Theorems

Intermediate Value Theorem

If $f(a) \leq M \leq f(b)$

AND $f(x)$ is continuous

Then There is a "c" on $[a,b]$

so that $f(c) = M$

Ex $f(x) = x^{20} - 5x + 2$

$f(0) = 2$

$f(1) = -2$

$f(0) \geq 0 \geq f(1)$

AND $f(x)$ is continuous

because All Polynomials are continuous everywhere

Then by IVT.

There is a "c" on $[0,1]$

so that $f(c) = 0$

Squeeze Theorem

$$h(x) \leq f(x) \leq g(x)$$

$$\lim_{x \to a} h(x) = \lim_{x \to a} g(x) = L$$

Then $\lim_{x \to a} f(x) = L$

Ex $\lim_{x \to \infty} \frac{\sin x}{x}$

$$\frac{-1}{x} \leq \frac{\sin x}{x} \leq \frac{1}{x}$$

$$\lim_{x \to \infty} \frac{-1}{x} \leq \lim_{x \to \infty} \frac{\sin x}{x} \leq \lim_{x \to \infty} \frac{1}{x}$$

$$0 \leq \lim_{x \to \infty} \frac{\sin x}{x} \leq 0$$

$\lim = 0$ by Squeeze Theorem

Mean Value Theorem

Average Rate of change on $[a,b]$

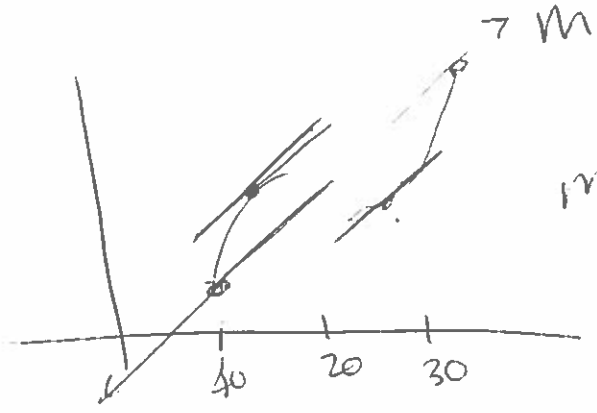
$$\frac{\Delta y}{\Delta x} = \frac{90-60}{30\text{min}} = \frac{30\text{mile}}{30\text{mile}} = \frac{60\text{mph}}{60\text{min}}$$

$$60\left(\frac{1}{60}\right)$$

If $f(x)$ is continuous, / differentiable.
Then there is a c on $[a,b]$

$$\frac{f(a)-f(b)}{a\ \ b} = f'(c)$$

Ave. Rate = Instantaneous.



(1) $Y_1 =$ reg Equation
Prefer Exponential

Turn off

(2) Find ave. Rate of Change

$Y_2 = (Y_1(13) - Y_1(8))/(13-8)$

(3) Find instanteous Rate of Chg

$Y_3 = nderiv(Y_1, X, X)$

Matrix $\frac{d}{dx} Y_1 \Big|_{x=\text{ }}$

(4) Calc 5. Intersect

<enter> <enter> <enter>

$X = 10.56$ $Y = 2.50$

(5) In (June) 2010, Lady G record sales are growing at the same rate as between 2008 to 2013 Rate was 2.5 million/yr

Growth in 2010 is representative of the region/time 2008 and 2013

Functions

Hyperbolic Trig Functions

Hyperbolic cosine
$$\cosh(x) \equiv \frac{e^x + e^{-x}}{2} \qquad \frac{d}{dx}\cosh(x) = \sinh(x)$$

Hyperbolic sine
$$\sinh(x) \equiv \frac{e^x - e^{-x}}{2} \qquad \frac{d}{dx}\sinh(x) = \cosh(x)$$

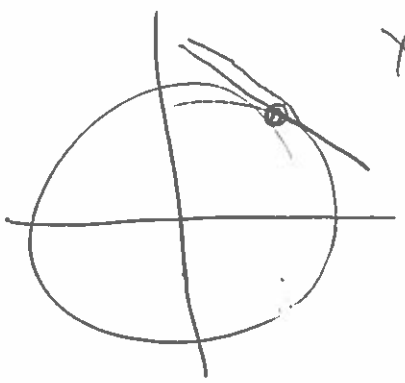
Hypebolic tan
$$\tanh(x) \equiv \frac{\sinh(x)}{\cosh(x)}$$

$$\cosh^2(x) - \sinh^2(x) = 1$$

Implicit Differention.

Explicit	Implicit
"I'm cutting your head off"	"Heads are gonna roll"
$f(x) = 2x+1$	$2x = 1 - y$

Ex



$x^2 + y^2 = 1$

$$x^2 + y^2 = 1$$

Find dy/dx at $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

Use implicit Differentiation

$$\frac{d}{dx}\left(x^2 + y^2\right) = \frac{d}{dx}(1)$$

$$2x^1 + 2y^1 \frac{dy}{dx} = 0$$

Chain Rule

$$2y \frac{dy}{dx} = -2x$$

$$\frac{dy}{dx} = \frac{-x}{y}$$

at $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ $\quad \frac{-1/\sqrt{2}}{1/\sqrt{2}} = -1$

$$\frac{d}{dx}\left(\sin(y) = x\right)$$

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

GROUP NAME: Polar Bears

Date: 2/26/13

Student Names (First and Last)

Speaker/Presenter: [illegible]

Writer/Prep: Fremont Bekele

Leader/Collaborator:

Independant Variable (x-axis): year

Dependant Variable (y-axis): # deaths

Conclusion (in words):

The rate of deaths is the same .13

Supporting Work:

[illegible]

1

2) Average = .13

X	Y
2009	2.1
2010	2.3
2011	2.6
2012	2.4
2013	2.7

[illegible] rate 5

[illegible] 3 times

= rise run

Y=.13

X=2011

GROUP NAME: Illuminatti

Date: 02/[illegible]

Independant Variable (x-axis): Years

Dependant Variable (y-axis): gas prices

Student Names (First and Last)

Speaker/Presenter: Ryan Piotrowski

Writer/Prep: [illegible]

Leader/Collaborator: Danyan Zhou

Conclusion (in words): In feb. [illegible] Gas prices are increasing at [illegible] as [illegible] [illegible] data [illegible] .10 [illegible] per year

Supporting Work:

X	Y
95	1
100	1.[illegible]
105	[illegible]
112	3
114	3.3

3.01 = [illegible]

[illegible] 100 - 112

X	y_2	y_3
100	3.01[illegible]	.398[illegible]
[illegible]	[illegible]	.5[illegible]

Intersection 2nd [illegible]

x = 106.21 y = .10[illegible]

GROUP NAME: [illegible]

Date: 02/26/14

Everyday we calculatin'

Independant Variable (x-axis): years

Dependant Variable (y-axis): sales

Student Names (First and Last)

Speaker/Presenter: [redacted] Jose

Writer/Prep: Purav Patel

Leader/Collaborator: onur Turkay

Conclusion (in words): - In 2010 the sales record are growing at the same rate as between 2008 and 2013 of Heroin in MCCCC

Supporting Work:

HEROIN IN MCCCCCCCC

Year	Sales.
8	11
9	13
10	16
11	18
12	21

Y_1 = Exponential $3.05 \cdot x^{1.175\ldots}$

Y2 = (Y1(12) − Y1(8)) / (12 − 8)

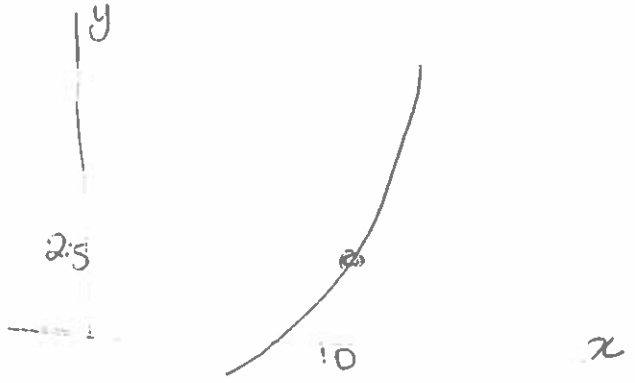
Y3 = nDeriv(Y1, X, X)

2nd Calc Intersect

First curve -

X 10.1

Y = 2.53



X = 10.1 .... Y = 2.53 ....

Growth in 2010 is rep of the time 2008 & 2012 rate was at 2.53 million.

GROUP NAME: W# Mean Business

Date: 2/26/14

Student Names (First and Last)

Speaker/Presenter: Christina Trujillo

Writer/Prep: Yasmin Silverio

Leader/Collaborator: Simar Kalra

Independant Variable (x-axis): Years

Dependant Variable (y-axis): Interest

Conclusion (in words): In Oct 2009, the interest rate are decreasing at same % rate as between 2009 to 2011.
The average rate is -0.43 which is one at 9.9 yr
Approximately in Oct 2009.

Supporting Work:

X	Y
8	3.71
9	1.53
10	.29
11	.38
12	.58

Y1 = 134.503383... * .600233...^X

Y2 = (Y1(11) - Y1(9))/(11-9)

Y3 = nDeriv(Y1, X, X)

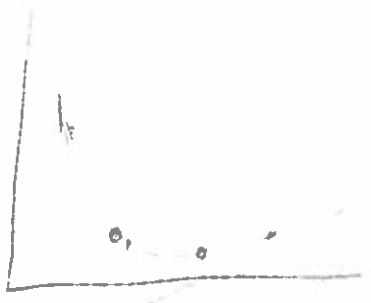
Intersection X = 9.9156 Y = .41...

Y2 = Average rate of change between 2009 & 2011

Y3 = Instantaneous rate of change

intersection at yr 9.9 = Oct 2009

X	Y2	Y3
8	-.43	-1.15
9	-.43	-.69
10	-.43	-.41
11	-.43	-.25
12	-.43	-.15



GROUP NAME: Money Makers

Date: 02/28/2014

Independant Variable (x-axis): time

Dependant Variable (y-axis): cri

Student Names (First and Last)

Speaker/Presenter: Bryan Sapon

Writer/Prep: Edna

Leader/Collaborator: Mon ca

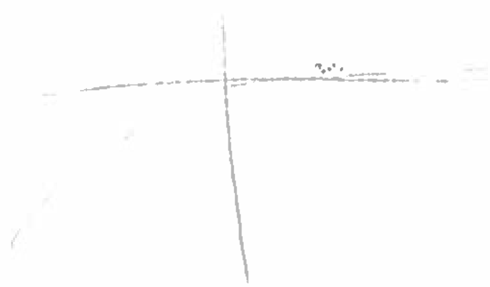
Conclusion (in words):

Supporting Work:

[illegible]	[illegible] delonal
2009	.75
2010	.52
2011	[illegible]
2012	.4[illegible]
2013	[illegible]

(1.) Y_1 = reg Equation pre[illegible] tial
2.653 [illegible] = [illegible] * .86201046 - 88X
2.65 * .86 x

(2.) Y_2 $(Y_1(13) - Y_1(8)) / (13-8)$



(3.) Y_3 = [illegible] ([illegible], x, x)
math : 8

(4.) Calc : [illegible]
[illegible] - [illegible]

(5.) [illegible] March of 2010 [illegible] crime rate [illegible] entative of the time between 2008 and 2013 [illegible] 8% / year

GROUP NAME: Functional Paradigm

Date: 02/26/2014

Student Names (First and Last)

Speaker/Presenter: Nader Shenouda

Writer/Prep: Karol Zaski

Leader/Collaborator:

Independant Variable (x-axis): time in hours

Dependant Variable (y-axis): memory usage in MB

Conclusion (in words):

~~During~~ At 2 hours and 9 minutes the instintanious rate of change is 445.22 MB/hour which is the same as the average rate of change between hour 0 and hour 4 which is 445.22 MB/hr

Supporting Work:

$Y_1 = \text{Exp Reg}$

$Y_2 = (Y_1(4) - Y_1(.001))/(4 - .001)$

$Y_3 = nDeriv(Y_1, X, X)$

X	Y
0	1000
1	1500
2	2500
3	2250
4	2600

$X = 2.1537864$

$Y = 445.22$

GROUP NAME: Cha - Ching

Date: 02/26/14

Student Names (First and Last)

Speaker/Presenter: Vinnie Avtuch

Writer/Prep: Sheila Mac Gan

Leader/Collaborator: Tatiana Calderon

Independant Variable (x-axis): Years

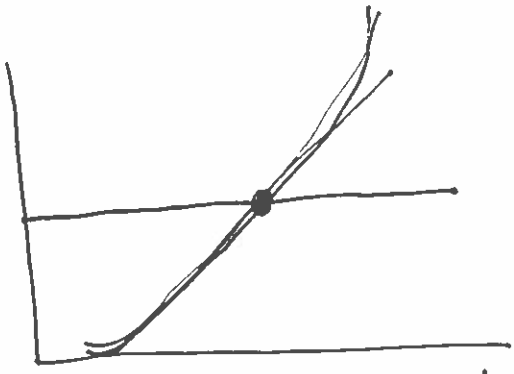
Dependant Variable (y-axis): Revenue

Conclusion (in words):

In Jan 2011 the club's revenue rate is growing at the same rate as between 2009 and 2013. Rate was 4.82 mil/year

Supporting Work:

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



$X = 11.134476$ $Y = 4.8298981$