Frequency Plot

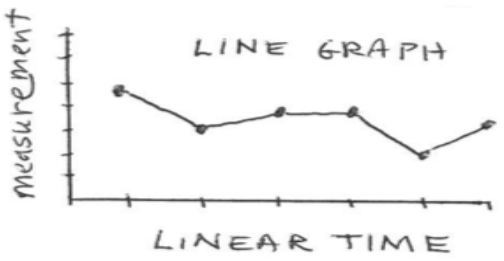
Question Development: **Numerical Correlations**

What is the mathematical model or relationship between variables?



Sample Questions

1. How does force vary with mass?
2. What is the variance of rainfall in Connecticut in 2010?



Graph Types:

Correlation between variables – Scatter Plot

Relationship between time and variable – Line Graph

Question Development: **Total/Proportionality**

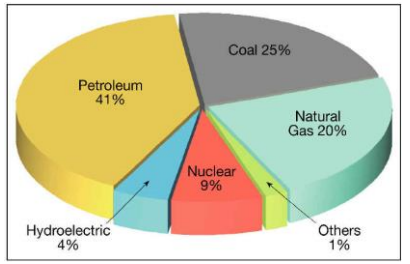
What is the percentage/amount/total of variable?

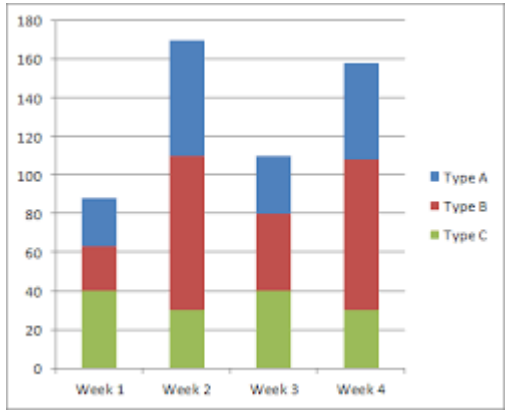
Sample Questions

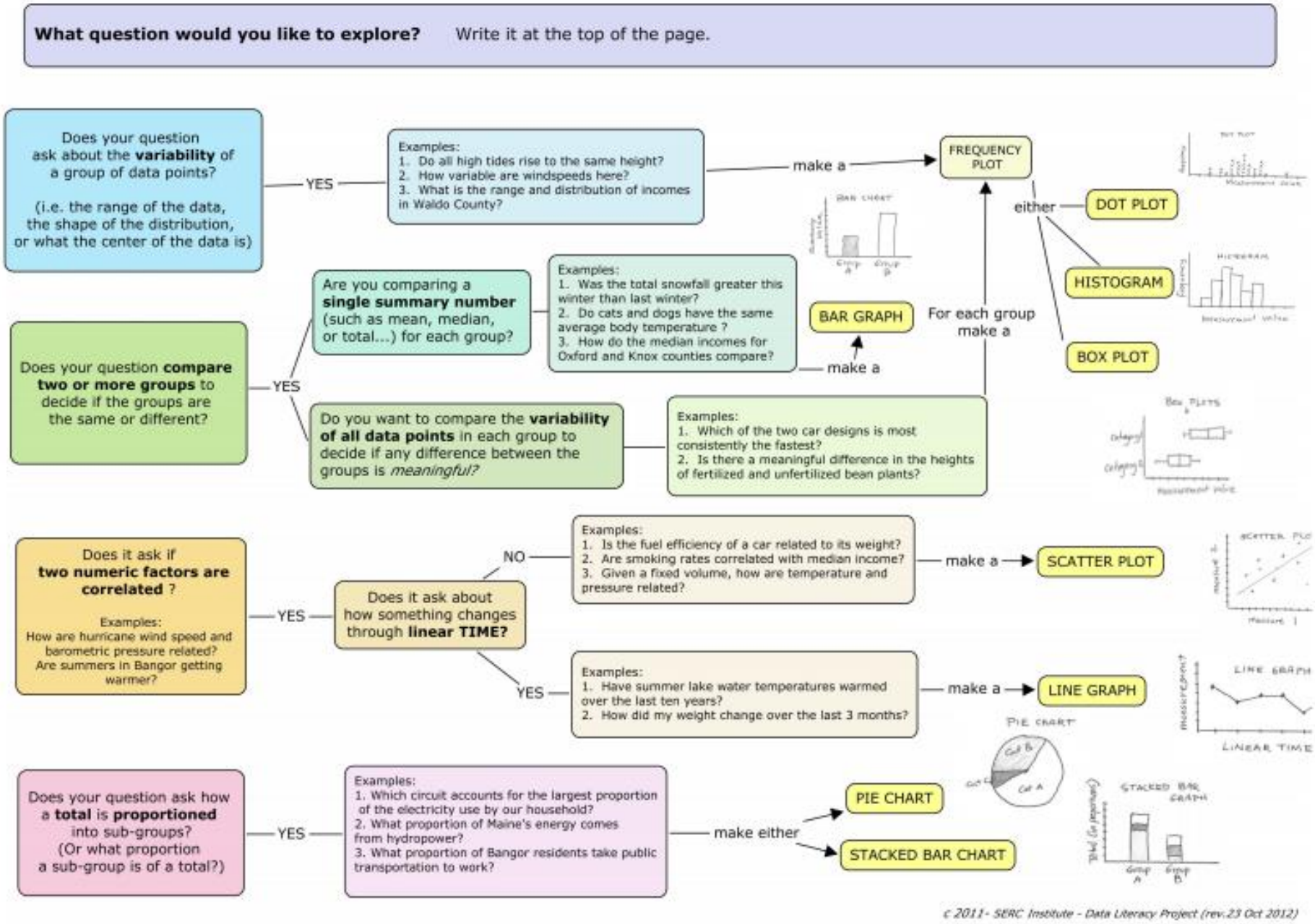
1. What consumes the most amount of energy in your household?
2. What portions of corn production is used for animal consumption?

Graph Types:

Pie Chart, Stacked Bar Graph



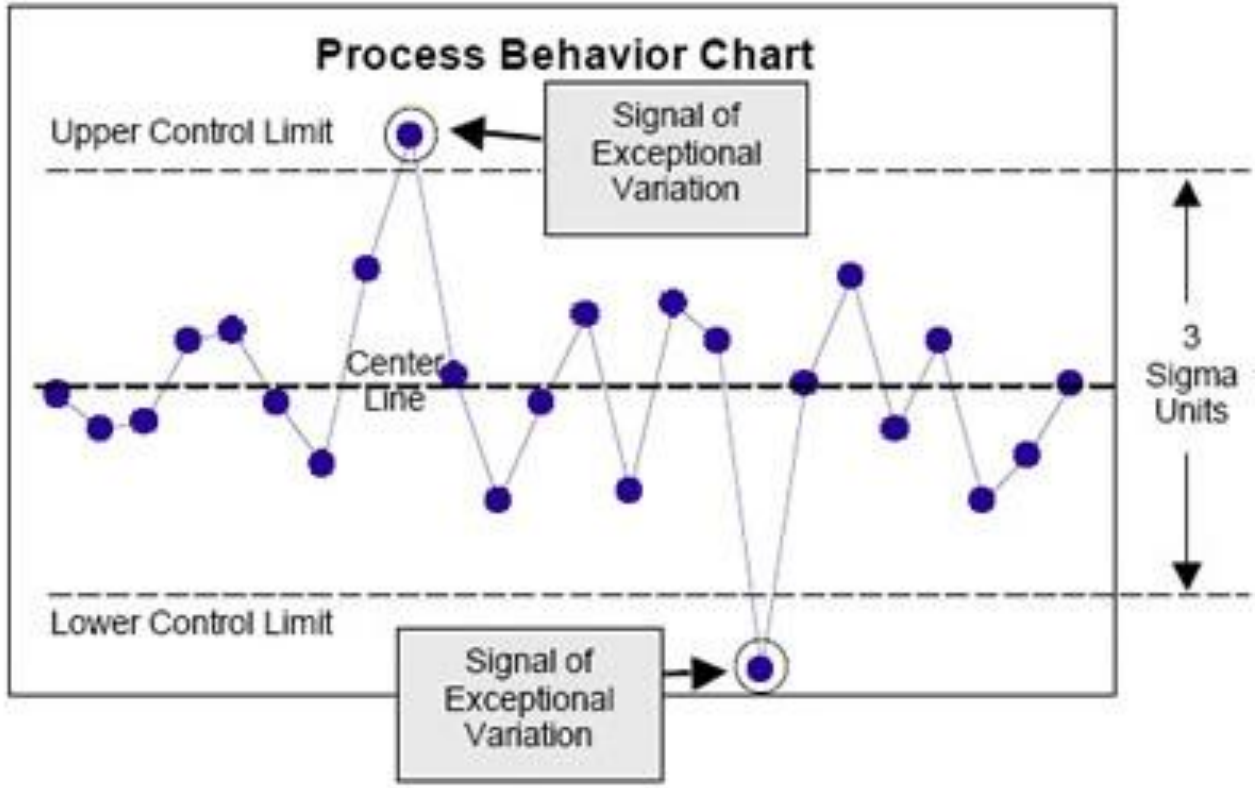




Slide From : "Practice 4". *Participatoryscience.org*. N.p., 2017. Web. 8 Mar. 2017.

Variation - Process Behavior Chart (PBC)

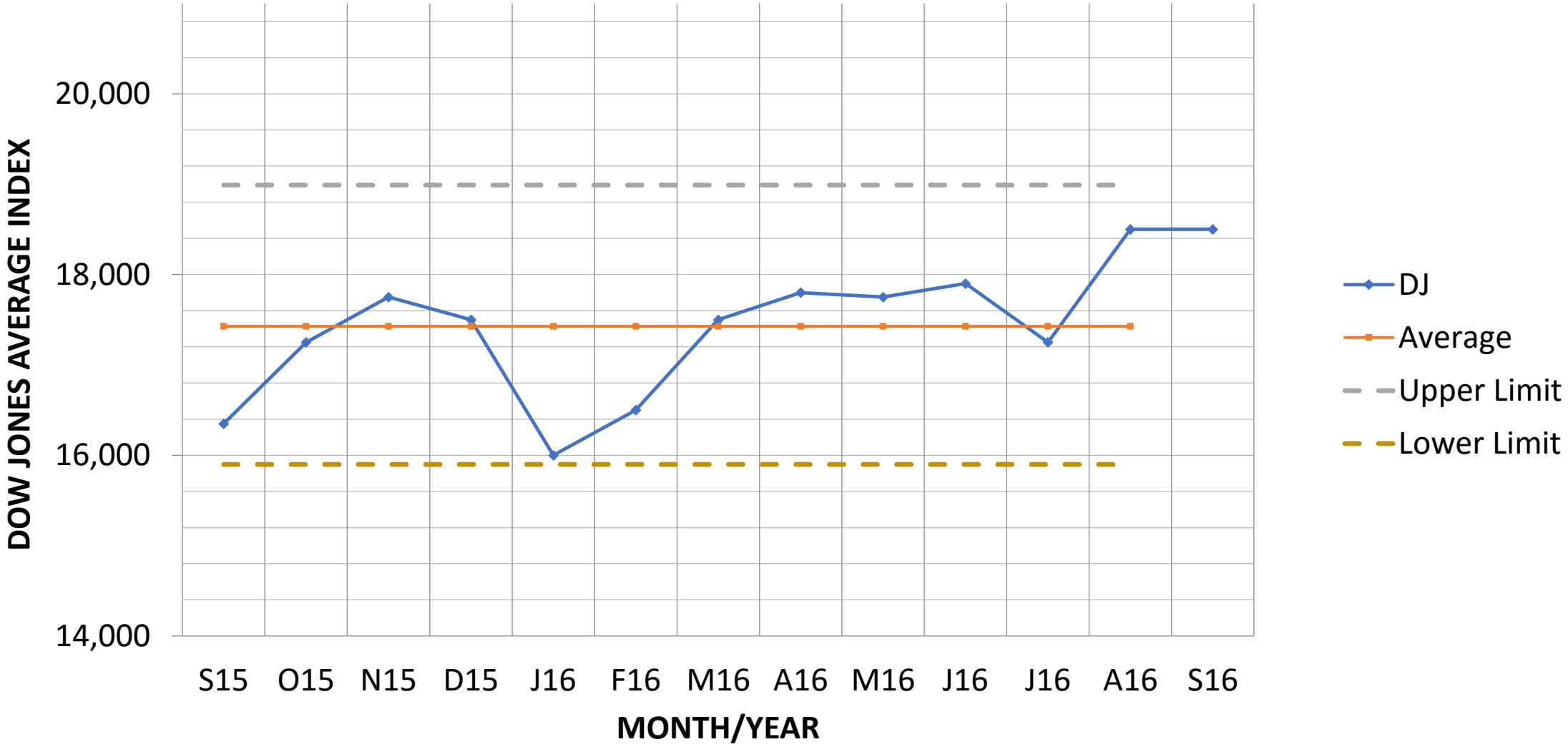
- Dr. Donald Wheeler
- Accounts for natural variable within systems – distinguishes from signals and noise
  - Noise = natural variable in systems
  - Signal = data outside the upper/lower limits of noise
- Analyzes variances in systems for
  - Trends
  - Signals
  - Extremes



DOW JONES INDU AVERAGE INDEX

WOW! LOOK AT JAN 2016, THERE WAS A BIG DIP IN DATA!
Is the variance within the natural limits of the system?

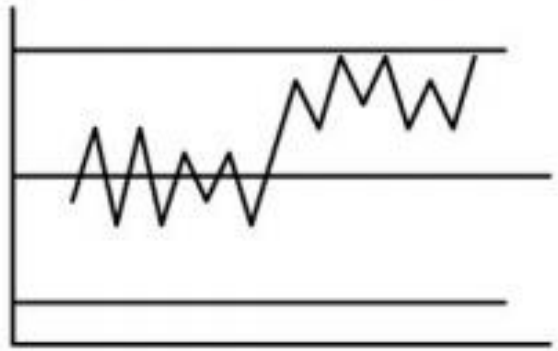
PBC -Individual Values: Index Dow Jones



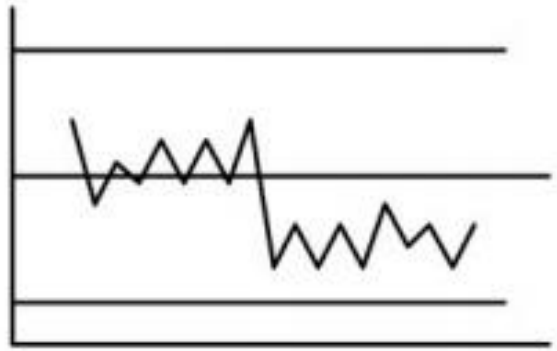
There are no signals. The noise is within the natural variance of the system.

Process Behavior Chart Patters

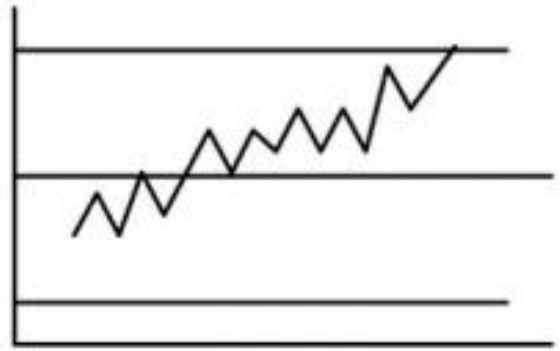
When you see certain patterns you should look for some systematic explanation



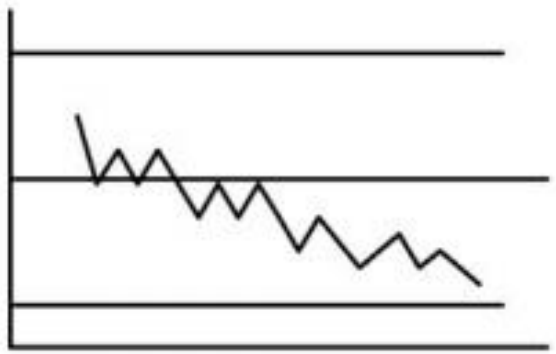
Upward Shift Pattern



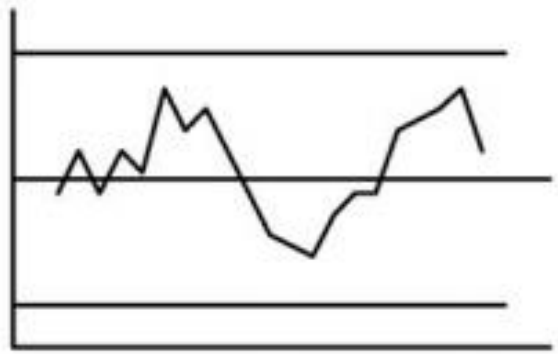
Downward Shift Pattern



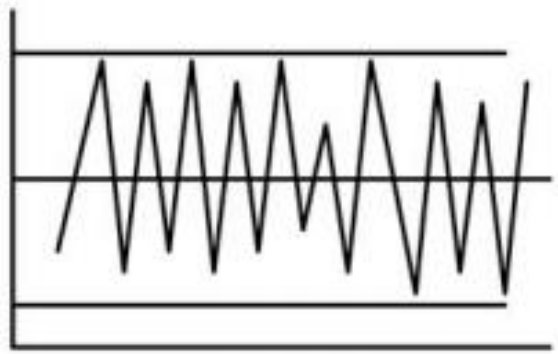
Upward Trend Pattern



Downward Trend Pattern

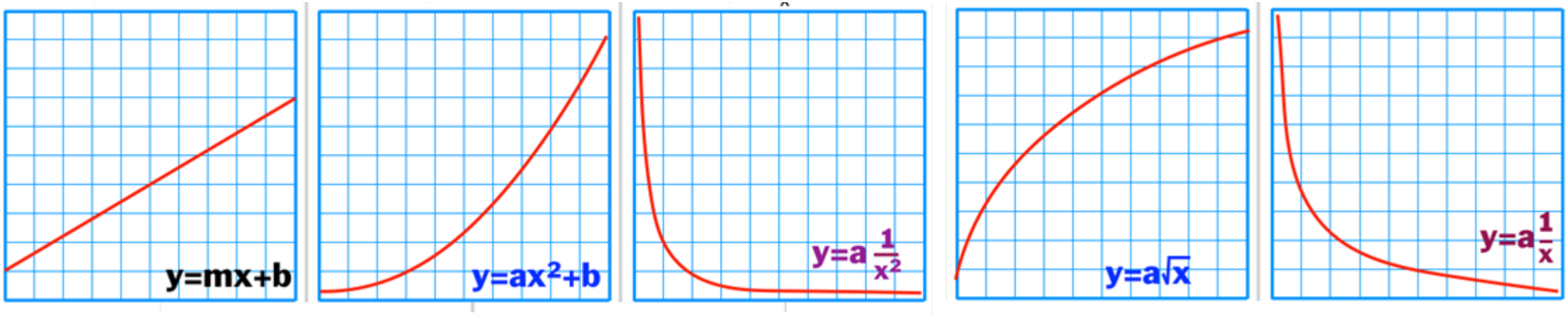


Cycle Pattern



Systematic Pattern

Which mathematical model does your data fit?



Linear **Power** **Inverse Square** **Square Root** **Inverse**

Shape of the plot gives information about the mathematical relationship between the variables - predictability

Linear Model

Equation

y = mx + b

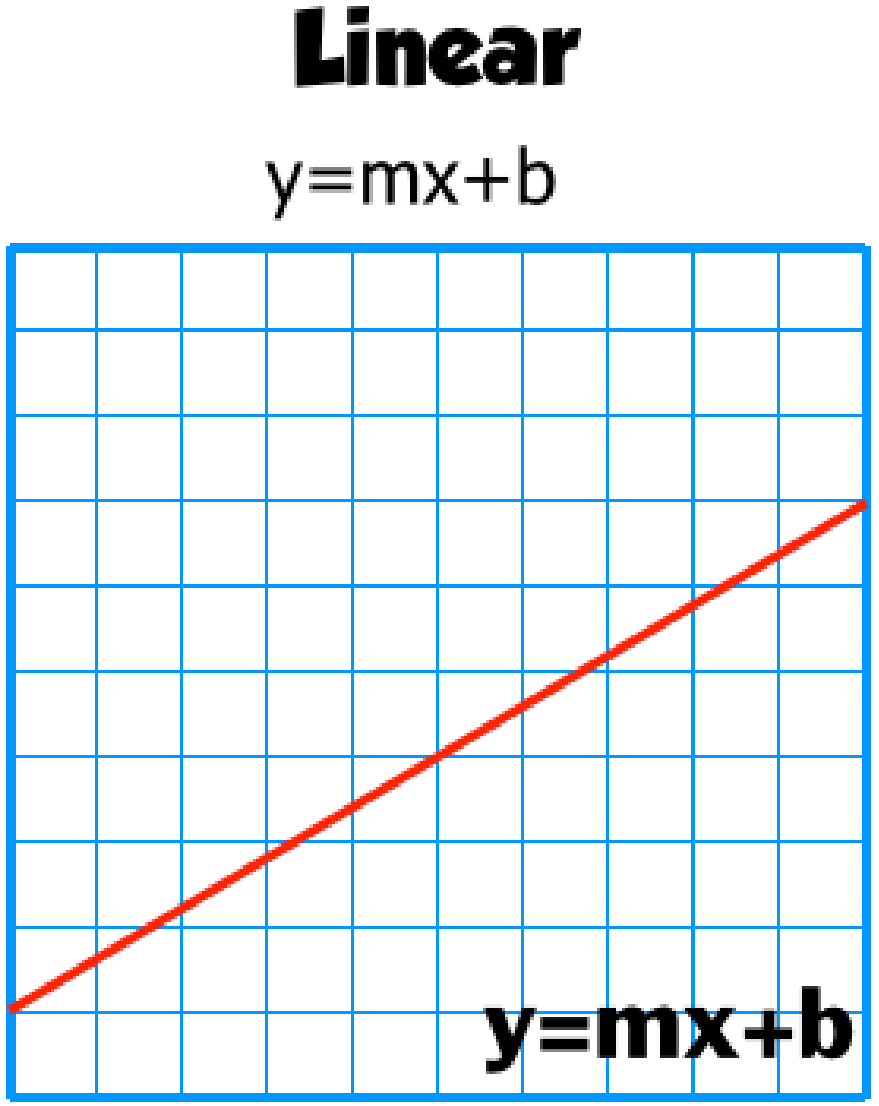
y = dependent variable
x = independent variable
m = slope – rate of change
b = y intercept – initial conditions

Shape

Straight Line

Meaning: Proportional

Direct Relationship, as x increases, y increases variable; constant rate of change



Power Model

Equation

$y = ax^c + b$

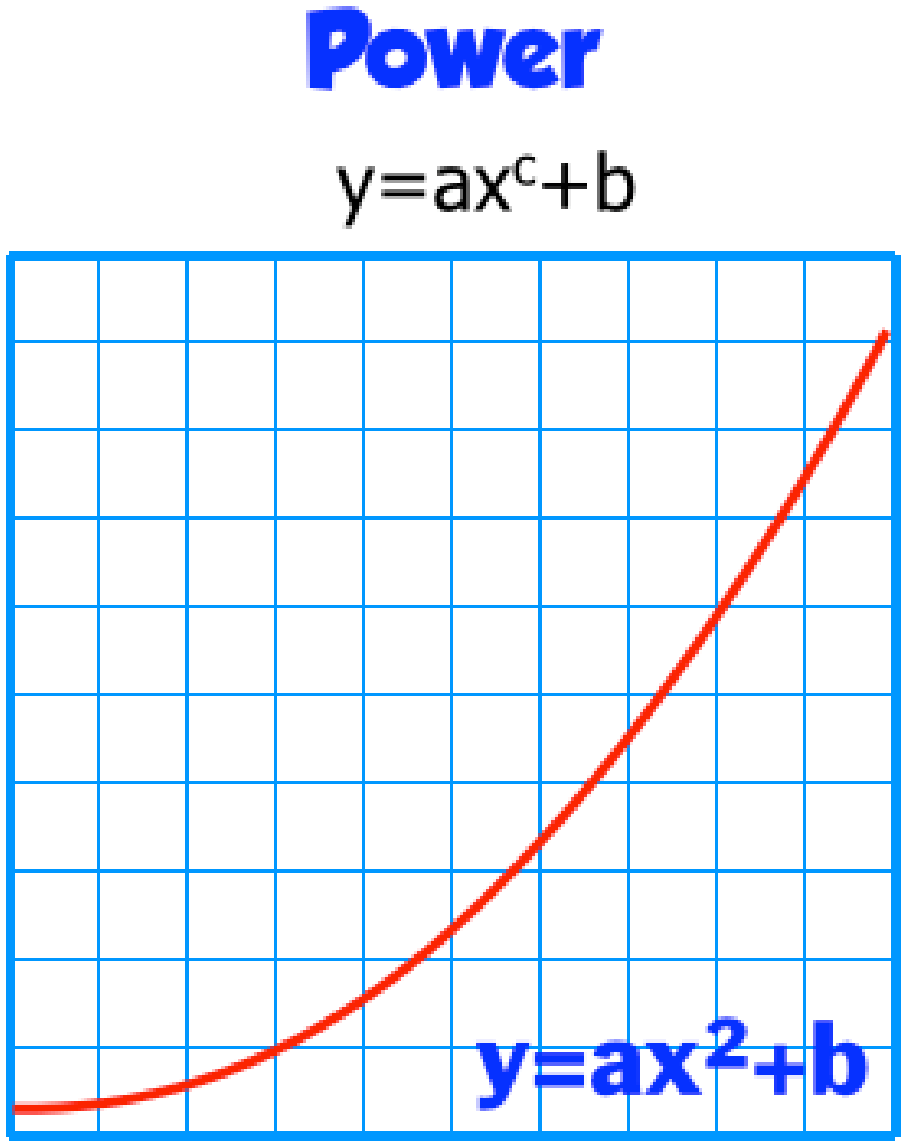
y = dependent variable
x = independent variable
a = coefficient – scaling
c = power
B = y intercept – initial conditions

Shape

Curved line

Meaning: Proportional

Power Relationship, as x increases, y increases as a square; does not increase at a constant rate; changes the rate it increases



Inverse Square Model

<u>Equation</u>

$y = a\ 1/x^2$

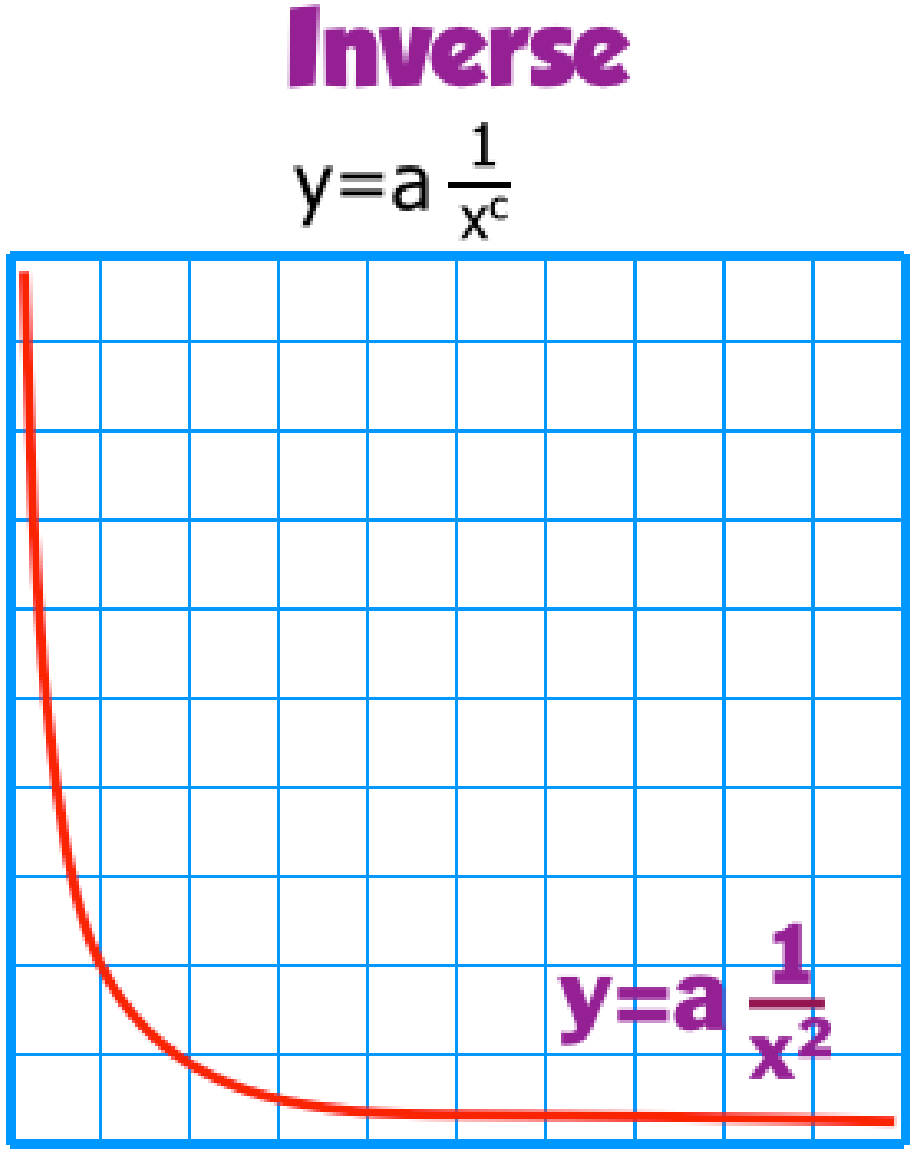
y = dependent variable
x = independent variable
a = coefficient – scale
c = power

<u>Shape</u>

Steep Drop off; downward curve

<u>Meaning: Proportional</u>

Inverse square Relationship, as x increases, y decreases as a square; factor quickly dissipates; only visible at close ranges



Square Root Model

<u>Equation</u>

$y = a\sqrt{x}$

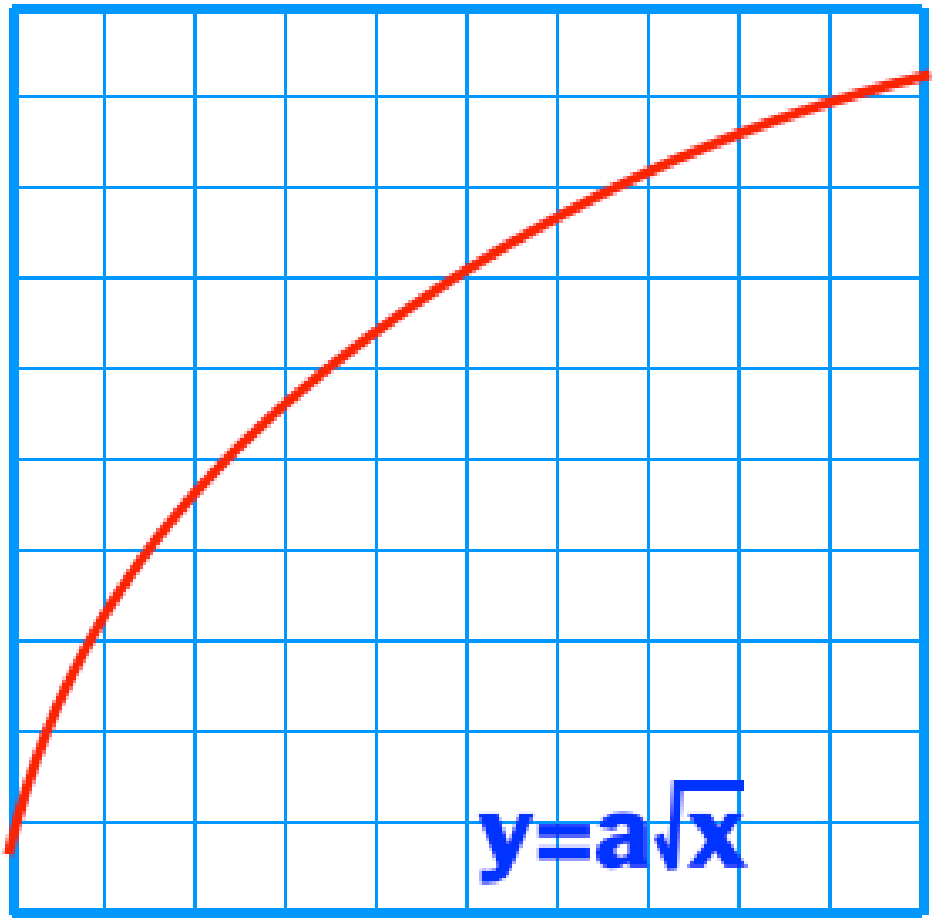
y = dependent variable
x = independent variable
a = coefficient – scale

<u>Shape</u>

Curve that plateaus over a long interval

<u>Meaning: Proportional</u>

Power Relationship, as x increases, y decreases as a square; increases quickly and then effect goes away



Inverse Model

Equation

$y = a\frac{1}{x}$

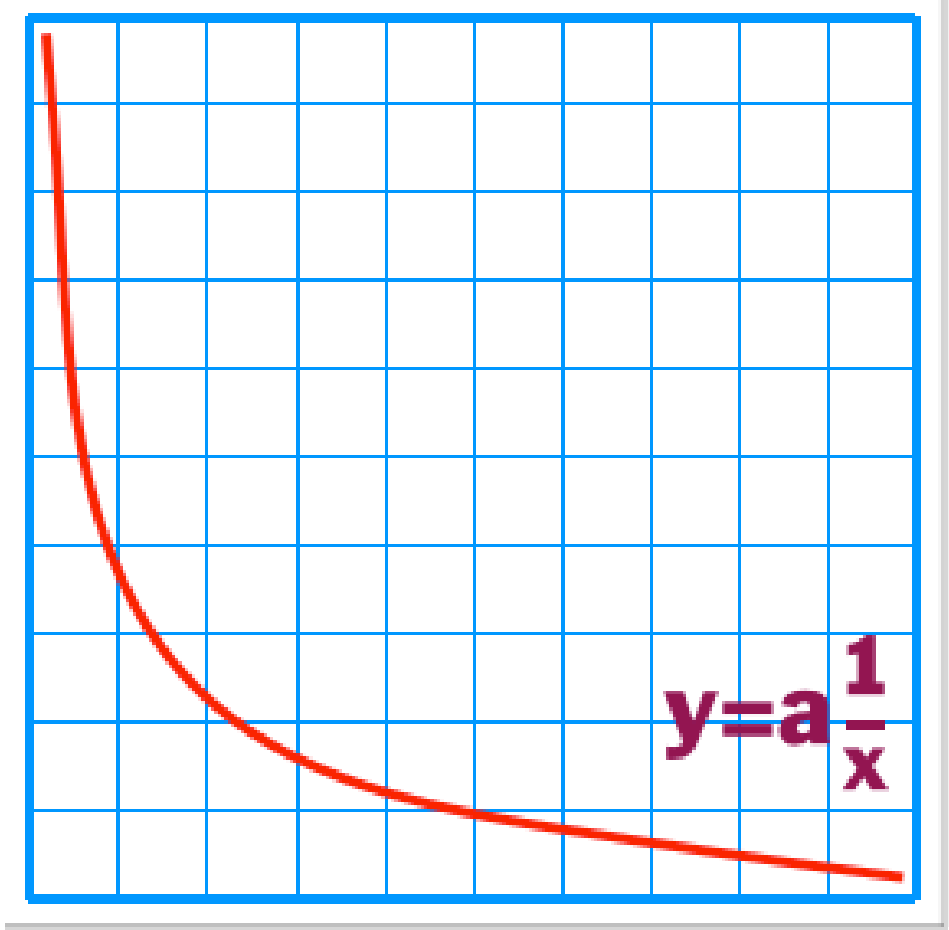
y = dependent variable
x = independent variable
a = coefficient – scale

Shape

Curve that plateaus over a long interval

Meaning: Proportional

Power Relationship, as x increases, y decreases as a square; increases quickly and then effect goes away



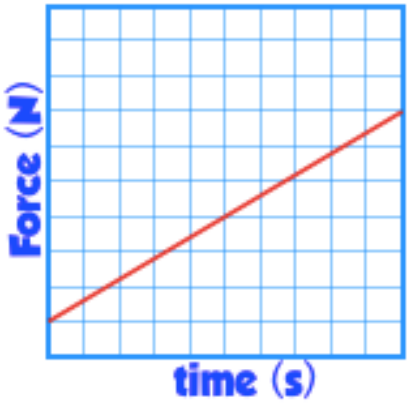
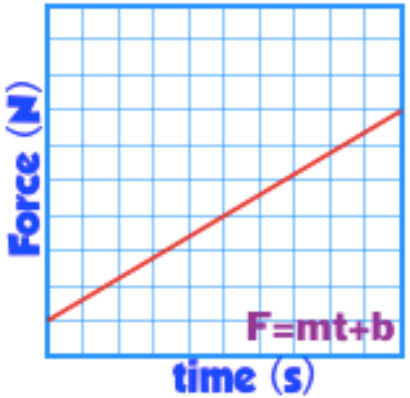
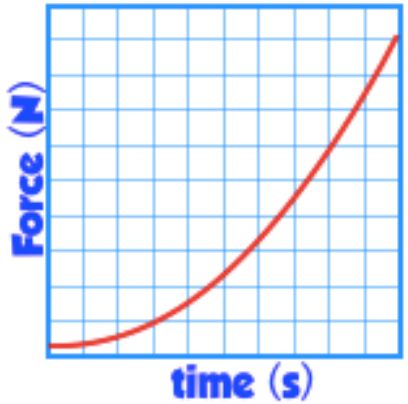
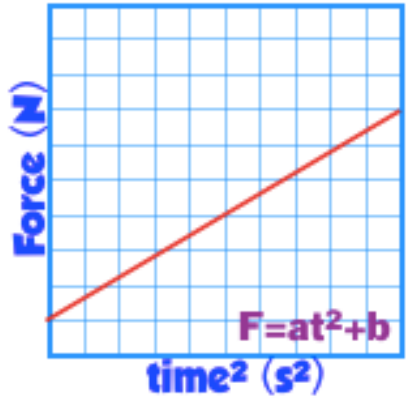
Linearization

- Vary the power of the variables to generate a linear trend
- Generation of an equation

Ex: Kepler's Third Law

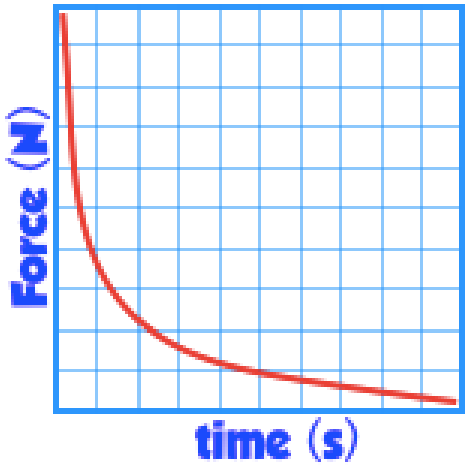
What is the relationship between the average orbital distance (r) of the planets and their average orbital period (T)?

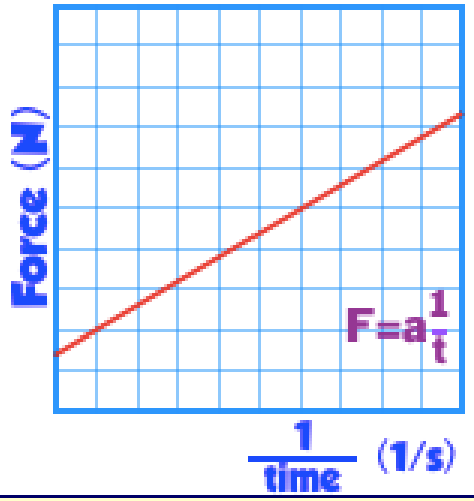
Example Relationships

What the graph of raw data looks like	What the linearized data looks like & its equation.	Description in words
Linear		
		Force is directly proportional to the time.
Power		
		Force is proportional to time squared.

Example Relationships

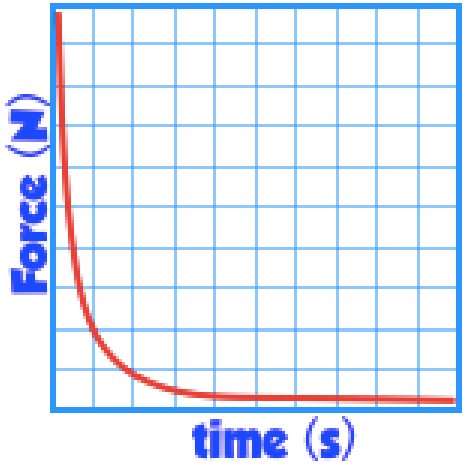
Inverse

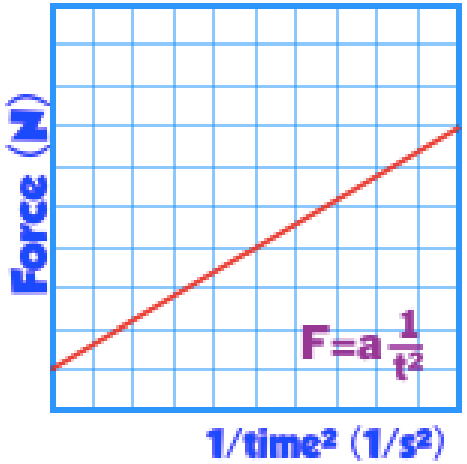




Force is proportional to the inverse of time.

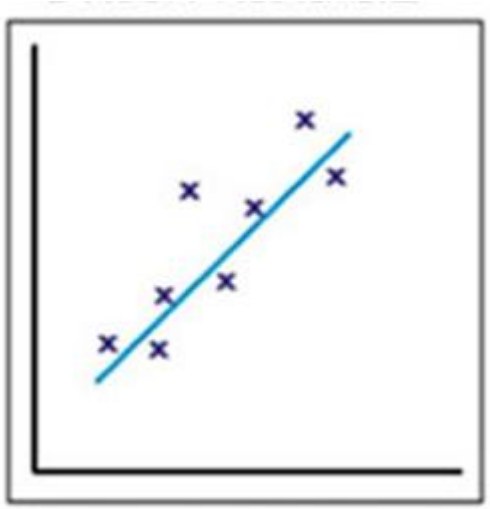
Inverse squared





Force is proportional to the inverse square of time.

Correlation Data

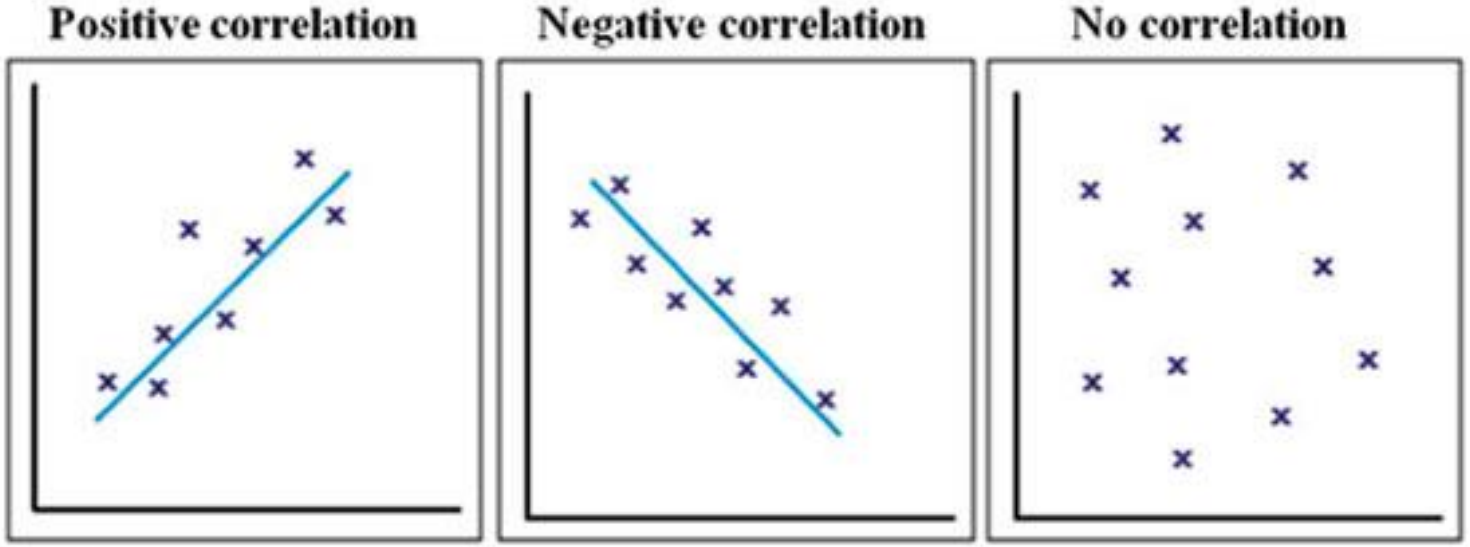


- Determines the relationship between two variables
- Determines the predictability of two variables
- R^2 on excel Plot measures the percent of verifiability in y in relation to x & y.

Correlation does not determine causality

"The Scatter Plot & Linear Regression." *CQE Academy*. N.p., n.d. Web. 08 Mar. 2017.

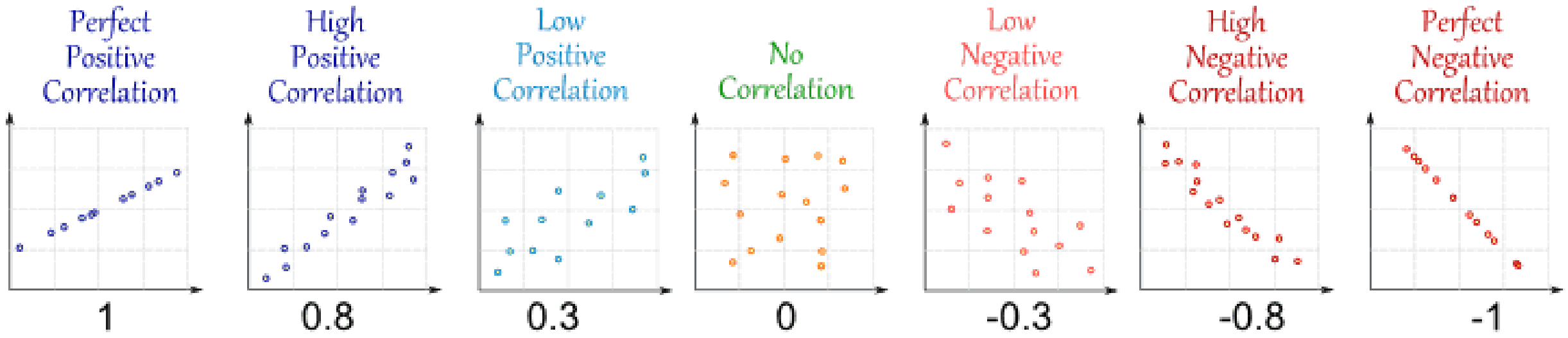
Correlation Examples



Visuals to match their data with the most appropriate correlation

McLeod, S. A. (2008). Correlation. Retrieved from www.simplypsychology.org/correlation.html

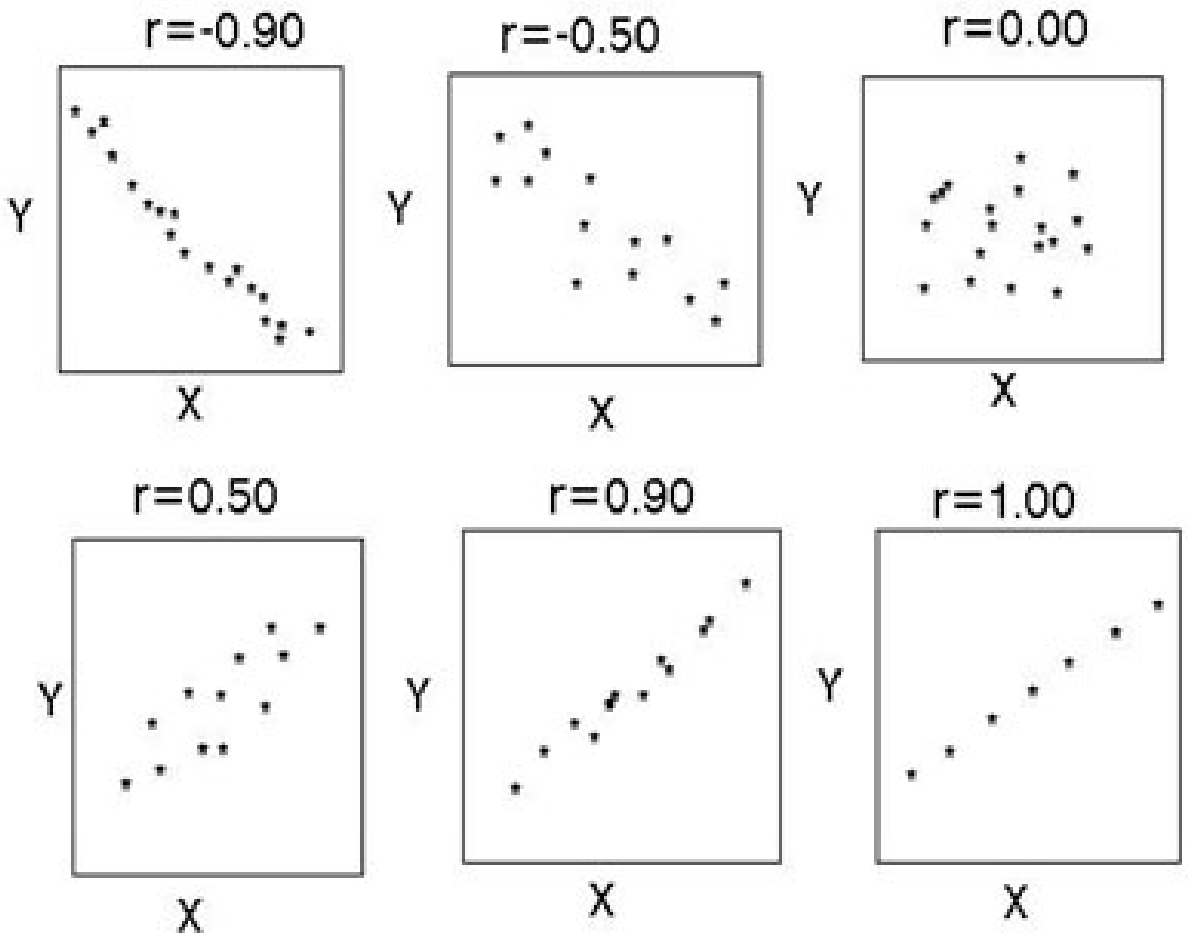
Correlation & R^2 Examples



- Positive correlation refers to an upward trend
- Negative correlation refers to a downward trend
- 0 correlation shows no relation between variables

"The Scatter Plot & Linear Regression." *CQE Academy*. N.p., n.d. Web. 08 Mar. 2017.

Correlation Examples

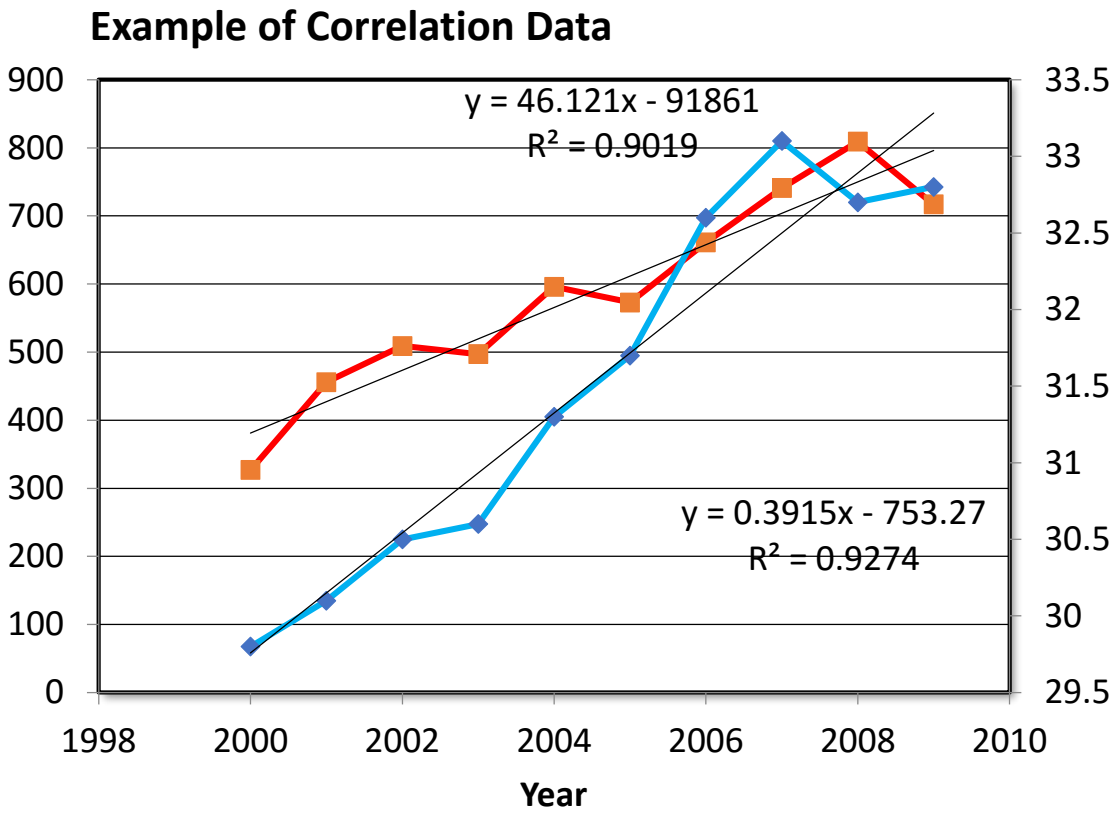


Using Excel:

- Right click on data series
- Select Add Trendline
- Select Display equation
- Select Show R^2
- CORREL = 0.941

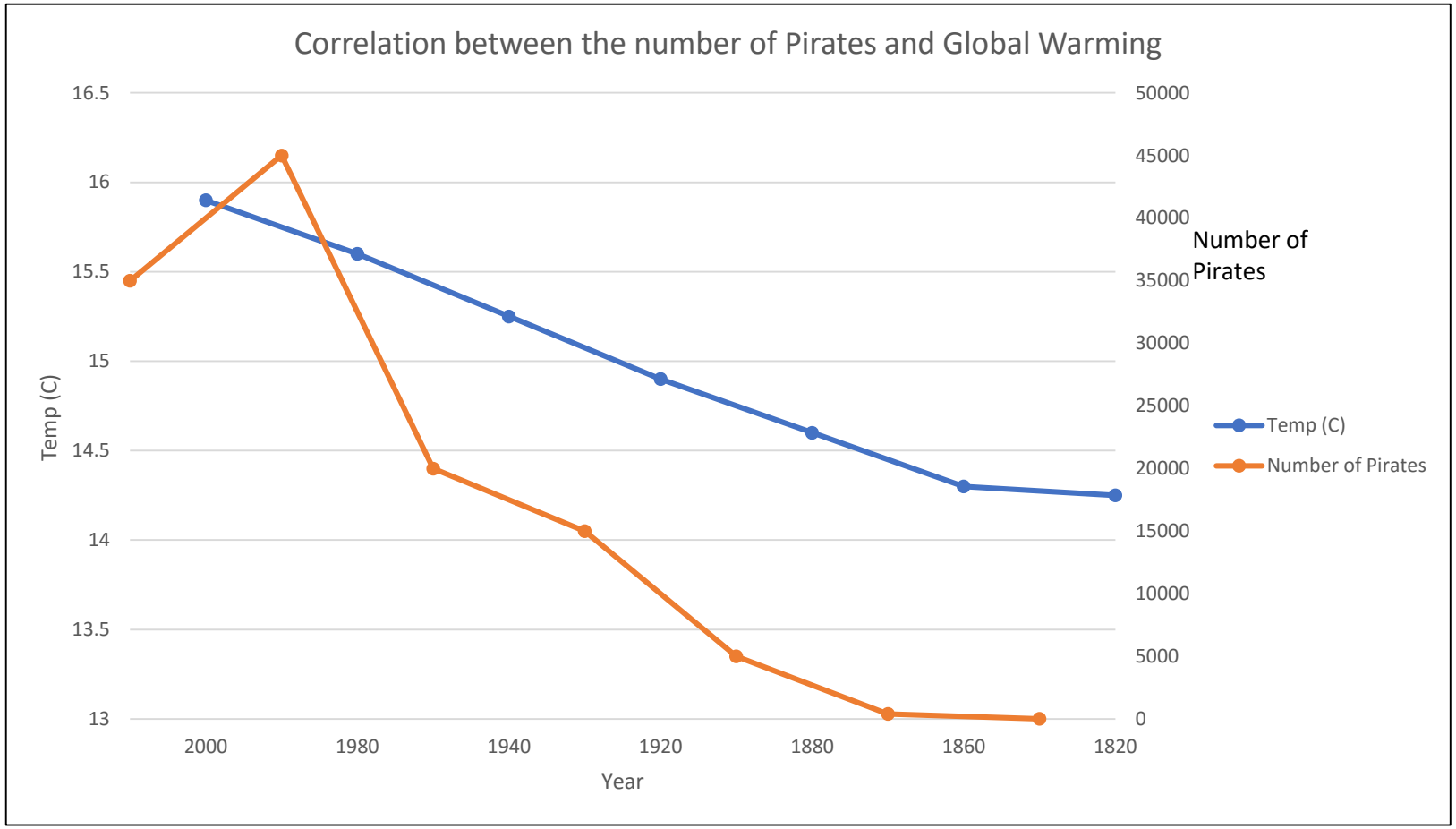
McLeod, S. A. (2008). Correlation. Retrieved from www.simplypsychology.org/correlation.html

Correlation Between Two Data Sets



- Individual correlation values are different than the correlation between two data sets
- Use CORREL Function in excel to find correlation between two data sets
- CORREL = 0.941

Correlations between two data sets



R = -0.93

Correlation and Causality

Pirate shortage is the cause of global warming

Citations

- Wayne, Tony. "Linearizing data." *Linearizing data*. N.p., n.d. Web. 09 Mar. 2017.
- "Practice 4". *Participatoryscience.org*. N.p., 2017. Web. 8 Mar. 2017.
- McLeod, S. A. (2008). Correlation. Retrieved from www.simplypsychology.org/correlation.html
- "The Scatter Plot & Linear Regression." *CQE Academy*. N.p., n.d. Web. 08 Mar. 2017.