1  8.9: Improper Integrals

Improper integrals are integrals involving a region which is unbounded in some sense. There are two types of improper integrals, each of which is handled similarly:

**Examples:** \( \int_0^\infty x e^{-2x} \, dx = \)

\( \int_0^1 \ln x \frac{1}{x} \, dx = \)
Find all values of $p$ for which $\int_1^\infty \frac{1}{x^p} \, dx$ converges.

**Comparison Theorem**: Suppose $f$ and $g$ are continuous and $0 \leq f(x) \leq g(x)$ for $x > N$:

a) If $\int_N^\infty g(x) \, dx$ converges, then

b) If $\int_N^\infty f(x) \, dx$ diverges, then
Determine whether \( \int_1^\infty \left( \frac{\sin x}{x} \right)^2 \, dx \) is convergent or divergent and explain why.

On Beyond Average:

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\int_3^\infty \frac{x + 1}{x^2 - 4} \, dx =
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\int_2^\infty \frac{\ln x}{x^2} \, dx =
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