

Preface

This book is a survey of the numerical methods that are common to undergraduate courses in Science, Computing, Engineering and Technology. The aim is to present sufficient methods to facilitate the numerical analysis of mathematical models likely to be encountered in practice. Examples of such models include the linear equations describing the stress on girders, bridges and other civil engineering structures, the differential equations of chemical and thermal reactions, and the inferences to be drawn from observed data.

The book is written primarily for the student, experimental scientist and design engineer for whom it should provide a range of basic tools. The presentation is novel in that mathematical justification follows rather than precedes the description of any method. We encourage the reader first to gain a familiarity with a particular method through experiment. This is the approach we use when teaching this material in university courses. We feel it is a necessary precursor to understanding the underlying mathematics. The aim at all times is to use the experience of numerical experiment and a feel for the mathematics to apply numerical methods efficiently and effectively.

Methods are presented in a *problem–solution–discussion* order. The *solution* may not be the most elegant but it represents the one most likely to suggest itself on the basis of preceding material. The ensuing *discussion* may well point the way to better things. Dwelling on practical issues we have avoided traditional problems having neat, analytical solutions in favour of those drawn from more realistic modelling situations which generally have no analytic solution.

It is accepted that the best way to learn is to teach. But even more so, the best way to understand a mathematical procedure is to implement the method on a totally unforgiving computer. Matlab enables mathematics as it is written on paper to be transferred to a computer with unrivalled ease and so offers every encouragement. The book will show how programs for a wide range of problems from solving equations to finding optimum solutions may be developed. However we are not recommending re-inventing the wheel. Matlab provides an enormous range of ready to use programs. Our aim is to give insight into which programs to use, what may be expected and how results are to be interpreted. To this end we will include details of the Matlab versions of the programs we develop and how they are to be employed.

We hope that readers will enjoy our book. It has been a refreshing experience to reverse the usual form of presentation. We have tried to simplify the mathematics as far as possible, and to use inference and experience rather than formal proof as a first step towards a deeper understanding. Numerical analysis is as much an art as a science and like its best practitioners we should be prepared to pick and choose from the methods at our disposal to solve the problem at hand. Experience, a readiness to experiment and not least a healthy scepticism when examining computer output are qualities to be encouraged.

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