



UNIVERSITY OF RHODE ISLAND

Department of Mathematics  
and Applied Mathematical Sciences



## Applied Mathematics and Scientific Computing Seminar

**Location:** Lippitt Hall 204

**Time:** Monday, December 9, 2024, 1:00pm  
(refreshments at 12:55 p.m.)

### Gaussian Quadrature and the Tridiagonal Eigenvalue Problem

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**Abstract:** Quadrature methods are a way to approximate the definite integral of a function  $f(x)$  on the interval  $[a, b]$  by using a weighted sum of the form

$$\int_a^b f(x) dx \approx \sum_{j=0}^n w_j f(x_j),$$

where the  $x_j$  are  $n + 1$  distinct points in  $[a, b]$  called the nodes, and the  $w_j$  are  $n + 1$  positive real numbers called the weights.

Our presentation will begin by constructing this method. Through a nontrivial derivation, we will see that by choosing the nodes  $x_j$  and weights  $w_j$  strategically we can exactly integrate polynomials of degree much higher than  $n$ . This requires use of orthogonal polynomials and the tridiagonal matrix eigenvalue problem, leading to what is called *Gaussian Quadrature*.

Time permitting, we will introduce how the weights of Gaussian Quadrature can be used to accelerate convergence in some numerical linear algebra algorithms that approximate eigenvalues of a large matrix. More information on this will be presented in an upcoming seminar.

Graduate students, and undergraduate students with exposure to numerical analysis, are encouraged to attend.