

fear NO Lab Math



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Math trouble? Who ya gonna call?



Topics

*I have hardly ever known
a mathematician who was
capable of reasoning.*

- Plato

- Math Myths
- So... Do U Sudoku?
- Allergic to Algebra
- $C1V1 \neq R2D2$
- What did you Geomean by that?
- The Nerds Factor
- Prozac for Linear Depression
 - Surviving the Slippery Slope
 - Not Another Intercept (ion)
 - What's this about the "X-intercept"?
 - Relating to Correlation
- So... Deviation that is Standard is a Good Thing?
- 8.34 is a Magic Number
- Magical Math is not a Criss Angel Stunt

Dispelling Math Myths

- **Myth #1 It takes a math mind to be good at math.**
Math must be nurtured with a supportive learning environment that promotes risk taking and creativity, one that focuses on problem solving.
- **Myth #2 There is one way to solve a problem.**
There are a variety of ways to solve math problems and a variety of tools to assist with the process.
- **Myth #3 Math requires pure logic.**
Sure, logic helps....but you need not be a 'Mr. Spock'.
Creative thinking helps frame concepts such that you 'see' things according to your particular learning style.
- **Myth #4 It's all about getting the right answer.**
The most important aspect to learning math is understanding. Always ask yourself if you really 'understand' how and why the procedure works.



So...Do U SUDOKU???



		5	3		6	9	7	1
1	4	7	2	5	9		8	
3		6		8		4		5
4	3	9	6	2		5	1	
6	8		4		5	7	9	3
		1	8	9			6	
	6		1	3	2		5	7
		8			4	6	3	2
2	7	3	5		8	1		

Looks so daunting!

Columns and rows must each have only 1 incidence of a value.

In addition each of 9 3x3 blocks can only have 1 incidence of a number



So...Do U SUDOKU???



		5	3		6	9	7	1
1	4	7	2	5	9		8	
3		6	7 9	8		4		5
4	3	9	6	2		5	1	
6	8		4		5	7	9	3
		1	8	9			6	
	6		1	3	2		5	7
5		8	7 9		4	6	3	2
2	7	3	5		8	1		

Missing from this vertical are numbers 7, and 9

The cell in the 3x3 block can't be 9 because then there'd be two 9s in the 3x3

...which means the 7 goes there and the 9 below





So...Do U SUDOKU???



		5	3	6	9	7	1	
1	4	7	2	5	9		8	
3		6	7	8		4		5
4	3	9	6	2		5	1	
6	8		4		5	7	9	3
		1	8	9			6	
	6		1	3	2		5	7
5		8	9	67	4	6	3	2
2	7	3	5	67	8	1	49	49

Now we have only 2 open spots in the bottom center 3x3

Both can only be a 6 or 7, but since there's already a 7 in the bottom row and a 6 in the one above ...

Now we know that the last 2 boxes in the bottom row can only be 4 or 9



So...Do U SUDOKU???



A	B	C	D	E			
		5	3	6	9	7	1
1	4	7	2	5	9	8	
3		6	7	8	4	2 4	5
4	3	9	6	2	5	1	
6	8		4	5	7	9	3
		1	8	9		6	
	6		1	3	2	5	7
5		8	9	7	4	6	3
2	7	3	5	6	8	1	4 2 9

Now on the vertical we can only fill the 2 slots with a 2 or 4.

Because there's already a 4 in the 3rd row, our empty slot must be a 2
And the bottom cell becomes a 4.

Which forces the final cell in the bottom row to be 9





So...Do U SUDOKU???

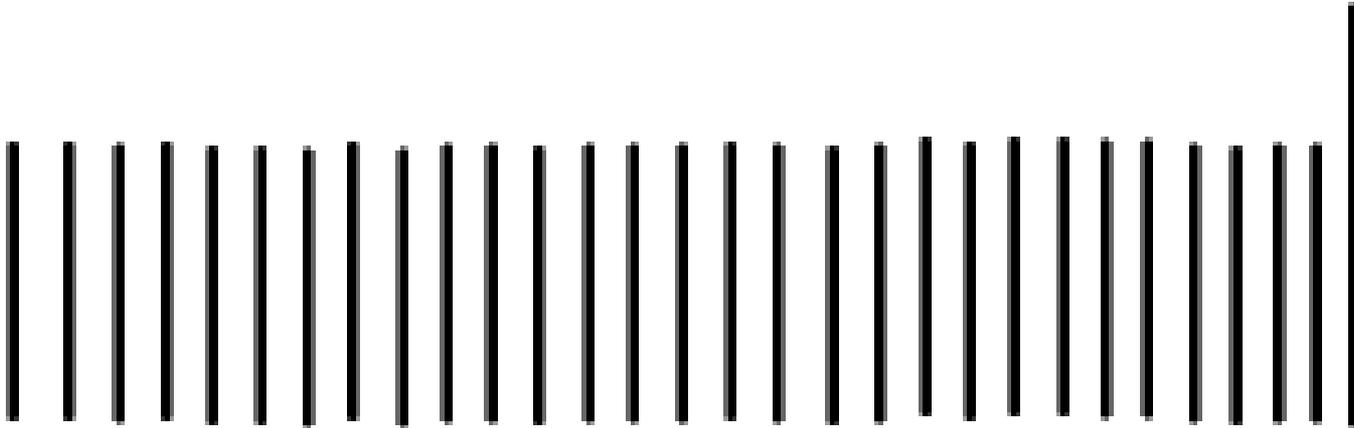
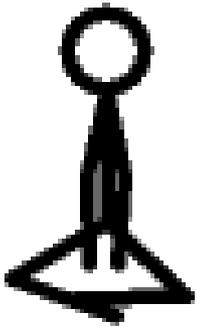


A B C D E

		5	3		6	9	7	1
1	4	7	2	5	9		8	
3		6	7	8		4	2	5
4	3	9	6	2		5	1	
6	8		4		5	7	9	3
		1	8	9			6	
	6		1	3	2	8	5	7
5		8	9	7	4	6	3	2
2	7	3	5	6	8	1	4	9

That enables us to complete the lower right 3x3 with an 8.





2

1

3

5

0

8

1

4

9

Allergic to Algebra

- Linear regression equations are in the form $Y = mX + b$
- m = slope; b = intercept
- Since X = concentration, and Y = absorbance.....
- This solves for absorbance...which we already KNOW
- Therefore we have to “re-arrange” the equation....

We have to get from this:

Absorbance = *slope* x **Concentration** + *intercept*

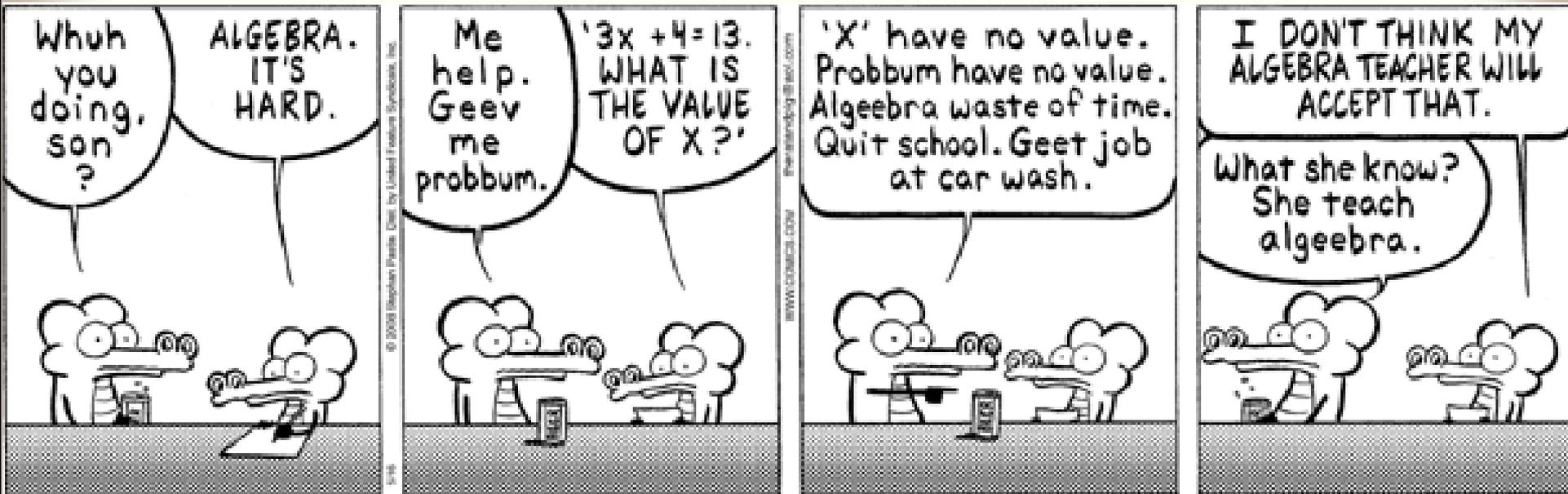
To this (by using simple algebra):

Absorbance - *intercept* = **Concentration**
slope

Allergic to Algebra?



$$Y = mX + b?? \quad \text{or} \quad X = \frac{Y - b}{m}$$



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Stand firm in your refusal to remain conscious during algebra. In real life, I assure you, there is no such thing as algebra.

- Fran Lebowitz

Allergic to Algebra

2

Order of Operations:

In order to simplify a mathematical expression:

1. Calculate any values inside all grouping symbols; i.e. (), [], or { } such as { [()] }
2. Simplify any terms with exponents (*rare*)
3. Multiply and/or divide in order from left to right
4. Add and/or subtract in order from left to right

■ Parentheses
■ Exponents
■ Multiplication
■ Division
▲ Addition
■ Subtraction

The following mnemonic saying will help to remember the order of the 'Order of Operations' :

Please Excuse My Dear Aunt Sally

Johnny Mnemonic

- A mnemonic is a memory aid. For example the name **Roy G. Biv** is a mnemonic for remembering the order of the colors in a rainbow.

**Red Orange Yellow Green Blue
Indigo Violet.**



Run Over Your Gerbil Because It's Vicious!!!

Johnny Mnemonic

2

Please Excuse My Dear Aunt Sally reminds us that solving math is not like simple reading from right to left.

;

;







Allergic to Algebra

3

Simplifying Equations begins with Canceling Values/Variables

To Cancel, Do the Opposite

For example, the opposite of "adding 3" is "subtracting 3". In Algebra, every operation is paired with its "opposite":

- Cancel Addition with Subtraction,
- Cancel Multiplication with Division,
- Cancel Powers with Roots, and
- Cancel Reciprocals with Reciprocals.

When trying to simplify an equation, we *really* only have two options:

- substitute an equal expression for part of an equation (which includes "simplifying" part of an equation), or
- **do the same thing to both sides.**

Allergic to Algebra

4

Example: You strike it big at the casino and win a jackpot of \$5250.00. You owe \$1500.00 on your Best Buy card with a 22.99% interest rate. Your other 5 credit cards all have similar balances but all have interest rates of 9.99%. So you want to pay off the one high interest card and make equal payments on the other 5 cards. How much of a payment will you make on each of the 5 cards.

- **Step 1:** Write a statement (equation) that involves what is known and not known:

$$\text{Jackpot} = \text{Best Buy balance} + 5 \text{ equal payments}$$

- **Step 2:** Substitute values for as much as you can:

$$\$ 5250 = \$1500 \text{ to Best Buy} + 5 \text{ equal payments}$$

- **Step 3:** Treat both sides of the equation equally — subtract \$1500 from both sides:

$$\begin{aligned} \$ 5250 (-\$1500) &= \$1500 (-\$1500) + 5 \text{ equal payments} \\ &= \$ 3750 = 5 \text{ equal payments} \end{aligned}$$

- **Step 4:** Treat both sides of the equation equally — divide both sides by 5:

$$\begin{aligned} \frac{\$ 3750}{5} &= \frac{5}{5} \text{ equal payments} \\ &= \$ 750 = 1 \text{ equal payment} \end{aligned}$$

$Y = mX + b??$ or $X = (Y - b) / m$



This solves for absorbance (response) which we already know.

What we DON'T know, is the concentration of X.

Subtracting 'b' from both sides removes 'b' from the right side of the equation.

Dividing both sides by 'm' removes 'm' from the right side of the equation.

...and that is why you'll hear an auditor use this equation. As long as X is concentration and Y is response, then this is the equation that must be used to determine sample concentration.

$$X = \frac{Y - b}{m}$$



$$C_1 V_1 \neq R_2 D_2$$



$$C_1 V_1 = C_2 V_2$$

(Concentration of existing solution)

x

(Volume of existing solution)

=

(desired concentration of new solution)

x

(desired volume of new solution)



$$C_1V_1 \neq R_2D_2$$



Basic Rules for Solving $C_1V_1 = C_2V_2$ Problems.

- (1) 3 of the 4 values must be known.
- (2) The units of volume and concentration must be the same respectively.
- (3) Either C_1V_1 or C_2V_2 must be known and it must be clear which is which.
- (4) Any unit of volume or concentration may be used

Mathematics is the science which uses easy words for hard ideas.

--Kasner, E. and Newman, J

Tricks to $C_1V_1=C_2V_2$



NOW, SERIOUSLY

WTF is that??

$$C_1 V_1 \neq C_2 V_2$$



You have a 50 mg/L Phosphorus stock standard.
You want to make a 'working' solution of 2 mg/L
from which to prepare calibration standards. You
want to make 100 mLs of this 'working' standard.

$$C_1 = 50 \text{ mg/L}$$

$$C_2 = 2 \text{ mg/L}$$

$$V_1 = ? \text{ mL}$$

$$V_2 = 100 \text{ mL}$$

$C_1 > C_2$...so 50 mg/L must be C_1 ; so $C_2 = 2$; $V_2 = 100$

$$(50 \times V_1) = (2 \times 100)$$

$$(50 \times V_1) = 200 \quad \text{Divide both sides by 50!!!}$$

$$V_1 = 200 \div 50$$

$$V_1 = 4 \text{ mL}$$

C1V1 problem

YOUR turn!

- Joe Consistent-Analyst wants to make a spike for Test N Tube Phosphorus.
- The Test n Tube Volume is 5 mLs total (spike + sample)
- He wants the spike concentration to be 0.5 mg/L
- ...and he wants to use 0.1 mL of spike
- What concentration spike solution must he use?

What did you geomean by that?

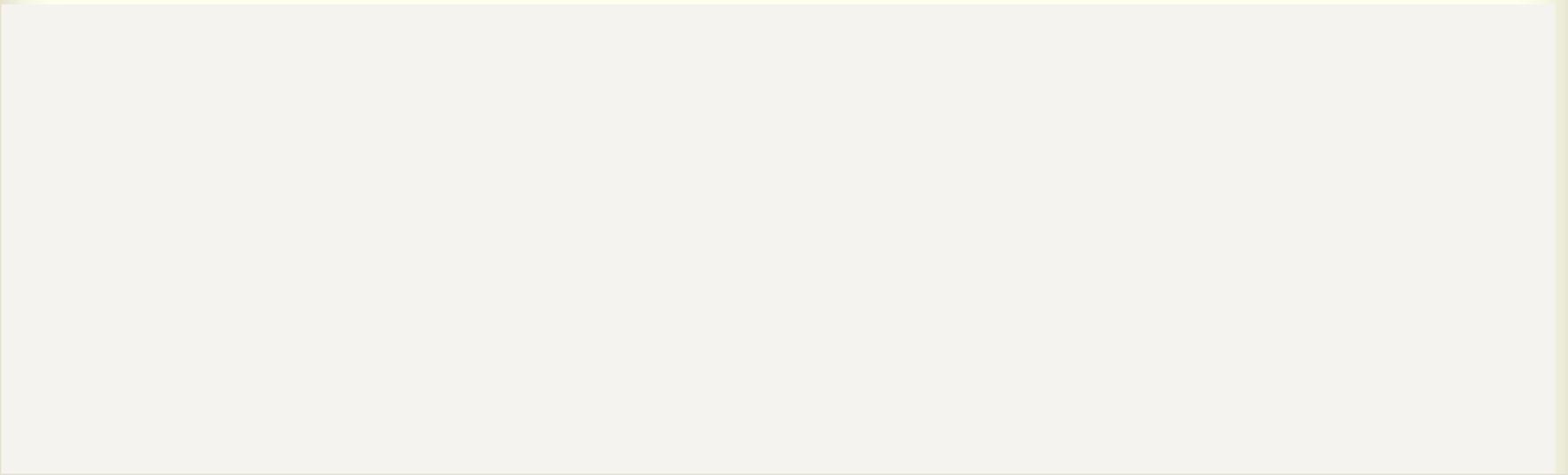
- The geometric mean answers the question, "if all the quantities had the same value, what would that value have to be in order to achieve the same product?"

$$A * B * C... * Zn = \text{Product} = X * X * X... * Xn$$

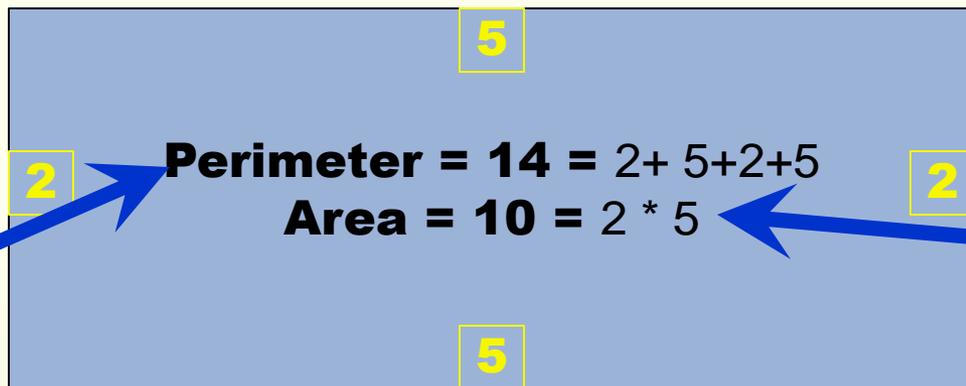
- Any time **you have a number of factors contributing to a product**, and you want to find the "average" factor, the answer is the geometric mean.
- The geometric mean is always less than the arithmetic mean.
(*equal to the arithmetic mean when all individual values are the same*)
(10,10,10,10) Arithmetic mean = 10 = Geomean
- The geometric mean is similar to the arithmetic mean, which is what most people think of with the word "average," except that instead of adding the set of numbers and then dividing the sum by the count of numbers in the set, n, the numbers are multiplied and then the nth root of the resulting product is taken.



Geomean vs. arithmetic mean

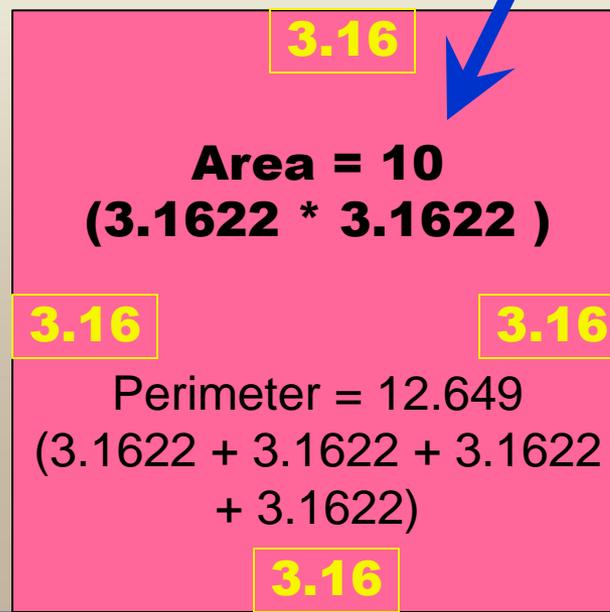
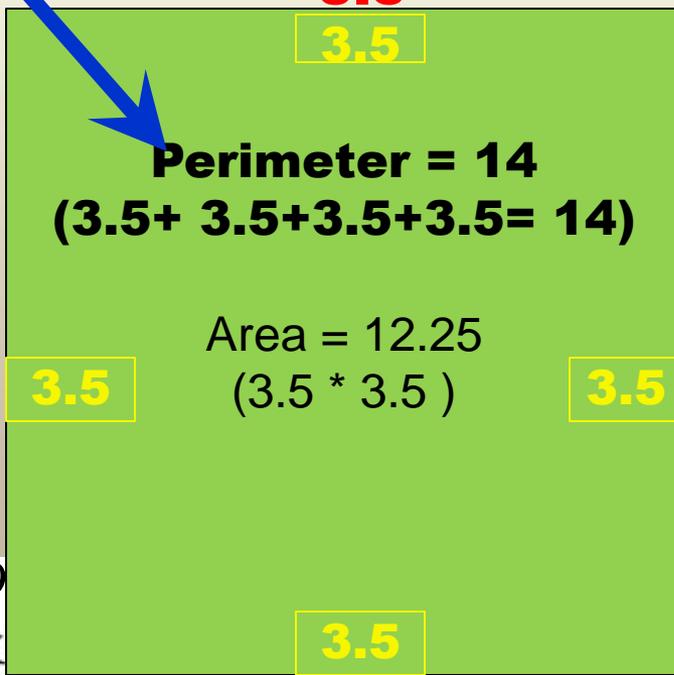


What are the geomean and arithmetic mean of the numbers 2,5?



Arithmetic Mean = 3.5

Geometric "Geo"Mean = 3.1622



Geomean simplified

The geometric mean of a data set $[a_1, a_2, \dots, a_n]$ is given by

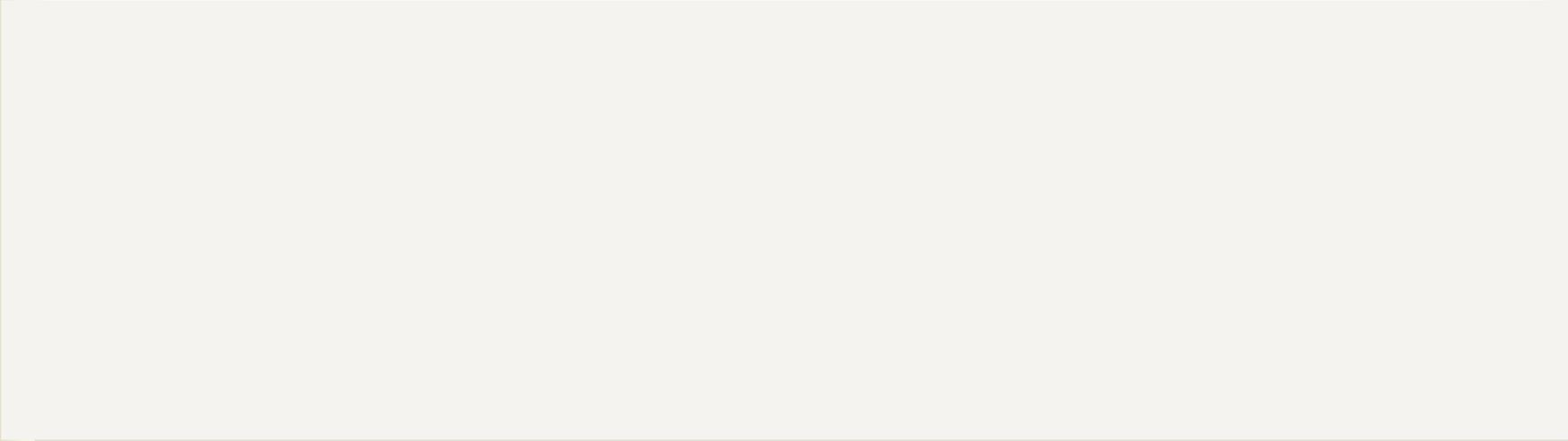
$$= \sqrt[n]{a_1 \cdot a_2 \cdot \dots \cdot a_n}$$

- ..or the n^{th} root of each of the values in the data set multiplied together.
- If roots scare you off, “powers” can be used:
- Geomean = $(a_1 \cdot a_2 \cdot a_3 \dots \cdot a_n)^{1/n}$

Fishing may be said to be so like mathematics that it can never be fully learned.

- Walton, Izaak

Getting square on roots



What did you geomean by that?

Using Excel to find the geomean of fecal coliform data:
10, 20, 18, and 50 cfu/100 mL

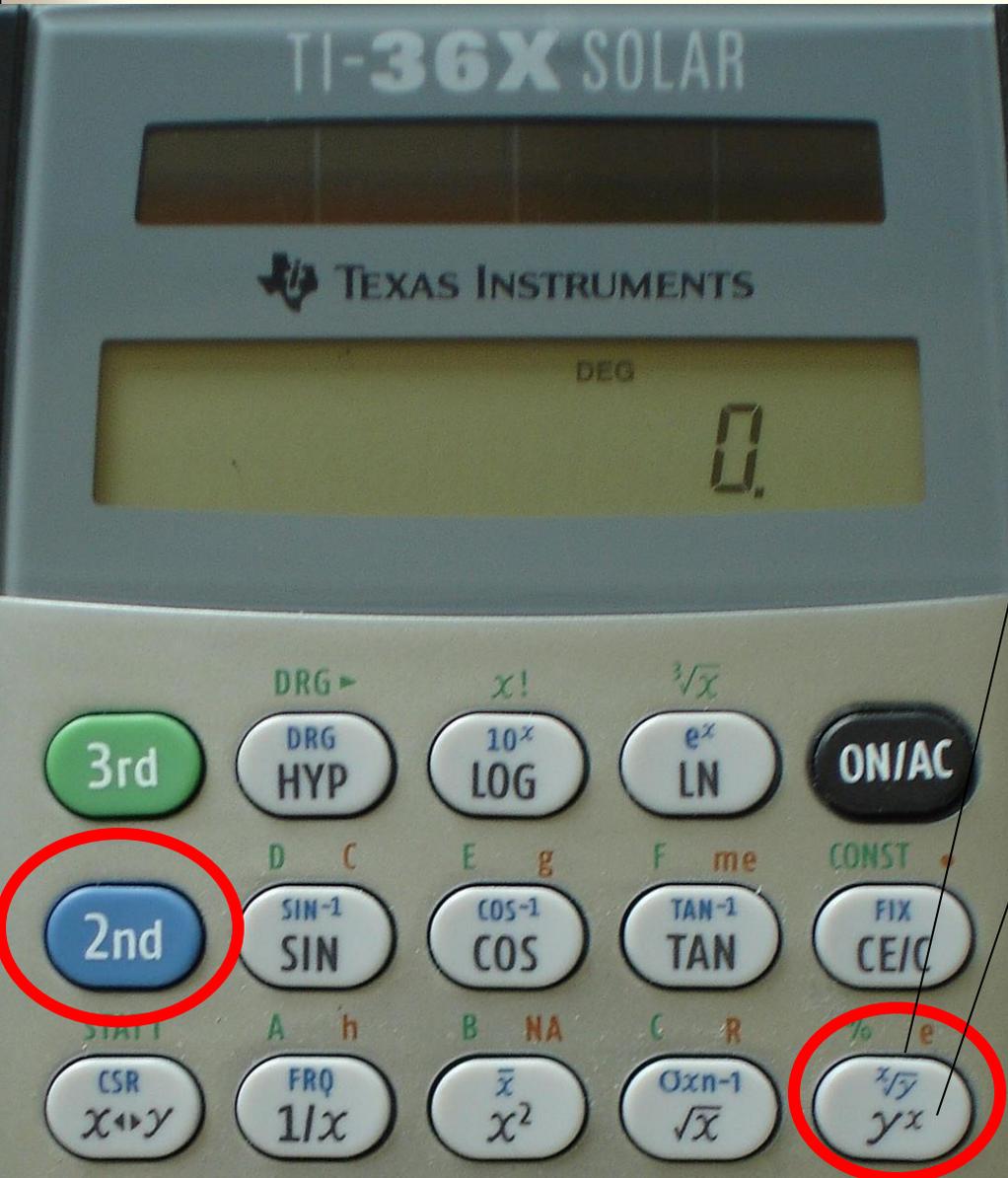
	A	B	C
27			
28		10	cfu/100 mL
29		20	cfu/100 mL
30		18	cfu/100 mL
31		50	cfu/100 mL
32			
33	mean	24.5	=AVERAGE(B28:B31)
34	geomean	20.598	=GEOMEAN(B28:B31)
35			
36		20.598	=180000^0.25

$$10 \otimes 20 \otimes 18 \otimes 50 = 180000$$

$$\begin{aligned} \sqrt[4]{180000} &\equiv 180000^{1/4} \\ &= 180000^{0.25} = 20.598 \end{aligned}$$

What did you geomean by that?

GeoMean on an inexpensive calculator

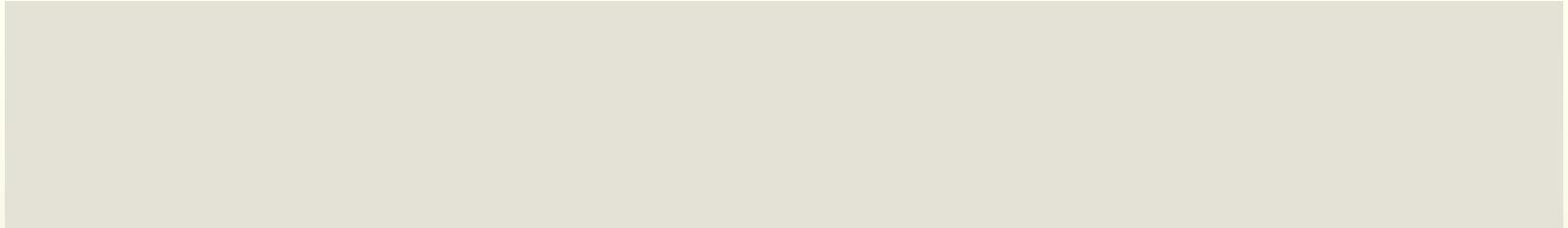


The x/\bar{y} key allow you to calculate any geomean. Just multiply the values together, press this key (+ 2nd) and then enter the number of values.

The y^x key also allows you to calculate any geomean. Just multiply the values together, press this key (+ 2nd) and then enter the decimal equal to $1 \div$ the number of values.

What did you geomean by that?

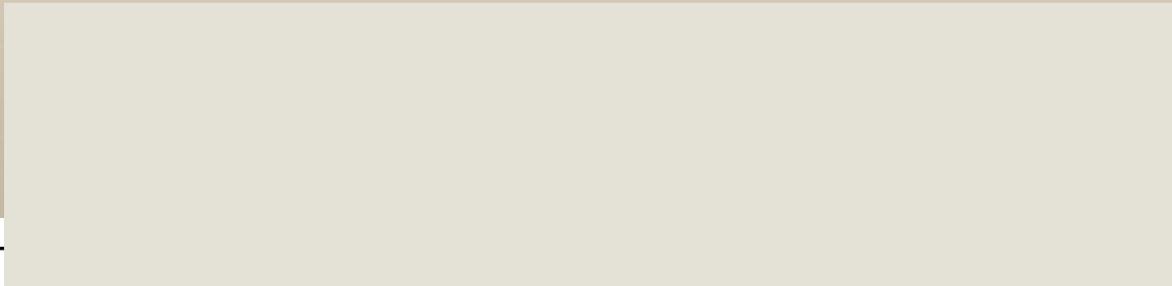
GeoMean on an inexpensive calculator



Or...



=



Geomean is used in finance

Geomean is used to determine the average return on investments over a period of years.

start with	return	\$10,000.00	return	10,000.00
2004	5%	\$10,500.00	-2.63%	\$ 9,737.48
2005	17%	\$12,285.00	-2.63%	\$ 9,481.85
2006	7%	\$13,144.95	-2.63%	\$ 9,232.93
2007	11%	\$14,590.89	-2.63%	\$ 8,990.55
2008	-40%	\$ 8,754.54	-2.63%	\$ 8,754.53
	0% mean			

geomean = -2.63%

Geomean is a little more realistic in saying the investment averaged a loss. But that's little comfort after losing \$2250 on the initial investment and almost \$6,000 in one year

On-line Geomean Calculator

Geometric Mean Calculator Results

Number of points	4	Arithmetic mean	24.50	Graphs are currently not available.
Geometric mean	20.60	Maximum value	50.00	
Standard deviation	17.54	Sum of points	98.00	
Minimum value	10.00	Equation is	$y=11.80x + -5.00$	

Horton's Geometric Mean Calculator



[Revised 03/21/2007](#)

Enter 2 to 100 values. Do not leave blanks between values.

[NEED HELP?](#)

POINT 1:	<input type="text" value="10"/>	POINT 2:	<input type="text" value="20"/>	POINT 3:	<input type="text" value="18"/>	POINT 4:	<input type="text" value="50"/>
POINT 5:	<input type="text"/>	POINT 6:	<input type="text"/>	POINT 7:	<input type="text"/>	POINT 8:	<input type="text"/>

<http://www.graftacs.com/geomean.php3>

More On-line Geomean help

Math. Fast.
instacalc

<http://instacalc.com/v0.5/>

Instant results.
Variables and formulas.
Shareable. Linkable. Lovable.

Examples: BMI Hourly Wage Temperature Met
Dice Website earnings

[Overview](#) | [Quickstart](#) | [Reference](#) | [About](#)

1 POW(180000,0.25)

20.597671439071177



Easy Calculation.com

Geometric Mean - Calculator

To Calculate Geometric Mean :

www.easycalculation.com/statistics/geometric-mean.php

Enter all the numbers separated by comma ",".
E.g: 13,23,12,44,55

10,20,18,50

calculate

Results:

Total Numbers:

4

Geometric Mean:

20.59767

Geomean problem

YOUR turn!

- An operator has 4 fecal coliform results for the month of June. Calculate the geomean that s/he should report.
- Results= 16, 81, 1, 16

$2^4 =$	16	$\sqrt[4]{16} =$	2.0
$3^4 =$	81	$\sqrt[4]{81} =$	3.0
$1^4 =$	1	$\sqrt[4]{1} =$	1.0
$2^4 =$	16	$\sqrt[4]{16} =$	2.0
Mean=	28.5		
Geomean=	12.000		
$16 * 81 * 1 * 16 =$		$\frac{20736}{20736}$	
		$\sqrt[4]{20736} =$	12.000
$2 * 3 * 1 * 2 =$		12	

The 'Nerds' Factor

- The Nernst factor, $2.3 RT/nF$, includes
 - *the Gas Law constant (R),*
 - *Faraday's constant (F),*
 - *the temperature in degrees Kelvin (T) and the*
 - *charge of the ion (n).*
- For pH, (and NH₃), $n = 1 \therefore$ the Nernst factor is $2.3 RT/F$.
- Since R and F are constants, the factor and therefore electrode behavior is **dependent only on temperature**.
- The electrode slope is a measure of the electrode response to the ion being detected and is equivalent to the Nernst factor.
- When the temperature is equal to 25 °C, the Nernst factor or slope is 59.16 mV/pH unit.
- Older Orion pH meters displayed the slope as a percentage of the theoretical value. For example, a 98.5% slope is equivalent to a slope of 58.27 mV/pH unit for a two-point calibration at 25 °C.

ISE: The 'Nerds' Factor



Temperature
is the only variable

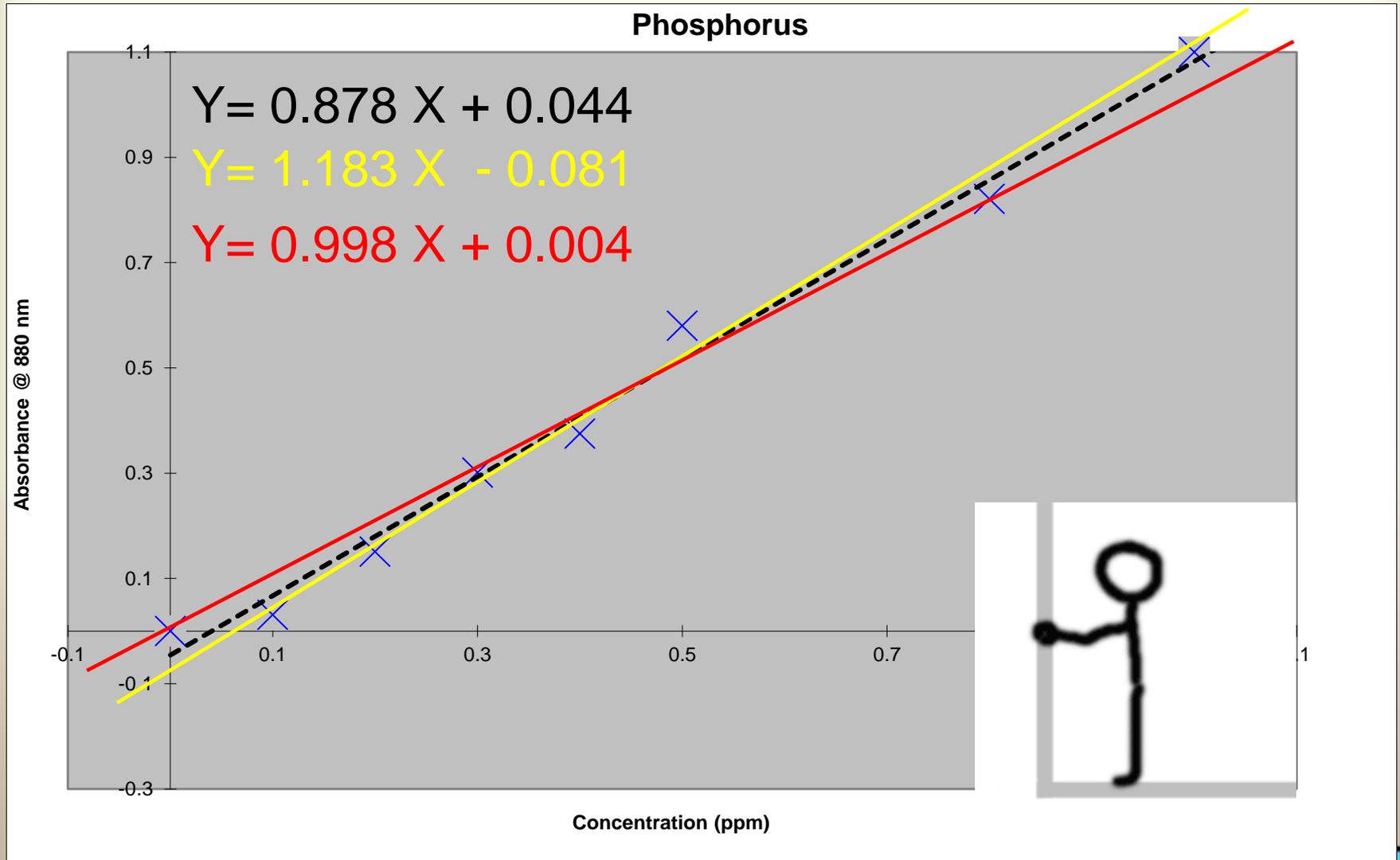
Prozac for Linear Depression

- A linear regression mathematically determines the line which minimizes the difference between each of the calibration points and the resultant line.
- It's basically a computerized "perfect" best fit line.
- The math is mightier than the eye.

Math is like love -- a simple idea but it can get complicated.

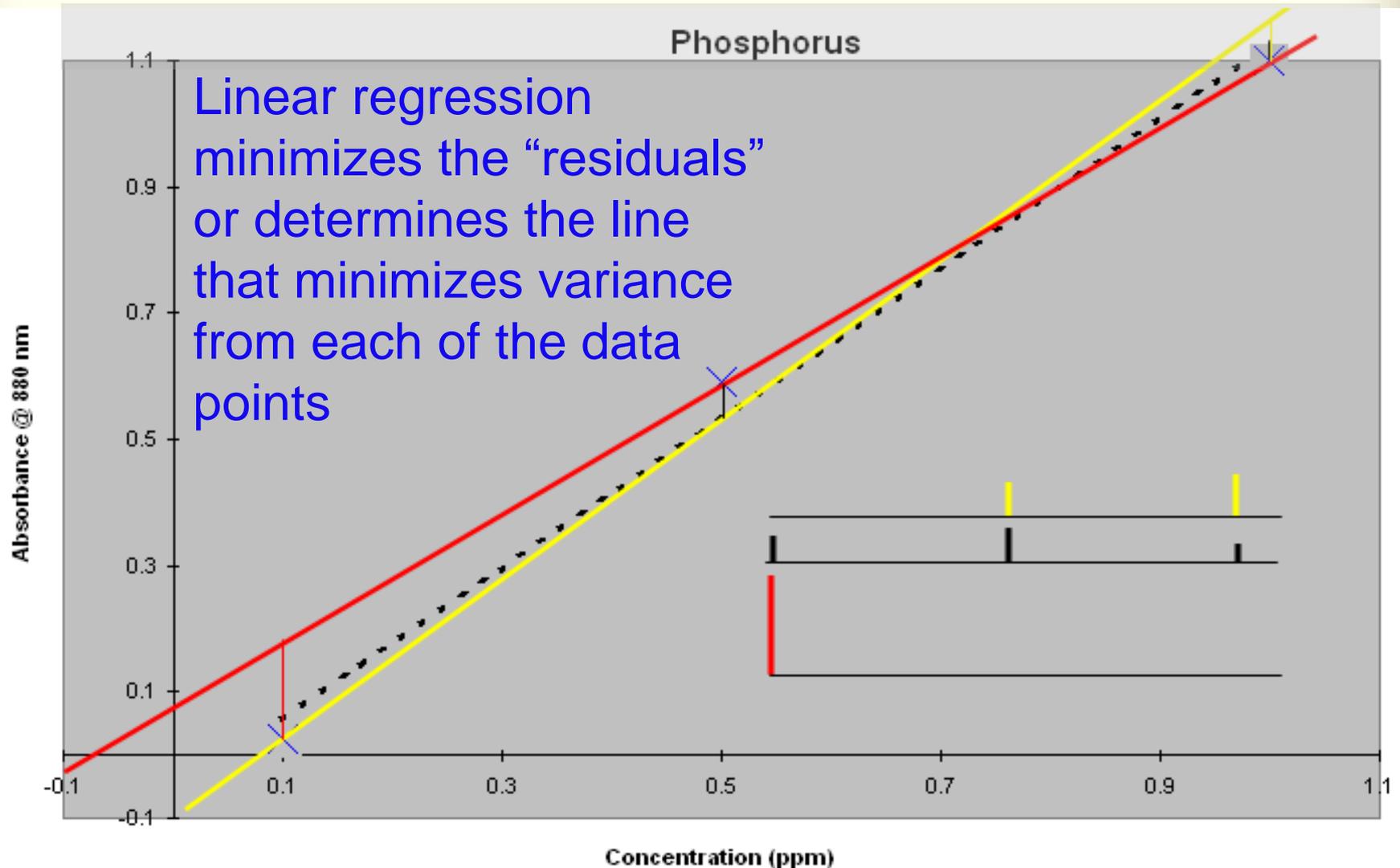
- Odd Thomas

Prozac for Linear Depression



Which line is the “best fit”?

Prozac for Linear Depression



Looking at Residuals



Residual = result of 'plugging' standard response into the resulting $Y = mX + b$ equation

	Regression line	Red line	Yellow line
0.1	0.077	-0.012	0.103
0.5	0.549	0.553	0.668
1	0.974	1.063	1.178

Will always add up to zero



Prozac for Linear Depression

Summary

- The linear regression equations (slope and intercept) mathematically minimize variance at all calibration points.
- Residuals= inserting responses for calibration standards to the $Y=mx+b$ equation to “back-calculate” standards as samples.
- Result is that the sum of residuals (*regression concentration – true concentration*) to be zero.
- Goal is to minimize the standard deviation of residuals.
- No matter how good your eye, math is the only way to draw the ‘perfect’ line.

The Value of Regression Coefficients

Value of the Slope (m)

- ❑ With ISE, helps tell condition of the electrode (-54 to -60)
- ❑ Can keep records to show when the analysis is changing

Value of the Y-Intercept (b)

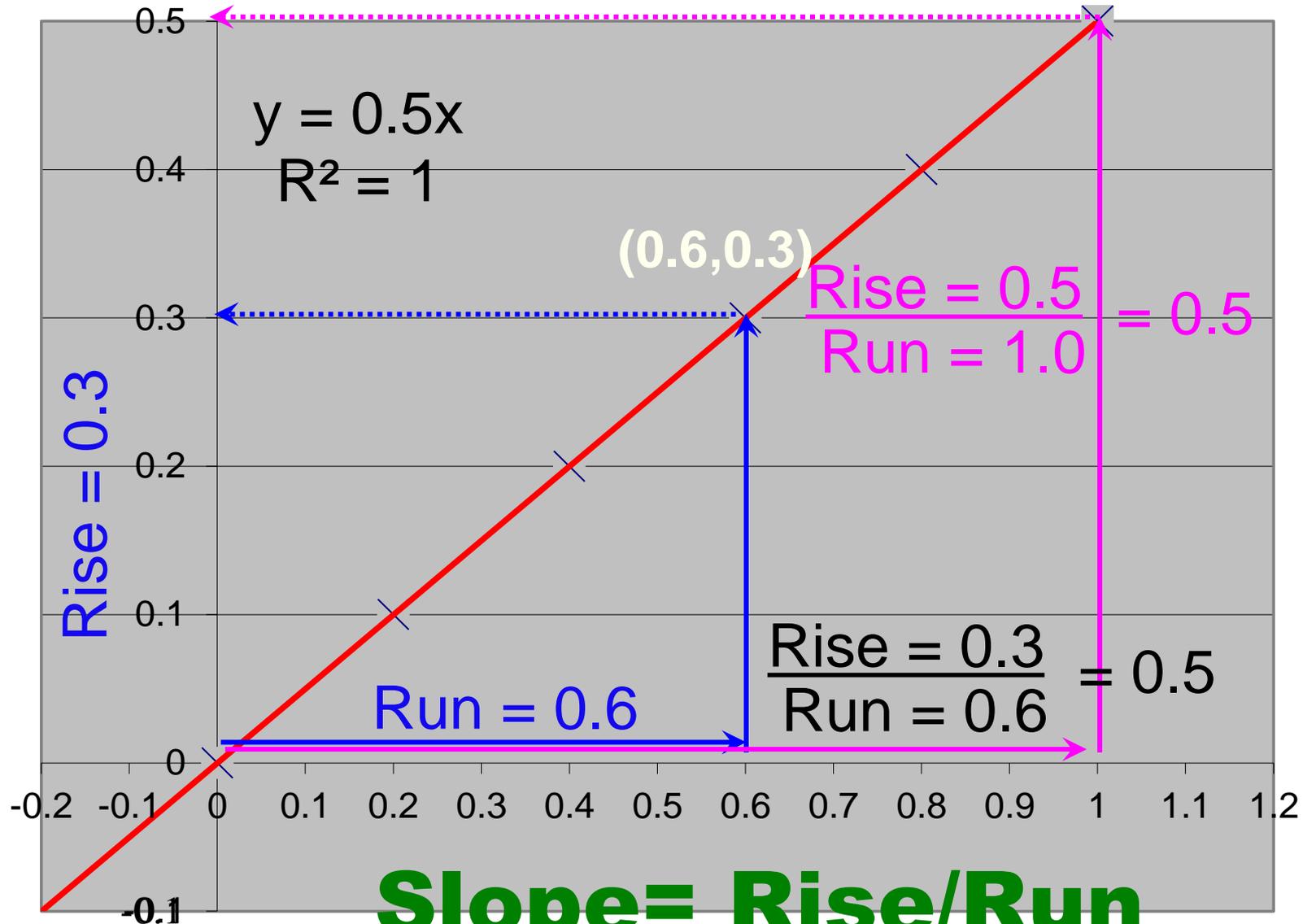
- ❑ Equals response associated at ZERO(0) concentration
- ❑ The level of the intercept can impact the LOD

Y-intercept affects X-intercept and if that exceeds your LOD, the calibration is biased

The ONLY downside to using a calculator vs. a spreadsheet program is that you do NOT get the visual evaluation power afforded by charting the data and regression line.

Prozac for Linear Depression

Surviving the slippery SLOPE



Surviving the slippery SLOPE

Slope by Hand?

Sum

N

slope=



-56.45

0
0

SERIOUSLY

That's just wrong...



Not Another Interception!

Intercept by Hand

	A	YIKES!	G
2			
3			
4			
5			
7	Sum		
8	N		
9			

= 437.80

= 437.80

= 488.77

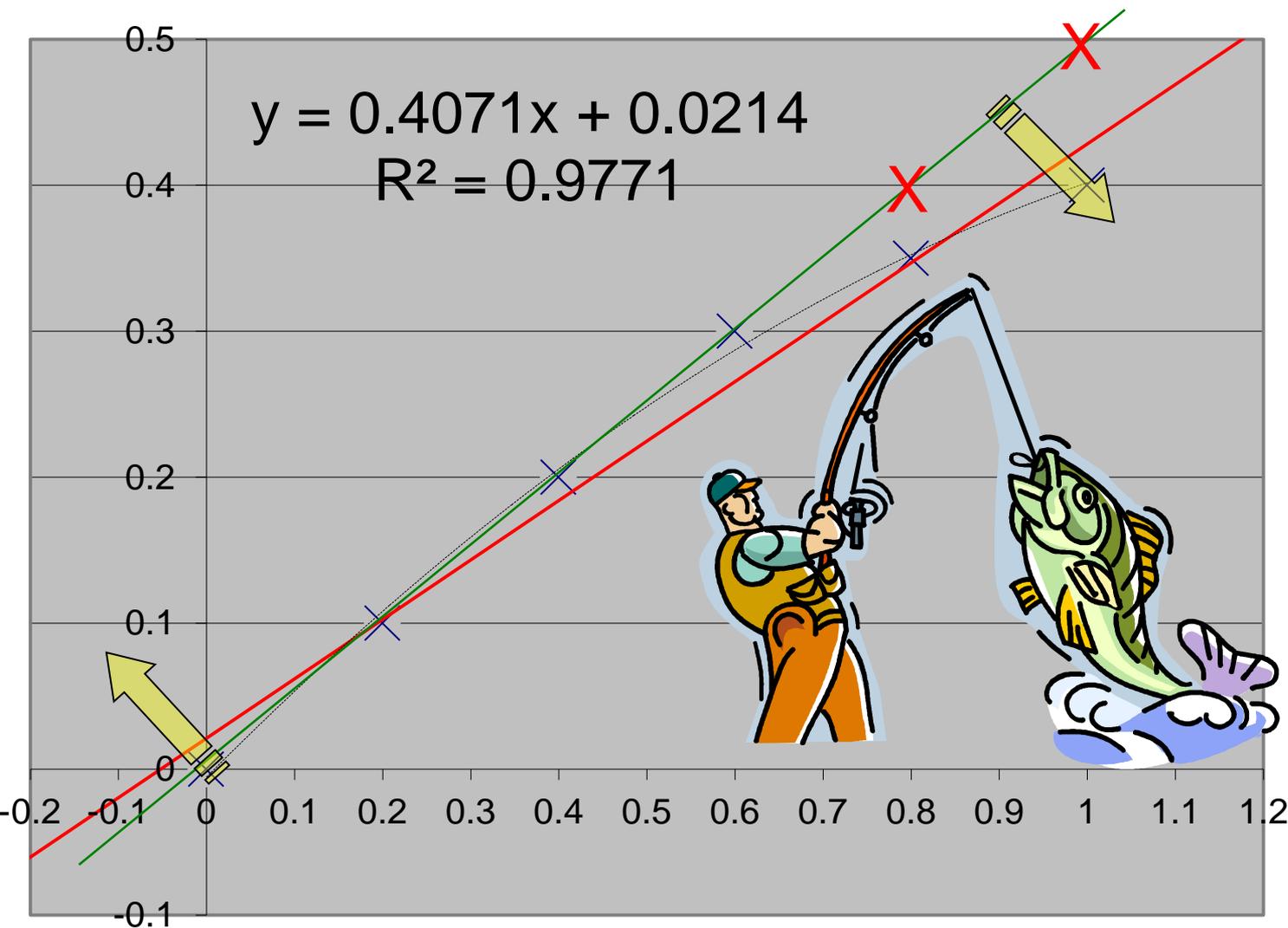
= 162.9

X 0.903090



What causes a positive intercept?

Non-linearity at the upper end of the calibration range (e.g., Phosphorus)



As the calibration line tips like a fish is on the line, the lower end of the regression line gets kicked up and the upper end pushed downward

Note that the effect is more pronounced at the upper end.

Prozac for Linear Depression

Surviving the slippery SLOPE

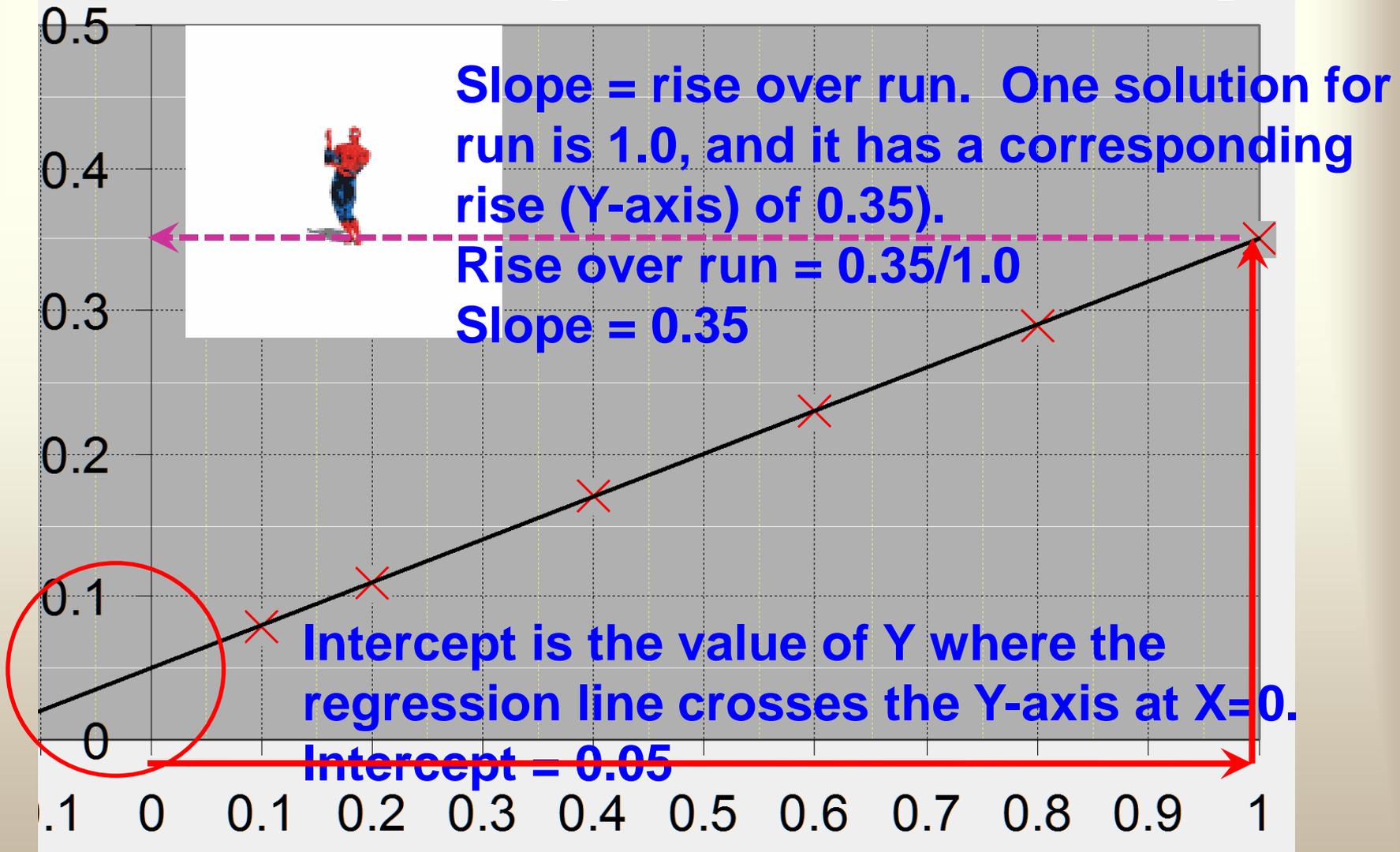
Not Another Interception

	A	B	C	D	E
5			X	Y	
6		Concentration	Log of		
7		mg/L	Concentration	mV	
8		0.2	-0.699	202	
9		2	0.301	146.7	
10		20	1.301	89.1	
11					
12					
13		Slope=	-56.45	=SLOPE(D8:D10, C8:C10)	
14		Intercept=	162.926	=INTERCEPT(D8:D10, C8:C10)	
15		Correlation (r)=	-0.99993	=CORREL(D8:D10, C8:C10)	

$$\log X_{[\text{concentration}]} = (Y_{[\text{mV}]} - 162.926) \div -56.45$$

Using Excel
to generate Regression Equations

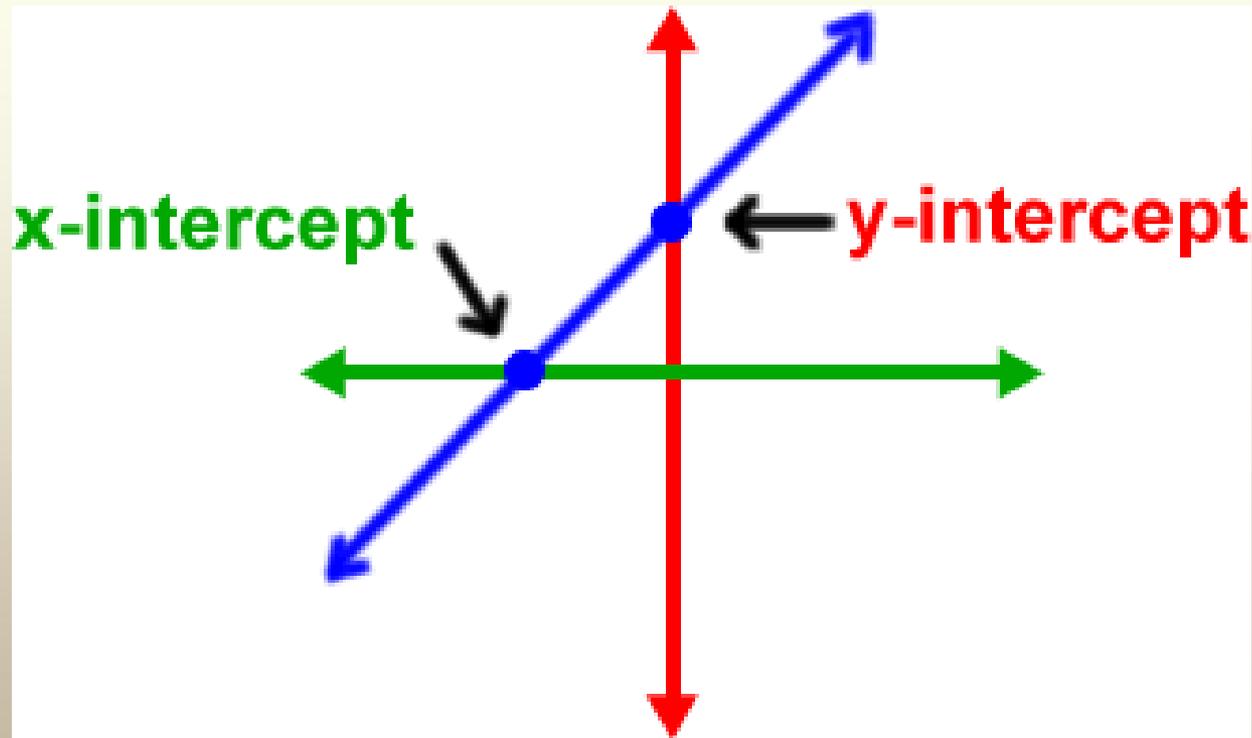
Find the slope and intercept



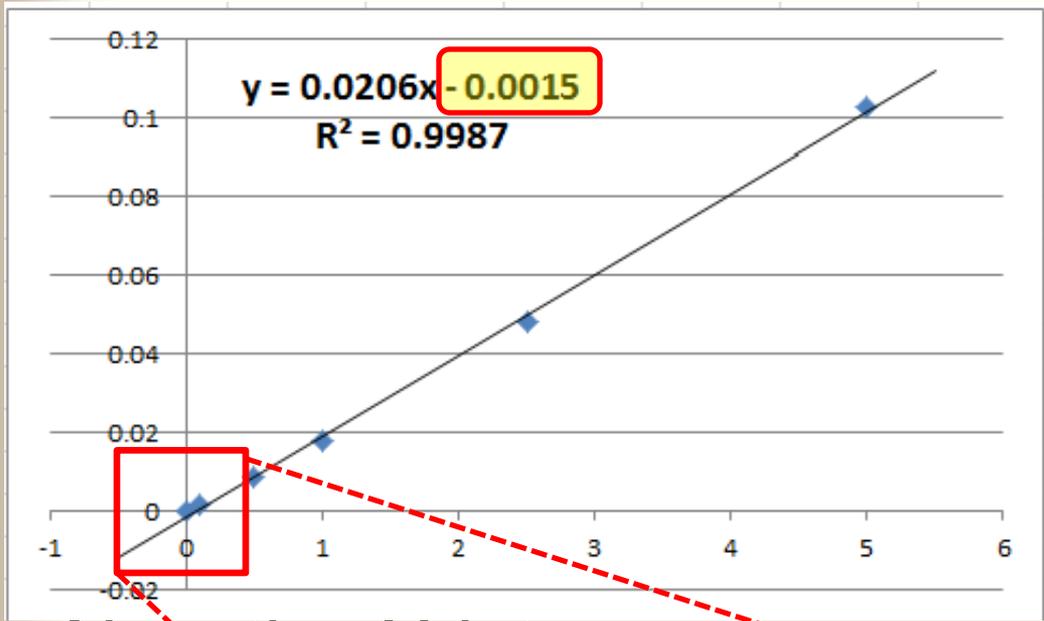
$$Y = 0.35 X + 0.05 ???$$

What's this about the X-intercept?

You just get used to the “Y-intercept” and now we're switching things up and talking X-intercept.

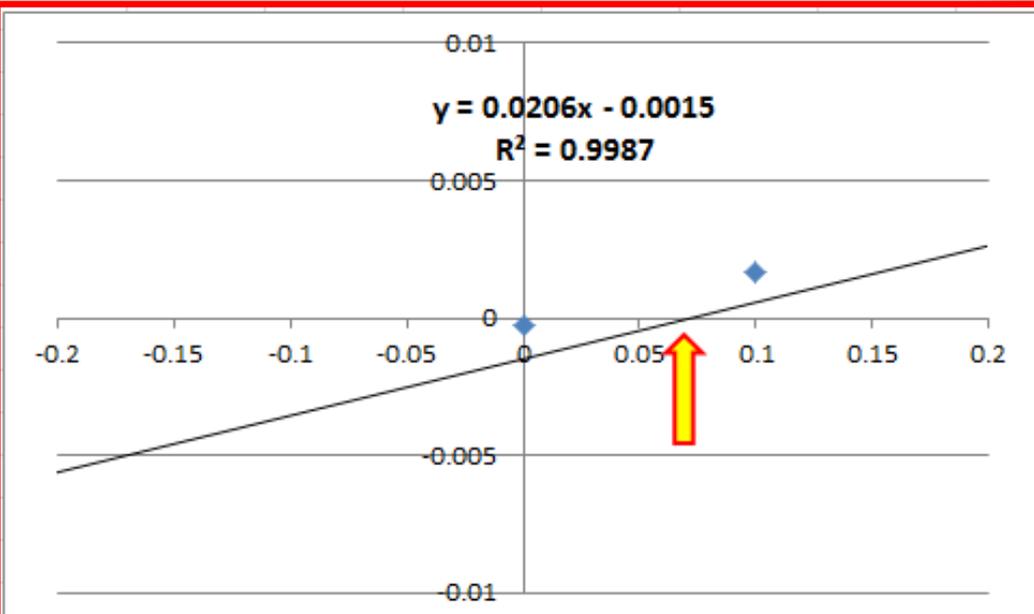


Nitrate by ion chromatography (IC)

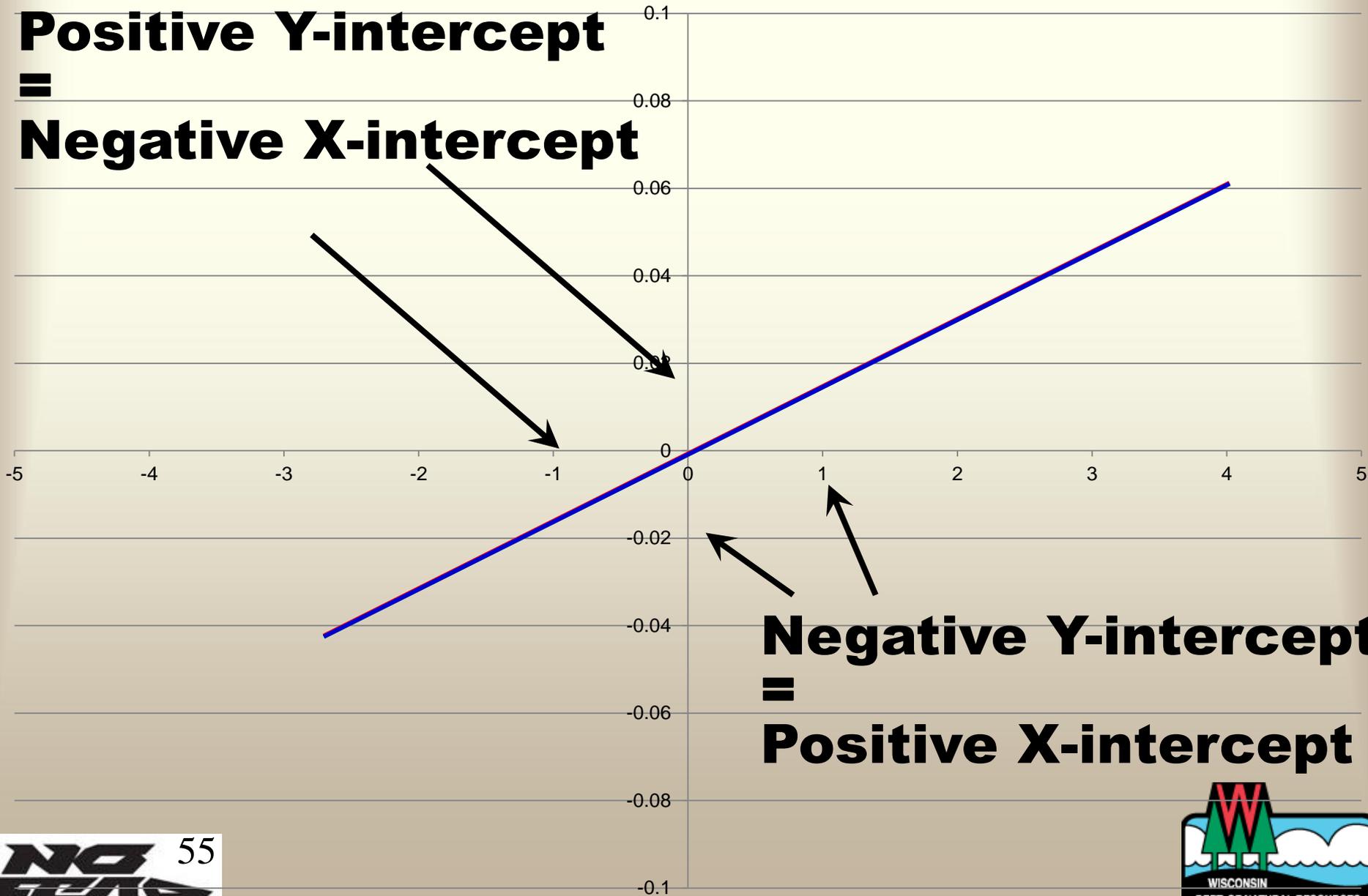


Sample	Nitrate	
	Conc. (mg/L)	Area (V.min)
BLANK		-7.99e-4
CalStd A	5.00	0.103
CalStd B	2.50	0.0480
CalStd C	1.00	0.0179
CalStd D	0.500	8.63e-3
CalStd E	0.100	1.63e-3
CalStd F	0.00	-2.44e-4

- Negative Y-intercept means a positive X-intercept.
- A positive X-intercept means zero response = negative concentration

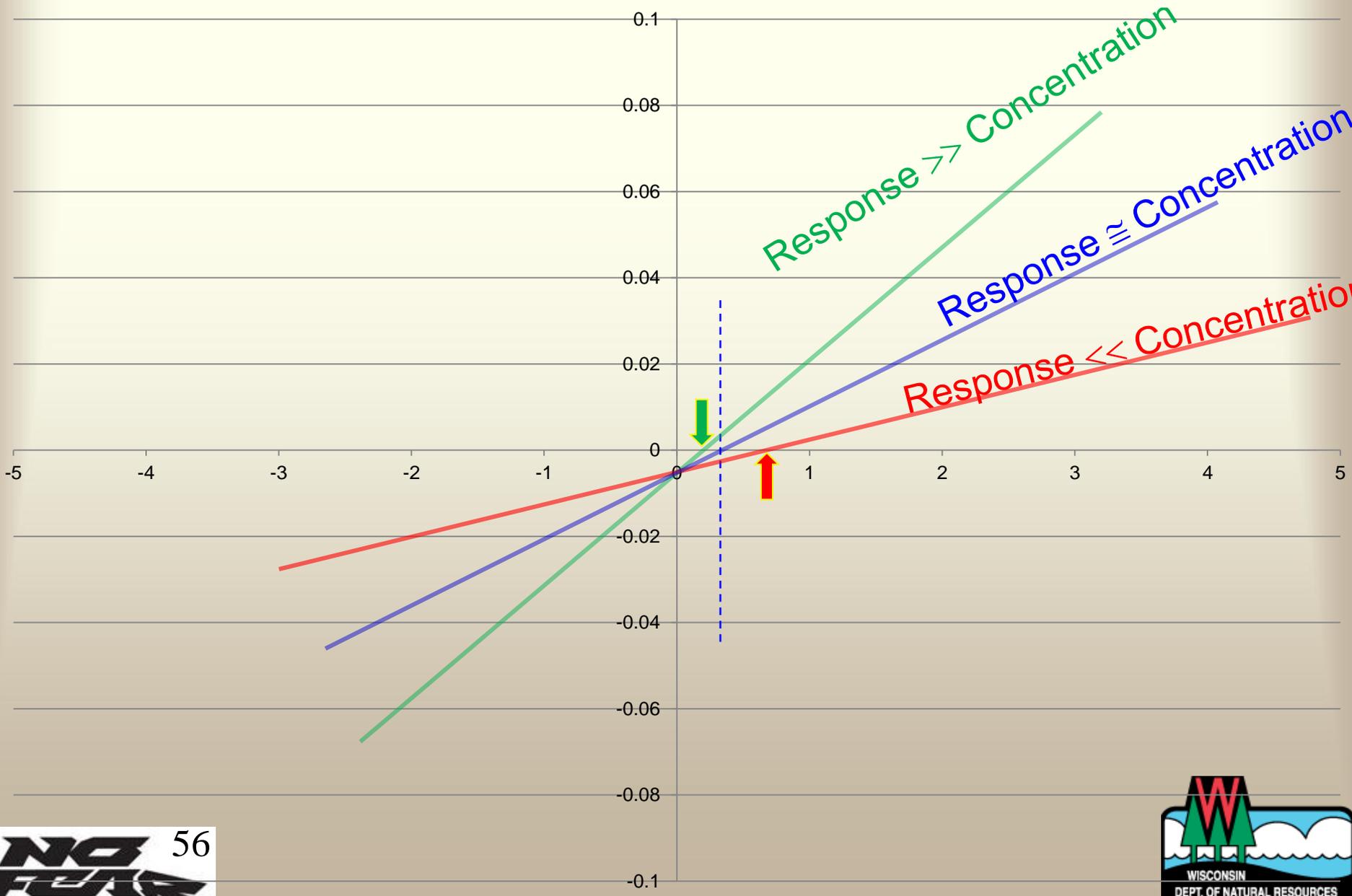


**Positive Y-intercept
=
Negative X-intercept**



**Negative Y-intercept
=
Positive X-intercept**

Effect of Slope on the Intercept



Relating to Correlation

With linear regression, the correlation coefficient “**r**” provides a measure of the acceptability of a particular calibration curve.

- “**r**” = complex mathematical equation
- Values between 0 (no correlation) and 1 (perfect correlation).
- Correlation coefficients can be obtained using:
 - any scientific calculator with 2-variable statistics capability
 - most spreadsheet programs, e.g., Excel

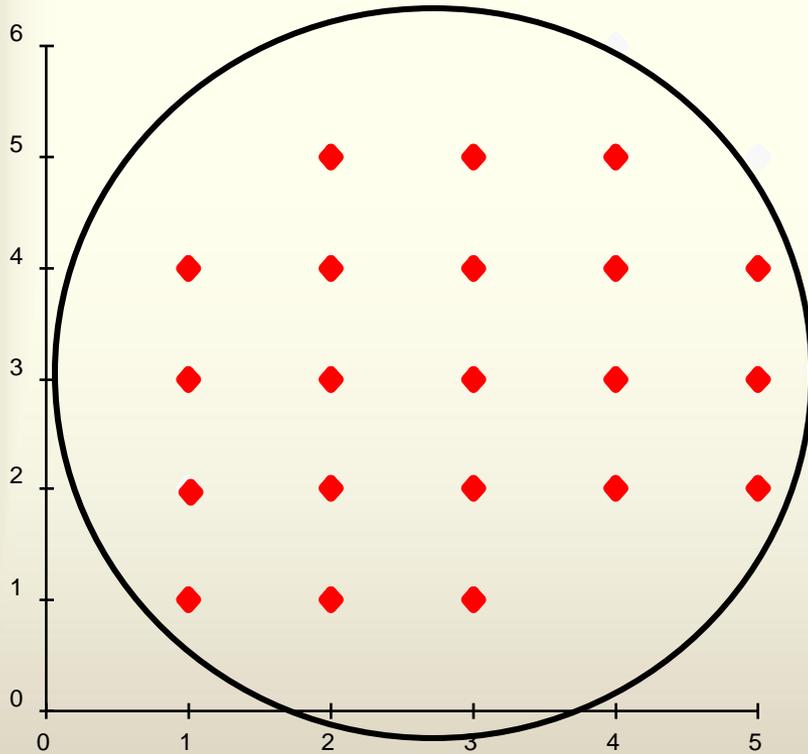
BOTTOM LINE: “**r**” **SHOULD** be 0.995 or greater
 $r^2 \neq r$

if your instrument/software provides r^2 , then:

- take the square root of r^2 (which equals r) or
- an r^2 of 0.990 = r of 0.995

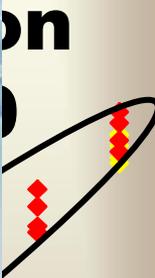
$$\sqrt{r^2} = r$$

Relating to Correlation



The "Rubber Band" test

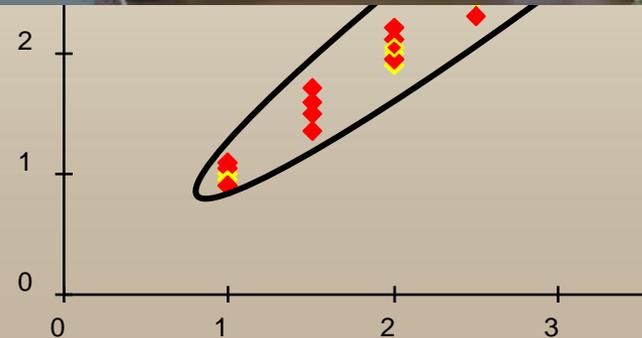
...simply visualize how a rubber band would "fit" the data...



POOR correlation

$$"r" = 0$$

...the more it is stretched taut in a "cigar" shape, the higher the correlation.





Relating to Correlation

Correlation Coefficient by Hand

$$n \sum xy - (\sum x)(\sum y)$$

Why that's...
kooky talk!



Sum
N

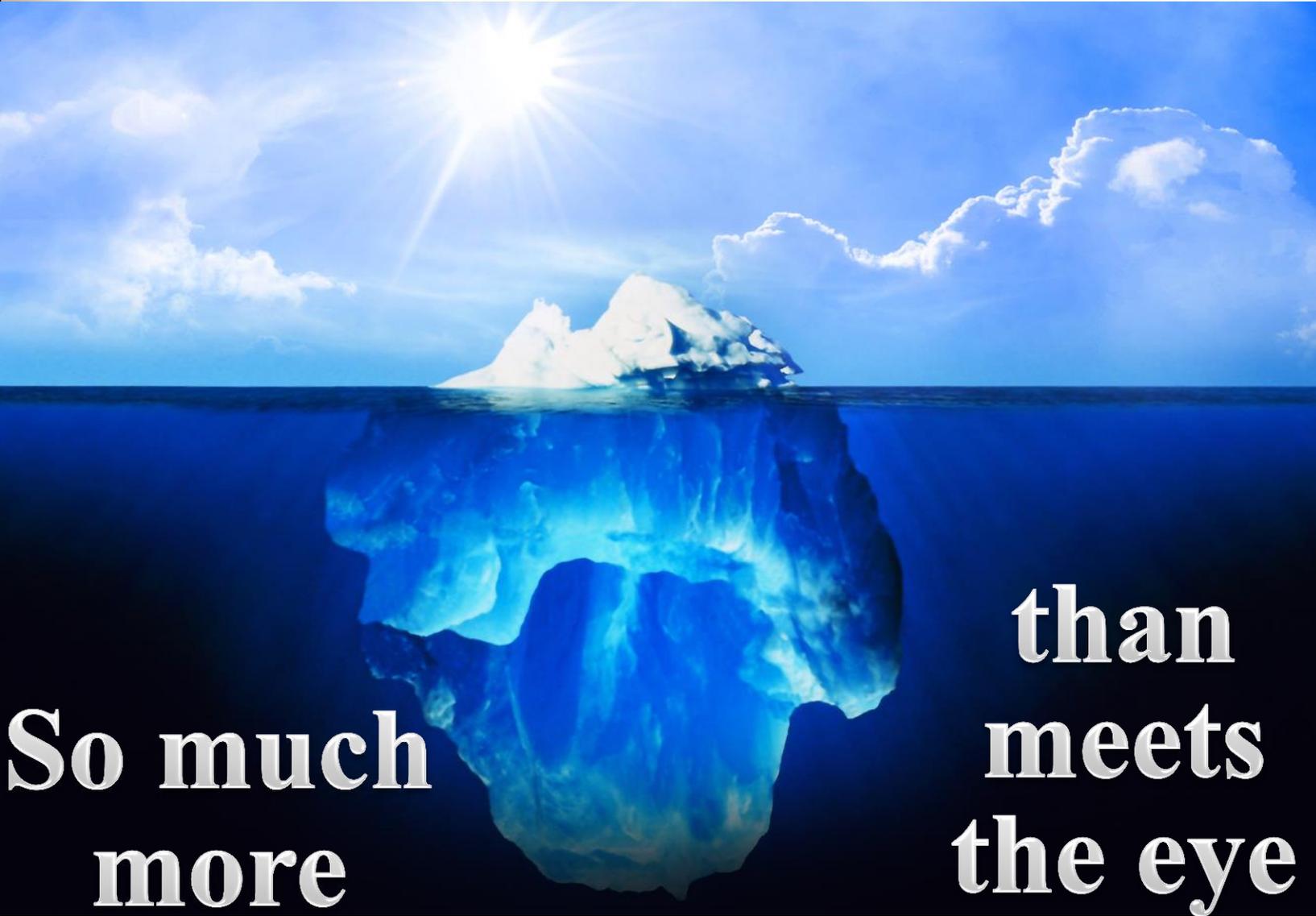
	Y^2
59	40804
19	21520.89
79	7938.81
19	70263.7000

37.8^2
191669

59	-338.7001	=	-0.99992
	<u>338.727053</u>		



The Correlation Coefficient



So much
more

than
meets
the eye

So...Deviation that is Standard is a Good Thing?



The most widely used indicator of dispersion is the standard deviation which, in a nutshell, is based on the deviation of each score from the mean.

Standard deviation is used to determine:

In the lab:

- LOD
- LOQ
- Control Limits
- Outliers
- PT criteria

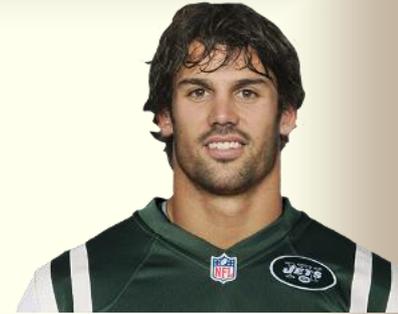
Daily Life:

- Fantasy sports (stats)
- Finance: investment risk
- Weather ranges
- Test scores

So...Deviation that is Standard is a Good Thing?



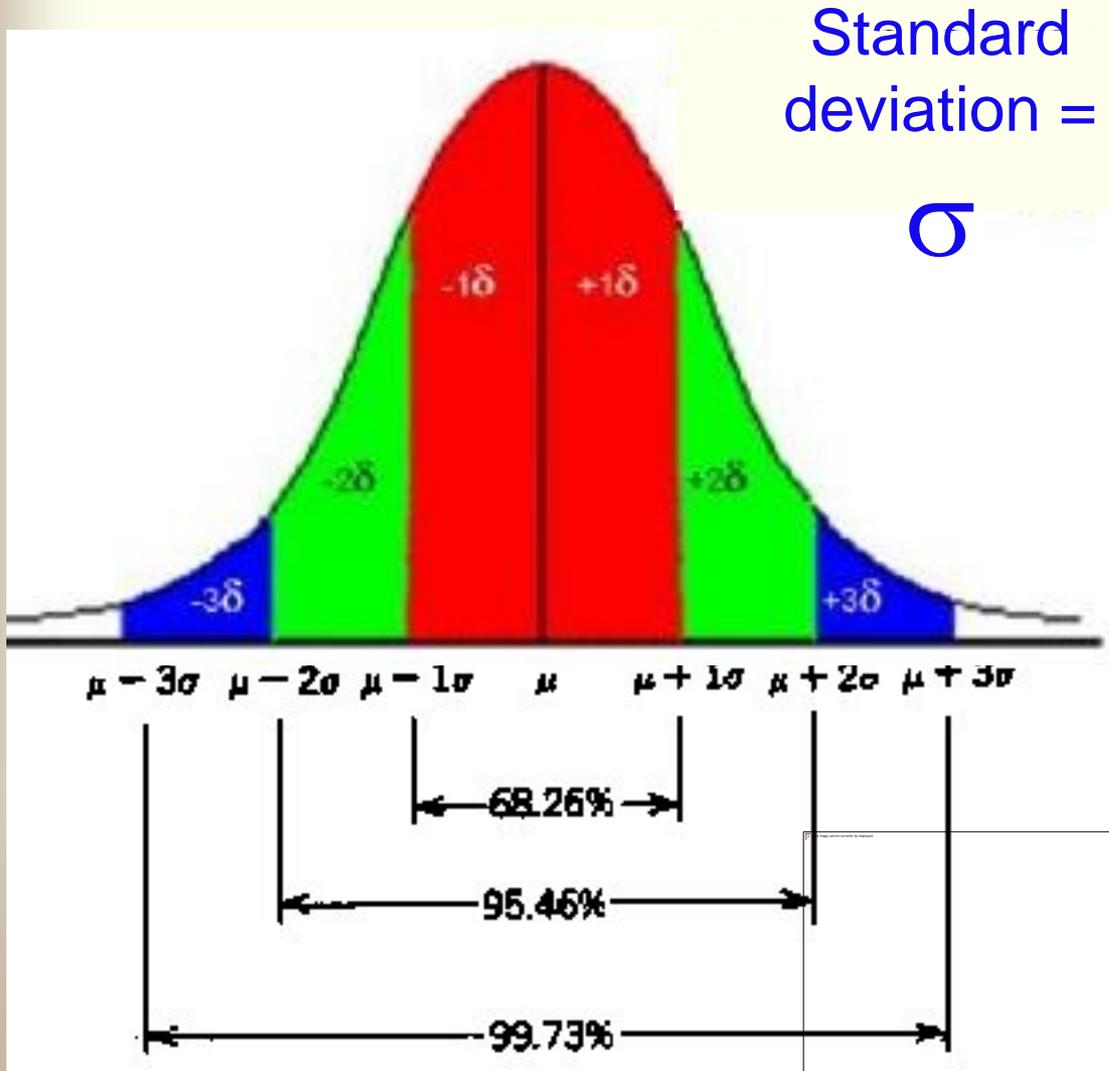
Fantasy Football Example:
Megatron or Eric Decker for WR?
Think back to FFL Draft day 2015



Based on SD...arguably
Eric Decker is the more
consistent player.
Yet Decker was selected
in Fantasy Football drafts
on average 8 rounds later
than Megatron (late round
1/early round 2)



So...Deviation that is Standard is a Good Thing?



Standard deviation =

σ

$z\sigma$

percentage

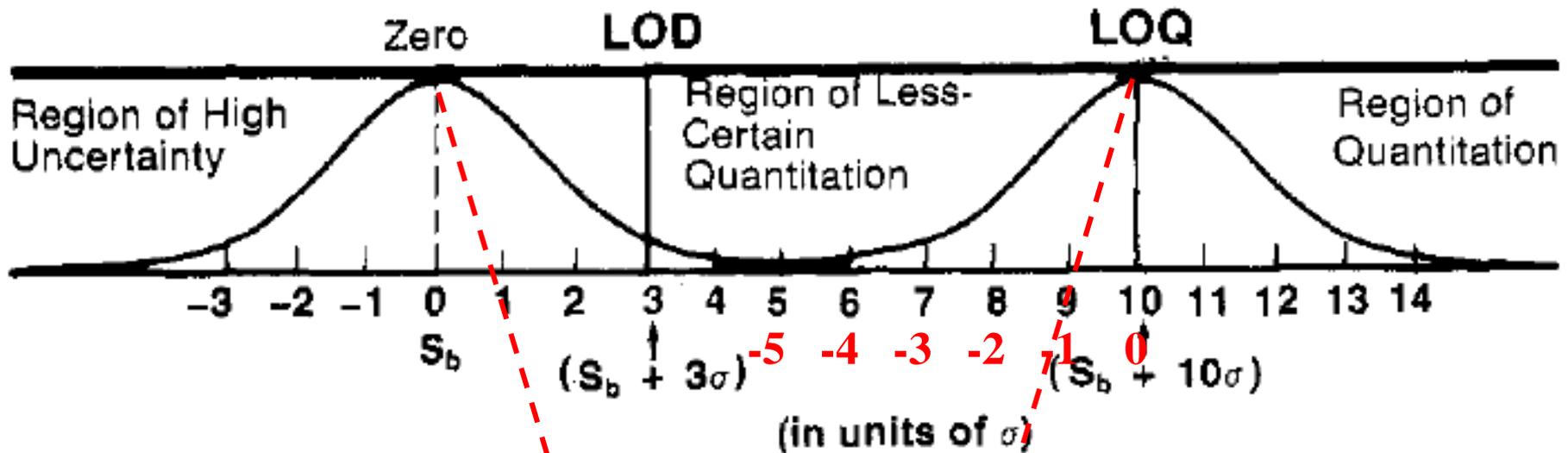
$z\sigma$	percentage
1σ	68.27%
1.645 σ	90%
1.96σ	95%
2σ	95.45%
2.58σ	99%
3σ	99.7300%
3.291 σ	99.9%
4 σ	99.993666%
5 σ	99.99994267%
6 σ	99.9999998027%
7 σ	99.999999999744%

So...Deviation that is Standard is a Good Thing?

- Standard deviation is important in identifying consistent data. A low standard deviation represents consistent data.
- Standard deviation is typically viewed relative to the mean. %RSD (relative standard deviation) is used.
 - In a set of QC data, with mean = 100% and %RSD of 10%
 - 99.7% of results expected to fall between 70-130%
- 99.7% of data in a given set fall within 3 standard deviations of the mean (*this explains why data is expected to fall outside of control limits only 1 out of 100 times*)
- 95% of data fall within 2 standard deviations of the mean.
- Dividing by “n” instead of “n-1”, gives the population standard deviation (assumes every possible value)

The LOD, the LOQ, and the standard deviation

Remember when NR 149 used to define the LOQ as 10/3 time the LOD? This chart explains why.



Note that if you plot the number of standard deviations on either side of the LOQ and a blank (Zero) the LOD falls in the valley between the two.

The LOD is the point at which >99% (99.73%!) confidence exists that the response is NOT equal to a blank.

So...Deviation that is Standard is a Good Thing?

1. Determine the average (mean value) of your set of numbers
2. Calculate the difference between each number and the mean
3. Square the differences
4. Add up the square of all the differences
5. Divide this by one less than the number of values in your set
6. The square root of that number is the standard deviation

use Excel: =STDEV(*range*)
 =STDEV(0.45,0.52,0.54,0.46,0.49,0.51,0.46) = 0.034641

This is an LOD calculation

	X	X-mean	(X-mean) ²
	0.45	-0.04	0.0016
	0.52	0.03	0.0009
	0.54	0.05	0.0025
	0.46	-0.03	0.0009
	0.49	0	0
	0.51	0.02	0.0004
	0.46	-0.03	0.0009
Mean	0.49		
Sum			0.0072
N=	7		
std dev			0.034641



So...Deviation that is Standard is a Good Thing?

Standard Deviation - Calculator

To Calculate Mean, Variance, Standard deviation :

www.easycalculation.com/statistics/standard-deviation.php

Enter all the numbers separated by comma ",".

E.g: 13,23,12,44,55

0.45,0.52,0.54,0.46,0.49,0.51,0.46

calculate

Results:

Total Numbers:	7
Mean (Average):	0.49
Standard deviation:	0.03464
Variance(Standard deviation):	0.0012
Population Standard deviation:	0.03207
Variance(Population Standard deviation):	0.00103

Mathematicians are like Frenchmen: whatever you say to them they translate into their own language, and forthwith it is something entirely different.

- Author Unknown

So...Deviation that is Standard is a Good Thing?

1	110
2	90
3	78
4	91
5	83
6	91
7	81
8	92
9	102
10	80
11	94
12	83
13	79
14	140
15	82
16	92
17	80
18	94
19	98
20	80

The Grubbs outlier test simply calculates how many standard deviations a suspect point lies from the mean.

From our table of standard deviation percentages, we know that > 99.9% of a data set falls within 3.3 standard deviations.

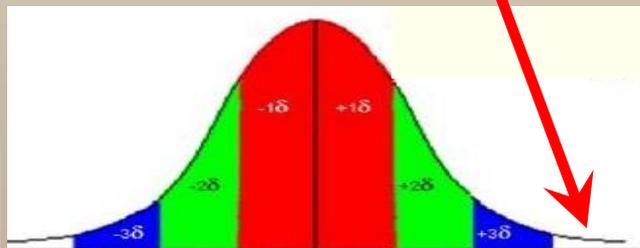
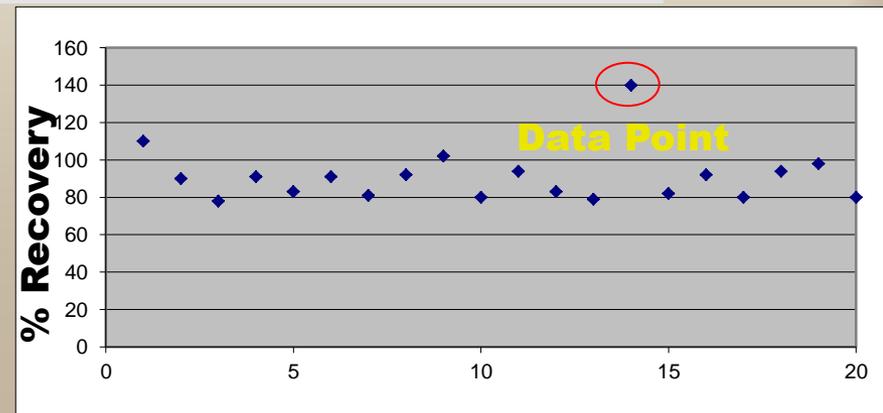
$$Z = \frac{(140 - 91)}{14.39664}$$

$$Z = 3.4035726 \gg \text{criterion} = 2.709$$

REMOVE

Mean
stdev

91
14.3966



~~8.34~~ is a Magic Number

- There ARE no magic numbers!
 - All magic numbers are merely a factor derived from a series of “equivalents”
 - Gain the understanding!
 - Take back control!
 - Remove the ‘black box’

8.34 is a Magic Number

Convert mg/L to lbs/day

When trying to calculate the amount of a parameter (*for example, 1 mg/L of total phosphorus*) that would be contained in a quantity of wastewater discharged (*for example, 1 MGD*), you may have heard that you multiply the concentration of that parameter (in mg/L), by the quantity of wastewater (in MGD), and then to multiply the result by **8.34** to get result in lbs/day.

Amount (lbs/day) = 1 mg/L × 1 MGD × **8.34** = 8.34 lb/day.

8.34 must be a magic number!

8.34 also just happens to be the weight of a gallon of water.

Coincidence???

As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality.

- Albert Einstein

8.34 is a Magic Number

Simply cancel units!

1 gallon of fresh
water weighs
8.34 pounds.

7.48 is also a magic number

Thanks to Kay Curtin for the graphic!

You need to remember this fact forever



One cubic foot contains 7.48 gallons

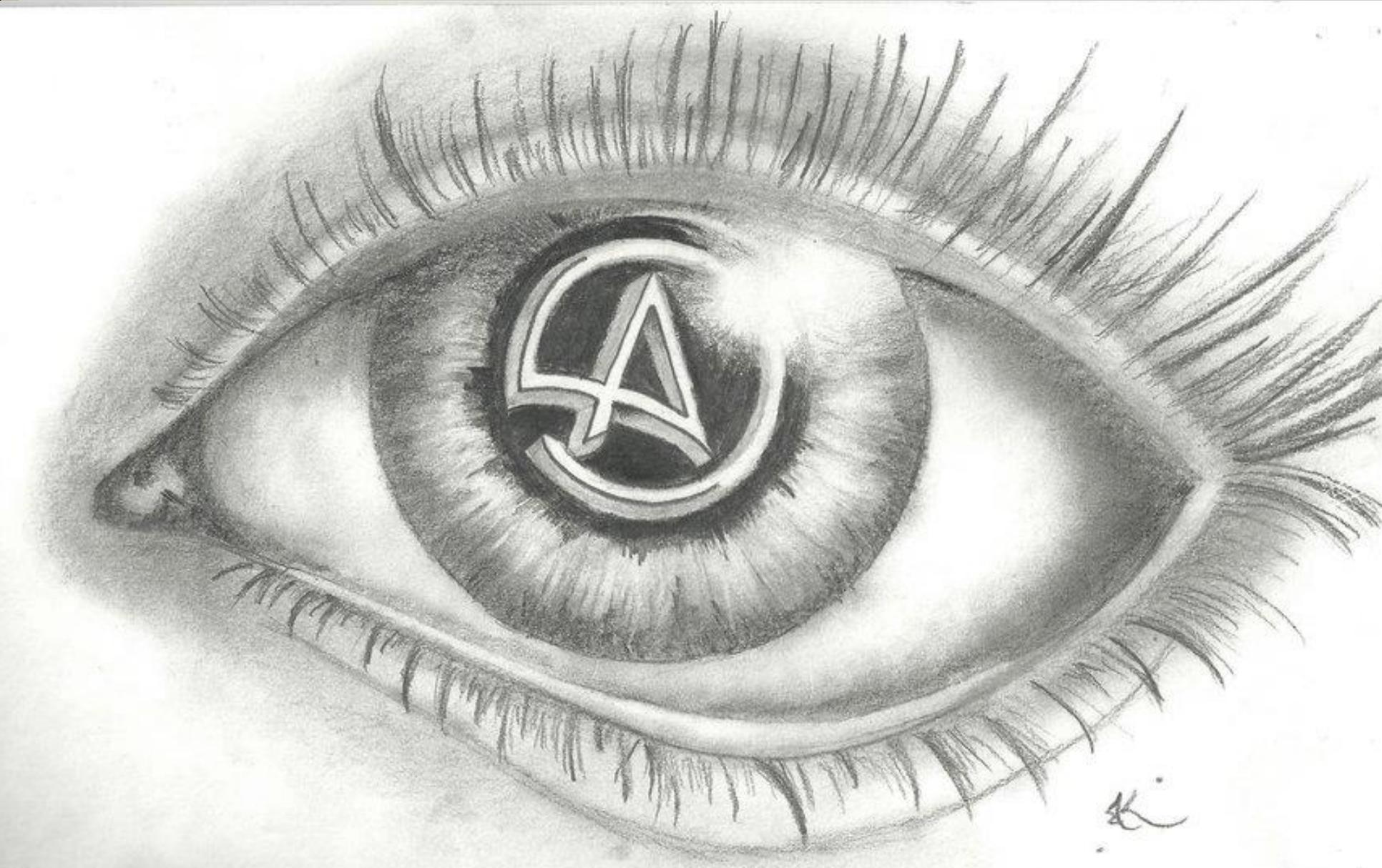
To find volume of a tank, simply multiply the cubic feet by 7.48 to get gallons.

$$\frac{1 \text{ gal}}{3.78} \times \frac{1}{1000} \times \frac{1}{1} \times \frac{16.387}{1} \times \frac{1728}{1} = \frac{28316.8466}{3781} = 7.48925 \frac{\text{gal}}{\text{ft}^3}$$

1 inch = 2.54 cm
 1 inch³ = 1 inch X 1 inch X 1 inch
 1 inch³ = 2.54cm X 2.54cm X 2.54 cm
 1 inch³ = 16.387 cm³

1ft = 12 inches
 1 ft³ = 1 ft X 1 ft X 1 ft
 1 ft³ = 12 in. X 12 in. X 12 in.
 1 ft³ = 1728 inch³

Magical Math is not a Criss Angel Stunt



Phone Magic unveiled

Yes you can do it in your head!

- Let X = first 3 digits phone # (264)
- Let Y be last 4 digits of your phone # (6006)

A. $X \otimes 80 = 80x$

B. $\oplus 1 = 80x + 1$

C. $\otimes 250 = 20,000x + 250$

D. $\oplus Y = 20,000x + 250 + Y$

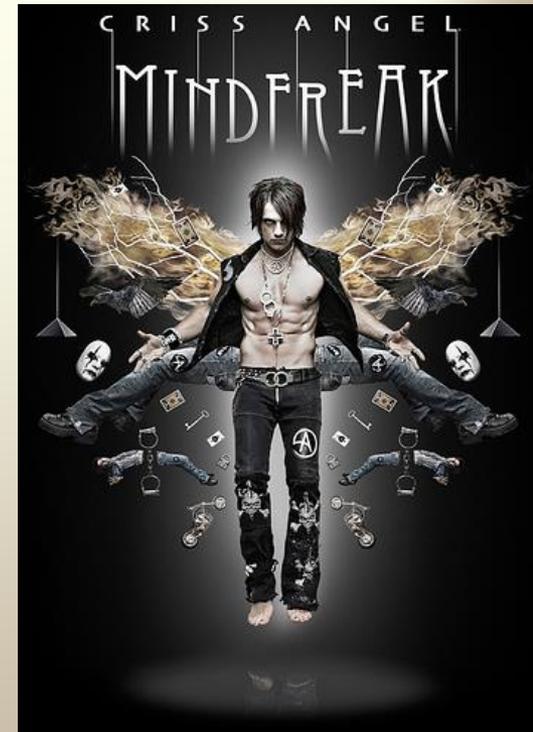
E. $\oplus Y = 20,000x + 250 + 2Y$

F. $\ominus 250 = 20,000x + 2Y$

G. $\div 2 = 10,000X + Y$

$= 10,000 \otimes 264 \oplus 6006$

$= 2640000 + 6006 = 2646006$



On-line Assistance

- On-line units conversion site:
 - www.eppo.go.th/ref/UNIT-ALL.html#4%20Area
- On-line Conversions:
 - www.shodor.org/UNChem/unit_conv_tab.html
- On-line Conversions (Volume):
 - www.onlineconversion.com/Volume.htm
- On-line Conversions (Mass/Weight):
 - www.onlineconversion.com/weight_common.htm
- Lots of on-line calculators
 - statpages.org/index.html
- On-Line Math help
 - www.webmath.com/
- Dilution calculator on-line (C1V1):
 - www.spectronic.co.uk/info/dilucalc.htm
- On-Line Standard Dilution Calculator:
 - www.tocris.com/dilution.php
- Dilution Solution On-Line Dilution Calculator:
 - www.supermagnus.com/med/dilutions/index.html

I'm sorry to say that the subject I most disliked was mathematics. I have thought about it. I think the reason was that mathematics leaves no room for argument. If you made a mistake, that was all there was to it.

- Malcolm X

More On-line Assistance

- On-line Linear Regression Calculator:
- www.xuru.org/rt/LR.asp#CopyPaste
- On-line Linear Regression with Graph
- science.kennesaw.edu/~plaval/applets/LRegression.html
- On-line Standard Deviation
- www.easycalculation.com/statistics/standard-deviation.php
- On-line nth root (GeoMean) calculator
- <http://instacalc.com/v0.5/>
- On-line GeoMean calculator
- www.graftacs.com/geomean.php3
- On-line GeoMean calculator
- www.easycalculation.com/statistics/geometric-mean.php
- On-line GeoMean calculator
- www.easycalculation.com/statistics/standard-deviation.php
- Outliers: Grubbs test on line
- www.graphpad.com/quickcalcs/Grubbs1.cfm

Thanks for staying awake!

For More Information



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Program Chemist

WI DNR

Lab Certification – SS/BW

PO Box 7921

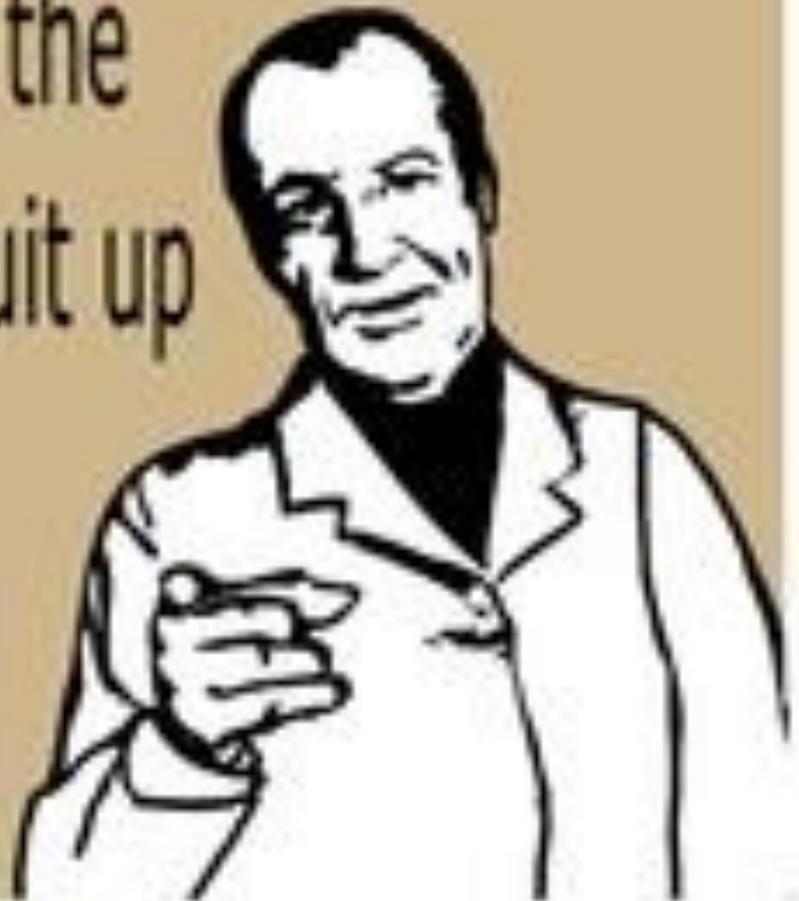
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Courage is not
the absence of fear.
It is the ability to face it,
overcome it,
and finish your job.

Coffee, you're on the
bench. Alcohol, suit up



Math %#@~!



If necessity is the mother of invention
Then I'd like to kill the guy who invented this
The numbers come together in
some kind of a third dimension
A regular algebraic bliss.

Let's start with something simple,
like one and one ain't three
And two plus two will never get you five.
There are fractions in my subtraction
and x don't equal y
But my homework is bound to multiply.

Math suks math suks
I'd like to burn this textbook, I hate this stuff so much.
Math suks math suks
Sometimes I think that I don't know that much
But math suks.

I got so bored with my homework, I turned on the TV.
The beauty contest winners
were all smiling through their teeth.
Then they asked the new Miss America
Hey babe can you add up all those bucks?
She looked puzzled, then just said
"Math Suks".

Math suks math suks
You don't even have to spell it,
All you have to do is yell it...
Math suks math suks
Sometime I think
that I don't know that much
But math suks.

Geometry, trigonometry
and if that don't tax your brain
There are numbers to big to be named
Numerical precision
is a science with a mission
And I think it's gonna drive me insane.

Parents fighting with their children,
and the Congress can't agree
Teachers and their students
are all jousting constantly.
Management and labor
keep rattling old sabers
Quacking like those Peabody ducks.

Math suks math suks
You don't even have to spell it,
All you have to do is yell it...
Math suks math suks
Sometime I think
that I don't know that much
But math suks.

Math Suks

Jimmy Buffett

"Beachhouse on the Moon"