

MAT 151 Calculus 1

Agenda

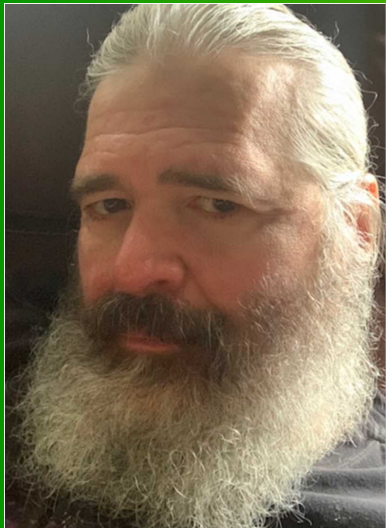
Prof. Porter

Homework Questions

Lecture:

Analysis of Functions

Groupwork



151d12

Homework Questions?

What is Zero times Infinity?

- a) Zero
- b) Infinity
- c) Could be anything

Lecture:

What is Math?

What is precalculus?

What is Calculus?

What are the rates of change?

How many points do you need?

Why did we invent limits?

What else is the velocity?

What is the second derivative?

What is Math? Language

What is precalculus? Functions

What is Calculus? Study of Change

What are the rates of change? Average and Instantaneous

How many points do you need? 2/1

Why did we invent limits? Takes two points to one

slope of the tangent line

What else is the velocity?

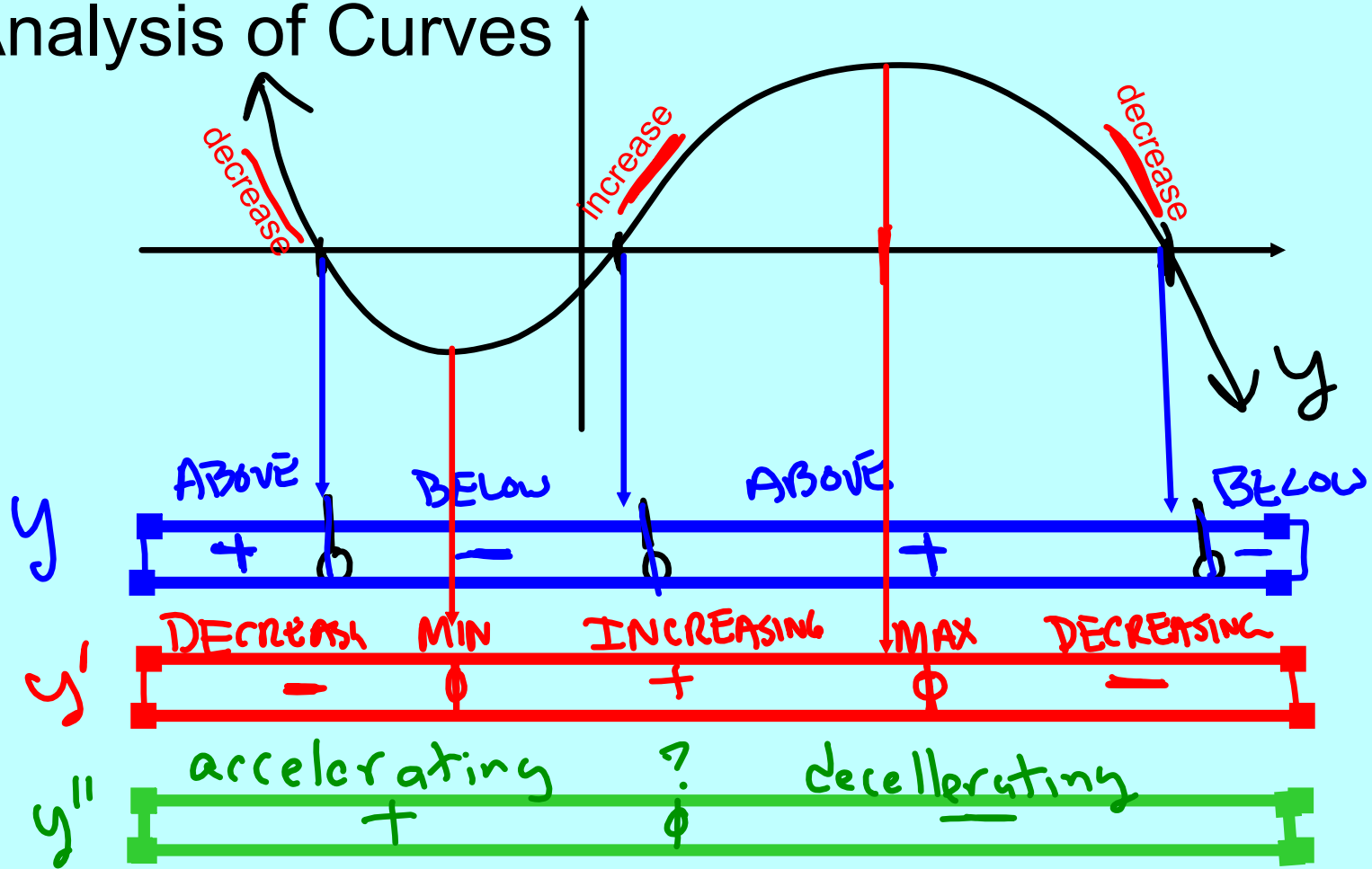
is the derivative

is the instantaneous rate of change

is the velocity

What is the second derivative? Acceleration

Analysis of Curves

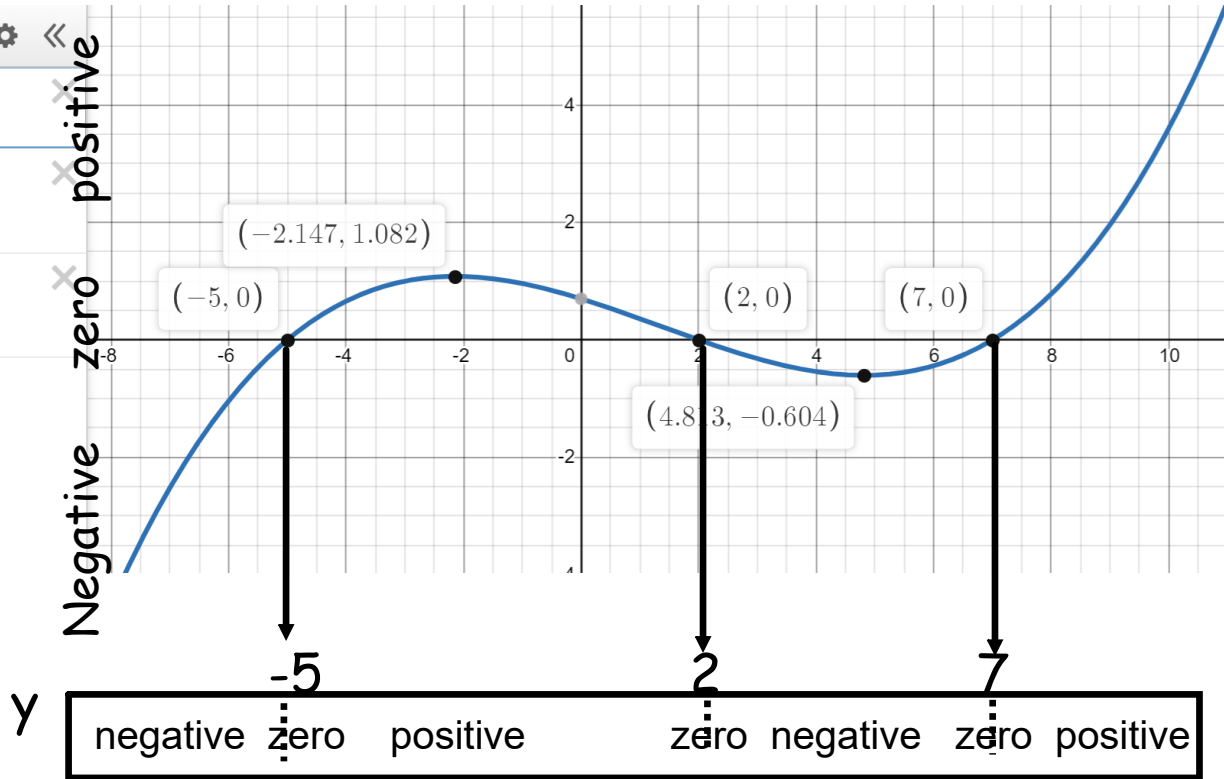


Example Function

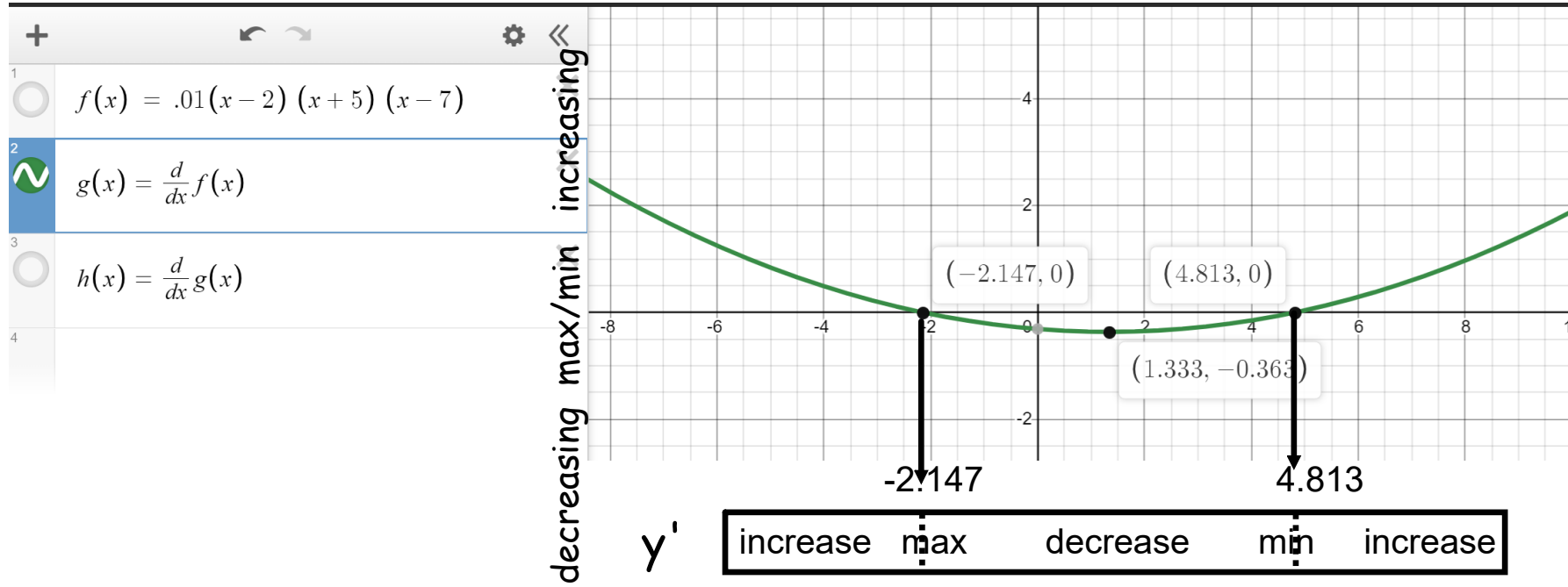
$$f(x) = .01(x - 2)(x + 5)(x - 7)$$

$$g(x) = \frac{d}{dx}f(x)$$

$$h(x) = \frac{d}{dx}g(x)$$



Derivative

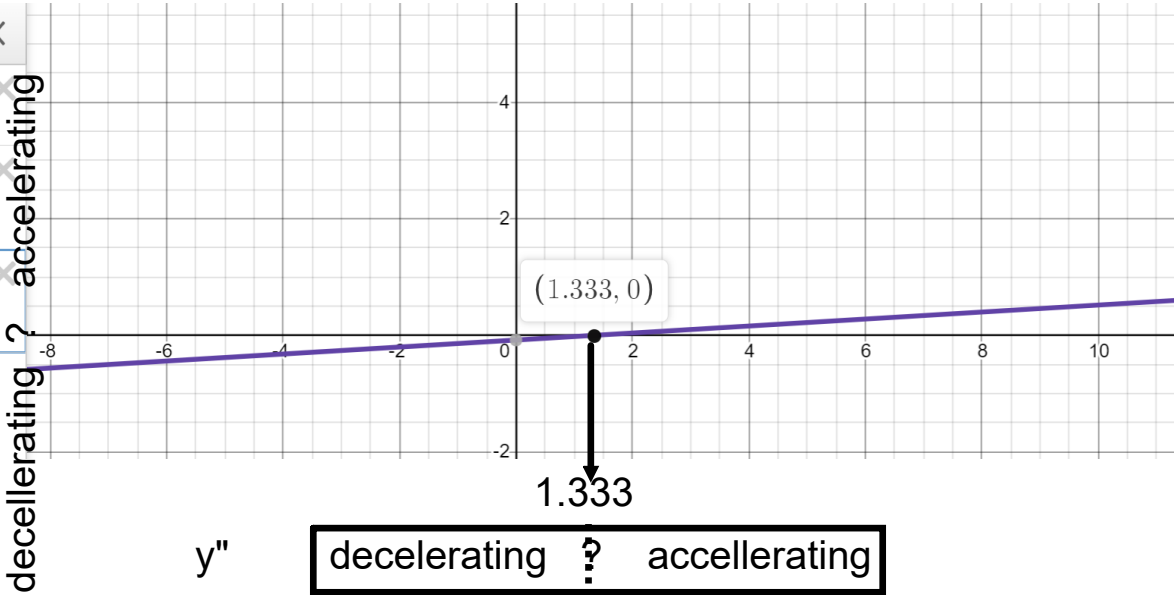


Second Derivative

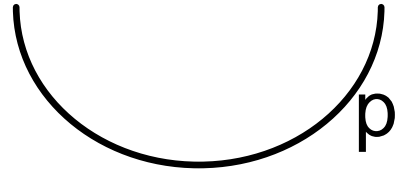
$f(x) = .01(x - 2)(x + 5)(x - 7)$

$g(x) = \frac{d}{dx}f(x)$

$h(x) = \frac{d}{dx}g(x)$



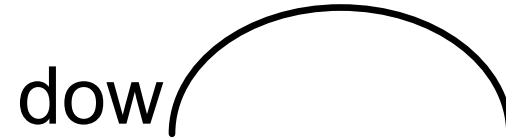
Concave Up



Second derivative

Positive

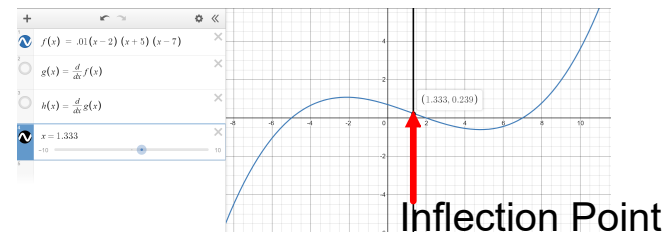
Concave Down



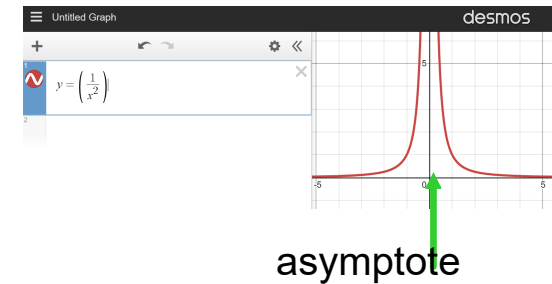
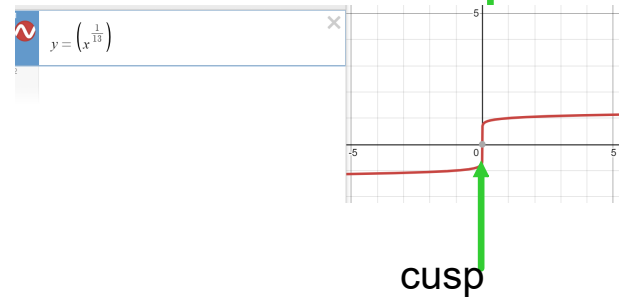
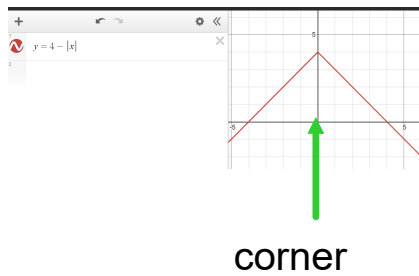
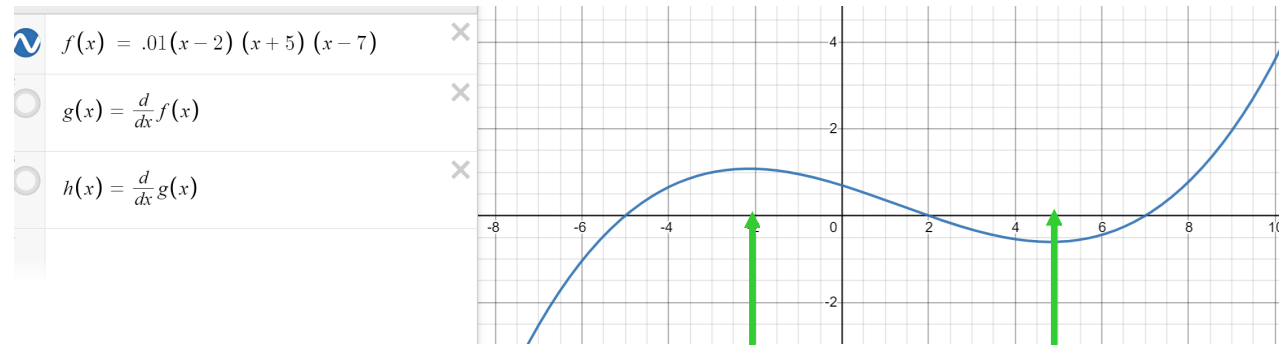
Second Derivative

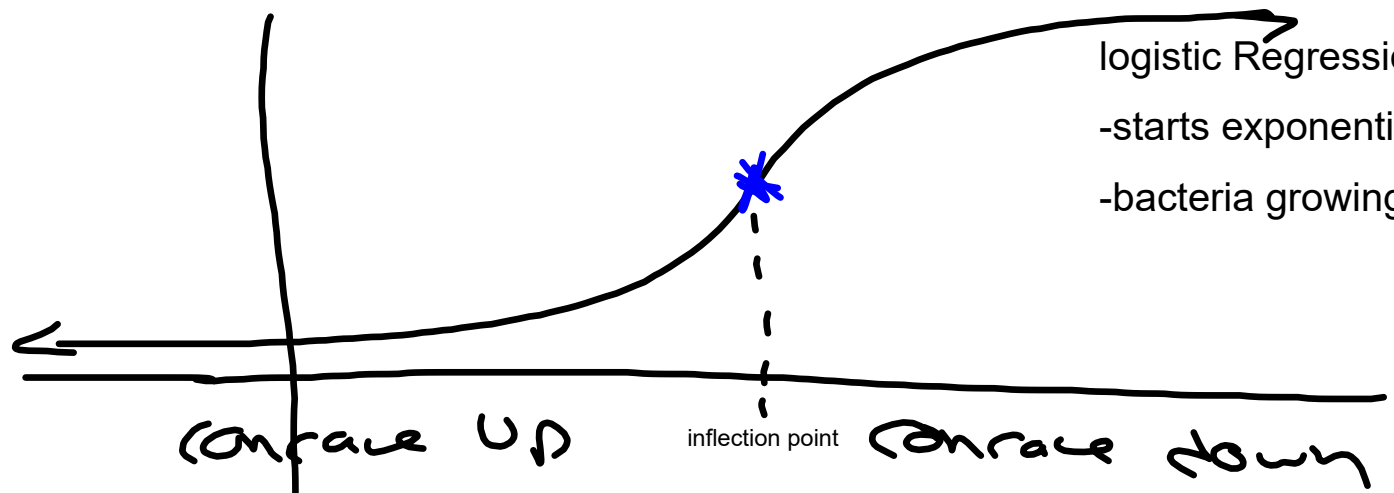
Negative

Inflection Point = any point where second derivative changes sign.

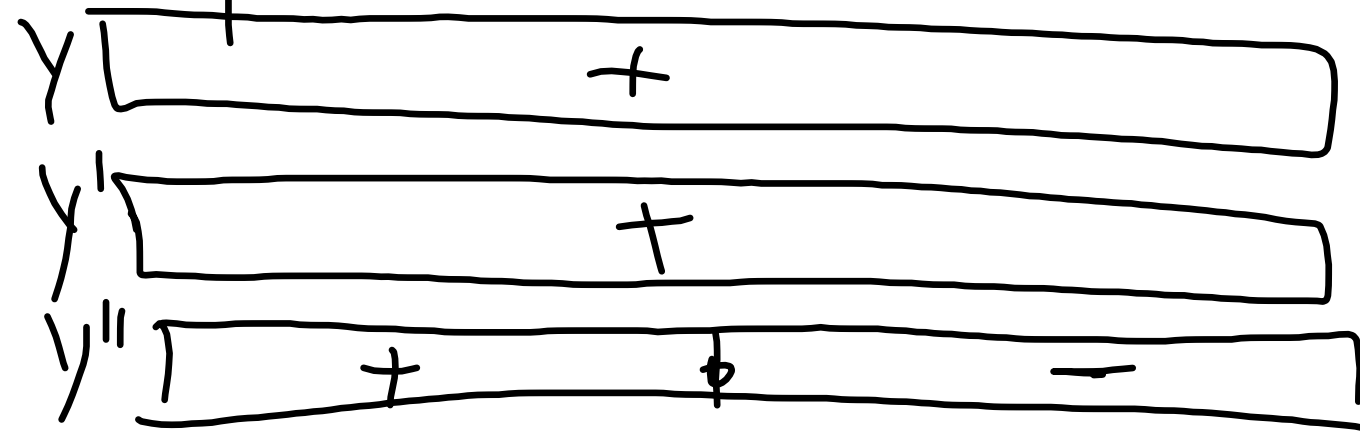


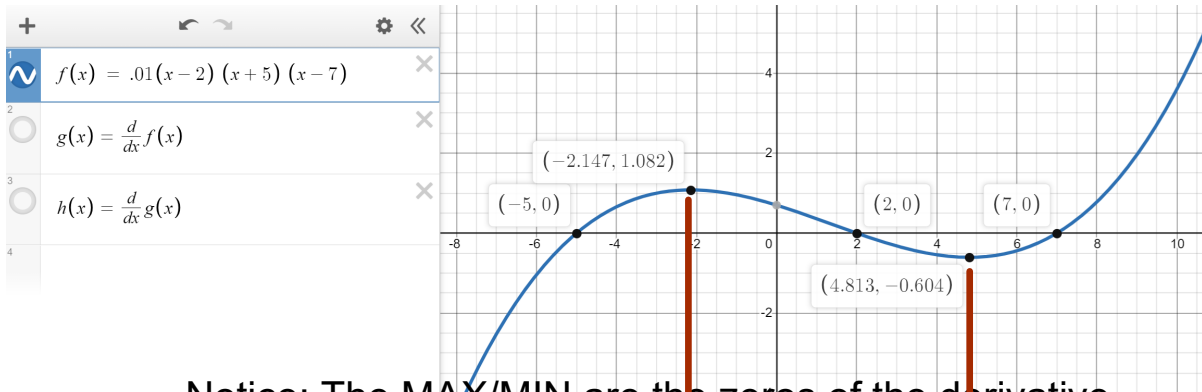
Critical Points : any point on the graph where the first derivative is either zero or undefined.



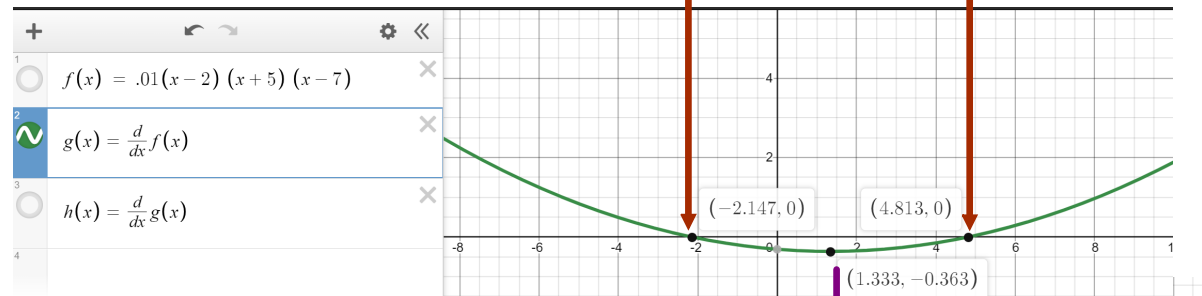


logistic Regression
 -starts exponential then levels off
 -bacteria growing in yogurt

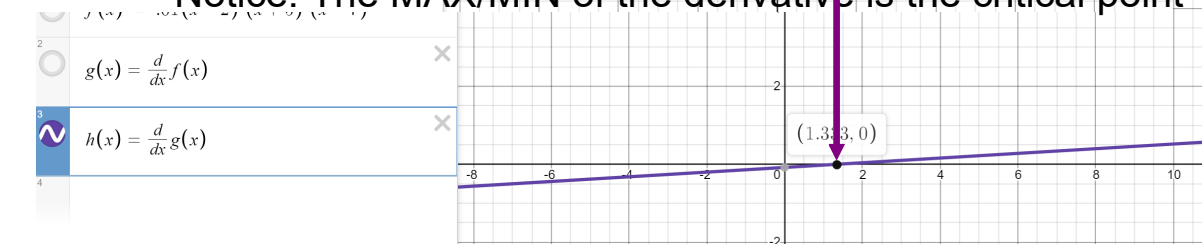




Notice: The MAX/MIN are the zeros of the derivative



Notice: The MAX/MIN of the derivative is the critical point



First derivative Test: If derivative goes positive-zero-negative, then the critical point is a maximum. Negative-zero-positive is min.

Second derivative test: If the second derivative of a critical number is negative, its a max. If its positive, then a minimum.

EX: Where's the max for $f(x) = x^3 - 3x + 7$

$$f'(x) = 3x^2 - 3 = 0 \quad \text{so } x=1, -1 \text{ are critical points}$$

$$f''(x) = 6x$$

$f''(1) = 6$ is positive so minimum, $f''(-1) = -6$ so maximum
 $x = -1$ is where the max is.

Group Work

Analysis of Functions

1. Put in a quartic regression or cubic
2. Put in the derivative
3. Put in the second derivative
4. Look for sign changes in y' to find critical point(s)
5. Look for sign changes in y'' to find inflection point(s)

Regressions:

Linear regression has no critical points or inflection points

Exponential has no critical points or inflection points

Logarithmic has no critical points or inflection points

Sine regression has an infinite number of both

Quadratic regression has only one critical number

Cubic Regression will have inflection point, maybe no max/min

Quartic regression may have critical point but no inflection point

	y	y'	y''
X	Y_1	Y_2	Y_3
7	3.7	.825	-.0917
8	4.5	.79167	.00833
9	5.3	.80833	.00833
10	6.1	.775	-.0917

y' always positive

No critical points between 7 and 10

X	Y_1	Y_2	Y_3
20	11.641	.10104	-.0122
40	11.627	-.0032	-.0064
60	9	-.1643	-.0019
80	5.5771	-.1669	.00142
120	1.1463	-.0351	-.00435
150	2	.00682	.00332
180	5.6299	.13615	-5E-4
200	8.0043	.0877	-.0046
240	5.033	-.3152	-.0164
260	-5.049	-.7189	-.0242

critical point between 20 and 40

critical point between 120 and 150

another critical point?

	y	y'	y''
X	Y_1	Y_2	Y_3
7	3.7	.825	-.0917
8	4.5	.79167	.00833
9	5.3	.80833	.00833
10	6.1	.775	-.0917

inflection point between 7 and 8

inflection point between 9 and 10

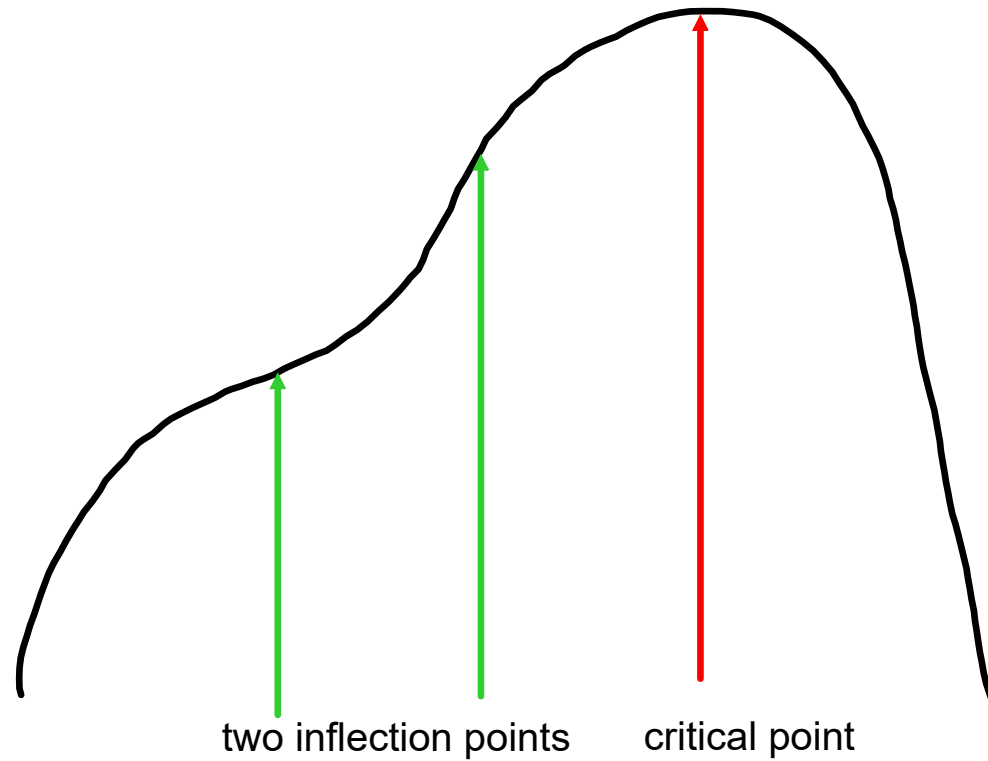
X	Y_1	Y_2	Y_3
20	11.641	.10104	-.0122
40	11.627	-.0032	-.0064
60	9	-.1643	-.0019
80	5.5771	-.1669	.00142
120	1.1463	-.0351	.00435
150	2	.08682	.00332
180	5.6299	.13615	-5E-4
200	8.0043	.0877	-.0046
240	5.033	-.3152	-.0164
260	-5.049	-.7189	-.0242

inflection point between 60 and 80

inflection point between 150 and 180

(another critical point between 200 and 240)

According to the quartic regression....



Producer:

X	Y ₁	Y ₂	Y ₃		
20	11.641	.10104	-.0122	Writer:	
40	11.627	-.0032	-.0064	Inflection:	
60	9	-.1643	-.0019	f'(70)=0	
80	5.5771	-.1669	.00142	f'(130)=0	
120	1.1463	-.0351	.00435	Critical:	
150	2	.08682	.00332	f'(30)=0	f''(30)=negative MAX
180	5.6299	.13615	-5E-4	f'(130)=0	f''(130)=positive MIN
200	8.0043	.0877	-.0046	f'(230)=0	f''(230)=negative MAX
240	5.033	-.3152	-.0164		
260	-5.049	-.7189	-.0242		

Speaker: According to the quartic regression, we find two inflection points at 70 and 130, as well a two relative maximums at 30 and 230 and a minimum at 130

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Group Name: Tom Xiao Speaker: Yvette
 DATE: 3/8/16 Writer: Mariam
 x-axis (independent variable): years Team Leader: _____
 y-axis (dependent variable): people (population of NJ)

Conclusion in words: According to the Quartic regression the inflection points occur at 58.479 (1958) + 79.9209 (1979).

13. Graph the cubic or quartic regression. Identify all critical points.

X	1950	1960	1970	1980	1990
Y	56766	148386	629235	-5666	127169
Increasing or Decreasing	↑	↓	↓	↑	↑
Y	23645	-2825			
Concavity? Up or Down					

TI-84 Plus
 X-V on Data 1 of 1
 X1=58.47983821
 X2=79.92125816

$5x^4 + 6x^3 + \dots + c$
 7.770964167
 $6 = -2120986417$
 $c = 2171133186$
 $d = -9787620158$
 $e = 159138189$

y-axis (dependent variable): _____

Conclusion in words: According to the quartic regression, the Max/and min occur at 1, 2.5, and 5. The inflection points occur at 1 and 2.

13. Graph the cubic or quartic regression. Identify all critical points.

X	1	1.5	2	2.5	3
Y	-43	83	17	-1	26
Increasing or Decreasing	↑	↓	↓	↑	↑
Y	64	-20	-169	173	32
Concavity? Up or Down	Down	0	U	U	

TI-84 Plus
 Graph of a quartic function on a coordinate plane.

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Group Name: Blitz Speaker: Nina
 DATE: 3/8/16 Writer: RS
 x-axis (independent variable): year Team Leader: Shay
 y-axis (dependent variable): log website Steve

Conclusion in words: According to the quartic regression maxima occur at $x = 21 = 1779$ & inflection points at $(-46.6577, 0)$; $(98.810716, 0)$
 1946 1998

13. Graph the cubic or quartic regression. Identify all critical points, concavity, and inflection points.

X	90	100	110	116	117	120	122	125	130
Y	7829	6629	81625	1181	2482	1484	686	1920	2957
Increasing or Decreasing	↓	↓	↑	↑	↑	↑	↓	↑	↑
Y	-23.4	3.9	39.5	63.5	67.1	79.6	88.1	1039	129.2
Concavity? Up or Down	down	up	up	up	up	up	up	up	up

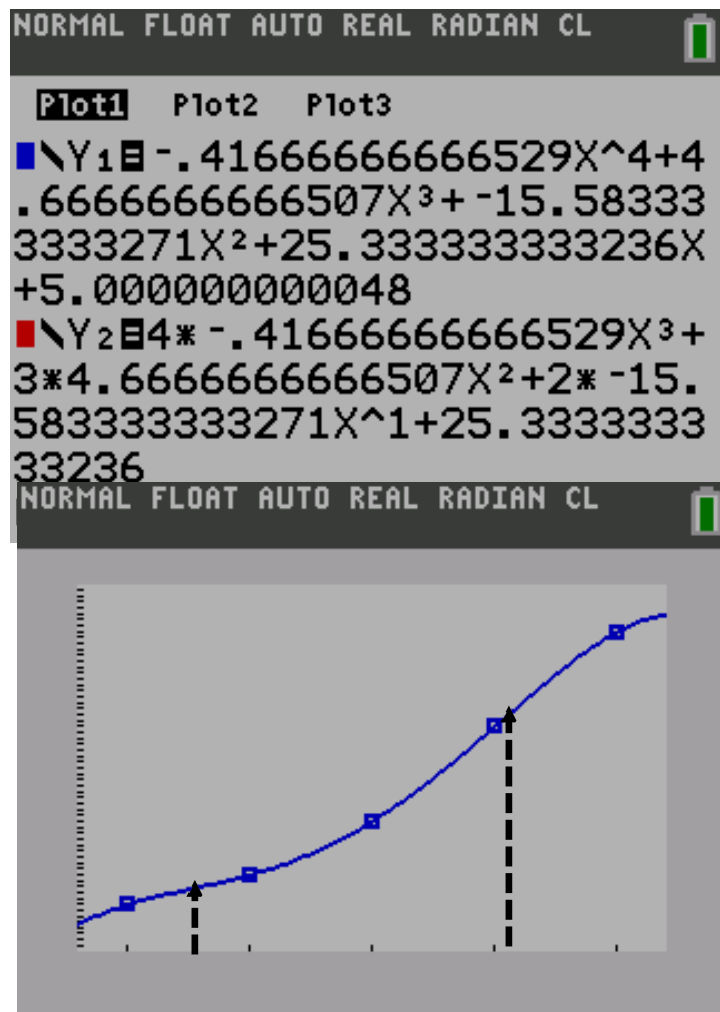
$(-46.6577, 0)$
 $(98.810716, 0)$

Conclusion in words: According to the inflection points of the quartic regressions, years ~~1958~~ 2010.19 and ~~1979~~ 2070.54 show a shift.

Graph of a quartic function showing inflection points.

13. Graph the cubic or quartic regression. Identify all critical points, concavity, and inflection points.

X	5	8	9	10	11	15	25	26	30
Y	49.3	59.8	43.6	46.3	46.2	8.3	464.8	674.3	232.8
Increasing or Decreasing	-	+	+	-	-	+	+	+	+
Y	-15.49	3.6	3.59	1.93	-1.87	-15.06	200.53	260.96	607.61
Concavity? Up or Down	up	up	up	up	down	down	up	up	up



NORMAL FLOAT AUTO REAL RADIAN CL

TABLE SETUP

TblStart=

ΔTbl=.78539816339745

Indent: Auto Ask

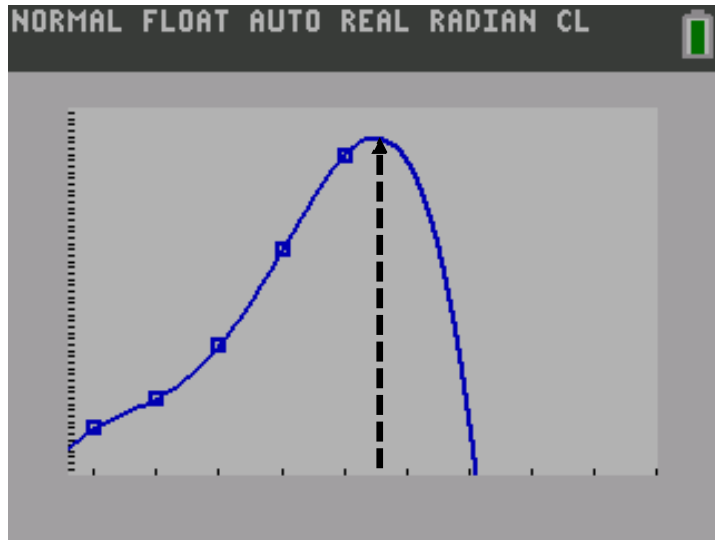
Depend: Auto Ask

NORMAL FLOAT AUTO REAL RADIAN CL

X	Y1	Y2	Y3
1	19	6.5	-8.167
2	24	5.6667	4.8333
3	33	12.833	7.8333
4	49	18	.83333
5	65	11.167	-16.17

X=

Inflection points!



Critical Point

X	Y ₁	Y ₂	Y ₃
1	19	6.5	-8.167
2	24	5.6667	4.8333
3	33	12.833	7.8333
4	49	18	.83333
5	65	11.167	-16.17
6	64	-17.67	-43.17

X=7

Reminders....

