

# Mathematics 503 Objectives for Midterm 1

## 1 Interpolation

- (1) Use the Lagrange method, the VanderMonde method, or the Newton divided difference method to represent an interpolating polynomial.
- (2) Represent the interpolation error in terms of divided differences.
- (3) Use the Hermite-Genocchi representation of divided differences.
- (4) Convert between forward differences and divided differences for functions on equally-spaced points.

## 2 Approximation

- (1) Use Bernstein polynomials to demonstrate the existence of the minimax approximation.
- (2) Use the Chebyshev criterion to recognize the minimax approximation.
- (3) Use Legendre or Chebyshev polynomials to construct least-squares approximations.
- (4) Characterize the least-squares approximation by orthogonality of the residual.

## 3 Quadrature

- (1) Construct interpolatory quadrature formulas.
- (2) Bound the error in an interpolatory quadrature formula.
- (3) Use extrapolation to estimate the error in an approximation by numerical quadrature.
- (4) Use Romberg integration to improve the accuracy of the trapezoid Rule.

## 4 ODE Theory

- (1) Use the matrix exponential to represent the solution of a linear homogeneous constant coefficient system.
- (2) Derive the variational equation and use it to estimate the sensitivity of an ODE.