Lesson 2: Absolute Max and Minimum Values and Rates of Change from Data

Critical Number. A critical number is a number where the derivative is equal to zero (most common) or a number where the function exists but the derivative does not, i.e. a vertical point or a bounce point. (not very common)

Read:

http://tutorial.math.lamar.edu/Classes/CalcI/AbsExtrema.aspx

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Absolute values will occur at local max and mins or the endpoints of a closed interval.

Example 1: Find the absolute Max and minimum of $y = x^3 + 2x^2 + x + 2$ on $[-2, \frac{1}{2}]$.

$y' = 3x^2 + 4x + 1$

$0 = 3x^2 + 4x + 1$

$0 = (3x+1)(x+1)$

$x = -\frac{1}{3} \quad x = -1$

$y(-\frac{1}{3}) = 1\frac{23}{27}$

$y(-1) = 2$

$y(-2) = 0$ min

$y(\frac{1}{2}) = 3\frac{1}{8}$ max

∴ We have an absolute max @ $(\frac{1}{2}, 3\frac{1}{8})$

" " min @ $(-2, 0)$

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Example 2:
The rate of change of concentration of one of the reactants during a chemical reaction is also known as the "rate of reaction". The concentration of dinitrogen pentoxide, $[N_2O_5]$ in the reaction $2\,N_2O_5 \rightarrow 4NO_2 + O_2$ were measured at one-minute intervals as in the table below:

a) Calculate the average rate of reaction for the interval $2 \le t \le 3$.
b) Determine a model for $[N_2O_5]$ in terms of the Time.
c) Determine the rate of reaction at the start and at t = 2.5 minutes.

Time (min)	$[N_2O_5]$
0	0.160
1	0.113
2	0.080 ←
3	0.040 ←
5	0.018

a) $AROC = \frac{0.040 - 0.080}{3 - 2}$

$= -0.04$ mol/L/min $y = 0.160 \cdot r^t$

b) $[N_2O_5] = \frac{0.040}{0.160} = \frac{0.160 \cdot r^3}{0.160}$

$0.63 \doteq r$

$C \rightarrow [N_2O_5] = 0.160(0.63)^t$

c) $C' = 0.160 \cdot \ln 0.63 \cdot (0.63)^t$

$C'(0) = -0.074$ mol/L/min

$C'(2.5) = -0.023$ mol/L/min

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Example 3:
Effectiveness of Fertilizer: The table give the mass (in tonnes) of carrots produced when a hectare of land is subjected to varying amounts of fertilizer.

a) Determine a model for the carrot tonnage in terms of the fertilizer.

b) How much fertilizer should be added for maximum carrot production?

Fertilizer per Hectare (kg)	Carrots Produced (t)
0	0.16
0.25	0.46
0.50	0.63
1.75	0.88
2.00	0.78
2.25	0.57

$y = ax^2 + bx + 0.16$

$= -0.449x^2 + 1.196x + 0.167$

quadratic

$y' = -0.898x + 1.196$

$0 = -0.898x + 1.196$

$x = 1.33$ kg/Ha of fertilizer.

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Try at least three examples, one polynomial, and two others. Copy at least one.
http://archives.math.utk.edu/visual.calculus/3/max.1/index.html

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