MTH 252 Lab
L'Hôpital's Rule

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Purpose

Take a moment to answer the following questions.

(a) When can you use L'Hôpital's Rule?

(b) Why can't we use L'Hôpital's Rule on the limit $\lim_{x\to 0} \frac{\cos x}{x^2}$?

Prompts

1. Evaluate the limit.

   (a) $\lim_{x\to 9} \frac{\ln \frac{x}{9}}{81 - x^2}$

   (b) $\lim_{y\to 1} \frac{5^y - 4^y - 1}{y^2 - 1}$

   (c) $\lim_{\theta\to 0} \frac{1 - \cos 3\theta}{1 - \cos 2\theta}$

   (d) $\lim_{z\to\infty} \frac{37z^3}{e^{42z}}$

2. To identify a horizontal asymptote, we compute a limit as $x \to \infty$ or $x \to -\infty$.

   Let $f(t) = \frac{3t^3 + 24}{2t^3 + 4t^2 - 5t - 10}$. Compute the following limits to find the horizontal asymptote(s) of f.

   a. Evaluate $\lim_{t\to\infty} f(t)$

   b. Evaluate $\lim_{t\to-\infty} f(t)$

3. Computer scientists and chaos theorists often compare functions and their growth rates. Some functions grow at a seemingly similar rate while others grow at very different rates. When one function grows way faster than another, we say it *dominates* the slower function. Mathematically, we say that g **dominates** f if $\lim_{x\to\infty} f(x) = \lim_{x\to\infty} g(x) = \infty$ and either $\lim_{x\to\infty} \frac{f(x)}{g(x)} = 0$ or $\lim_{x\to\infty} \frac{g(x)}{f(x)} = \infty$.

   a. Show that e^x dominates x^2.

   b. Show that x^2 dominates $\sqrt{x}$.

   c. Show that $\sqrt{x}$ dominates $\ln x$.

Student Skills

Throughout the term, different student skills will explored during these labs. These will cover study skills, behavior during class, behavior outside of class, and so on.

Recognizing Gaps in Knowledge

As you are working through a math exercise, pay attention to what you are feeling. Are you feeling comfortable and confident? Are you feeling distressed? Are you on cruise control?

When you recognize any discomfort while doing math, ask yourself what is causing that discomfort. If it is due to not knowing a math property or what to do next, then write down your question. Then *get that question answered.*