

## Information for Instructors

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Many of the exercise sets in *Calculus*, by Johnston and Mathews, contain technology exercises which are intended to be solved with the help of a graphics calculator or with a computer algebra system (CAS), such as *Mathematica*. Additionally, the text contains a wide variety of student projects which are designed to give students significant experience in solving multistep problems with the aid of a graphics calculator or a CAS. The purpose of this manual is to introduce you to the *Mathematica* computing environment and to show you and your students how to use *Mathematica* to investigate calculus concepts and exercises found throughout the textbook.

Proper integration of *Mathematica* into your course can be rewarding for both you and your students, but it will also require a little extra work on your part. Please spend a few minutes reading through this introduction, which contains general information and advice on successfully using *Mathematica* in your course. After reading through this document, open *Intro.nb*, which is found on the website for Johnston/Mathews *Calculus* at [www.aw.com/johnston](http://www.aw.com/johnston). This notebook is entitled *Getting Started with Mathematica* and it contains important details about the *Mathematica* computing environment as well as information for learning how to use *Mathematica* to perform mathematical calculations. If you are an experienced *Mathematica* user, then skim through *Getting Started with Mathematica* quickly, otherwise read the material carefully and practice using *Mathematica* for yourself to become more comfortable with this CAS. Once you finish *Getting Started with Mathematica*, you can explore the other notebooks: *Derivatives.nb*, *Integrals.nb* and *Multivariable.nb* to learn about using *Mathematica* to solve mathematical problems in differentiation, integration, and multivariable calculus, respectively.

### ■ Getting Started

#### Student Accessibility to *Mathematica*

First, you need to determine *where* your students will have access to *Mathematica*. If you plan on having students do their work on campus in a computer lab, then be sure that *Mathematica* is readily available in the lab and that your students have the proper computer accounts and passwords to use the computers in this lab.

If possible, the labs should have the latest version of *Mathematica* (presently version 4.1 at the time this document was published). Up-to-date information about *Mathematica* (e.g. available platforms, buying online, etc) can be found on the web at <http://www.wolfram.com/products/mathematica/>. If you or your school is planning on purchasing *Mathematica* for use in a computer lab, then visit <http://www.wolfram.com/solutions/highered/> and then click on *Academic Purchase Programs* for more information about obtaining an educational site license at a considerable discount. Once you purchase and obtain your site license for *Mathematica*, have the person or persons in charge of your computer lab install *Mathematica* on the computer lab machines.

If you are unable to make *Mathematica* available for students on campus, then you will need to make arrangements for students to purchase *Mathematica for Students* - a fully functional version of *Mathematica*, which is available only for students at special, low price. Students can purchase this software online at <http://www.wolfram.com/products/student/mathforstudents/> and you should also make this software available in your campus bookstore for student purchase. Your bookstore can contact *Mathematica* reseller Douglass Stewart by phone at 1-800-279-2002 for more information. If you wish to obtain more general information about *Mathematica* by phone, contact 1-800-WOLFRAM (965-3726).

## Familiarize Yourself with the Student Computing Environment

You should spend some time working with *Mathematica* in the same environment as your students. If they will be working in a computer lab on campus, then you should spend time in this lab working with *Mathematica*. Pay attention to special procedures for logging in and out of a computer in the lab, starting and closing the *Mathematica* program and printing out a *Mathematica* notebook. Also determine if there is a computer lab assistant available to assist students with the general procedures of the computer lab. Pass along all of this information to your students along with the times when the computer lab is open for student use.

## Provide *Mathematica* Training For Computer Lab Assistants

If possible, you may want to provide *Mathematica* training for computer lab assistants (preferably upper division mathematics or CS majors) so that they can then better assist your students in the computer lab throughout the semester. Give assigned technology problems to the lab assistants in advance, so they can try out the problems for themselves first and therefore be better prepared to answer student questions in the lab.

Also, have the computer lab assistants explore *Mathematica* for themselves. Encourage them to read through *Intro.nb* to learn more about doing mathematics with *Mathematica*. Then, as the semester progresses, you can direct them to read through portions of the other notebooks (*Derivatives.nb*, *Integrals.nb* and *Multivariable.nb*) as they become relevant to the technology problems you plan on assigning to your students. Also, make sure that these files are accessible in the computer lab for student use and set up these notebooks as Read-only files so that students cannot change or erase portions of the file. You can also inform students of where to find these files at [www.aw.com/johnston](http://www.aw.com/johnston).

## Consider Equipment for Classroom Demonstrations

If possible, you are encouraged to provide your students with short 5-minute demonstrations of *Mathematica* during class. Find out what classroom you are teaching in and then determine if a portable computer and computer projector are available to use in your classroom. Your school may also have classrooms with technology already installed and therefore you might request one of these rooms for your class to meet in on a regular basis.

Be sure to arrive a few minutes early on days when you plan on providing in-class demonstrations in order to set up your equipment, to start up the computer and to open the *Mathematica* program. Your students will appreciate practical, live demonstrations of *Mathematica* and this will help them see how easy it is to work with a *Mathematica* notebook. Also, *Mathematica* demonstrations can help you give visual demonstrations of important concepts encountered in calculus.

If you do not have access to equipment for classroom demonstrations, then you may want to schedule some of your office hours early in the semester in the student computer lab so that you can assist your students with *Mathematica* and/or to provide hands-on *Mathematica* training to computer lab assistants.

## ■ Planning Your Course

### Know Your Student's Background

You may find it helpful to collect some academic information (e.g. majors and minor, year in school, other computer courses taken, ...) about your calculus students in order to determine if they have had any prior experience with computing and working with *Mathematica* or some other CAS. Knowing a little bit of background information about your students will help you determine the type and number of technology problems you may wish to assign during the semester.

## Planning your Syllabus

Students often have more free time at the beginning of the semester and therefore you might want to use this time to your advantage by assigning technology exercises during the first week of the semester. For example, you might give them a list of functions to plot using *Mathematica* or have them read through the notebook *Intro.nb* and then make up a set of exercises, similar to those discussed in the notebook, for your students to complete with *Mathematica*.

If integrating technology problems into your assignments is a relatively new experience for you, then it is recommended that you select assigned technology problems very carefully and keep the total number of problems you assign relatively small compared to overall number of assigned exercises in the course. Be sensitive to the amount of time that is required for your students to complete technology problems in the computer lab so that you don't take too much time away from the other exercises in the text which can be completed by hand.

## Do Assigned Technology Exercises for Yourself First

Before assigning a technology exercise to your students, solve the problem yourself first. Sometimes a technology exercise may look straightforward and easy to complete, but when you work through the exercise yourself, you may discover that it takes more time to complete it than you previously estimated. By solving the exercise yourself, you can then evaluate the length and difficulty of the exercise and determine if any additional instructions or hints need to be passed along to your students.

## Discuss Technology Exercises with Students in Class

When you are ready to assign a technology exercise, or set of exercises, provide a brief overview of the assignment to your students in class. Discuss the relevance of the exercises to the topics being covered in your course and tell your students what you hope they learn by working through these exercises. Students might perceive the technology problems as "busy work" with no real importance to the other course material unless you successfully communicate the relevance of these exercises to the course topics and objectives.

## Group or Individual Work

Determine whether you want your students to work individually or in small groups on the technology exercises. There are several reasons why you may want to consider having students work in groups on some or all technology exercises. First, using your student background information, you can have more experienced computer users work together with less experienced users so that the more experienced users can help out those other students with weaker computer skills. Another reason for considering group work is that while one student types in the commands on the computer, the other group members can watch and catch any syntax or spelling errors. Group work may also help many of students feel less isolated in your class and working together may help your students establish study groups for working on homework assignments and for preparing for examinations. Of course, there is always the concern that one or two students will do all of the work for the rest of the group. A couple of ways to encourage all members of a group to participate is to include one or two questions on each examination relating to the technology exercises and/or you can have members of each group complete a written evaluation of the effectiveness of their group members at the end of the course. If you do decide to allow group work, then be sure you decide how many members per group are allowed and be sure to clearly explain how you want each group to turn in their completed work.

## Acceptable Form of a Completed Assignment

If your students work together in groups, then you will probably want to have groups turn in one copy of their work rather than one copy per student. Students can either turn in a printout of their completed work or you can have students turn in their work electronically via an e-mail attachment or on a floppy disk. If you decide to allow them to turn in an electronic version of their work, then be sure you give them specific instructions about the filename they should use.

### **Don't Overdue It**

Be careful about the number of technology problems that you assign. If you assign too few problems, then your students may never become comfortable with *Mathematica* and they may never master basic *Mathematica* syntax. But you also must be careful not to assign too many technology exercises, especially if students must use the computer lab to complete their work. Having to go to the computer lab makes technology problems less convenient for students to complete than other text exercises which can be completed by hand. Sometimes it might be difficult for students to find a free computer to use in the computer lab and therefore it might not be practical to expect students to be able to find time to complete a large number of assigned technology exercises.

### **Get Feedback from Students**

When students turn in their technology exercises, feel free to ask them how long it took them to complete their work. You can also find out if they found the problems challenging and see if they understand how the technology problems relate to the course topics discussed in class. You can use this information to get a better sense of what the students are learning by completing these exercises and you can evaluate the additional workload the computer exercises are adding to their studies. You can also use student feedback to adjust the number of technology problems you assign in the future and to determine if there are any additional difficulties students are having with *Mathematica* that you need to discuss in class.

### **Encourage Students to Finish Their Computer Assignments Early**

Encourage students to begin their computer assignments as soon as possible after you assign them. Students who wait until the last day to complete their assignments will often get frustrated and may develop an aversion towards doing any future computer assignments. You might offer extra incentives (e.g. extra credit) for quality work finished and turned in ahead of time.

### **Read Information for Students**

As mentioned earlier, if you are an experienced *Mathematica* user, then skim through *Getting Started with Mathematica*, found in the notebook entitled *Intro.nb*, otherwise read the material carefully and practice using *Mathematica* for yourself to become more comfortable with this CAS. Once you finish this document, you can then begin to explore the other notebooks: *Derivatives.nb*, *Integrals.nb* and *Multivariable.nb* to learn about using *Mathematica* to solve problems in differentiation, integration, and multivariable calculus, respectively.