

MANY CHEERFUL FACTS

presents

Numerical Integration For Fun and For Profit

a talk by Bradley Froehle

2:10–3:00pm on Tuesday, March 17, in 939 Evans.

In beginning calculus courses, we teach students several methods to approximate integrals including Riemann sums, Simpsons rule, and the trapezoid rule. In each case, the integration rule can be written in the form

$$\int_a^b f(x) dx \approx \sum_{i=0}^N w_i f(x_i)$$

with some appropriate choice of weights w_i and equally spaced x_i . While these formulas have wonderful geometric interpretations, their ability to quickly and accurately numerically approximate integrals is relatively poor.

One surprising method of improving the accuracy of such a numeric integration rule is to remove the hypothesis that the x_i are evenly spaced. In this talk I will explain *Gaussian Quadrature*, a numerical integration technique that can integrate certain classes of functions exactly, and its relationship to classical orthogonal polynomials.

*I am the very model of a modern Major General,
I've information vegetable, animal, and mineral,
I know the kings of England, and I quote the fights historical
From Marathon to Waterloo, in order categorical;
I'm very well acquainted, too, with matters mathematical,
I understand equations, both the simple and quadratical,
About binomial theorem I'm teeming with a lot o' news,
With many cheerful facts about the square of the hypotenuse!*

— Gilbert & Sullivan, $P \circ P$

The website for Many Cheerful Facts is
<http://math.berkeley.edu/~mcf/>