Warm Up

Given that $f(x) = -2(x - 3)^3 + 1$, determine the slope of the secant that connects the points where $x = -1$ and $x = 4$ on this function. (Provide a sketch)

X	Y_1
-1	129
4	-1

X=

$$m = \frac{129-(-1)}{-1-4} = \frac{130}{-5} = -26$$

*Make sure you have a graphing calculator at your seat

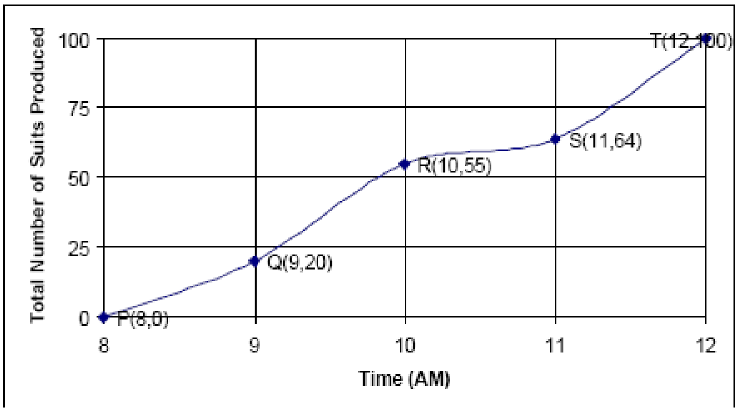
- Review table feature
- Demonstrate how to scatterplot

To Sum it Up..........

The Average Rate of Change for any quantity (speed, rpm, product/cost, $/hour etc....) is the slope of the line between two known quantities.

Example

The graph above shows the total production of suits by Raggs Ltd. during one morning of work. Industrial psychologists have found curves like this typical of the production of factory workers.



The average number of suits produced per hour are as follows:

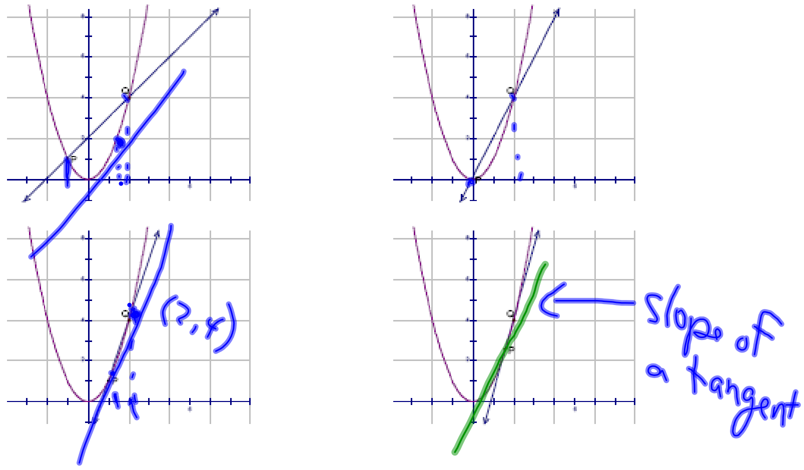
from 8 to 9 $m = \frac{20-0}{9-8} = 20/1$ **so 20 suits per hour**

from 9 to 10 $m = \frac{55-20}{10-9} = 35/1$ **so 35 suits per hour**

etc .....

Instantaneous Rate of Change

Average Rate of Change on $y = x^2$, as x approaches 2 (as P approaches Q).

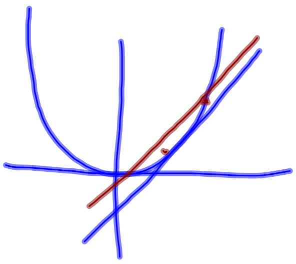


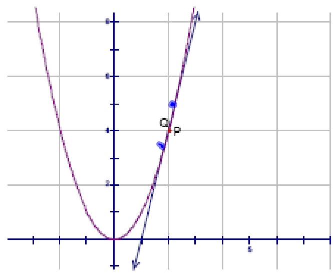
x interval	$y_2 - y_1$	$x_2 - x_1$	$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$
$1 \le t \le 2$	4 - 1 = 3	1	3
$1.5 \le t \le 2$	4 - 2.25 = 1.75	0.5	3.5
$1.9 \le t \le 2$	4 - 3.61 = 0.39	0.1	3.9
$1.99 \le t \le 2$	4 - 3.9601 = 0.399	0.01	3.99
$1.999 \le t \le 2$	4 – 3.996001 = 0.003999	0.001	3.999

As time gets closer to x = 2, the average rate of change is approaching a value which is called the instantaneous rate of change at x = 2. It appears that, as we shorten the interval of x, the average rate of change becomes closer to a value of 4.

To find the instantaneous speed at t = 2, we find the slope of the tangent at t = 2.

Instantaneous Rate of Change at t = 2 is 4 (slope of tangent).





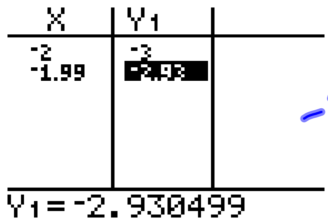
Instantaneous Rate of Change

The slope of the tangent to a graph of continuous ordered pairs of data, at a particular point.

- To approximate **instantaneous** rates of change, the slope of a tangent line (touching the curve at only one point) must be found. This is done by making the interval between two points very small (ex. 0.01 or 0.001 in the difference)

- When you are determining the instantaneous rate of change from a graph, then the point you want is used, and the next closest one.

How will we find the slope of a tangent at a particular point??



$\frac{-3 - -2.93\ldots}{-2-(-1.99)}$

$m = 6.95$

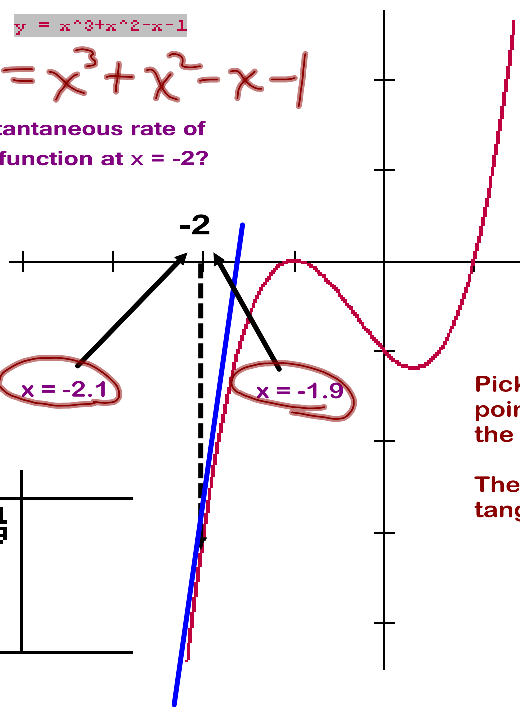
y = x^3+x^2-x-1

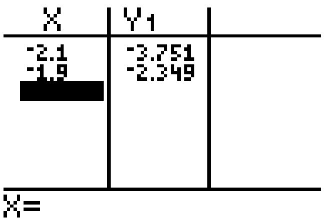
$y = x^3 + x^2 - x - 1$

What is the instantaneous rate of change of this function at x = -2?

$f(-2.1) = ?$

$f(-1.9) = ?$



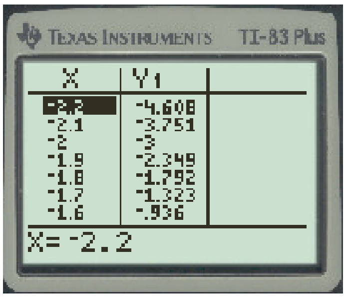


Pick a point just above and just below the point at which you are trying to determine the slope of the tangent.

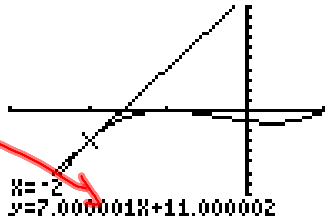
The closer the points are to the point of tangency the better!!

Calculations...

$y = x^3 + x^2 - x - 1$



IRC



$y = mx + b$

We can see that...

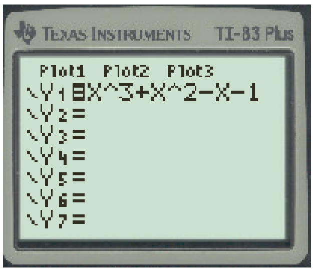
if x = -1.9 y = -2.349

if x = -2.1 y = -3.751

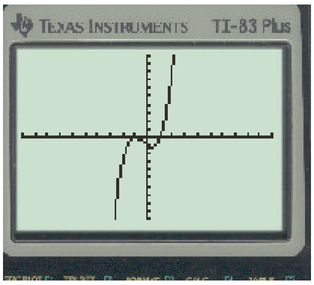
$$IRC = \frac{-3.751-(-2.349)}{-2.1-(-1.9)} = 7.01$$

Let's verify using a graphing calculator...

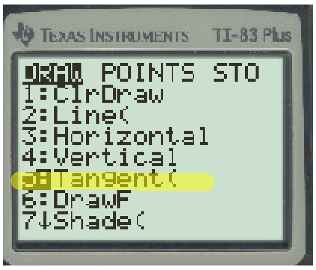
Step 1: Enter the function into Y=



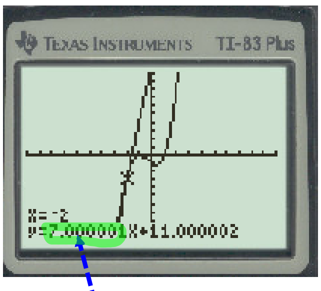
Step 2: Graph the function



Step 3: Go into the DRAW menu and find "Tangent"

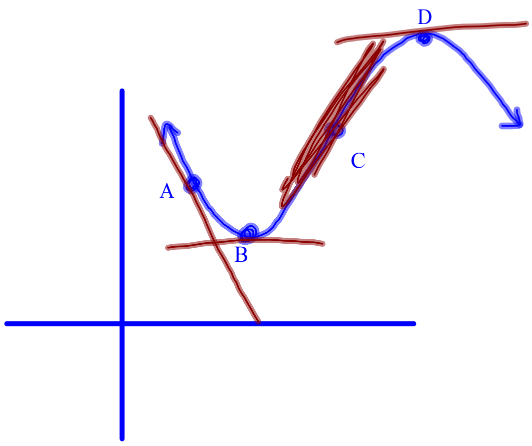


Step 4: You will be taken back to the graph screen, now enter the x-value where you would like the tangent to be drawn. The equation of the tangent will show up at the bottom of the screen in the form y = mx + b. The instantaneous rate of change is the slope of this tangent.



slope of the tangent...thus the instantaneous rate of change at x = -2.

Instantaneous Rate of Change (IROC)



At what point would a tangent be drawn to best indicate a **negative** instantaneous rate of change?

A

At what point would a tangent be drawn to best indicate a **positive** instantaneous rate of change? **zero?**

C