

Numerical Methods for Science and Statistics | 02545 / 02745

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Robust, scalable data analysis is built on numerical methods. **This course develops the theoretical and computational machinery needed to turn mathematical and statistical models into reliable and efficient scientific tools.** Core topics include:

- floating-point error, numerical stability, and conditioning
- numerical linear algebra (especially iterative / randomized methods)
- interpolation and approximation
- numerical differentiation and integration (quadrature)
- ordinary differential equations

We will emphasize applications in life-science and statistical workflows--e.g., regression and GLMs, PCA/SVD for high-throughput assays, mixed models/REML, and epidemiological and biochemical ODE models. We will evaluate methods in terms of **accuracy, stability, and practical performance on real datasets**. Students will analyze and implement fundamental numerical approaches underlying modern scientific methods, and **apply these techniques to their own research projects**.

This course is aimed at graduate students and advanced undergraduates in Computer Science, Computational Biology, Statistics / Data Science, Machine Learning, ECE, Bioengineering, and other quantitative fields seeking a rigorous, implementation-focused treatment of numerical methods with direct scientific applications. The course is largely self-contained; any supplementary reading will be provided by the instructor.