WARM UP:

x	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
0	1	1	-3	$\frac{1}{2}$
1	3	5	$\frac{1}{2}$	-4

1. Given the table, find the following derivatives:

(a) $f(x)g^2(x)$ at $x = 0$ (b) $g(f(x))$ at $x = 0$

2. $\lim_{x \to 0} \frac{\sin^2 x + 2 \sin x}{x \sec 2x}$

L'Hopital's Rule

Objective: Apply L'Hopital's Rule to find limits that produce indeterminate forms.

When evaluating limits, recall that we had two indeterminate forms. When direct substitution yields one of these results, we had to do algebraic techniques to try to find the limit (if it exists).

Indeterminate forms: $\frac{0}{0}$ or $\frac{\infty}{\infty}$

$$\lim_{x \to 0} \frac{\sin^2 x + 2\sin x}{x \sec 2x}$$

Sometimes we can use algebraic techniques

$$\lim_{x \to 0} \frac{e^{2x} - 1}{x}$$

Sometimes we can't

L'Hôpital's Rule

If $\lim_{x \to a} \frac{f(x)}{g(x)}$ yields either of the indeterminate forms $\frac{0}{0}$ or $\pm\frac{\infty}{\infty}$, then $\lim_{x \to a} \frac{f(x)}{g(x)} = \lim_{x \to a} \frac{f'(x)}{g'(x)}$.

$$\lim_{x \to 0} \frac{e^{2x} - 1}{x}$$

$$\lim_{x \to 4} \frac{3x - 12}{x^2 - 16}$$

$$\lim_{x \to 1} \frac{x - 1}{\sqrt{x} - 1}$$

$$\lim_{x \to 0} \frac{\sqrt{25 - x^2} - 5}{x}$$

$$\lim_{x \to 0} \frac{sinx}{x}$$

You can use the rule for limits to infinity

$$\lim_{x \to \infty} \frac{lnx}{x}$$

$$\frac{\infty}{\infty}$$

You can also repeat the rule over and over (if needed)

$$\lim_{x \to \infty} \frac{x}{\ln(1 + 2e^x)}$$

$$\lim_{x \to 0} \frac{1 - cosx}{x^2}$$