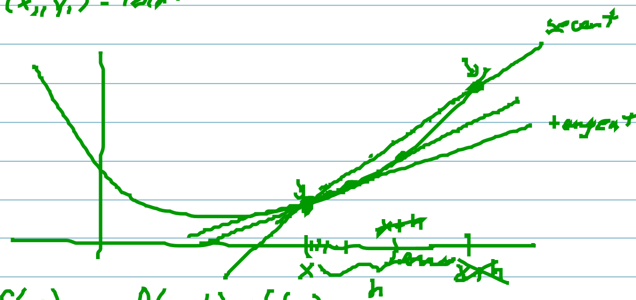
Tangent Line

Point - slope

$y - y_1 = m(x - x_1)$

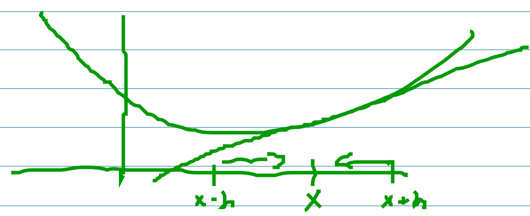
slope $\quad (x_1, y_1) = \text{Point}$

secant Line



$$m_{sec} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{f(x+h) - f(x)}{x+h - x} = \frac{f(x+h) - f(x)}{h}$$

$$m_{tan} = \lim_{h \to 0} \left(\frac{f(x+h) - f(x)}{h} \right)$$



$h = 1$
$h = 0.5$
$h = 0.1$
$h = 0.01$
$h = 0.001$

$y = x^3 \qquad (1,1)$

$$m_{sec} = \frac{f(x+h) - f(x)}{h} = \frac{(x+h)^3 - x^3}{h} = \frac{(1+h)^3 - 1}{h}$$

h	x	x+h	m_{sec}
1	1	2	7
0.5		1.5	4.75
0.1		1.1	3.31
0.01		1.01	3.0301
→ 0.001		1.001	3.003001

h	x	x+h	m_{sec}
-1	1	0	-1
-0.5		0.5	1.75
-0.1		0.9	2.71
-0.01		0.99	2.9701
-0.001		0.999	2.997001

$m_{tan} = 3$

$y - 1 = 3(x - 1)$
$y - 1 = 3x - 3$
$y = 3x - 2$

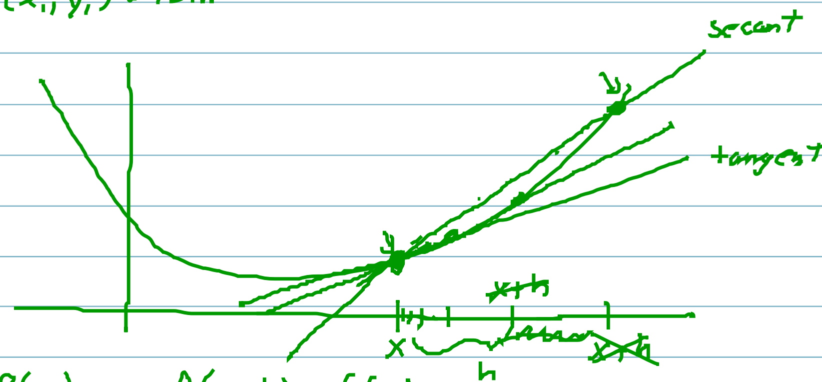
Tangent Line

Point - Slope

$$y - y_1 = m(x - x_1)$$

m = slope $\qquad (x_1, y_1)$ = Point

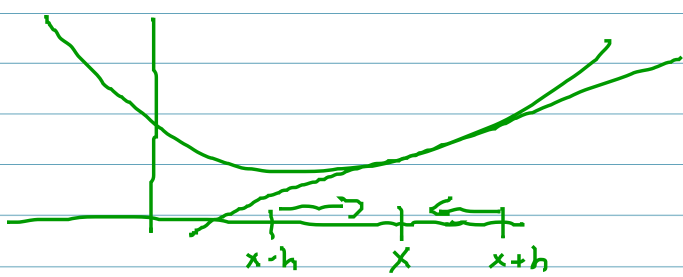
secant Line



$$\frac{y_2 - y_1}{x_2 - x_1}$$

$$m_{sec} = \frac{f(x+h) - f(x)}{x+h - x} = \frac{f(x+h) - f(x)}{h}$$

$$m_{tan} = \lim_{h \to 0}\left(\frac{f(x+h) - f(x)}{h}\right)$$



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$y = x^3 \qquad (1,1)$

$$m_{sec} = \frac{f(x+h) - f(x)}{h}$$

$$= \frac{(x+h)^3 - x^3}{h}$$

$$= \frac{(1+h)^3 - 1}{h}$$

h	x	x+h	m_{sec}
1	1	2	7
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$m_{tan} = 3$

$$y - 1 = 3(x - 1)$$
$$y - 1 = 3x - 3$$
$$y = 3x - 2$$

Velocity

Position $- f(x)$

50 miles $-$ 1 hr $\rangle$ 25 mph.
75 miles $-$ 2 hr

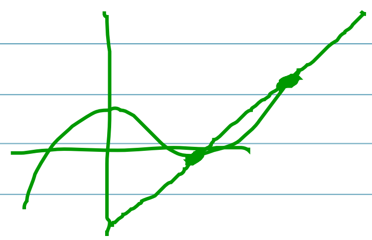
Average Velocity $= \dfrac{\text{displacement}}{\text{time}} = \dfrac{f(a+h) - f(a)}{h}$

Instantuneous Velocity $= V(a) = \lim\limits_{h \to 0} \left(\dfrac{f(a+h) - f(a)}{h} \right)$

speed $= |v(a)| = |f'(a)|$

Derivative - slope

Rates of Change - slope



increment - change in independent variable
$- \Delta x = x_2 - x_1$

Average rate of change of y with respect to x

$\rightarrow \dfrac{\Delta y}{\Delta x} = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{f(x_2) - f(x_1)}{x_2 - x_1}$

Instontaneous rate of change of y with respect to x

$$\lim_{\Delta x \to 0} \left(\frac{\Delta y}{\Delta x} \right) = \lim_{x_2 \to x_1} \left(\frac{f(x_2) - f(x_1)}{x_2 - x_1} \right) = f'(x_1)$$