

Preface

PreCalculus, fourth edition, is designed for a one-term course to prepare students for the standard university calculus sequence. This may be a strange opening sentence in the Preface, since it seems that any precalculus book would have this as its goal. However, a quick review of the university precalculus books on the market reveals that nearly all are over 800 pages, which is far more material than can reasonably be covered in one term. There is so much unnecessary algebra and trigonometry review material in most precalculus books that the precalculus course is often dominated by these topics at the expense of the graphing and function analysis that is needed for calculus.

In *PreCalculus*, fourth edition, we have concentrated on the concepts that will be specifically needed in calculus. Algebra and trigonometry review topics that are needed for review in calculus are covered in the context in which they are seen in calculus. Instructors can adjust the extent of this review material based on the level of their class, and, when appropriate, can refer to the more extensive review material presented in the Student Study Guide and on our web site

<http://www.as.yosu.edu/~fares/PreCalculus4>

The mathematical preparation of the students entering our colleges and universities is much broader than in the past. More students are arriving with a university-level calculus background, as reflected by the fact that the number of students taking the Advanced Placement Examination in Calculus has steadily increased to over 200,000 annually. On the other end of the spectrum, there is an increasing number of students who, although they have taken the college preparatory courses in high school, are not quite prepared to do the type of analysis that is required to successfully complete a university calculus sequence. These students often have some knowledge of the elementary computational techniques of calculus, and many are quite proficient in the use of graphing calculators, but they have not had a comprehensive analysis and elementary functions course while in high school. They need the calculus-context review that a good precalculus course provides.

Universities, particularly the predominantly commuter campuses, have seen a substantial increase in serious students with a nontraditional background; those who have been away from mathematics for a while. Many of these students had not considered science-oriented careers when in high school and need to take preparatory mathematics courses before they can enter their intended major subject. Most universities now have a wide range of remedial courses to serve their needs, but precalculus is not a remedial course. Precalculus is the course that specifically puts this review material in the perspective needed for a student to succeed in calculus.

TRANSITION TO CALCULUS

To make the transition from precalculus to calculus as smooth as possible, the terminology and level of exposition in precalculus should closely match that commonly used in calculus. There is a sufficient number of new and important terms, concepts, and applications for the student to master in calculus without the added difficulty of learning new ways to express old ideas. You will find that this *PreCalculus* book leaves no gap between the end of precalculus and the beginning of calculus, and is of a length that will reasonably permit it to be covered in one term. It includes material from algebra, geometry, and trigonometry that is sufficient to fill holes in a student's background, but this review material is interwoven into the book rather than presented as a block in the beginning. This permits the student to review these topics in the manner they will be used in calculus. In addition, it does not mislead those who need more review than a true precalculus course can provide.

The terminology used in the book parallels that used in calculus books, and the examples and exercises are presented in the way the student will see them in calculus. Concepts are presented in a student-friendly manner using an intuitive approach. Examples are used to reinforce the concepts, which are further reinforced by the exercise sets. In addition, there are exercise sets at the end of each chapter that preview calculus, so that students can see the type of material they will encounter in their next mathematics course.

TECHNOLOGY IN PRECALCULUS AND CALCULUS

Included in the book is a significant amount of material that is appropriate for use with graphing calculators and computer algebra systems. Although these devices are helpful for developing mathematical intuition and visualizing important concepts, we have not assumed that they are essential for the understanding of the basic concepts of precalculus. We treat graphing devices as an important tool—not as a substitute for the analysis that is necessary for a complete understanding of calculus and its applications. To successfully complete the calculus sequence, students need to feel comfortable with the graphs and behavior of all the basic functions and equations that are commonly seen in calculus. Our primary use of graphing devices is to take a problem further than would be reasonable without this tool.

Exercises that require technology are placed near the end of exercise sets where they will not disrupt the sequencing of exercises that do not use technology. Section 1.5, entitled Using Technology to Graph Equations, is the only section in the book that specifically deals with technology. This is an optional section that is not referenced in the remainder of the text.

STUDENT STUDY GUIDE

The Student Study Guide provides more detail on algebra, trigonometry, and other background material, as well as numerous supplemental examples and worked-out exercises. We have found that this material is particularly useful for students with a nontraditional background; those who have been away from mathematics for a while. It is also helpful for students who don't have ready access to an instructor, such as those taking the course in a distance-learning environment.

The format of the material in the Guide is similar to that of the book. We have written all of this material ourselves so there will be no transition problems from the text to the Guide, which can be the case when the supplemental material is not written by the authors of the textbook.

Also included in the Student Study Guide are two copies of an examination that students can take to test their readiness for precalculus and for calculus. We expect students will be successful in a precalculus course based on this book if they score 16 or higher on the 40-question test before taking the precalculus course. Students will be well-prepared for a university calculus sequence if they score 30 or higher after they take the precalculus course.

We suggest that students try one of the examinations before taking their precalculus course and the other after completing it, and we predict that they will see a significant improvement.

For those who do not have access to the Student Study Guide, the examinations are also available on our web site.

MODIFICATIONS FOR THE FOURTH EDITION

WEB MATERIALS We have made a concerted effort to keep the review material in the book to a minimum to ensure that the topics that are so badly needed in calculus can be covered thoroughly. We also have resisted the temptation to include somewhat extraneous topics that we particularly like, but do not quite fit into the philosophy of the book. However, we recognize that not everyone will agree on those topics that are needed in precalculus, as we don't always agree ourselves. So to meet the needs of as many instructors and students as possible we have added PDF files on our web site containing additional material written in the same format as the text. Currently there is material on the web site regarding the following topics.

- Descartes' Rule of Signs
- Systems of Equations
- Rotations of Axes
- Sequences and Geometric Series
- Vectors

We intend to continue to add material to this web site when we feel it might be useful even though it is not covered in a majority of precalculus courses. If a school is particularly interested in having one of these chapters included in the text, this can be arranged through the publisher.

EXERCISE SETS Before starting to write this edition, we once again went through every exercise set to be sure that the techniques covered in the examples are sufficient for students to work all the routine problems (generally the first 70%). Where necessary we then modified the exercise sets, rewrote text examples, and added additional text examples. We also had all the exercise sets reviewed by undergraduate students who tutor students in precalculus, to be certain that the topics that cause difficulty for students are thoroughly reviewed.

The Review Exercises were re-examined to ensure that a student who could work these problems truly had a firm grasp of the material in the chapter. Problems that consider topics not essential to a review have been moved from the Review Exercises to the section exercises. For example, exercises that extend the theory and applications of the material of the book are always placed in the section exercises, not in the place where the student should look when doing a chapter review.

ADDITIONAL EXAMPLES AND APPLICATIONS Each edition of Pre-Calculus has included applications of the material in many of the sections and in every chapter. In the fourth edition we have added additional applications to further emphasize the importance of precalculus and of the calculus course that they will soon be taking. To give added emphasis to the applications in this edition, each set of applications is headed with the title "Applications."

This edition also contains additional worked Examples to give even more clarification to certain topics. For example, we have added background material on factoring and examples that consider the typical kinds of factoring problems encountered in precalculus and calculus. We have provided similar examples on solving equations.

ACCURACY Every problem and example in the book has been checked by the authors as well as two independent accuracy checkers. One of the accuracy checkers was a student at Youngstown State University who was instructed to be particularly aware of situations where statements, even though correct, might be misinterpreted by students. Faculty often use a higher degree of formal rigor and logic than do students, and the mathematical vocabulary that faculty use is not always familiar to students. We wanted to be sure that this book is truly clear to the intended audience, while still using the mathematically precise statements that students will see in calculus.

FOUR-COLOR FORMAT In the third edition we introduced a modest four-color format. This worked well in the third edition and has been enhanced in this new edition. There is an important pedagogical reason for the adoption of four color in this book. Our major theme is to emphasize the problem-solving strategy of breaking new and difficult problems into a series of smaller,

less difficult, and more familiar problems. This is particularly the case in our approach to graphing. We consistently construct a small collection of functions whose graphs it is essential to know. Then we illustrate how techniques such as scaling, translation, and reflection can be used to construct graphs of many other functions. Having a variety of colors permits us to make the individual steps much clearer. We have consistently shown the base graphs in cyan, the first translation in red, and the next in yellow. Our students have found this to be a natural color transition. It permits them to better see precisely how the final graph is constructed, and shows that each individual step is not complex. The artist and the production editor have spent many hours creating what we feel is the best choice of colors to distinguish the various graphs, taking into consideration even things like assistance for those who have some tendency toward color blindness.

You will see very little other use of color in the book. It is used only where it adds to the understanding of the material or helps in the highlighting of important topics.

SUMMARY

In *PreCalculus*, fourth edition:

- The focus is on the essential prerequisites needed for calculus, with the assumption that the students taking the course will be in a calculus course in their next term.
- Graphing and the analysis of functions is used to smooth the transition to calculus.
- Algebra and trigonometry review is woven through the text to help students see where the gaps in their background must be filled before they take calculus.
- Explanations in the margin alert students to material that applies directly to calculus.
- New concepts are presented using relevant applications, reinforced first with examples and then with exercises.
- Technology is integrated throughout as a tool to extend knowledge, never as a substitute for the mastery of basic concepts that will be needed in calculus.
- Important applications of technology are highlighted throughout the text, even though the use of technological devices is not required.
- The amount of essential material has been kept to a length that can reasonably be covered in a single term.
- Modest four-color format is used to improve explanations of complicated subjects.

- Additional course material will be added to the book web site when it is helpful to instructors and students. This allows flexibility while keeping the core material of a reasonable size.

We hope you have a productive and pleasant experience with *PreCalculus*, fourth edition. If you have any suggestions that will help us improve your experience, please do not hesitate to contact us at the e-mail addresses listed at the end of this Preface.

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