# Preface

Keeping pace with new technologies, new career opportunities and new ways to explore career options (i.e., the Internet) has infused undergraduate mathematics with a new sense of excitement and purpose. The old question, "What will I use this for?" has some new and provocative answers! Not only in the field of computers, but in many other scientific and statistical areas, a firm background in basic calculus and its applications is more essential now than ever. Additionally, I have been pleased beyond the bounds of modesty by the number of students who have said that the book is easy to read; that was the main reason I had for writing it.

More important than style is clarity of exposition. Calculus need not be obscure. Every sentence in this book has been constructed with care, to convey the intended message with a minimum of confusion. Although clear writing cannot make a tough subject easy, it can go a long way toward removing unnecessary obstacles to understanding.

Most important of all is what I must call, for want of a better term, motivation. It is devastating to encounter one major idea after another that has been simply announced in a dreary procession of definitions, theorems, proofs, examples, and exercises. This book does not offer that kind of mathematics. The efforts to motivate the study of important ideas are not spectacular; the seasoned teacher who does such things routinely in class will not be surprised by any of them. But they run through the whole book.

Additionally, this book has been updated in the following ways. Entirely new chapter openers have been provided that motivate topics within the chapter and draw attention to the ideas discussed above; namely, use of technology and careers using calculus. These openers may provide food for discussion; I hope they will inspire projects or suggest topics for research essays. Also, new exercises have been added to many chapters. These problems focus on the use of graphing calculators or other technologies, inviting student and instructor alike to explore more challenging or more abstract problems, or in some cases to take a closer look at some elementary ones. The pedagogical focus of the text has undergone no serious shift: pencil and paper methods and traditional approaches to basic calculus remain the focus. However, it is to be hoped that the new

exercises will encourage students to keep their calculators handy and encourage instructors to be open to newer approaches. In this way, the best of the classical traditions of beginning calculus instruction can march arm-in-arm with the best of the new instrumentalities.

One of the most visible changes in the fourth edition is the large number of new problems. There are now more than 6000 exercises in the regular problem sets (an average of 53 per section), more than 1200 Additional Problems (60 per chapter), and about 700 True-False exercises (35 per chapter), for a total of almost 8000 problems. More important than the number of problems is how helpful they are to the student and the instructor. I have put a great deal of effort into providing good problems (ranging from the routine to the challenging in every section).

The first seven chapters of this book cover the standard topics of first-semester calculus in 40 sections (which in a typical course leaves room for two-day treatment of many sections). The next seven chapters constitute a solid second-semester course in 36 sections. The rest of the book (on vectors, multi-variable calculus, vector fields, and differential equations) has six chapters and 37 sections.

I am grateful to the many users who responded to the publisher's survey and to the reviewers who offered more detailed suggestions. The reviewers were:

Walter Kelley, University of Oklahoma
Melvin D. Lax, California State University, Long Beach
Carol S. O'Dell, Ohio Northern University
Charles Slavin, University of Maine
David A. Smith, Duke University
Paul Van Steenberghe, University of Maine
Robert B. Wenger, University of Wisconsin-Green Bay
Jack Wilson, University of North Carolina-Ashville
Elliot S. Wolk, University of Connecticut

*Paul Bedard, editor*

# To the Student

One of the best teachers I ever had was in the habit of announcing on the first day of class that "the time to start studying for the final exam is now." Good advice. Since you are about to embark on a calculus course, I would add that the best way to stay afloat is to reserve a solid block of time for it on a regular basis.

That time ought not be spent in only one way, however. This book is designed to be *read* (not merely consulted when difficulties in a problem assignment drive you to it). A quick first reading of each section (to give you the basic ideas) should be followed by a careful, line-by-line study (with pencil and paper at hand to fill in details that may not be clear to you). If you are not in the habit of this kind of preliminary study, you will be pleasantly surprised, I think, by the difference it makes.

Enough sermon. You would not be in a calculus course at all if you were not already accustomed to success in mathematics. Calculus was a great watershed in my education; I never saw the world in quite the same way again. I hope you enjoy the subject. There is nothing else like it (with the possible exception of a good climb of a lovely mountain). Use your ice axe and crampons when the going gets rough; when you get to the end of your rope, tie a knot in it and hang on. And don't forget to look at the scenery along the way.