Math 194 Topic List

Unit 1 – Systems of Linear Equations

- Systems of linear equations, augmented matrices
- Visualizing systems in $\mathbf{R}^2$ and $\mathbf{R}^3$
- Existence and uniqueness of solutions
- Elementary row operations, row equivalence
- Gaussian elimination, pivot positions, free variables
- Row echelon form, reduced row echelon form
- Linear combinations, spanning sets
- Matrix-vector multiplication
- Vector equations, matrix equations
- Application: Markov chains (population models, pseudo-text, etc.)
- Application: Closed economic models
- Application: Network flow models

Unit 2 – Matrix Algebra

- Matrix notation, matrix transposes
- Matrix addition, scalar-matrix multiplication
- Matrix multiplication, identity matrices, "funny algebra"
- Invertible matrices, inverse of a product of matrices
- Elementary matrices, finding matrix inverses
- The Invertible Matrix Theorem (Unit 1—2 Version)
- Linear independence
- Application: Hill ciphers
- Application: Open economic models

Unit 3 – Subspaces

- Subspaces
- Null space, row space, column space
- Basis, dimension, rank
- Rank-Nullity Theorem
- The Invertible Matrix Theorem (Unit 1—3 Version)

Unit 4 – Linear Transformations

- Linear transformations
- Standard matrix of a linear transformation
- Linear transformations in $\mathbf{R}^2$ and $\mathbf{R}^3$ (reflections, rotations, etc.)
- Onto, one-to-one

- Homogeneous coordinates, translations
- Compositions of linear transformations
- Invertible linear transformations
- The Invertible Matrix Theorem (Unit 1—4 Version)

Unit 5 – Eigenvalues and Eigenvectors

- Eigenvalues and eigenvectors
- Determinant of a matrix
- Visualizing eigenvalues and eigenvectors of linear transformations
- Complex eigenvalues
- The Invertible Matrix Theorem (Unit 1—5 Version)
- Application: Population models

Unit 6 – Special Topics

- Vector norms, distance
- Orthogonality, orthogonal bases
- Projections, best approximations
- Generalized vector spaces, subspaces, bases
- Polynomial spaces (P_n)
- Application: Least squares problems