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Preface

Of the many facets of mathematics, numerical computation is one of the most ancient. It is also one of the areas with the broadest relevance in the modern world. Ancient astronomers computed the seasons and the solstices; modern mathematical models allow highly accurate weather predictions. The Babylonians used a simple iterative method to compute the approximate value of square roots; today there are many powerful methods for solving nonlinear equations of great complexity. The practicality of various numerical methods depends on the available computational tools; simple methods are useful for quick solutions to small problems while more sophisticated methods are appropriate for large-scale scientific computing.

Applied Numerical Analysis Using MATLAB provides a clear explanation of the classic methods of numerical analysis; these form the basis for the more recent and more advanced methods, which are introduced in the latter part of each chapter. The title of the text conveys several key points about the perspective of the presentation.

First, the title clearly indicates the emphasis on the applied nature of the material. Each chapter (after the first) follows the same basic plan. The chapter is introduced with descriptions of applications in which the methods presented in the chapter are useful. The presentation of each method starts with some motivation for how the method works, i.e., how it can be applied. The presentation then proceeds to consider a numerical procedure (simple computer program) for carrying out the computations, before considering the theory behind the method. Examples throughout the chapter focus on applying the methods both to simple hypothetical situations (clarifying how the method works) and to simple applications (showing the method in a somewhat broader context). Finally, the exercises at the end of the chapter include problems for practicing the techniques, using the methods to solve applications from a variety of areas of science and engineering, investigating the computational aspects of the methods further, and extending one's understanding (perhaps in a more theoretical direction).

Next, the term "numerical analysis" implies that the goal is to obtain an accurate, but in most cases approximate, numerical solution to the problem under consideration. The terms "numerical analysis", "numerical methods", "numerical techniques", and "scientific computing" each suggest a slightly different emphasis on the scale of the problem, the type of computing resources available, and the extent to which one is interested in "how it works" as compared to "why it works" and "when it works". In this text, the analysis of each method follows the more applied introduction of the method, and the suggestions for further reading give references for more in-depth treatment of the theoretical aspects of the subject matter. "Theory guides practice; practice inspires theory". There are many instances in which scientists and engineers developed computational methods for solving problems that were later refined and put on a firm theoretical foundation