Mathematics 1110H – Calculus I: Limits, Derivatives, and Integrals
TRENT UNIVERSITY, Summer 2025 (S62)

Assignment #4 – Integration
Due on Friday, 18 July.[*]

Please at least skim Sections 1.12, 4.8, and 4.19 of *Sage for Undergraduates*, which cover the basics of the `integral`, `limit`, and `sum` commands, respectively, before tackling this assignment. Please note that SageMath uses `oo` when you need to indicate ∞ in these commands. For the Right-Hand Rule, please take a look at the handout *Right-Hand Rule Riemann Sums*, which you can find in the *Textbook and Handouts* folder in the *Course Content* section on Blackboard, or on the archive page. You can find the basics of what definite and indefinite integrals (*i.e.* antiderivatives) are in Chapter 7 of the textbook.

In questions **1**–**5**, let $f(x) = x^2 - 1$.

1. Use SageMath to solve the first-order linear differential equation $\dfrac{dy}{dx} = f(x)$ to find the (general) antiderivative of $f(x)$. *[1]*

2. Use SageMath to find the (general) antiderivative of $f(x)$ with the `integral` command. *[2]*

3. Use the antiderivative you found in answering question **1** or **2** to compute the definite integral $\displaystyle\int_{-1}^{2} f(x)\,dx$. *[1]*

4. Compute the definite integral $\displaystyle\int_{-1}^{2} f(x)\,dx$ using the Right-Hand Rule, using SageMath to do the actual calculation. *[3]*

5. Compute the definite integral $\displaystyle\int_{-1}^{2} f(x)\,dx$ using the Right-Hand Rule by hand. *[3]*

HINT FOR **5**. You may make use of the summation formulas $\displaystyle\sum_{i=1}^{n} 1 = n$, $\displaystyle\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$, and $\displaystyle\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$.

GENERAL HINT. You may be able to find some similar questions and their solutions among the material from past iterations of this course on the archive page at:
`http://euclid.trentu.ca/math/sb/calculus/`

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[*] You should submit your solutions via Blackboard's Assignments module, preferably as a single pdf. If submission via Blackboard fails, please submit your work to your instructor by email or on paper. You may work together and look things up, so long as you write up your submission by yourself and give due credit to your collaborators and any sources you actually used.