School of Mathematics

Course 464a - Numerical methods 2006-07
(SS Theoretical Physics
JS & SS Mathematics)

Lecturer: Dr. M. Peardon

Requirements/prerequisites:

Duration: One semester (10 weeks)

Number of lectures per week: 3

Assessment:

End-of-year Examination:

Description: This course, and its continuation course 464b, aims to give an introduction to solving problems in theoretical physics and related subjects using numerical methods. The emphasis is on practical solutions and implementations on the computer. Software will be developed during the course using the C programming language.

Course 464a is available to students who do not wish to continue to 464b.

Numerical methods for linear algebra This section covers the basic toolkit used in most numerical simulations; methods for solving linear systems. Gaussian elimination and back-substitution with pivoting and Crout's algorithm for writing a matrix in LU form are presented.

Numerical solutions to ordinary differential equations Algorithms for solving ODEs are presented. Starting from Euler and Runge-Kutta, more advanced methods that encorporate adaptive step-size control and extrapolations are developed. Symplectic integrators for solving equations of motion are described. Methods for solving boundary valued problems are presented, and eigenvalue problems such as determining energy eigenstates of Schrodinger's equation are solved.

Numerical solutions to partial differential equations After revising the basic classification, methods for solving initial-value problems are developed. Emphasis is on stability and consistency of solutions. The diffusion equation is taken as the case study and the Crank-Nicholson method is described. For elliptic PDEs, the Poisson equation is used as the example, and simple iterative solutions are presented, such as Gauss-Siedel and Jacobi methods. Convergence properties are investigated.

See `http://www.maths.tcd.ie/~mjp/464/` for additional details.

April 2, 2007