# Section 2.1 – Derivatives and Rates of Change

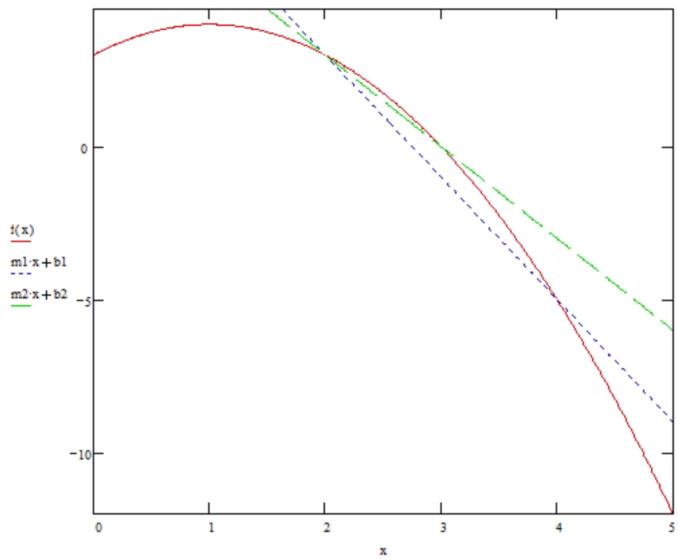
*Recap:*

- Lets look at the function $f(x) = -x^2 + 2x + 3$.

  Q: What is the equation of the line through the points on the graph at $x$ = 2 and $x$ = 4?
  A:

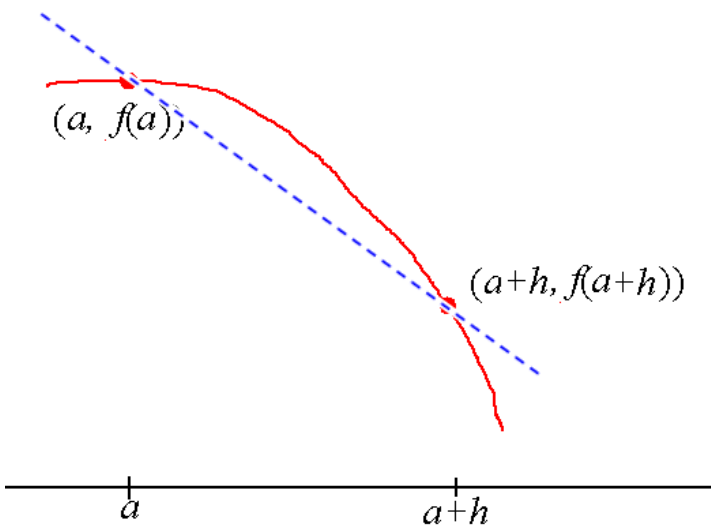
  Q: What about the equation between 2 and 3?
  A:

  Q: Can you predict the tangent line at $x$ = 2?
  A:




*The General Process:*

- From an original starting point ( $a$, $f(a)$ ) we are looking at the slope of the line connecting it to another point a distance of $h$ away from $a$.




- What is the slope of this dashed line connecting ( $a$, $f(a)$ ) and ( $a+h$, $f(a+h)$ )?

$$\Delta y = f(a+h) - f(a)$$

$$\Delta x = (a+h) - a = h$$

$$slope = \frac{\Delta y}{\Delta x} = \frac{f(a+h) - f(a)}{h}$$

- We want to let $h$ tend to zero, so that the point ( $a+h$, $f(a+h)$ ) collapses into ( $a$, $f(a)$ ). So we take $\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}$.
- This is slope of the tangent line, also called the instantaneous rate of change of $f(x)$ at $x = a$.

*<u>Same Definition, Different Names:</u>*

- The formula given by $\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}$ has a few different names.
- The ______________________________ to the curve $f(x)$ at the point $a$.
- The ______________________________ of the function $f(x)$ at the point $a$.
- The ______________________________ of $f(x)$ at the point $a$.
- The ______________________________ of $f(x)$ at the point $a$.
- If $f(x)$ represents distance at any time, then the above definition is the ______________________ at the point $a$. If we take the absolute value of this, it represents ______________________________.

*<u>Some Examples:</u>*

- *Find the slope of the tangent line to the parabola $y = x^2 - 3x$ at the point $x = -1$.*

- *Find an equation of the tangent line to the curve* $y = \sqrt{5x - 4}$ *at the point x = 4.*

- *Find the slope of the tangent to the curve* $y = \dfrac{1}{x-3}$ *at any point a.*

- *Find the slope of the tangent to the curve* $y = 2\sqrt{x}$. *This time we will leave it as x instead of a.*