Rates of Change

RATE	VALUE
$\frac{dy}{dt}$	$y(x)$
$\frac{dL}{dy}$	$L(y)$
\$ per year	ft
miles per hour	miles
	years

$$X = \sin y$$

Implicit Differentiation

$$\frac{d}{dx} X = \frac{d}{dx} \cdot \sin y$$

$$1 = \cos y \cdot \frac{dy}{dx}$$

$$\frac{d}{dt} X = \frac{d}{dt} \sin t$$

$$\frac{dx}{dt} = \cos t$$

Rates

dR/dt = Revenue is changing

dx/dt = Price is changing

Values

x = price

x = Price is \$1

dx/dt = Raise the price \$0.05/week

$$dR/dt = 22(.05) - 4(\$1)(.05)$$

$$= .9\ \$/\text{week}$$

x = Price = \$12

dx/dt = .05/week?

$$dR/dt = 22(.05) - 4(12)(.05)$$

$$= -1.3$$

Related Rates

Like Implicit differentiation.

Except Take $\frac{d}{dt}$ of both side.

t = value = time

Ex $V = \frac{4}{3}\pi r^3$ Volume of sphere.

$\frac{d}{dt} V = \frac{d}{dt} \frac{4}{3}\pi r^3$

$$\boxed{\frac{dV}{dt} = 4\pi r^2 \cdot \frac{dr}{dt}}$$

Rates

$\frac{dV}{dt} = 30 \frac{cm^3}{sec}$

$\frac{dr}{dt} = ? \frac{cm}{sec}$

Value

$r = 1_{cm}, 10_{cm}, 100_{cm}$

Balloon

$r = 1$ $\quad 30 \frac{cm^3}{sec} = 4\pi (1cm)^2 \frac{dr}{dt} \frac{cm}{sec}$

$$\frac{30}{4\pi (1)^2} = \frac{dr}{dt} = 2.38\ldots \text{ cm/sec}$$

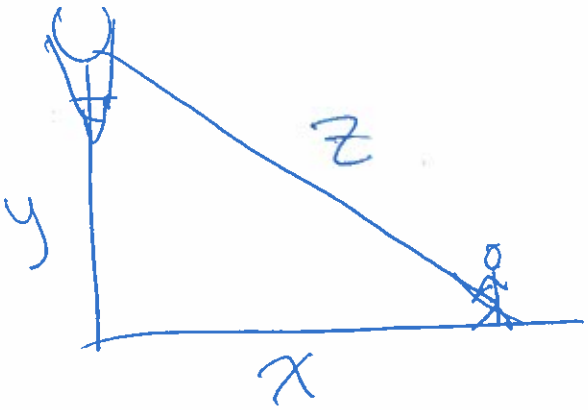
$r = r = 10$

$$\frac{30}{4\pi (10)^2} = \frac{dr}{dt} = .0238 \text{ cm/sec}$$

$r = 100$ $\quad \frac{dr}{dt}$ $.000028\ldots$ cm/se

Ex A balloon rises at 3 ft/sec (rate = 3 ft/sec) You are 10 ft away (rate = 10 ft) You walk away from the balloon at 4 ft/sec (rate = 4 ft/sec) After two seconds (rate $t = 2$)

How fast is the distance between you and the balloon changing?



Pythagorean

$$z^2 = x^2 + y^2$$

Related Rate Problem

$$\frac{d}{dt}(z)^2 = \frac{d}{dt}(x^2 + y^2)$$

$$2z \cdot \frac{dz}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}$$

$$z\frac{dz}{dt} = x\frac{dx}{dt} + y\frac{dy}{dt}$$

Rates

$dz/dt = ?$

$dx/dt = +4\ ft/sec$

$dy/dt = 3\ ft/sec$

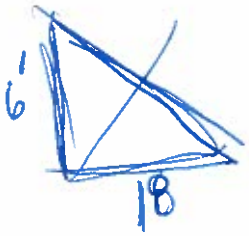
Values

$x = 18$

$y = 6$

$z = \sqrt{18^2 + 6^2}$

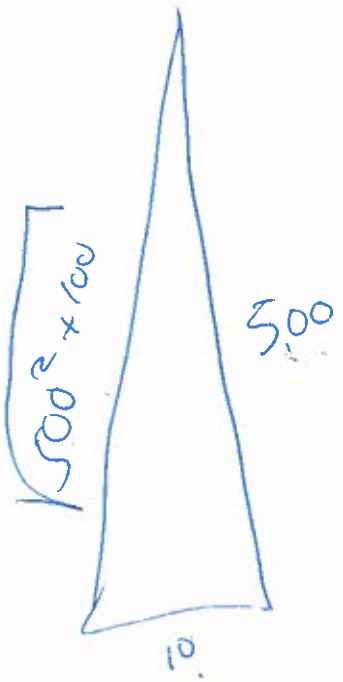
$= 18.97\ldots$



$d = rt$

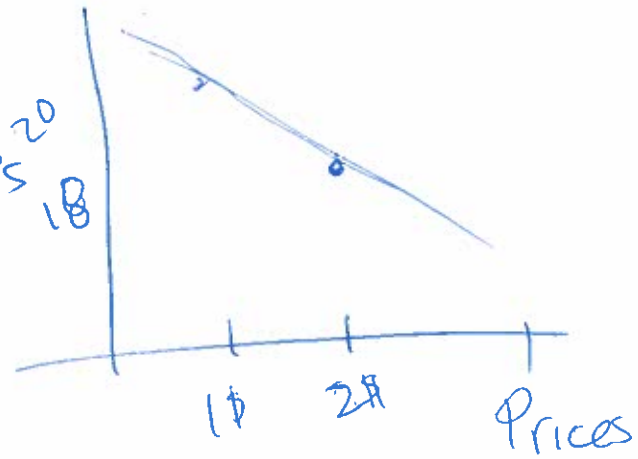
$3'/sec \cdot 2\ sec = 6'$

$$z\frac{dz}{dt} = \frac{x \cdot \frac{dx}{dt} + y \cdot \frac{dy}{dt}}{z} = \frac{18 \cdot (4) + 6 \cdot 3}{18.97} = 4.74'/sec$$



Sell Balloons Sales (Price)

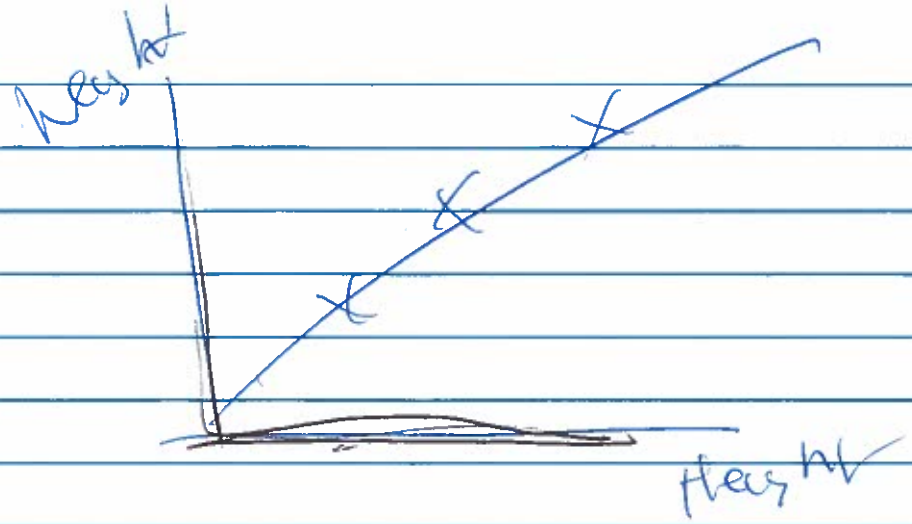
Revenue = Price x Sales



$R = x \cdot (22 - 2x)$

$R = 22x - 2x^2$

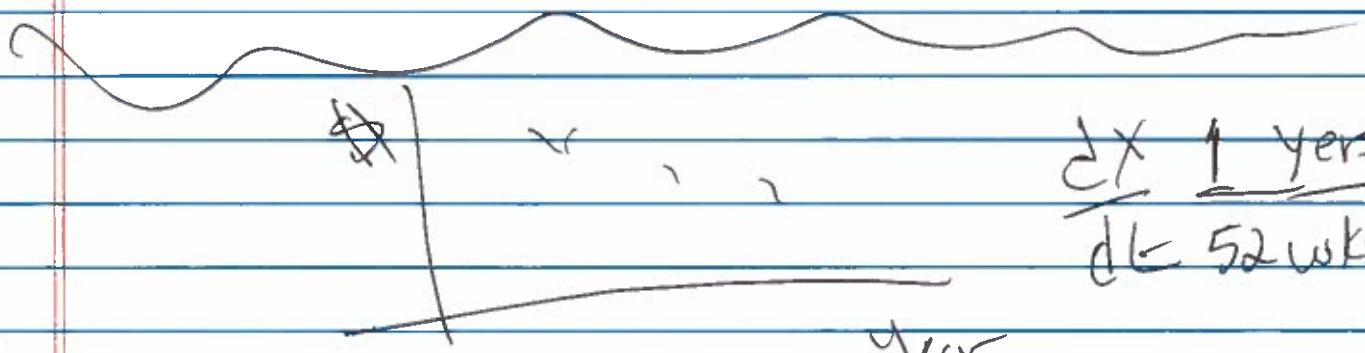
$\frac{dR}{dt} = 22\frac{dx}{dt} - 4x \cdot \frac{dx}{dt}$



Weight (Height) = regEq.

$$\frac{dW}{dt} = nDeriv(Y_1, X, M) \cdot dH/dt$$

Height was growing 1" per year



$$\frac{dX}{dt} \quad \frac{1 \text{ years}}{52 \text{ wks}}$$

Y_1 = regEq.

Y_2 = nDeriv (Y_1, X, X)

$$\frac{dH}{dt} = \frac{24 \text{ hrs}}{1 \text{ days}}$$

GROUP NAME: (BEST FRIENDS) - (ELLIOT)

Date: 3-10-2014

Student Names (First and Last)

Speaker/Presenter: VINNIE AVHAD

Writer/Prep: LAUREN DORO

Leader/Collaborator:

Independant Variable (x-axis): YEARS

Dependant Variable (y-axis): ELECTRIC CAR SALES

Conclusion (in words):

IN 2014, WE ARE LOSING 4080 CAR SALES PER WEEK.

Supporting Work:

YEARS	SALES
2009	290292
2010	274555
2011	284064
2012	487480
2013	592192

X	Y_1	Y_2
2014,0	350222	-4080

Val. Rate

$y = a\sin(bx+c)+d$

a = 170314.8844

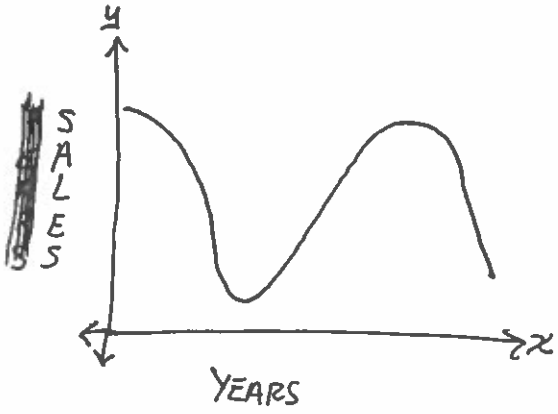
b = 1.272131339

c = -1.470607369

d = 384709.1247

$Y_1 = a\sin(bx+c)+d$

$Y_2 = (nDeriv(Y_1, X, X))/52$



GROUP NAME: Illuminatti

Date: 03/10/14

Student Names (First and Last)

Speaker/Presenter: Ryan Piotrowski

Writer/Prep: Bishop Barr

Leader/Collaborator: Danyan Zhou

Independant Variable (x-axis): ~~years~~ months

Dependant Variable (y-axis): gas prices

Conclusion (in words): gas prices are increasing at the rate of .15¢ per month

Supporting Work:

X	Y
1980	1
1990	1.54
2000	2.5
2008	3
2010	3.3

x12 months

95 x 12 =

1114

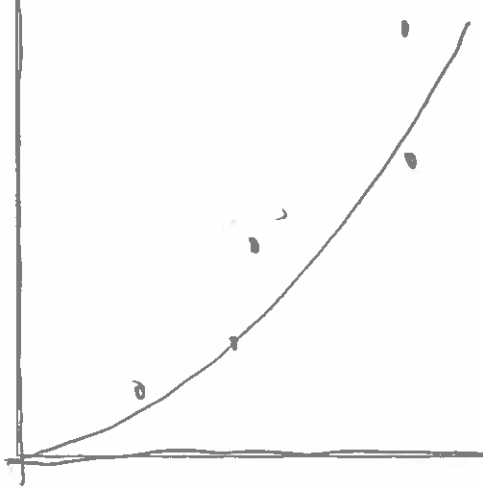
Exp Reg

$y = a \cdot b^x$

$y_1 = \text{expReg}$

$y_2 = \text{nDerv}(y_1, x, x)/12$

X	y_1	y_2
2014	3.96	.15
2020	5.027	.199
2050	16.4	.65



GROUP NAME: We Mean Business !

Date: 3/10/14

Student Names (First and Last)

Speaker/Presenter: Christina Trujillo

Writer/Prep: Simar Kalra

Leader/Collaborator: Yasmin Silverio

Independant Variable (x-axis): Years

Dependant Variable (y-axis): Interest Rates

Conclusion (in words): In 2014, the interest rates would be growing by 1.75 E-6% per week

Supporting Work:

X	Y
2008	3.71
2009	1.53
2010	.29
2011	.35
2012	.58

$X = 2014$

$Y_1 \text{ Reg}_{\text{Quad}} = 4.924x^2 + -9.441x + 51.338$

$Y_2 =$ nderiv$(Y_1, X, 2014)$ 1/52

x	y_1	y_2
2014	4.424	0.5267

GROUP NAME: Cha - Ching

Date: 3/10/14

Student Names (First and Last)

Speaker/Presenter: Trey Murrill

Writer/Prep: Sheila Mae Gan

Leader/Collaborator: ~~Erika~~ Tatiana Calderon

Independant Variable (x-axis): ~~Years~~ Days

Dependant Variable (y-axis): Revenue

Conclusion (in words):

~~In 2035 our club is making $131,900 per day~~

In March 1, 2016 our club daily rate is 55,686 per day

Supporting Work:

L_1	L_2
13	35
12	27
11	26
10	17
9	16

$Y_1 = 4.8x + -29.6$

$Y_2 = nDeriv(Y_1, X, X) \div 365$

	X	Y_1	Y_2
	35	139.4	0.1315
*	24	86.6	0.1315
	3	-14.2	0.4315

$Y_1 = 18.65\ldots * \sin(-.647\ldots X + 2.320\ldots) + 24.27\ldots$

$Y_2 = nDeriv(Y_1, X, X)\ 90 \mid 365$

X	Y_1	Y_2
14	15.93	-2.665
16	5.9442	.55686

GROUP NAME: POLAR BEARZ

Date:_____

Student Names (First and Last)

Speaker/Presenter: Kaushalya Munasinghe

Writer/Prep: Fremiwot Berhe

Leader/Collaborator:_____

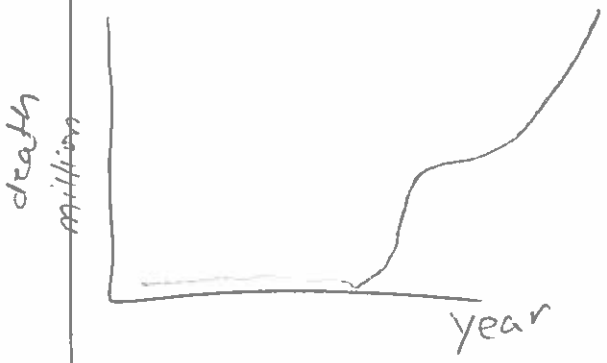
Independant Variable (x-axis): year

Dependant Variable (y-axis): deaths ~~of~~ in millions due to HIV's

Conclusion (in words):

per week .0151 millions of people die due to HIV in the year of 2014.

Supporting Work:



Y_1 = CubicReg

Y_2 = nDeriv $(Y_1, X, X) \cdot \frac{1}{52}$

Table

X	Y_1	Y_2
2014	3.2199	.0151
	Value	Rate

GROUP NAME: Money Makers

Date: 03/10/2014

Student Names (First and Last)

Speaker/Presenter: Bryan S.

Writer/Prep: Edna Onyiuke

Leader/Collaborator: Monica K.

Independant Variable (x-axis): Years

Dependant Variable (y-axis): Crime rate in detroit

Conclusion (in words):

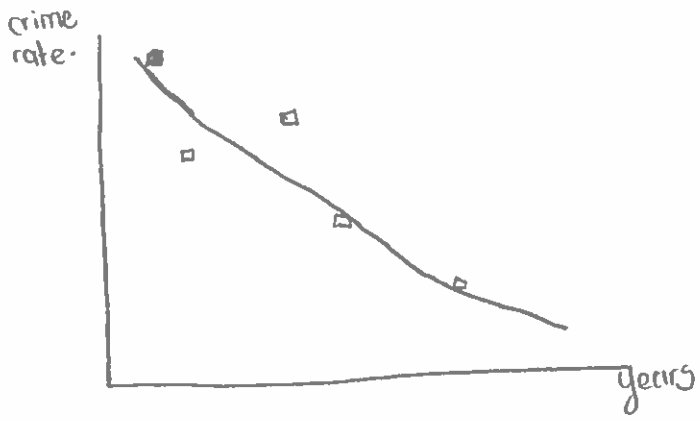
In 2013, the crime rate is decreasing at -.0011 or -00.11% per week

Supporting Work:

Y_1 = exponentialreg = 2.653903690052 4 × .8628704612988x

Y_2 = (nderiv. (Y_1, x, x)) $\frac{1}{52}$ = .. at year

	x	Y_1	Y_2
2013		.3901	-.0011



GROUP NAME:

Date:_____

Student Names (First and Last)

Speaker/Presenter: Sharon Isoe

Writer/Prep: Onur Turkan

Leader/Collaborator:_____

Independant Variable (x-axis): years

Dependant Variable (y-axis): rates (sales)

Conclusion (in words): rates decreasing at -.0706 monthly

In 2015 pink cars

Supporting Work:

Pink car Sales

x	Sales
01	50
05	46
08	34
11	55
12	51
14	25

Lin Reg.

$Y_1 = -.8468...x + 50.69...$

$Y_2 = nDeriv(Y_1, P, P) / 12$

	x	Y_1	Y_2 (Rates)
JAN	15	37.996	-.0706

Decades

Lin

x	Y_1	Y_2

Sin

x	Y_1	Y_2
15	46.92	2.2239

rate of sales

Sin Reg

	x	Y_1	Y_2
JAN	15	46.92	.01853 per month

GROUP NAME: Illuminatti

Date: 3/5/14

Student Names (First and Last)

Speaker/Presenter: Ryan Pidtrawski

Writer/Prep: Bishop Burr

Leader/Collaborator: Danyan Zhou

Independant Variable (x-axis): years

Dependant Variable (y-axis): gas prices

Conclusion (in words): When it reaches $3.00 per gallon again, it will take 563 years to be to another $1.

Supporting Work:

x	y
95	1
100	1.54
105	2.5
112	3
114	3.3

114-95 = 19 × 2 = 38 = period

Sinreg Sinreg 1, L1, L2, 38

$y = a(\sin(bx+c)+d$

$y = 1.1$

$b = .165$

$c = 1.806$

$d = 2.08$

1.1 - 2.08

a - d

1.1 - 2.08 #'s between

x	y_1	y_2
3	328.03	563.6

years per dollar