"I feel like I'm diagonally parked in a parallel universe"

Math Review

Friday June 13 2003

A) Introduction
   a. Symbols
   b. Operations
   c. Central Tendencies

B) Linear Algebra

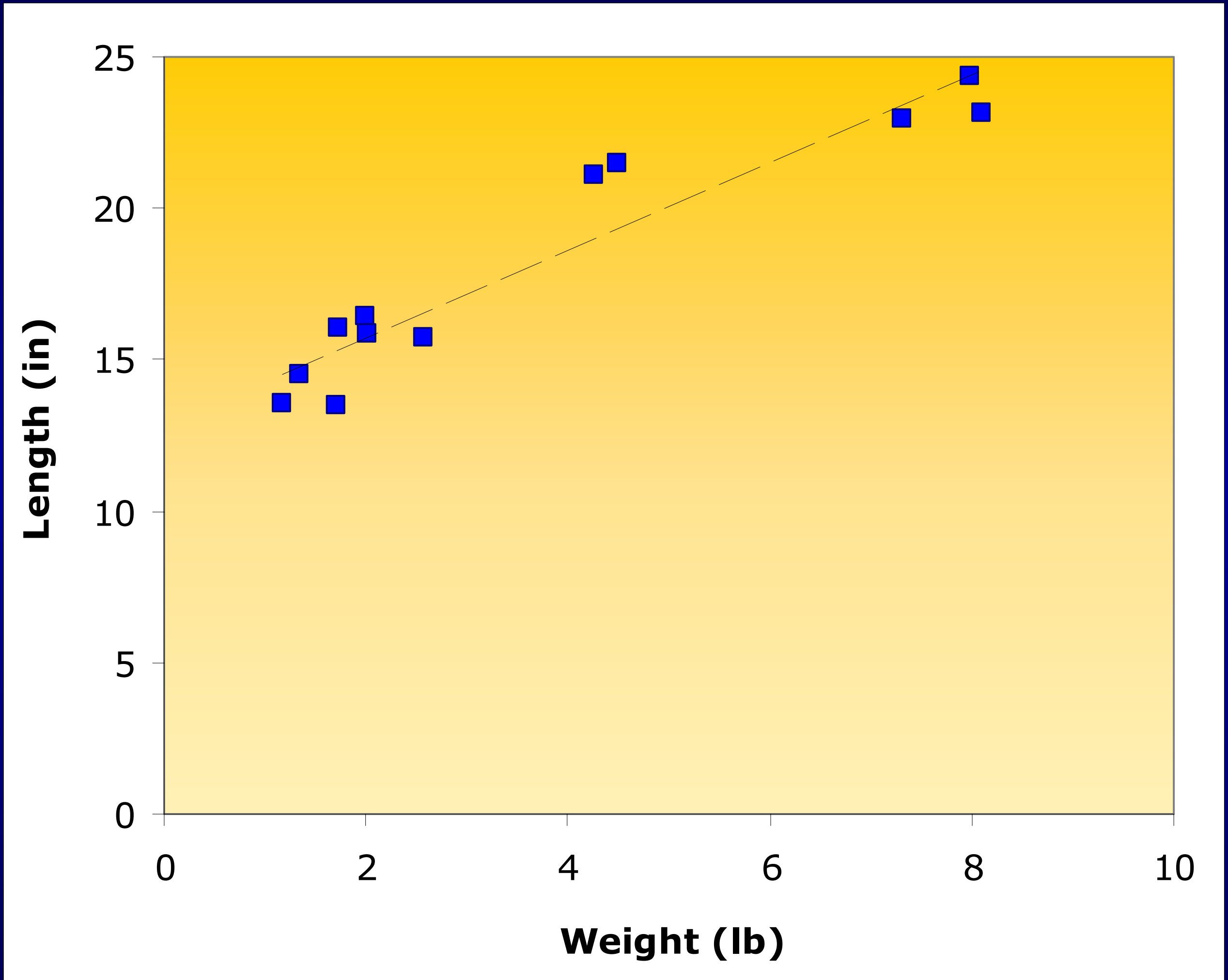
C) Correlation/Regression Analysis

D) Applied Calculus

Basic Math Review

B) Correlation: Fish Data

Weight (lb)	Length (in)
1.18	13.53
1.35	14.5
1.71	13.5
1.72	16.03
1.99	16.42
2.02	15.83
2.58	15.72
4.26	21.1
4.5	21.47
7.31	22.96
7.99	24.39
8.1	23.17

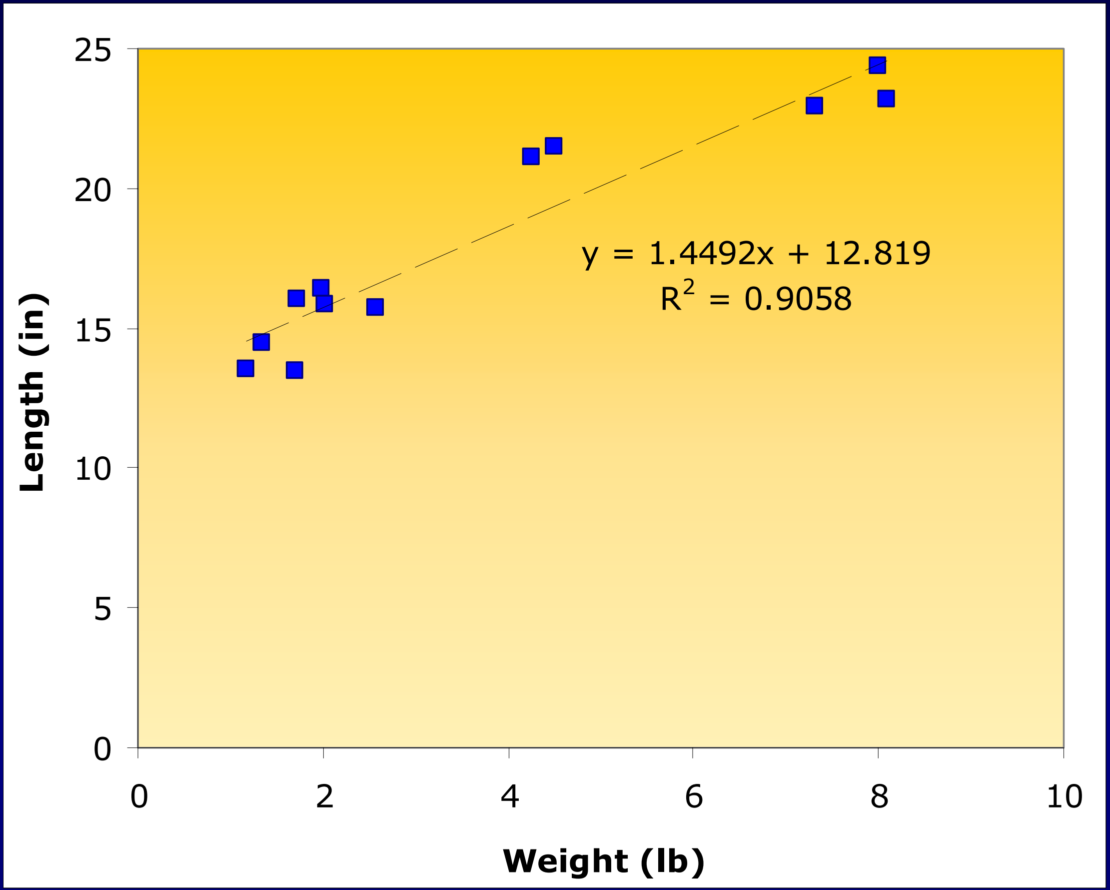


The correlation coefficient is positive

Basic Math Review

B) Correlation:

Weight (lb)	Length (in)
1.18	13.53
1.35	14.5
1.71	13.5
1.72	16.03
1.99	16.42
2.02	15.83
2.58	15.72
4.26	21.1
4.5	21.47
7.31	22.96
7.99	24.39
8.1	23.17



Here $r^2 = 0.91$

This statistic quantifies the proportion of the variance of one variable that is explained by the other - Functional?

Basic Math Review

B) Linear Algebra

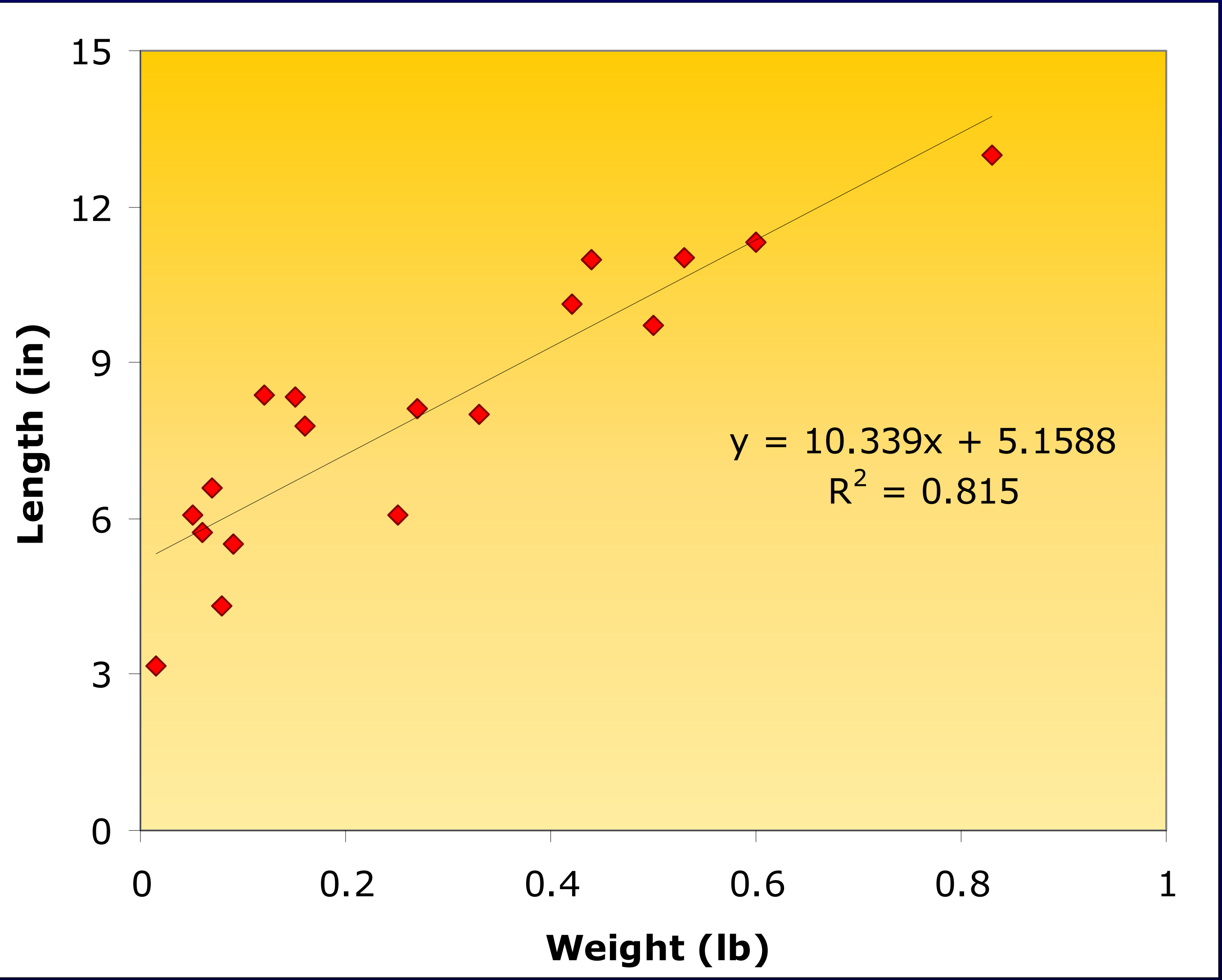
Forgot a section of the fish data set

Weight (lb)	Length (in)
0.015	3.16
0.05	6.07
0.06	5.72
0.07	6.57
0.08	4.32
0.09	5.52
0.12	8.39
0.15	8.32
0.16	7.79
0.25	6.05
0.27	8.11
0.33	8
0.42	10.13
0.44	10.97
0.5	9.72
0.53	11.02
0.6	11.33
0.83	13

Basic Math Review

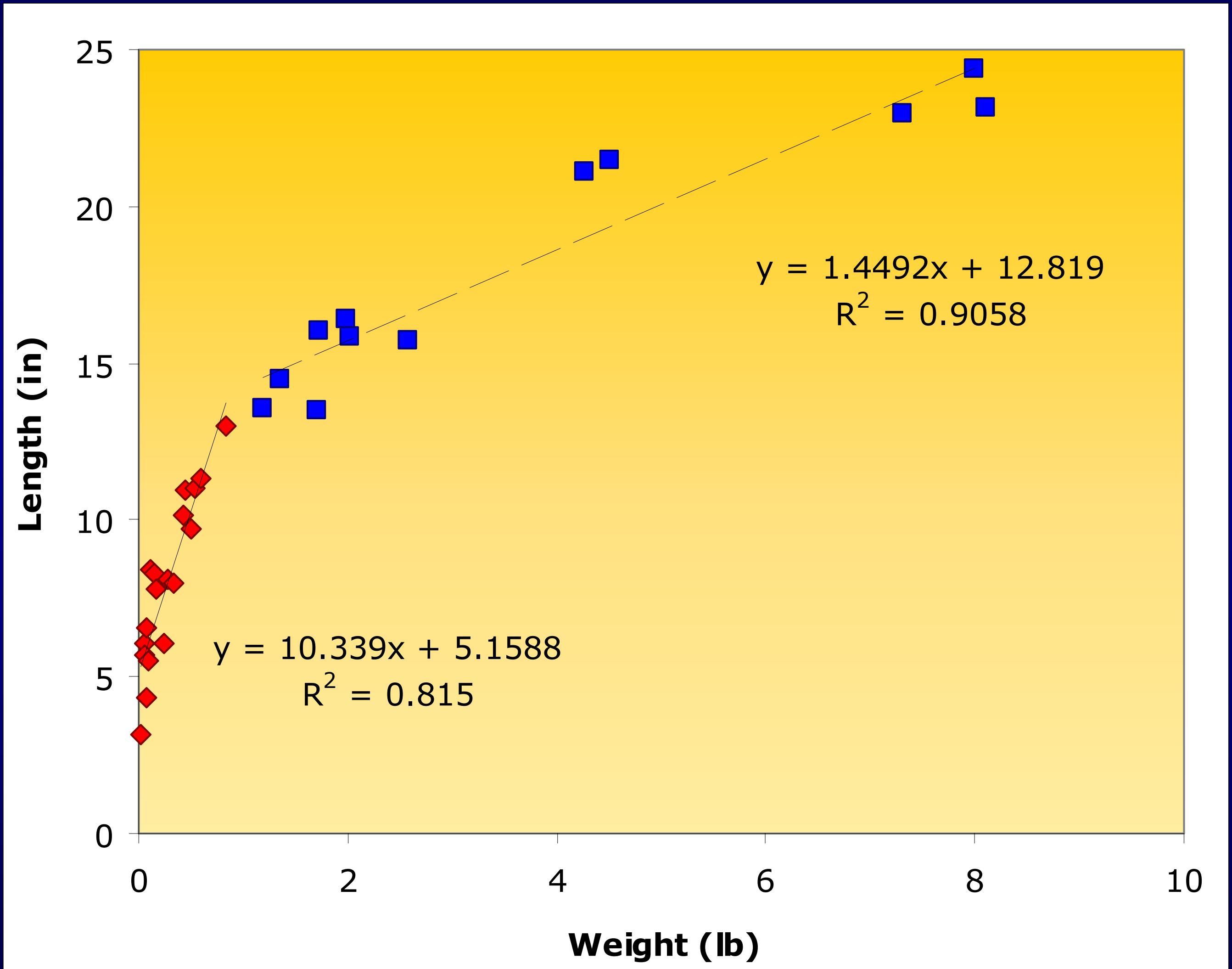
B) Correlation:

Here $r^2 = 0.82$



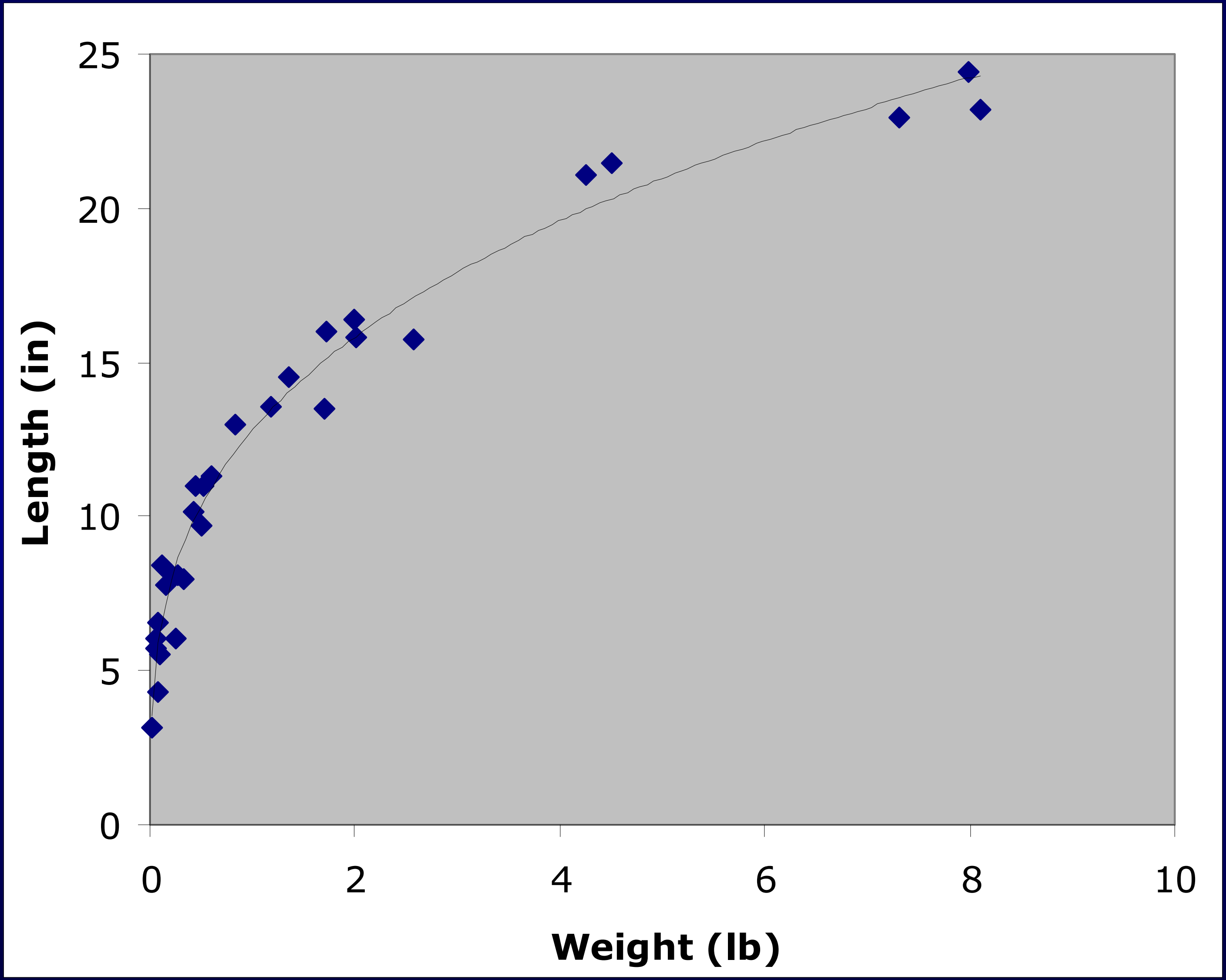
Basic Math Review

B) Correlation: Linear?



Basic Math Review

B) Non-linear relationship



Basic Math Review

B) Non-linear relationship

Let's make a statements about the relationship:

-) The weight is $\propto$ to the volume

$$W \propto V$$

Where:

$V = A \times L$

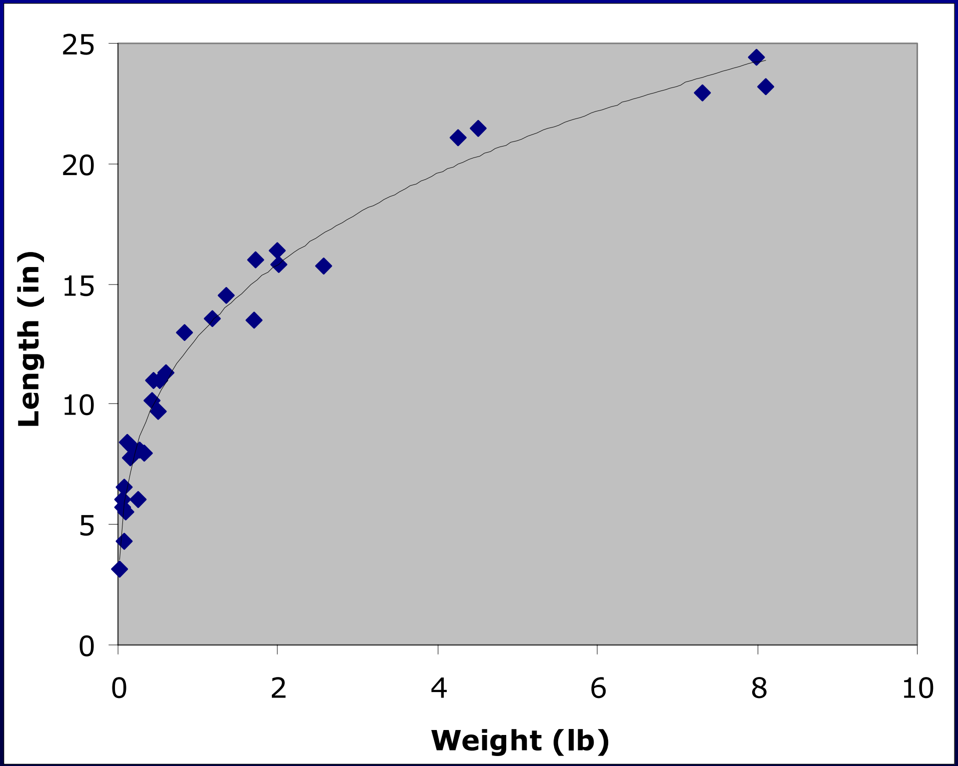
$A = \alpha \times L^2$

$V = \alpha \times L^3$

$W = \rho \times V$

Therefore

$W = \alpha \times \rho \times L^3$



Basic Math Review

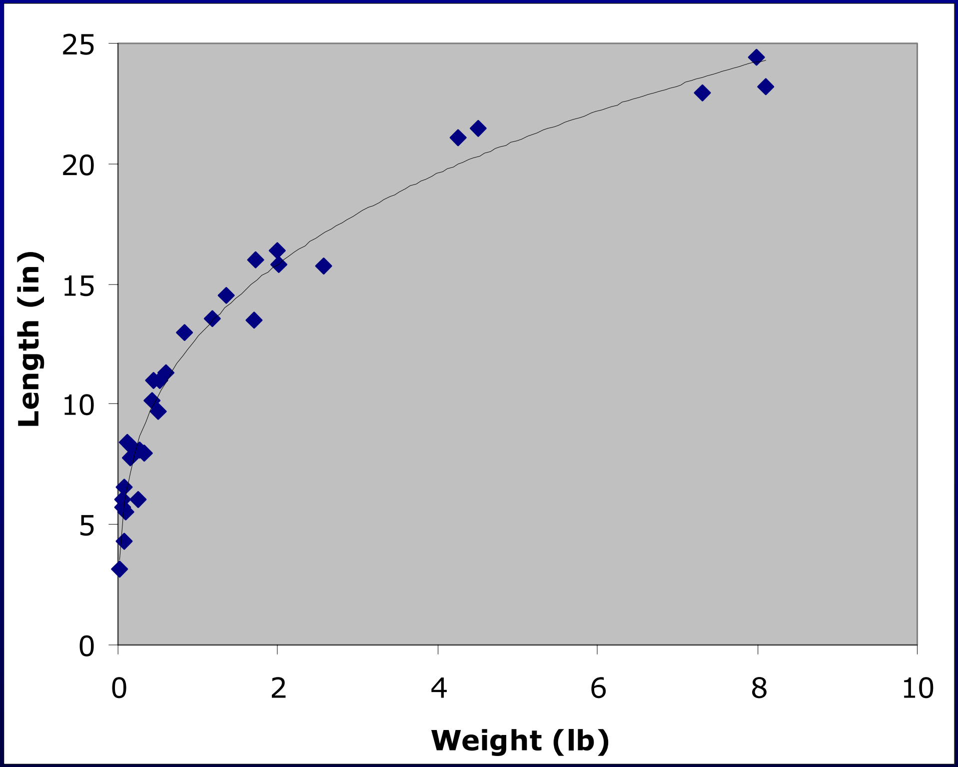
B) Non-linear relationship

$$W = \alpha \times \rho \times L^3$$

$$L^3 = W \times \frac{1}{\alpha\rho}$$

$$L = \sqrt[3]{W \times \frac{1}{\alpha\rho}}$$

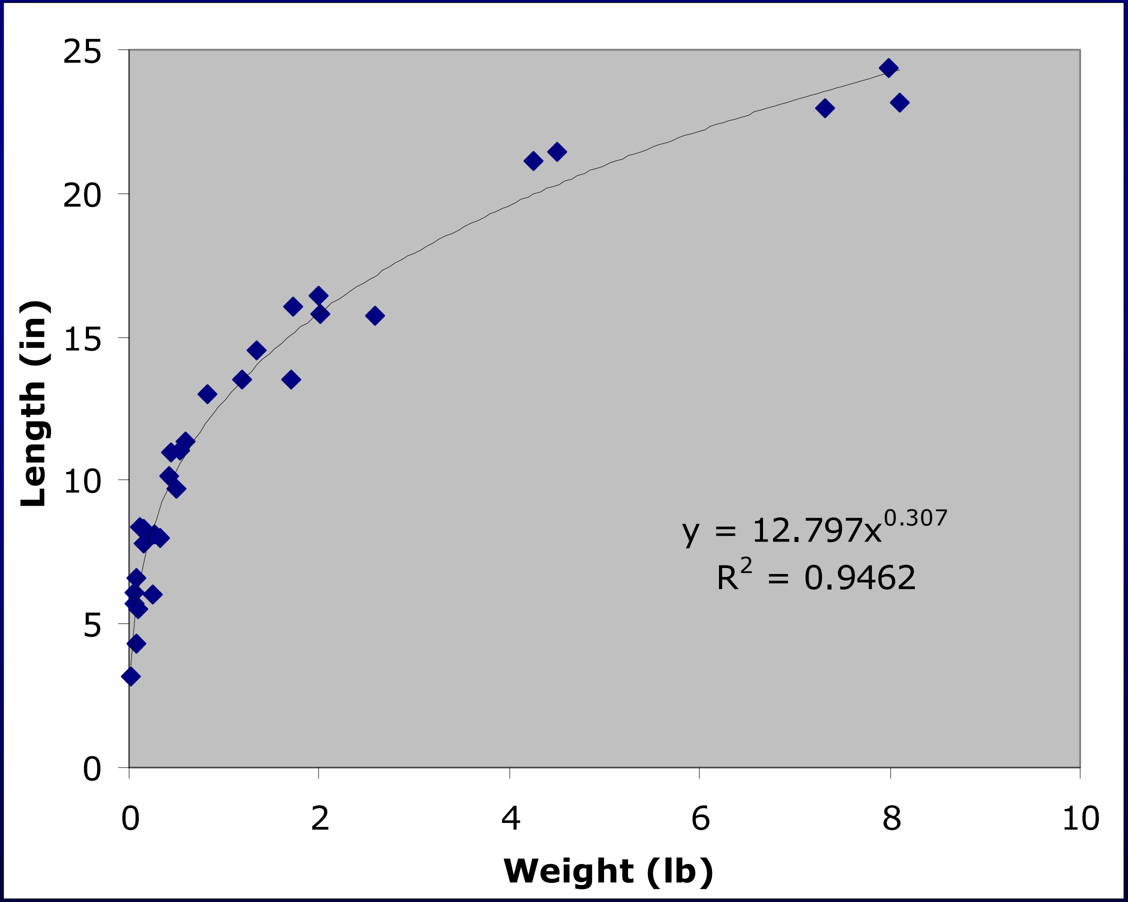
$$L = k\sqrt[3]{W} = kW^{\frac{1}{3}}$$



Basic Math Review

B) Non-linear relationship

$$L^3 = W \times \frac{1}{\alpha\rho} \rightarrow L = \sqrt[3]{W \times \frac{1}{\alpha\rho}} \rightarrow L = k\sqrt[3]{W} = kW^{\frac{1}{3}}$$

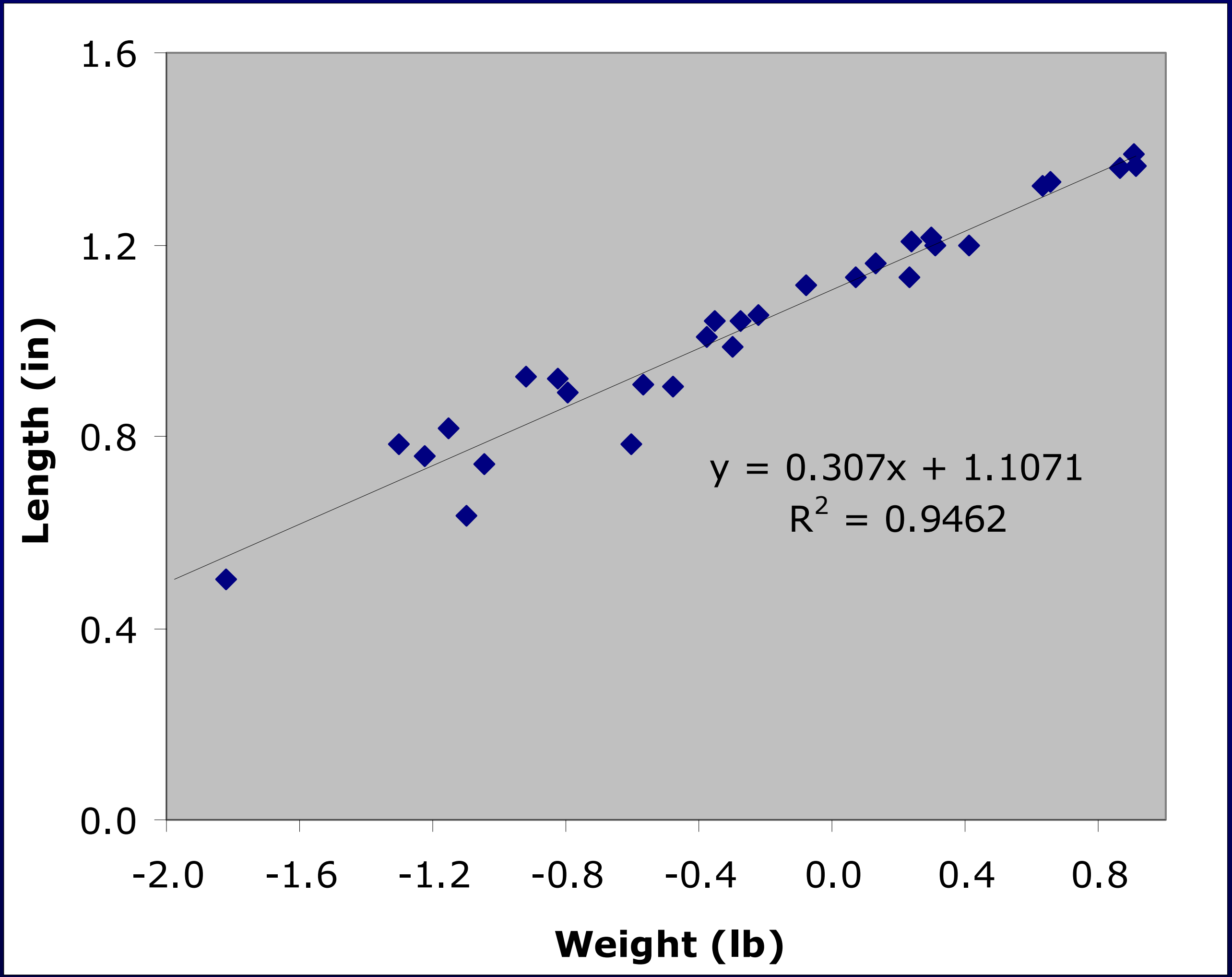


$$L = k\sqrt[3]{W} = kW^{\frac{1}{3}}$$

$$\text{Log } L = \text{Log }(k \times W^{1/3})$$

$$\text{Log } L = \text{Log } k + 1/3 \text{ Log } W$$

$$y = b + mx$$



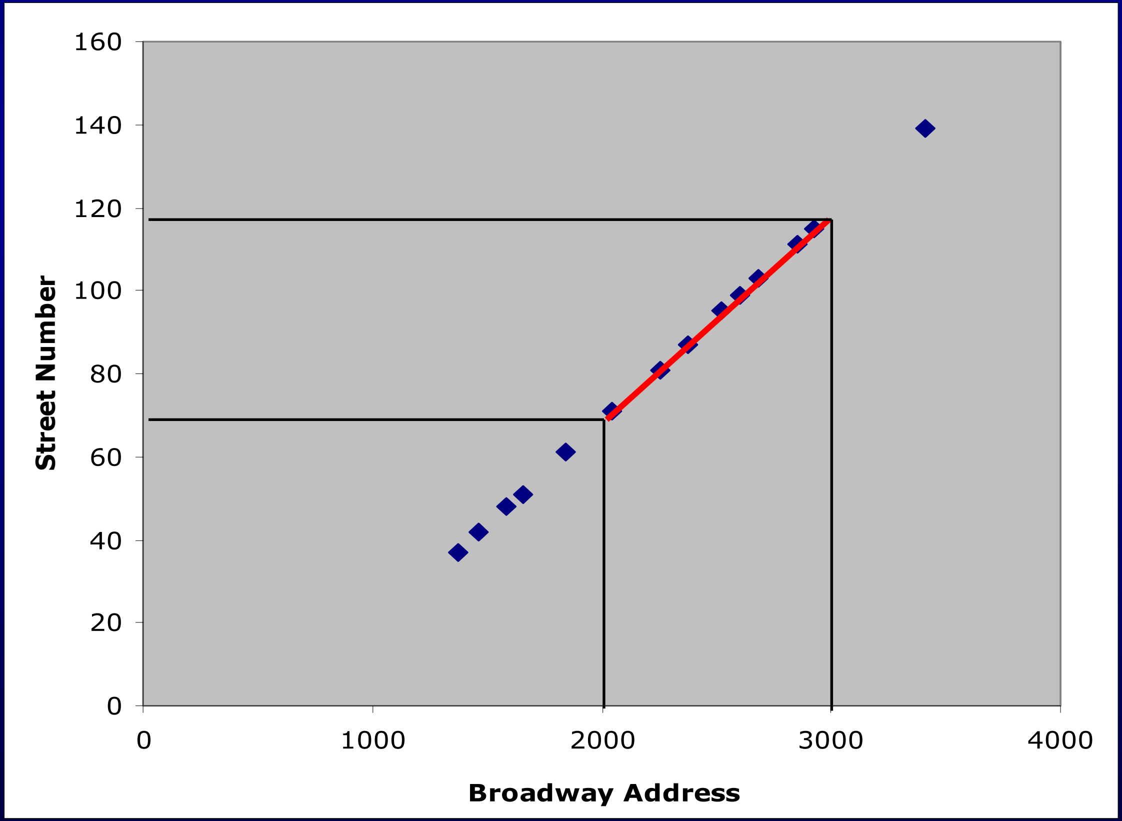
Basic Math Review

D) Applied Calculus

Rate of change (slope): $\Delta y/\Delta x$ or $(y_2-y_1)/(x_2-x_1)$

Here

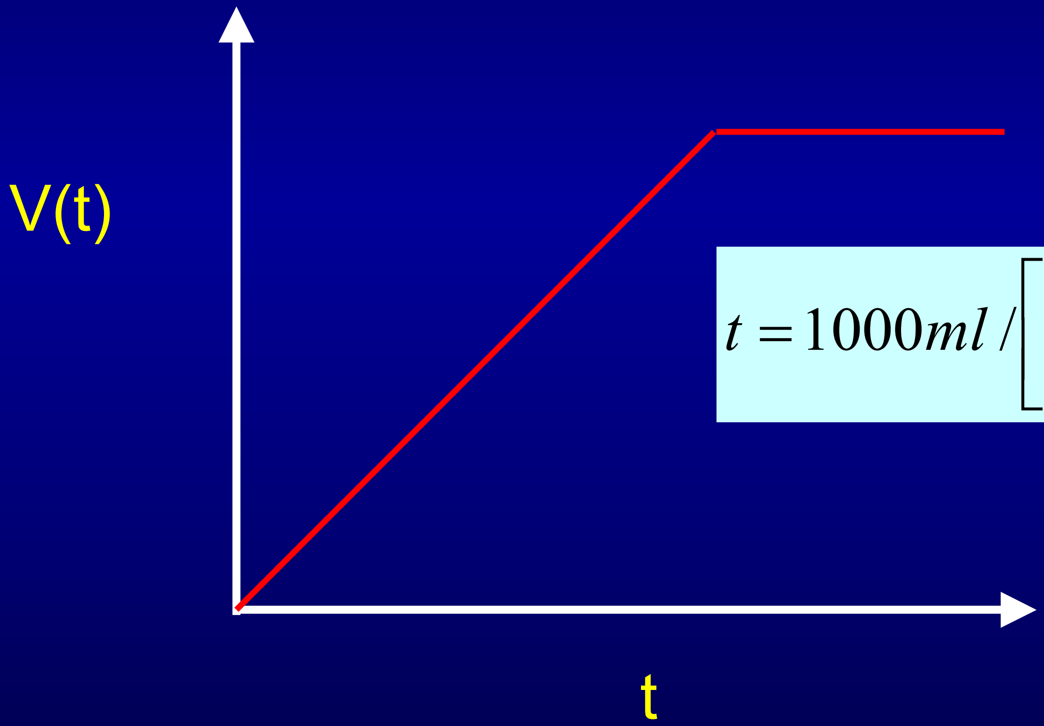
$\Delta y/\Delta x$ is constant regardless of the "limit"



Basic Math Review

D) Applied Calculus

How long does it take to fill one beaker (1L)?



$$t = 1000ml \,/ \left[\frac{dV}{dt} \right]$$

Basic Math Review

D) Differential equations

A differential equation is an equation in which one or more unknowns depend on its/their rate of change (or that of other variables included in the equations)

$$F = ma$$

where

$$a = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2}$$

Newton's principia

Basic Math Review

D) Definition of a derivative

$$f(x_0) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

The derivative of a function f(x) at a point a is the slope of the straight line tangent to f(x) at a → instantaneous rate of change!
One is pushing to limit to "0": the slope is close to real as d(x) approaches 0

Basic Math Review

D) Definition of a derivative

$$f(x_0) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

The derivative of a function f(x) = f′(x)

Important derivatives:

$f(x) = C$ → $f'(x) = 0$

$f(x) = x^n$ → $f'(x) = nx^{n-1}$

$f(x) = e^x$ → $f'(x) = e^x$

$f(x) = \ln x$ → $f'(x) = 1/x$

Basic Math Review

D) Maxima, Minima

One of the great applications of calculus (particularly in economics) is to determine the "maxima" and "minima" of functions.
The derivatives of the maxima and minima = 0

The function neither increase nor decreases!

$$f(x) = x^3 - 3x^2 - 24x + 5$$

$$f'(x) = 3x^2 - 6x - 24$$

$$3\ (x^2 - 2x - 8) = 3\ (x + 2)(x - 4)$$

$f'(x)$ vanishes (reaches a critical point) only when

$$f'(x) = 0$$

D) Maxima, Minima

$f''(x) < 0$ ➔ maximum

$f''(x) > 0$ ➔ minimum