

# Preface

This book grew out of a need for a text to use in a calculus class that is intended for students going into science, engineering, and mathematics. The course includes early vectors and early transcendentals to help prepare students for their calculus-based physics classes. There are a number of books that have tried to fill this need. Unfortunately, none of the books written for this audience have made it to a second edition, even though they all need significant revisions. In addition, some of my colleagues were lamenting the number of typographical errors in the text we were using. Since the only book that was being updated for this type of course was a version of a regular calculus text with a small amount of material on vectors and vector-valued functions tacked onto a few early chapters, I felt that a new text was needed that could be revised as appropriate.

There were a few things that I felt were important to help our students prepare for their first physics course that are often not in a first calculus course. These include vectors, a rigorous but not overly formal approach, examples and applications that they will see again, the early introduction of transcendental functions and using notation that is correct, but that does not always match what they have seen.

It has been an adventure thinking about how to approach some things so that they may be easier for students to get some basic understanding. One of these things is a change from the common  $\varepsilon$ - $\delta$  approach to limits to a sequence approach to limits. This change is partially motivated by the fact that the intuition given in most calculus texts coincides more closely with the sequence definition of limits of functions as opposed to the  $\varepsilon$ - $\delta$  definition of the limit of a function. The use of sequences for limits is also meant to prepare students for the chapter on series where everything depends on the limits of partial sums. Among the other things that do not follow the “standard” approach are the derivation of the derivatives of sine and cosine, leaving explicit discussion about the connection between increasing and decreasing functions and derivatives until the mean value theorem is available, rethinking the use of “tables” of integration and reordering the techniques of integration to allow the use of partial fractions for trigonometric integrals.

Including the use of technology has been a challenge since I use technology, a CAS calculator or Maple, as a normal part of my teaching. Since the tools available vary and may change rapidly, I did not want too much information that is specific to any software or hardware platform. On the other hand, there are large numbers of people teaching calculus who do not want to use technology and large numbers of people who are wedded to a specific technology. The science and engineering students will be using technology in almost all of their later classes. Given these facts, I do not have many examples of the specific use of technology. The major exception is in the section of integration tables. There is an example of how different CAS systems

may give differing results. In the text, there are a good number of problems and examples where technology is required and the materials do not avoid questions involving technology.

One consequence of the availability of technology is that students can easily find quantities such as sums of vectors, dot and cross products, derivatives, integrals, tangent lines, equations of planes, and volumes of revolution using current computer algebra systems. Since students now have the tools to find correct answers to many of the problems in this book, including answers to “drill” problems does not seem important. With access to the Internet, I am uncertain if there are many problems for which one cannot find a solution to an almost identical problem on some web site. I am fairly certain that solutions to any “new” problem in a calculus book will appear online within a few years. Because of this access to answers and solutions for calculus problems, I see very little need to include answers or solutions for exercises in this book.

In the United States, many of our students have gaps in the background expected for calculus. These missing pieces include a lack of familiarity with trigonometric functions and poor algebra skills. Several sections in the first appendix are included to help with some of the pieces, including some basic algebra review and some basic trigonometry.

A large number of proofs are not presented in the text, or are only presented in part. Many of the results are partially justified or the proofs are done as derivations rather than formal proofs. For many mathematics teachers and students, this is not enough. Since there are times when I would like to include certain formal proofs but I do not feel that they will help the readability of this book, some formal proofs are included materials that will be available online.

Some additional material for the text, including Maple worksheets with rotatable 3D graphs that can be viewed using Maple Player from Maplesoft, can be found at <http://extras.springer.com>. I will always appreciate being notified of all errata at [jay.treiman@wmich.edu](mailto:jay.treiman@wmich.edu). As I collect more proofs, problems, and other material, I will post them on my homepage, <http://homepages.wmich.edu/~treiman>.

I wish to thank all those people who have helped me learn to teach and those who have helped with this book. Among those who have given me examples of mathematics teaching to strive toward are G. D. Chakerian, Virginia M. Warfield, Isaac Namioka, and R. T. Rockafellar. My thanks go to all of them. I also wish to thank those who have helped me with this book. They include Yuri Ledyev, who made it clear that there are different ways to approach topics in calculus; Daniela Hernandez, who found numerous typos and other problems in the text; Christine Horsmon; Dennis Pence; and all of the students who have suffered through my errors. I am also indebted to Jonathan Borwein for years of encouragement and help, including his help getting this book published.

The reviewers made many useful suggestions and comments that have made this book better and deserve my thanks. Ms. Elizabeth Loew has been a helpful editor and I wish to thank her.

Finally, I would like to thank my wife, Janice Selden, for her support.

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