Reviewer's Guide to *Applied Calculus on the Web*

Applied Calculus on the Web is a web-based supplement to an undergraduate Applied Calculus class. It follows the same format as *Finite Math on the Web.* At many institutions, Finite Math and Applied Calculus form the core of an undergraduate math curriculum for liberal arts and business majors. Our goal is to provide supplementary instructional material to enable students to visualize basic mathematical concepts such as sets, probability, and statistics in Finite Math, and limits, derivatives, and curve sketching in Applied Calculus.

The final form of *Applied Calculus on the Web* will include ten web-based modules that cover the topics typically found in an Applied Calculus class. The web-based material will be delivered through a third-party courseware product called *Brooks-Cole Assessment,* which can be found at http://bca.brookscole.com. In addition to the modules, there is an accompanying workbook with additional activities, sample quizzes and supplemental problems. Included with the workbook will be a student CD containing detailed solutions and streaming videos.

Purpose

In teaching Applied Calculus at Texas A&M University, we have found that many students struggle with the mathematical concepts introduced in the class. With large classes and ill-prepared students, it is difficult to provide the students with the one-on-one help they need to master the material presented. To help remedy this situation we are creating a supplement to our Applied Calculus classes, called *Applied Calculus on the Web*. We have designed this to be a self-paced, self-contained supplement for students to use on their own, outside of class. We expect that *Applied Calculus on the Web* will increase their understanding of the basic principles of Calculus through interactive Java applets, animated gif movies and step-by-step tutorials.

We have already produced a supplement for Finite Mathematics, called *Finite Math on the Web* that has successfully helped many students understand the core concepts in Finite Mathematics. We hope to do the same for Applied Calculus through *Applied Calculus on the Web.*

Usage

In its final form, each unit of *Applied Calculus on the Web* will contain the following elements:

- A web-based computer module (accessible through the internet) that contains interactive Java applets, examples and tutorial problems. The applets allow the students to interact and explore the concepts presented in the module. The tutorial problems will provide feedback in the form of hints and detailed solutions to those questions that the students miss.

- A sample quiz at the end of each module. This sample quiz will let the students self-assess their understanding of the module material. This same sample quiz is also in print form in the workbook, along with a complete key.

- A separate module quiz is available that can be assigned for a grade on the module. The student is not provided any feedback other than a grade on this quiz. These graded quizzes will be available in later versions of these modules. The graded quizzes are similar to the sample quizzes, and are administered through the *Brooks-Cole Assessment* courseware package.

- A workbook chapter that has additional explanations and examples to reinforce the concepts from the associated computer module. Ten new exercises will be provided in the workbook. The students will have the answers to the odd questions for these exercises. The even questions are available to assign as homework.

- The student CD will contain full color solutions to the sample quizzes and the odd exercises, as well as additional documentation and streaming videos (to support the use of the Java applets).

Current usage of *Finite Math on the Web* indicates that the typical student will use the material in the following manner:

1. The student will immediately attempt to take the graded module quiz - sometime after the material is covered in class, but before actually reading the module material. If the student's grade is satisfactory, the student ends their use of the module at that point. However, few students can pass the module quiz without additional work; that is, reading the module materials and going through the activities.

2. The student will then go to the module activities and work through the interactive tutorials and then take the sample quiz either online or from the workbook.

3. The graded module quiz is tried again, usually with more success. The number of times a student can attempt the graded module quiz, and the allowable time frame for taking the quiz, is entirely up to the instructor and is set up in the courseware.

Within each computer module, the most useful resources are the interactive tutorials and the Java applets. The tutorial problems are particularly useful because if a student enters a correct answer, they can go on to the next question. If an incorrect answer is entered, the student is provided with a detailed solution to the problem. (At this time, only Module 2 has this feature enabled.) They can then attempt the question another time or go on to the next question. The Java applets provide visualization of the concepts of Calculus that cannot be done in a textbook. The student can interact with these applets to experiment and apply concepts in a fun and easy way.

To use *Applied Calculus on the Web*, a student needs a computer that has an acceptable browser (e.g. Internet Explorer version 5.0 and later under Windows, Netscape 6.0 or later for Windows and the Mac, and Mozilla 1.0 or later for Linux) and a connection to the internet. The speed of the connection is not critical, a 56K modem is sufficient.

For reviewing purposes, the enclosed CD contains all of the necessary components to use the current version of *Applied Calculus on the Web*. An updated version of the modules and workbook can be found at http://www.math.tamu.edu/AppliedCalc/reviewer.html. When *Applied Calculus on the Web* is available for commercial use, an instructor will be able to access students' quiz grades and progress on the modules using the *Brooks-Cole Assessment* (BCA) courseware product. Students are granted access to BCA through a PIN number which is available after purchasing the workbook.

Summary of the Review and Future Modules

Module 1 – Polynomials and Modeling: The basic concepts of lines and slopes are reviewed and then the various linear models of cost, revenue, profit, supply, demand and depreciation are discussed. To aid these concepts, there is a Line Applet and a Slope Applet. The Line Applet is used again when the topics of break-even and equilibrium point are discussed since this applet can graph two lines at the same time. For higher order polynomials, a Plotting Applet is available to graph these more complex functions. At the end of the module, modeling with polynomials is introduced. A Modeling Applet is used to compare how different polynomials can be used to model a data set. This applet allows for zooming out so that longer range behavior can be examined.

Module 2 – Exponentials and Logarithms: The basic techniques for working with exponentials and exponential functions are reviewed and then the important application of compound interest is discussed. There is a Compound Interest Applet available to let the students easily examine the effects of different interest rates, compounding times, and compounding frequencies. The idea of continuous compounding is introduced and then a Continuous Compounding Applet is available for calculating the final value for an account that is continuously compounded. Next, logarithms are reviewed and the behavior of logarithms is explored. The module ends with modeling using the Modeling Applet from Module 1, which now allows exponential and logarithmic fits to the data.

Module 3 – Limits and Continuity: When this module is available it will cover graphical limits, algebraic limits and continuity.

Module 4 – Rates of Change: This module begins by connecting the average rate of change and the slope. A Secant/Tangent Applet is used to visualize the secant and allows the student to "play" with different secant lines by dragging points on a curve. By making the two points come closer together, the students are led to the idea that the instantaneous rate of change is the slope of the tangent line. This then leads to the idea of the derivative. The students can explore tangent lines at different places on a curve by simply dragging a point and seeing the slope of the tangent line.

Module 5 – The Derivative: When this module is available it will cover derivative rules, the composition of functions, the chain rule, elasticity and higher order derivatives.

Module 6 – Curve Sketching: When this module is available, it will cover describing the behavior of a graph, and using the first and second derivative to sketch a curve.

Module 7 – Optimization: When this module is available it will cover finding absolute extrema and application problems.

Module 8 – Indefinite Integrals: When this module is available it will cover antiderivatives.

Module 9 – Definite Integrals: In this module the students learn to approximate the area under a curve using rectangles. A Riemann Sum Applet is used to quickly draw the rectangles, given a function and a range of x-values. The students can experiment with different numbers of rectangles and different endpoints to explore the connection between a function and the area under a function. The idea of the area between two curves is introduced and the Area Between Curves Applet can be used to calculate this area.

Module 10 – Multivariable Applications: When this module is available it will cover multi-variable functions and their graphs, level curves and contour maps, partial derivatives and finding extrema and saddle points.

Trigonometry concepts will be available as links in various modules, as needed. The workbook will include a "Chapter 0" with a diagnostic algebra pre-test. This pretest will have a key and advice on how to overcome algebra difficulties that are commonly encountered in an Applied Calculus class. Finally, some of the more advanced material, such as a rigorous discussion of the epsilon-delta formulation of limits, is available as optional links for motivated students.