MATH-305, Numerical Methods and Matrices

Prof. Kevin TeBeest, Ph.D.   Fall 2024

Course Learning Objectives:

1. Effectively approximate the real roots of single variable equations.
2. Approximate functions using interpolating polynomials.
3. Accurately and efficiently approximate single variable derivatives and integrals.
4. Perform matrix arithmetic and inverses, determinants, norms and condition.
5. Efficiently and effectively solve linear systems.
6. Numerically solve first order initial value problems.

APPROXIMATE LECTURE SCHEDULE [1,2]

WEEK	SECTIONS
1	— Introduction
	— Errors & Truncation Errors
	0.7 — Polynomial Nested Form: Horner's Method
	1.1 — Zeros of Functions: Bisection Method
2	1.1 — Bisection Method Error Analysis
	1.2 — False Position / *Regula Falsi*
	1.3 — Newton's Method
3	1.5 — Fixed Point Method
	— Fixed Point Convergence Theorem
	1.5 — Fixed Point Method with Aitken Acceleration
4	EXAM 1 (tentative)
	3.2 — Newton-Gregory Polynomial Interpolation
	— cont'd
	5.2 — Numerical Integration: Trapezoidal Rule
5	5.3 — Numerical Integration: Simpson's-1/3 Rule
	5.3 — Numerical Integration: Simpson's-3/8 Rule
6	5.6 — Numerical Integration: Gauss Quadrature
	cont'd
	5.1 — Numerical Differentiation
7	EXAM 2 (tentative)
	6.2 — Initial Value Problems: Euler Method
	— Error Analysis
	— Implicit Euler Method
8	— Trapezoidal Method
	— Modified Euler Method
	— Classical Runge-Kutta Method
9	— Runge-Kutta-Fehlberg & Runge-Kutta-Verner Methods [3]
	2.1 — Matrices & Elementary Matrix Operations
	2.2 — Linear Systems
	2.2 — Gauss Elimination
10	2.2 — LU Decomposition
	— Determinants
	— Inverses
	2.4 — Norms, Residual, and Condition Number
11	2.5 — Iterative Methods [3]
	3.3 — Splines [3]
	3.6 — Least Squares [3]
	Finish remaining material
	FINAL EXAM — date & time scheduled by Administration

[1] This schedule is approximate as some sections will take longer to cover than others. You should refer to the "Course Web Site" daily for actual assignments.

[2] Two or three Maple programming assignments (projects) will be scattered throughout the material.

[3] Instructor's choice if time permits.