Math 201
Section 2.1 <u>Tangent Lines and Rates of Change</u>

<u>Definition</u> The tangent line to the curve $y = f(x)$ at the point $P(a, f(a))$ is the line through P with slope

$$m = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

provided that this limit exists.

<u>Velocities</u> If $s(t)$ is a position function, then the average velocity on the interval $[t_1, t_2]$ is

$$\frac{s(t_2) - s(t_1)}{t_2 - t_1}.$$

If $s(t)$ is a position function, then the instantaneous velocity at $t = a$ is given by

$$v(a) = \lim_{h \to 0} \frac{s(a+h) - s(a)}{h}.$$

<u>Other Rates of Change</u> For any function $y = f(x)$ where y is some quantity depending on x,

$$\text{average rate of change from } x_1 \text{ to } x_2 \;=\; \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

$$\text{instantaneous rate of change at } (x_1, f(x_1)) \;=\; \lim_{x_2 \to x_1} \frac{f(x_2) - f(x_1)}{x_2 - x_1} = \lim_{h \to 0} \frac{f(x_1 + h) - f(x_1)}{h}$$