Math 1431

Section 16679

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Questions?

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1. Use differentials to approximate $\sqrt{24}$.

Section 5.3 - L'Hopital's Rule

Sometimes when taking the limit of a function we encounter answers in the form of $\frac{0}{0}$ or $\frac{\infty}{\infty}$. These forms are called **indeterminate** because they do not guarantee that the limit exists or fails to exist, nor do they indicate what the limit is.

For the indeterminate form $\frac{0}{0}$, L'Hopital's Rule states:

Suppose that $f(x) \to 0$ and $g(x) \to 0$ as either $x \to c^+$, $x \to c^-$,$x \to c$, $x \to \infty$or $x \to -\infty$, if $\frac{f'(x)}{g'(x)} \to L$, then $\frac{f(x)}{g(x)} \to L$.

Note that this theorem includes the possibility that the limit L equals infinity or negative infinity.

Section 5.3 - L'Hopital's Rule

For the indeterminate form $\frac{\infty}{\infty}$, L'Hopital's Rule states:

Suppose that $f(x) \to \pm\infty$ and $g(x) \to \pm\infty$ as either $x \to c^+$, $x \to c^-$,$x \to c$, $x \to \infty$or $x \to -\infty$, if $\frac{f'(x)}{g'(x)} \to L$, then $\frac{f(x)}{g(x)} \to L$.

Note that this theorem includes the possibility that the limit L equals infinity or negative infinity.

Section 5.3 - L'Hopital's Rule

Examples: Find each limit.

1. $\lim_{x \to 0} \dfrac{5e^{3x} - 5}{x^2}$

2. $\lim_{x \to \infty} \dfrac{7x^5 - 3x^2 + 4x}{2x^5 + x^2}$

Section 5.3 - L'Hopital's Rule

3. $\lim_{x \to 0} \dfrac{e^x - e^{-x}}{\sin(3x)}$

4. $\lim_{x \to 0} \dfrac{\sin(x)}{x}$

Section 5.3 - L'Hopital's Rule

5. $\lim_{x \to 0} \dfrac{\tan(2x)}{e^x - 1}$

6. $\lim_{x \to 0} \dfrac{e^x - x - 1}{x^2}$

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7. $\lim_{x \to 0} \dfrac{e^x - 1}{x^2}$

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Does L'Hopital's Rule apply?

2

3

Section 5.3 - L'Hopital's Rule

Other indeterminate forms of L'Hopital's Rule:

$$1^{\infty} \qquad \infty^{0} \qquad 0^{0} \qquad 0 \cdot \infty \qquad \infty - \infty$$

The first three arise from limits of functions that have variable bases and variable exponents.

When we encounter these forms, we must re-write the problem to the form of $\frac{f(x)}{g(x)}$ in order to use LR.

Section 5.3 - L'Hopital's Rule

Examples:

1. $\lim_{x \to \infty} \left(1 + \frac{1}{x}\right)^x =$

2. $\lim_{x\to\infty} (3^x + 4^x)^{1/x} =$

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Does L'Hopital's Rule apply?

4.

5.