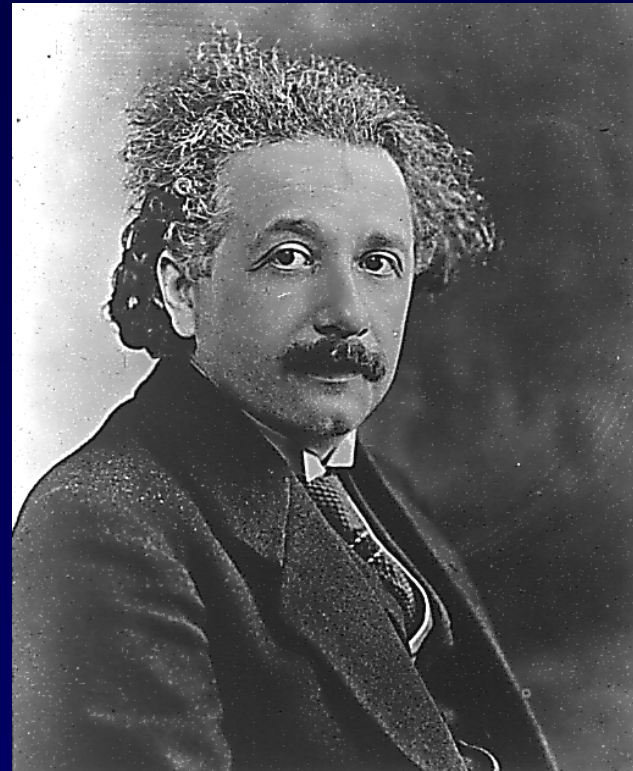


Math Review

"Don't worry about your difficulties in
Mathematics,
I can assure you that mine are still
greater"

Albert Einstein



Math Review

Tuesday-Friday, June 10-13 2003

A) Introduction

a. Symbols

b. Operations

c. Central Tendencies

B) Linear Algebra

C) Correlation/Regression Analysis

D) System of Equations: Linear/Quadratic

E) Applied Calculus

Math Review #1

Tuesday, June 10 2003

<http://www.columbia.edu/~pl2065/courses/mpa.htm>

- A) Introduction
 - a. Symbols
 - b. Operations
 - c. Central Tendencies
- B) Linear Algebra

Basic Math Review

a. Symbols

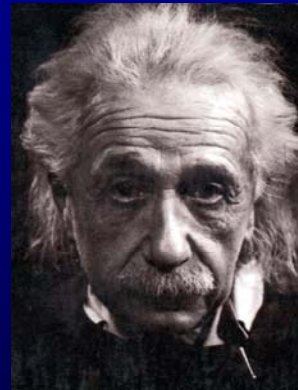
We need symbols to simplify expressions and develop abstract arguments



→ particularly for quantitative analysis.



$$F = ma$$



$$E = mc^2$$

A Better Math Curriculum

Dr. Tom Davis (B.Sc. Math at Caltech, Ph.D. in Math at Stanford, post-doc in electrical engineering at Stanford)

The problem today: "math is generally taught by and aimed at mathematicians"

(In many universities, engineering Depts teach their own math courses since students are unable to solve engineering (applied) problems with the tools they learn from the math Dept!)

Basic Math:

- Finances (household...)
- Problem-solving skills!!!
- Basic numeracy
- Estimation (including probability & statistics)
- Visualization, and
- Bullshit detector!!!

What's in a number

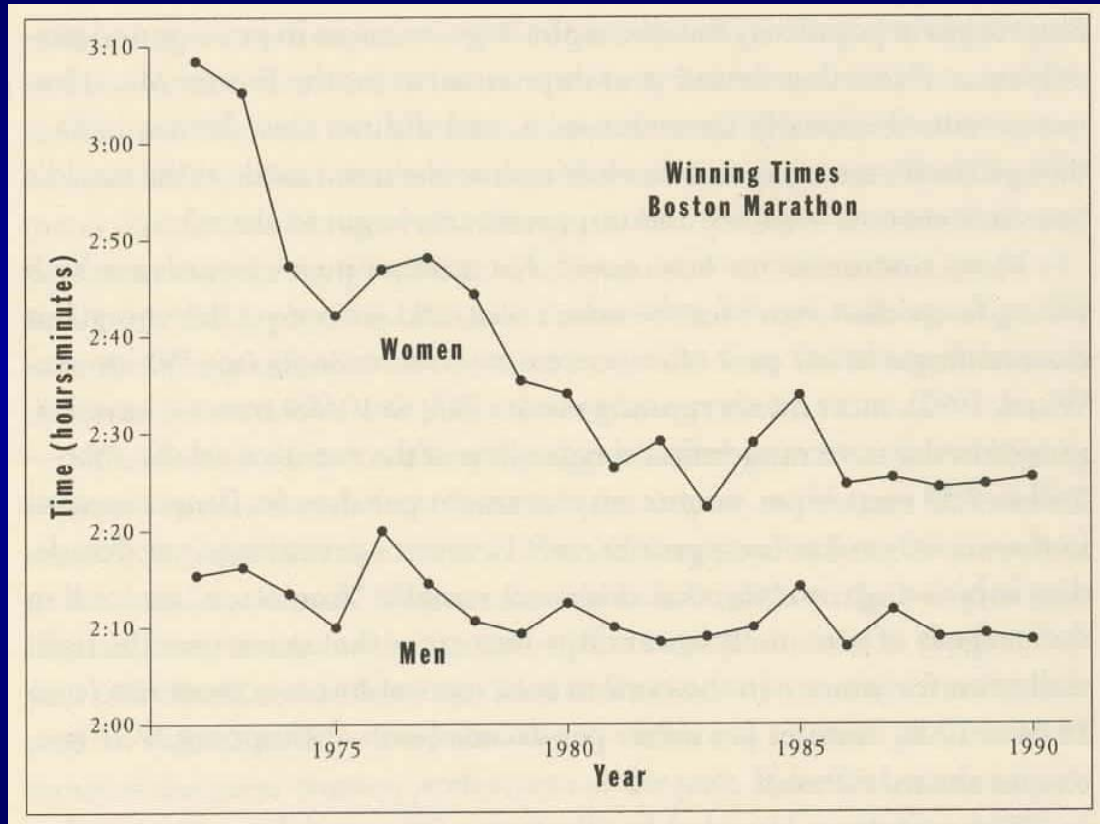
"Sex Drives"



Or the
"Gender Wars"

What's in a number

Really, shouldn't we be serious?



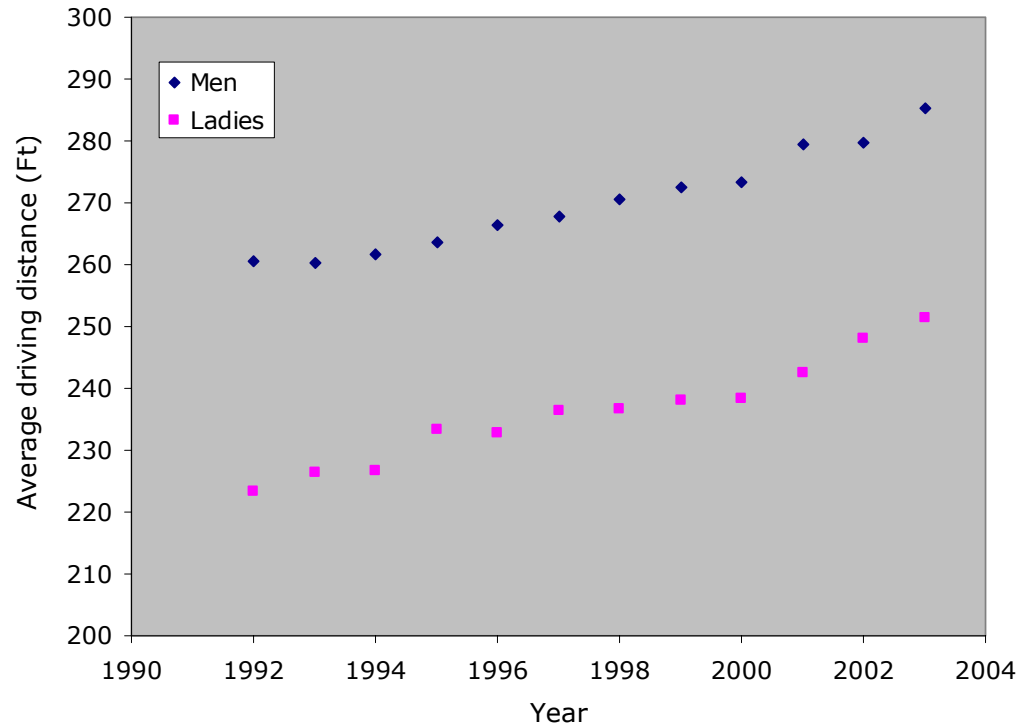
What's in a number

"Sex Drives"

VS.



Average driving distance of men's and women's tours (PGA and LPGA)



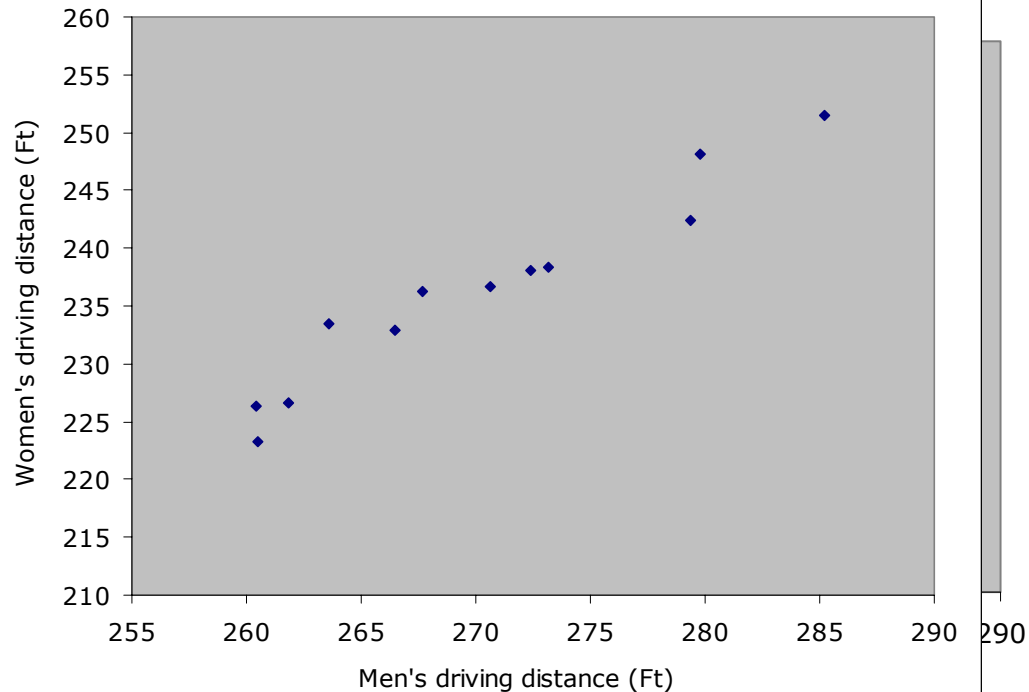
What's in a number

"Sex Drives"

VS.

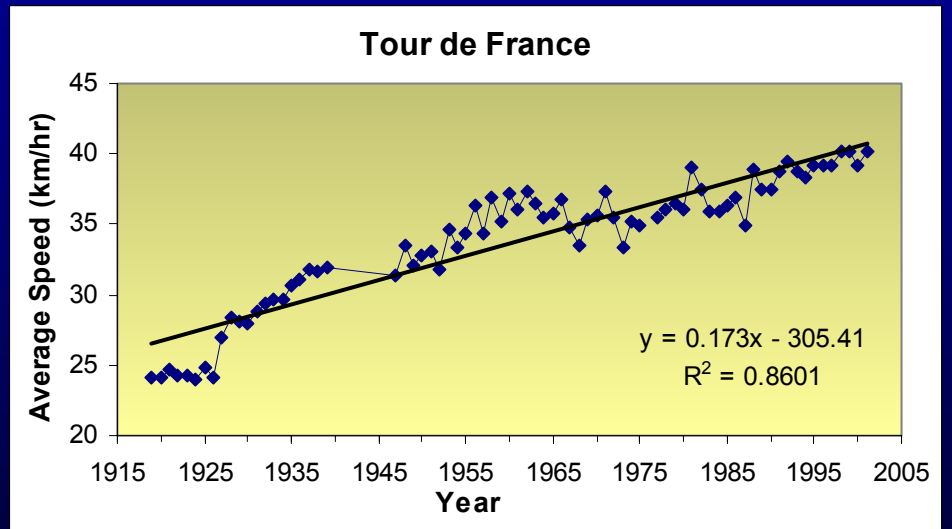
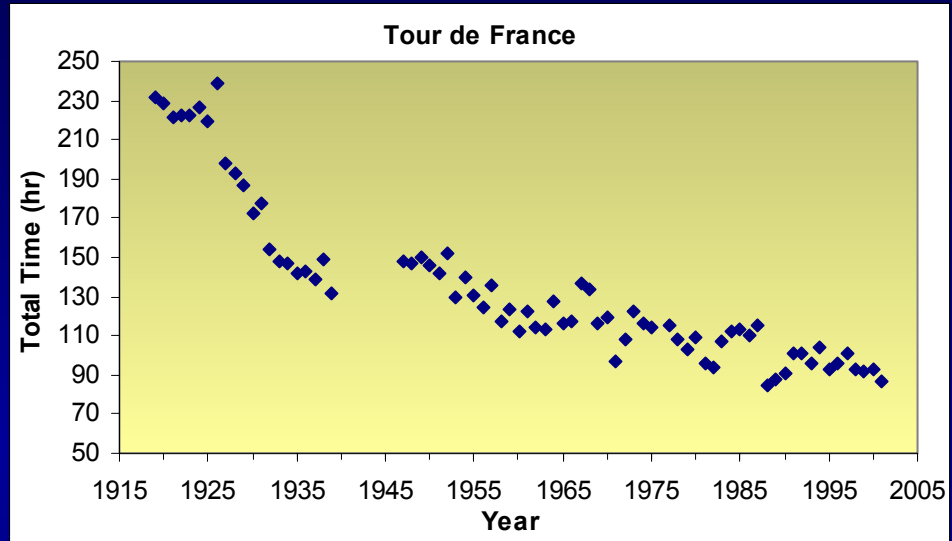


Average driving distance of men's and women's tours (PGA and LPGA)



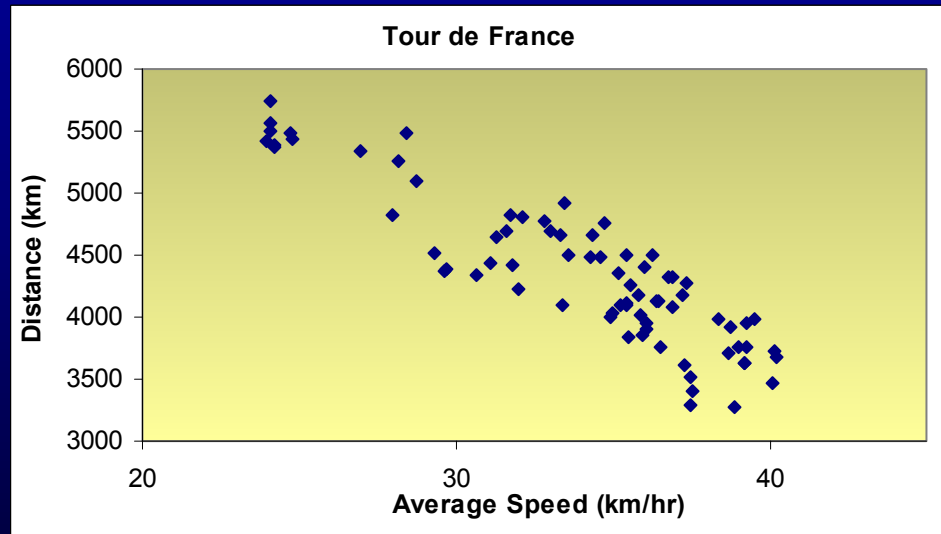
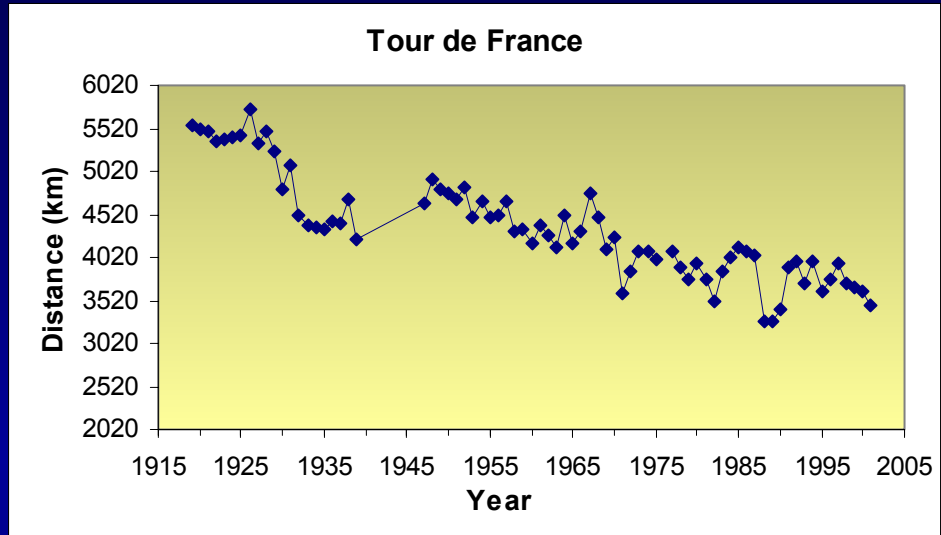
What's in a number

"Bullshit detector"



What's in a number

"Bullshit detector"



Basic Math Review

b. Operations

Summation: Σ (sigma)

$$\Sigma x_i = x_1 + x_2 + x_3 + \dots + x_n$$

Where:

n , represents the sample size

x represents the variable, and

x_i represents the value of the i^{th} observation

$$\Sigma(x_i+y_i)^2 = (x_1+y_1)^2 + (x_2+y_2)^2 + (x_3+y_3)^2 + \dots + (x_n+y_n)^2$$

$$\bar{x} = \frac{\sum x_i}{n} = \frac{1}{n} \sum x_i$$

Basic Math Review

b. Operations

Factorial: $n!$

$$n! = 1 \times 2 \times 3 \times \dots \times n$$

Where:

$$0! = 1$$

$$1! = 1$$

$$2! = 1 \times 2 = 2$$

$$3! = 1 \times 2 \times 3 = 6$$

$$5! = 1 \times 2 \times 3 \times 4 \times 5 = 120$$

$$10! = 3,628,800 \text{ (try it out)}$$

Or

$$n! = (n-1)! \times n$$

(for $n > 0$)

Basic Math Review

b. Operations

Powers (Exponents):

$$x^a \times x^b = x^{(a+b)}$$

$$x^a y^a = (xy)^a$$

$$(x^a)^b = x^{(ab)}$$

$$x^{(a/b)} = b^{\text{th}} \text{ root of } (x^a) = \sqrt[b]{x^a}$$

$$x^{(-a)} = \frac{1}{x^a}$$

$$x^{(a-b)} = \frac{x^a}{x^b}$$

Basic Math Review

b. Operations

Logarithms (base 10):

$\log_b(x) = y$ if and only if $b^y = x$

also: $\sqrt[y]{x} = b$

$$\log_b(b) = 1$$

$$\log_b(1) = 0$$

$$\log_b(x \cdot y) = \log_b(x) + \log_b(y)$$

$$\log_b(x/y) = \log_b(x) - \log_b(y)$$

$$\log_b(x^n) = n \log_b(x)$$

Warning:

$$\log_b(x) \times \log_b(y) \neq \log_b(x \times y)$$

$$\frac{\log_b(x)}{\log_b(y)} \neq \log_b\left(\frac{x}{y}\right)$$

Basic Math Review

b. Operations

Logarithms (natural log):

$\ln(x) = y$ if and only if $e^y = x$

$$\ln e = 1$$

$$\ln(1) = 0$$

$$\ln(x \times y) = \ln(x) + \ln(y)$$

$$\ln(x/y) = \ln(x) - \ln(y)$$

$$\ln(x^y) = y \ln(x)$$

$$\ln(e^x) = x \ln(e) = x \times 1 = x$$

$$e^{\ln(x)} = x$$

Basic Math Review

b. Operations

a) Solve for x : $\ln(e^a) = b^x$

b) Solve for y using common logarithms (base 10):

$$y = 17^5$$

Basic Math Review

c. Central Tendencies

The most commonly used descriptive statistics are measures of central tendency

The *sample mean* (: pronounced "x bar") is:

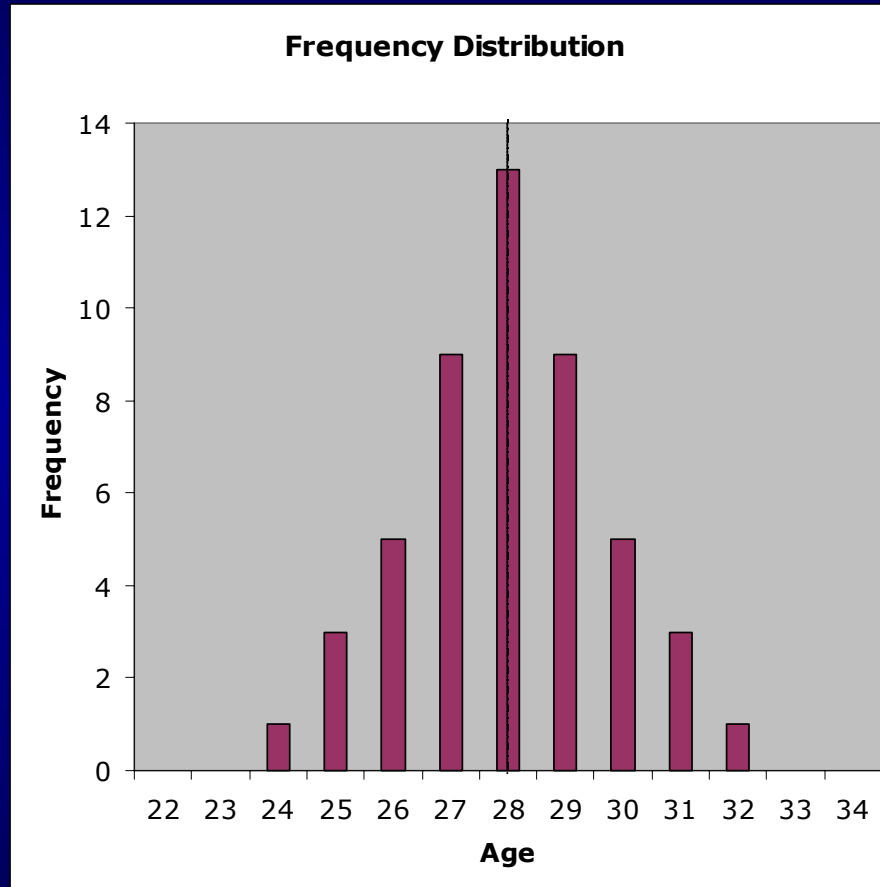
$$\bar{x} = \frac{\sum x_i}{n} = \frac{1}{n} \sum x_i$$

Where $\sum x_i$ represents the sum of all values in the sample and n represents the sample size

Basic Math Review

c. Central Tendencies

Let's assume we have a student population ($n = 47$)

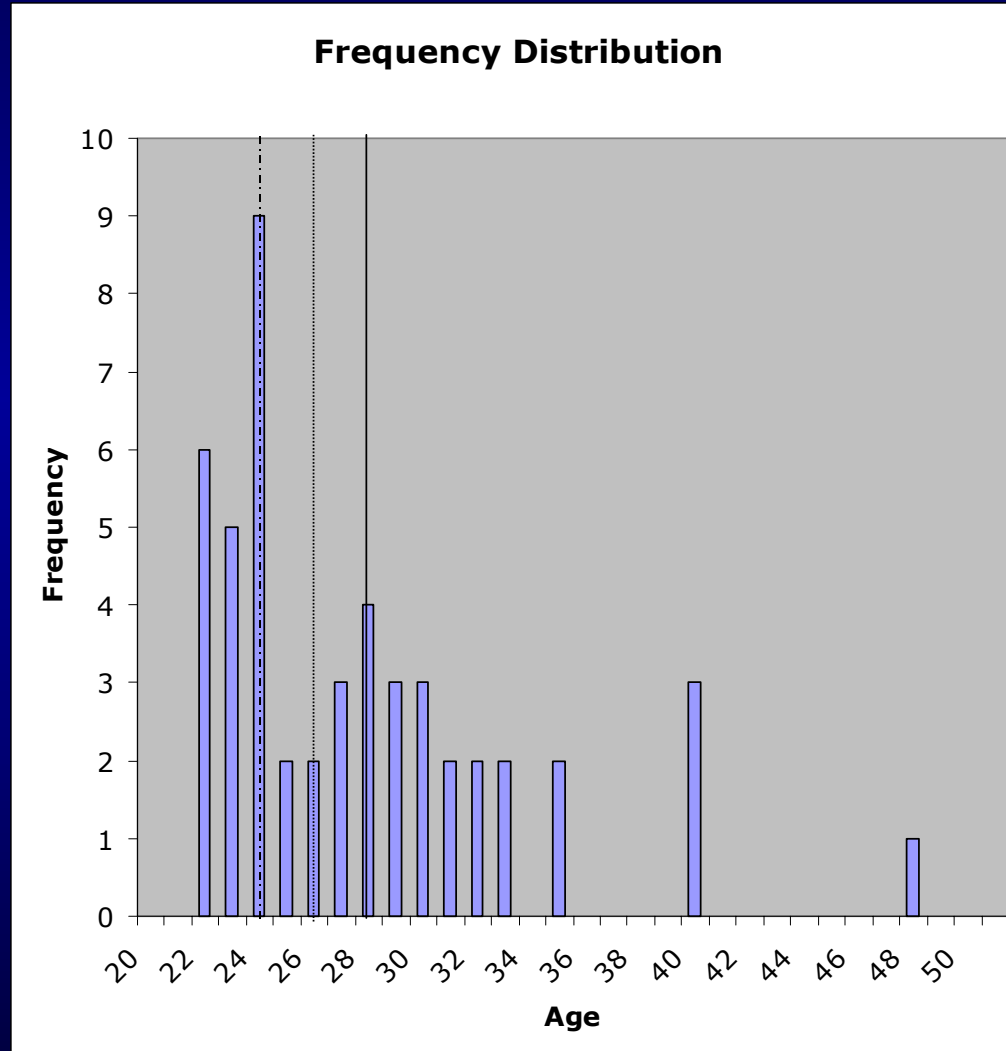


But what happens if we have an outlier (skewed distribution)?

Basic Math Review

c. Central Tendencies

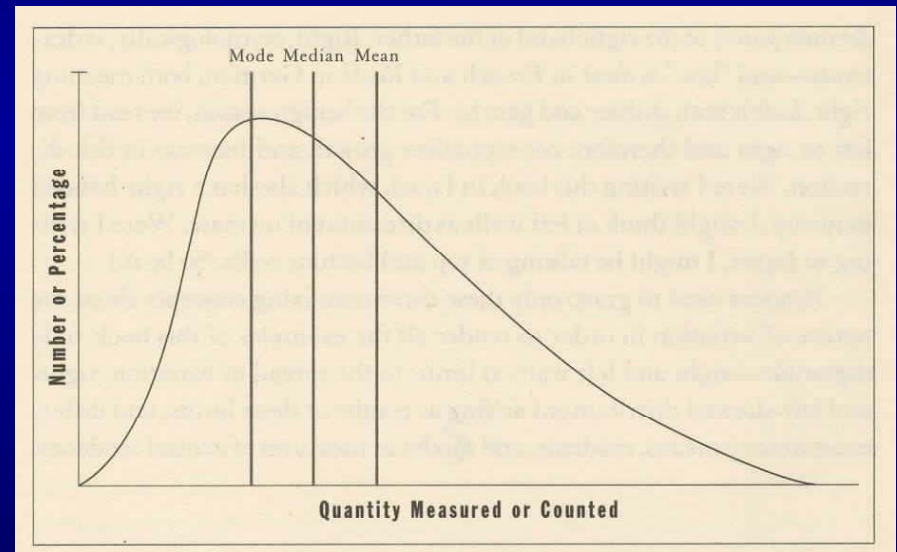
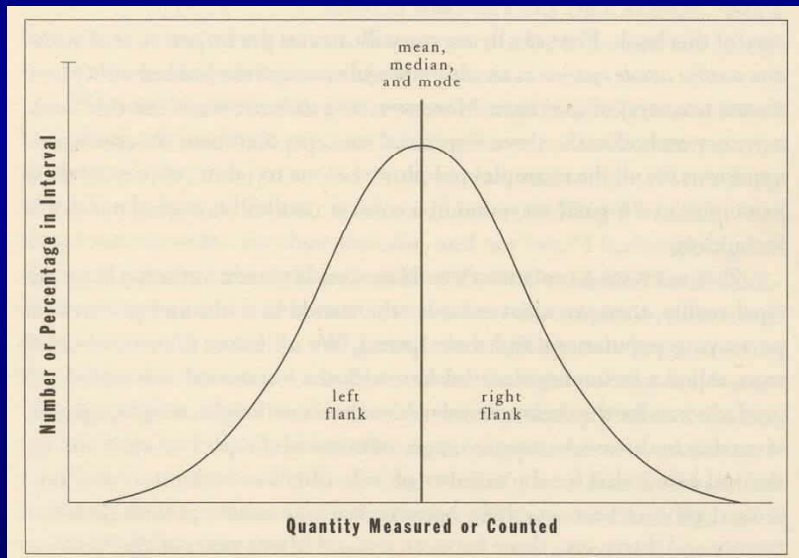
Let's assume we have a real student population ($n = 47$)



Basic Math Review

c. Central Tendencies

- Mean: arithmetic average
- Median: middle value of a set of values
- Mode: the data value that occurs most often



Thursday

- Environmental Chemistry I
- Math Review: Linear Algebra - Correlation/Regression Analysis
- Don't forget the website AND the math sheets!

<http://www.columbia.edu/~pl2065/courses/mpa.htm>