

Math 106-107-208 Instructor Notes

David Pitts Steve Cohn Wendy Hines Tom Marley
Cheryl Olsen John Orr Jamie Radcliffe Bill Rogge

Department of Mathematics and Statistics
University of Nebraska
Lincoln, NE 68588-0323

August 16, 1995

The purpose of these notes is to give conveners and instructors of Math 106-107-208 some idea of the issues which arise or may need to be dealt with when using the calculator and the Harvard materials when teaching the calculus sequence. Please send suggestions for improvements, additions, clarifications, etc. to David Pitts (email: dpitts@math.unl.edu). Thanks to all who have already done so! These notes are organized according to the following outline.

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 - * The green instructors manual (includes calculator programs)
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- * The instructors solutions manual
 - * The Ithaca College Projects book
 - * The Harvard Consortium Calculator book
 - * “Graphing Technology Guide” by Benjamin N. Levy, published by D. C. Heath, 1993 (ISBN: 0-669-34226-2). This contains information on how to use a variety of calculators. You may want to list it in the bookstore as a recommended book for students who don’t have a TI-85.
- Materials Produced by UNL
- * UNL World-Wide-Web Calculus Home Page. To locate: bring up the UNL Math and Stat Department home page: <http://www.math.unl.edu> and click on the calculus heading.
 - * UNL Calculator Programs
 - * UNL Homework solutions manual (the black binders)
 - * The BLUE Binders. These may be obtained from the secretaries and contain:
 - UNL Projects
 - Past exams given by UNL instructors
 - Catalog of Transparencies generated by UNL instructors
 - Fall and Spring Syllabae
 - Course Policy Statements
 - Miscellaneous Handouts (Welcome to Calculus, etc.)
 - Participation Report Forms

Classroom Philosophy

The first two semesters of calculus at UNL (MATH 106, 107) are taught in a lecture/recitation format. Three days a week, the students are taught by a professor in a large class of around 100 to 120 students. On two other days, they meet in smaller classes with a teaching assistant to go over homework problems, ask questions, and hopefully clear up any confusion which may have arisen from the last lecture. The third semester of calculus (MATH 208) is taught in small lectures of approximately 33 students which meet four times weekly. There is no TA for Math 208. We offer here a few suggestions on how to conduct your lectures and recitations.

Traditionally, most calculus lectures have been essentially monologues delivered by the professor. This isn’t intended as a put down. Many of our professors are extremely good lecturers. Lecturing was the most common method of classroom teaching in our own mathematical educations and it is how we feel most comfortable teaching. The word ‘monologue’ is used simply to indicate that the professor is doing all or almost all of the talking. (I am allowing that most of

us occasionally turn around in the middle of a proof to ask ‘Can anyone tell me why that’s true?’ — only to find glazed eyes and blank faces.) The main problem with lecturing is that the students are often lulled into becoming passive listeners. Of course, some students (usually the brighter ones) can learn this way. After all, this is the way calculus has been taught for decades and at least some of them (like us) got A’s. But most students learn better if they are given the opportunity to be active participants. It’s similar to when someone is demonstrating some new software on your computer. You can patiently watch that person for awhile but eventually your instincts say: ‘Hey, give me the mouse. I want to try.’ We are not suggesting that everyone quit lecturing entirely, but rather that you lecture less and spend more class time with the students actively participating. Here are some ways in which you can do that:

1. Solve a difficult problem on the blackboard using only input from the students.

2. Have the students work in groups of two or three on a problem. Be sure to give the students ample time to solve it. During this time you can be wandering around the room answering questions and providing hints to students who are stuck.

3. Do some mathematical experiments with the students. This is a great opportunity to show students how mathematics is really done (as opposed to always presenting them with polished solutions which offer no clue as to how the solver actually worked them out). For example, suppose your topic for the day was the derivatives of exponential functions. Instead of plunging directly into a formal computation of the derivative of e^x , you could ask the students to try to guess at the answer using numerical computations. Using their calculators, they can approximate the derivative at $x=0$, $x=1$, $x=2$, and so on. By plotting these points on a graph or by simply comparing the answers with the original function, most will be able to guess the correct answer. You can then follow this up with a formal proof, which will hopefully now have more meaning to the students.

You might wonder how, if you do all of these things, you will be able to “cover” all of the material. Well, frankly, sometimes you can’t. But remember, despite any worries to the contrary, the students can read. Most students have found the text to be very readable, and there’s no reason you have to comment on every detail in the book. Make it clear from the very beginning that you expect the students to read the book and are responsible for what’s in it even if you don’t talk about parts of it in class. Plus, there’s always recitation. If you skip something in lecture and feel that it probably deserves some classtime attention, have your TAs present it. In most cases, though, you will find that the text and the pace of the syllabus allow enough time to both lecture on the material and do some of the activities mentioned above.

Many of these suggestions also apply to running a recitation section. Again, the goal should be keeping the students in an active, participatory role. The biggest trap TA’s fall into is a situation where the students spit out problem

numbers and the TA obliges by solving the problems on the board, with little or no input from the class. This isn't always bad, particularly if the bell is about to ring and the students are tired of being kept in suspense. But as a rule you should avoid the temptation to simply work the problems for the students. (After all, there are solution manuals.) The best use of class time is to get the students THINKING in the classroom, by having the students work in small groups, by solving a problem with the help of the class, or maybe by occasionally having some brave students present their solutions on the blackboard. Of course, you will still want to mix in the occasional 'mini-lecture' to clear up a confusing point or because the students desire more explanation on a particular topic.

Calculators

The use of graphing calculators has had a substantial impact on the way we teach calculus. Our objective in introducing them was to take advantage of the fact that on the calculator screen one can *see* the phenomena of calculus: limits, Riemann sums, secant lines, etc. This immediacy is, for many students, a big improvement over a purely pencil-and-chalk presentation. Later on, when symbolic methods take over, calculators become less useful as a teaching tool and are thus used much less extensively. The same pattern shows itself in the calculus sequence as a whole; Math 106 uses calculators much more than 107 or 208.

The topics where we have found calculators to be the most useful have been: graphing functions; the graphical definition of the derivative; and Riemann sums. The last topic especially benefits from the calculator: now almost no one comes out of 106 believing that $\int_0^2 x^2 dx = x^3/3$, an error that is very hard to erase in a traditional course.

Classroom use of the Calculator

An important thing for you to remember as you teach using a calculator for the first time is *you are teaching calculus, not calculator use*. You should design your classroom activities accordingly. Bear in mind that students will want you to show them how to use the calculator in class. Some of this is appropriate, but it should be VERY LIMITED.

The first thing to tell students is that you will be using the TI-85. Trying to support the use of other calculators can be a nightmare for the instructor and TA. So tell students if they own a different model, they need to be prepared to go-it-alone. However, there are some additional resources you can give them. The green instructor's manual from the Harvard Consortium has a list of useful calculator programs designed for various calculators. Also, you might direct students to the book "Graphing Technology Guide" by Benjamin N. Levy, published by D. C. Heath, 1993 (ISBN: 0-669-34226-2). This contains information on how to use a variety of calculators.

Be sure to tell them to bring their calculator each day. Since you want them to bring the calculator to class, it is especially important during the first few days of class to plan some activities using the calculator. Show them how to graph a few functions, show them how to find function values, etc. This will get the students oriented to calculator use in class.

The Green Instructor's Manual (produced by Harvard consortium) has daily lesson guides which you may find useful as you prepare classroom activities.

A nice activity to introduce students to calculus is to draw the graph of a function and then show them how to zoom in far enough at a point so that the graph appears as a straight line. You can work in a discussion of the range and zoom features of the calculator here. Then have them use the trace feature to estimate the slope of the line. Talk a bit about the fact they just estimated their first derivative. Then say something about the fact that we're going to approximate functions by straight lines in the neighborhood of a point means that we need to understand straight lines. This motivates section 1.2.

Calculator Orientation for Students

Conveners need to be sure that several calculator orientation sessions are available for the students during the first two weeks of class. See the section on Calculator Orientation under "Details of semester planning" below for a bit more information.

When to give students programs

If you are organized well enough, you might consider giving the students all necessary programs for a given chapter at the beginning of each chapter. However, you'll probably wind up giving them the programs as the need for them arises. So it is a good idea at instructor meetings to discuss which programs will be needed soon. It is best to allow some time in advance to get the students the programs before they need them. See the section on Calculator Programs under details of semester planning below for more information.

Student Relations

Many students will be unaccustomed to the level of work required in the course, so it is important to set their expectations during the first week of the term. Please look at the first day handouts available in the resource section. Students need to be told about:

- working in groups,
- what projects are and what their project report should look like (suggestion: tell them to use correct mathematics, grammar and complete sentences, in short, write a document that would make their English teacher

proud and which could be read over the telephone to someone who knows no calculus),

- the level of effort required to solve the homework problems,
- what calculator to use and what to do if they don't have the right one,
- *that they will be expected to read the text* and
- all grading information.

Be sure to let the students know that they can find help in the Calculus Lab. This is similar to the Math Consultation room, but is intended for calculus students only.

Students with Previous Calculus Experience

It is a good idea to tell instructors to get some idea about whether their students have had calculus before. The classroom atmosphere can become tense if a student who has had a traditional calculus course whines publicly that

- “this isn't calculus” ,
- “why can't we just get to the rules and skip all the thinking?” , or
- “my previous calculus teacher didn't do it this way” .

Students will need lots of reassurance throughout the semester that they will be learning the calculus well, that what they are doing is indeed calculus, and that yes, the exercises are hard, so hang in there.

It is a good idea to look over the **Welcome to Calculus** document (available in the Blue Binders in the secretaries office) for some ideas about how to set the proper tone in the classroom.

Homework

One thing to note about the text is that it has far fewer routine or drill problems than a traditional text and far more conceptual and application problems. This means that it is important to supplement the text with drill problems whenever you feel it is necessary. Instructors should feel free to make up drill problems “on-the-spot” or use any traditional text as a resource.

Many of the conceptual problems are time consuming and difficult for students, yet some from each section should still be assigned.

BEWARE: *Be sure to work all the exercises you assign BEFORE they are assigned.* Many of the problems look innocent enough until you try them. Also, some of the problems require calculator use or programs which need to be considered before assigning.

IMPORTANT: The original 106-107 syllabuses were designed with too many problems in order to allow instructor flexibility. It is NOT intended for students to work all the assignment listed on a given day. Each instructor should decide individually how to trim an assignment, so be sure to tell instructors to plan on reviewing each day's assignment as part of regular class preparation.

Each week, students will be asked to individually turn in a subset of the assignment for grading by a TA.

Homework Solutions

For each of Math 106 and 107, there is a set of four large black three-ring binders which contain handwritten solutions to all the exercises on the original (Fall '94 106, Spring '95 107) syllabi. They are stored in the computer room and are for use by students in the calculus lab. The lab attendants will pickup the solutions from the eighth-floor computer room before opening the lab and return them there when the lab closes. At the beginning of the term, the convenor should remove all the solutions from all the binders and store them. Solutions should then be returned to the binders on a weekly basis approximately one week after each assignment is due.

It is important to consult with the other instructors at the beginning of the term to work out which day the solutions should be made available to the students. During the Fall of 1994, students turned in their homework assignments each Tuesday, so solutions were made available for use in the calculus lab on Tuesday afternoons. That way it was impossible for a student to go to the lab and copy the solutions for credit.

Please be sure to inform all Lab Attendants, TAs and other instructors that the solutions are not to be allowed out of the calculus lab and are not intended to be photocopied. The reason is that we do not want UNL solution manuals to be floating around campus.

Finally, it is necessary to inform all lab attendants about the logistics of getting the solutions from the eighth floor computer room to the lab and also how to return them to the computer room.

Group Projects

In the new approach to teaching calculus, we have several goals which we feel can be better met by asking the students to work on extensive group projects, rather than only assigning them homework problems. The projects typically require the students to analyze a "real-world" situation and string together several ideas to solve the given problem. They must see how to break the problem down into its different mathematical components and they must decide which concepts and methods from the course apply to each component.

In homework problems, the focus is usually on one specific idea or skill. By doing only homework problems, it is hard for the students to see how the

different ideas and techniques fit together to solve more practical problems. When we assign projects, we try to give the students the opportunity to see a bigger picture. The students must gain a practical understanding of the concepts in order to decide in which situation a concept should be used. They must explain why they have decided to use the concept they have chosen and they must convince the reader that what they are doing makes good mathematical and practical sense. We encourage the students to follow the motto “Explain-Justify-Verify” in presenting their work.

We also want to develop written communication and group cooperation skills in the students. These skills increase students understanding of the problems and solutions and will also be very important to them in their future jobs. It requires a greater understanding of a problem to be able to write its solution in an organized step-by-step fashion. Writing the solution of a multi-step problem itself increases understanding of the problem and its solution. By discussing a problem, the students realize the benefit of having several different points-of-view from which to draw ideas. Formulating ideas for others to understand and getting immediate feedback about those ideas is extremely helpful in developing and refining a solution to a problem. All mathematicians know that talking about a problem is one of the most effective ways to gain a good understanding of it.

The students will also need to be able to effectively communicate technical ideas in their future jobs. Also, the ability to break down a problem into separate parts and to designate group members to complete each part in such a way that facilitates completing the project successfully is a difficult skill to learn. Yet that ability is one of the most important skills used in the work world, so we believe it important to provide an environment where such skills may be practiced.

In constructing projects, we keep all of these goals in mind. We don't expect the students to already have these skills, but rather we try to develop these skills through a combination of guidance and challenge. We try to give the students several decisions to make, but at the same time we do give them some guidance in breaking the problem into mathematical components. We try to avoid recommending the application of certain methods or concepts; when we do make such recommendations, we do it in the form of a hint. We often ask the students specifically to find ways to verify their results. What questions might they ask themselves to decide whether or not their results make sense? This has proven to be a very important question to ask the students and has helped them greatly in developing the skill to apply the ideas in the course in a practical way.

As a practical matter, it is a good idea to design projects with at least one part which can be duplicated for an exam. That way students who worked on the project can have an easy exam question, while those who might not have a difficult time with the question.

IMPORTANT: While we have old projects filed in the blue binders and on-line, it is a good idea to create new projects for each semester. Various

living groups around campus do have files of solutions. Also, the convenor should organize a meeting of the instructors to pick the topics for the projects early in the semester. That way project construction can be assigned to subsets of faculty teaching the course well in advance of the time the project is to be assigned. Be sure to work the project with a complete solution prior to assigning it—surprising and subtle problems can occur and this will provide some measure of protection from such surprises.

In grading the projects, we look for several things besides a correct answer. The students must explain how they have broken down the problem and how and why they have used each concept or solution method. They must convince the reader that their results are reasonable. To receive full marks, the student must have the correct answer and must have successfully explained, justified and verified their work.

At the end of each project, students must sign their name to confirm that they have contributed to the project. In addition, students are often asked to evaluate their group. This is done in different ways by different instructors, but usually it involves each student writing a short paragraph about how well their group functioned.

Working with Groups

There are several things to be aware of when dealing with groups. Two of the most important are: 1) students find it difficult to arrange meeting times and 2) students resent it when they feel like a group member (or members) is not doing a fair share of the work. Hopefully some of the comments which follow will help you deal with these.

Optimal group sizes are between 3 and 4, however, if the students wish, allow the size to vary a bit from this.

You may decide you want the groups to remain the same during the entire semester, or you may want to allow the students to reform their group after each project has been handed in. The disadvantage to forcing the groups to remain the same for the whole semester is that intractable personality conflicts can arise, people drop and add the course, and someone unwilling to work can poison the atmosphere of the whole group. So bear these risks in mind when deciding what you want to do. You should ask the students to keep their group constant during a given project however. This does get them to learn to work together.

It is wise to provide structure to the groups at the outset. The following is from one of the handouts concerning group projects (available from the blue binders or online) and gives some ideas on how this can be done.

To help get everyone involved and the group functioning smoothly, each person in the group will adopt one of the following roles: the chair, the reporter, the scheduler, and the scribe. The chair acts, as

the name suggests, as the chairperson of the group. The primary role of the chair is to try to get everyone involved in the problem-solving process and make sure that each person understands the ideas and arguments being put forward in the group discussion. The reporter's job is to jot down the ideas of the group as they are being discussed. The scheduler has the difficult task of finding times and places where everyone in the group can meet. The duty of the scribe is to write up the final report for the group.

These roles should rotate among the members of the group from project to project and no one should feel limited to their specific role. In particular, everyone should help the scribe in his/her job by, at the very least, proofreading the final draft of the report.

Forming Groups

Students will need help forming groups. An effective way to do this is to have your TAs form the groups in recitation section. However, you will need to provide the TA with detailed instructions on how you want this done. One way to do this is to have the TA bring a package of 3×5 index cards to the first recitation. Have the TA instruct the students to list their names on the cards as well as several preferred meeting times, ranked in order of preference. The TA can then form groups (outside of classtime) according to the students preferences and inform students of their groups during the following recitation. This way very little time is taken away from instruction to form groups.

Use of Groups in Lecture

Some faculty have asked students to sit with their groups during lecture. This way the instructor can give the students a problem to work on in their groups during lecture or can ask a group to volunteer answers to questions. You may want to experiment with this, but do bear in mind the architecture of the room you are using: if there aren't moveable seats or if late students have to climb over others to get to their groups, you may not want to do this.

If you are lecturing in a room with fixed seats, you can still have students work with their immediate neighbors if you want to have them do in-class group work. Also, if you want to ask the class for responses to a question, you can ask someone from an entire row of students to volunteer an answer. This is less threatening than asking an individual to answer a question in a large lecture!

Use of Groups in Recitation

Since recitations are small, it is quite reasonable to have students work with their groups during recitation. The TA can prepare questions for each group to work on during recitation, or may decide to have groups give presentations during class.

Dysfunctional Groups

Unfortunately, sometimes these arise and you'll need to deal with them. If a group seems to be functioning poorly, the instructor may talk with that group and give them some ideas about how to solve their problems. If the problems seem unsolvable, the instructor may encourage the group to split or swap members with another group. Some instructors reserve the right to examine students on the content of their group's project and lower the project grade of a student who does not seem to be familiar with their group's work. In general, dysfunctional groups do not seem all that common. In two semesters I only saw three truly dysfunctional groups out of 200 students (a group generally has 4 members). In two of these cases, I was able to help the group to solve their problems.

The most common problem is that someone in the group feels that he/she is doing far more of the work than he/she should be doing or that several members of the group feel that a single person isn't coming to meetings or isn't "pulling their weight."

We don't have a completely satisfactory solution to this problem. One thing to try is the participation report form (see the blue binders). The idea is that part of a student's grade on the project comes from the other members evaluation of that person's participation. The problem with this is that students don't tend to want to honestly evaluate a problem student. For example, the participation reports will say everyone worked well together, but when you talk to a student, you might get a picture that the group was in fact, not working well at all.

Also, students sometimes want to divide up the projects. As an extreme example, if there are three group projects and three group members, the students might decide to have only one person do each project. **THIS SHOULD BE STRONGLY DISCOURAGED.** Not only does this defeat the idea of group work, but sometimes the person who is supposed to do a later project doesn't, and strong negative feelings result. Another tendency students have is to divide up an individual project into parts to be worked: Sally works question 1, Bob question 2, etc. This also defeats the point of group work and should be discouraged.

Exams and Quizzes

Weekly quizzes of 5 minutes length in recitation seem to be useful to keep students reasonably current. You may want to have the writing of the quizzes coordinated so that the same quiz is given to each student. If you have the TAs write the quizzes, be careful to look at the first few, so that they don't write quizzes which are too long or too difficult.

Hour exams and the final should not have trick questions, but should have questions which are in keeping with the spirit and philosophy of the course.

Sample UNL exams are in the blue binders and online. Also, do put questions on the exams which are closely related to the projects—this tends to keep students motivated to work on the projects.

Along with teaching of concepts (Yippee!) comes testing of concepts (Uh-oh). It is definitely harder to make up an hour exam or final for a Harvard based course since one cannot just ask the students to do one each of twelve standard manipulations. On the other hand, with a little thought, ingenuity, and stealing of other people's ideas it isn't too hard to write conceptual exams.

Since fluency of manipulation must still be tested, the burden has fallen on quizzes, and they have tended to be the place where such skills are judged. This is partly because the time allowed for a quiz is rather too short for serious thought. This can lead to difficulties, but this has not turned out to be an insuperable problem.

TA Issues

Our experience with TAs is that they want to do a very good job with their teaching. However, they may be a bit intimidated by the level of difficulty of the problems and they may not completely understand the active learning environment which they are expected to create.

The most important thing in dealing with TAs is communication. Decide how you are going to communicate with your TAs. Do you want to have weekly meetings, e-mail after lecture and every recitation? The more communication the better the TAs who are just starting with this text will feel. A weekly meeting with your TAs is a good idea. While this is a bit time consuming, you can discover quite a lot about how the course is going from your TAs. If you decide to use email, you'll need to remind them to check their accounts regularly.

Also, it is useful to give TAs a handout which summarizes how you would like them to work with you. Telling them at the beginning of the semester is very important, but they will appreciate a written document to refer to.

Unfortunately, it is not possible to require TA attendance at your lectures, but you should encourage TAs to attend whenever possible. That way they get a feel for how you are working with the students and how you are presenting certain topics.

You may find it a good idea to visit your TA recitation sections once in a while. You might be surprised by what you see. If you don't like something, bring it to the TA's attention in a kind way; conversely, praise the things you like.

During the early part of the semester, it is a good idea if you pick several problems for them to work in their recitation sections and you should discuss with them how you want them to work in their classroom (whether to have students working at the blackboard, in groups, etc). The TAs enjoyed knowing what were good problems to work when students didn't have questions. After

they gain experience and confidence, they will be able to decide many of these issues themselves.

Some TAs need guidelines about collecting homework at the beginning of class and giving the quiz at the end for better time management. Also, TAs will need to know what to do about late homework, make-up quizzes, late projects etc. (Do you want to give the TAs guidelines, or do you want them to make their own decisions?) It is a good idea to discuss these issues with them at the beginning of the term. Stress how important it is that TAs hand back homework and quizzes in a timely fashion. Students need the feedback.

Let TAs know that if they have questions on an exercise, that they should feel free to visit with you to discuss it. Welcome such requests! Remember that they may not be entirely comfortable with certain parts of calculus themselves and you would much rather have the students learn something correctly than discover that your TA taught a topic erroneously.

The TAs tend to need encouragement to use the calculator effectively. Give a handout or meet with your TAs when you want to give the students a new program or use a built-in calculator function. They are more willing to use the calculator if they feel comfortable with it! And most are more willing to learn something new if done by an example versus learning it completely on their own. We would like to see the TAs use the calculator more during recitations, so the more guidance you give on programs and on 'special' functions you use during class, (e.g. nDer), the better.

Orient your TAs to our department's Calculus Home Page on the World Wide Web (go to <http://www.math.unl.edu> and click on the calculus page). Before you start using a new program, show them where the documentation on it is and be sure to instruct the TAs in how to use the program. Work a few examples with the program with the TAs. You might also give the TAs some ideas of how the program could be used in recitation.

Groups and TAs: The TAs need to be (re)encouraged to use groups. During the first year, many of the TAs gave up on groups during recitations. Encourage the TAs to vary their teaching techniques (i.e. don't always use groups, don't always ask students to go to the board, etc).

Special Concerns of Honors Students

This has very little (if anything) to do with the Harvard text. It is based on my experience with honors students, most of whom were science and engineering majors. Most of what I can tell you about the general teaching of honors sections would be painfully platitudinous, so I'll try to be specific.

1. I pushed them pretty hard. In return for the required effort, I spent a lot of time with them one-on-one, and in small groups. The honors students tend to be inquisitive and conscientious, and one should count on spending a great deal of time with them.

2. Many of the honors students, first year though they be, approach their studies quite professionally, and I concentrated on keeping the course relevant for them. I kept away from those frivolous pseudo-applications that litter calculus texts (“Eddie’s hair is thinning at a rate of...”). I might suspend this policy if a problem were sufficiently challenging or entertaining, but too much of this sort of thing gives the students contempt for the subject. With a little work you can find similarly relevant exam questions. For example, instead of having the students use Lagrange multipliers to find constrained optima in some absurdly unrealistic microeconomic model, I had them use the technique to prove a simple statement about the entropy of an experiment. I was also guided by this policy in the preparation of computer projects. These were fairly long, involved assignments, and they dealt with topics that concern scientists, mathematicians and engineers, e.g. sums of independent random variables, numerical analysis, wave propagation and heat flow.
3. In a small class—and honors classes tend to be small—one has time for minutiae. My minutiae of choice were the details of presentation. I insisted that the student’s assignments be clearly written and laid out, with correct spelling, (approximately) correct grammar, and enough commentary to explain and motivate their mathematics. I distributed a short list of common transgressions against good mathematical writing, along with a few examples of “well-presented” problems. To get the students to conform to my canons of acceptable presentation, I found that I had to apply constant pressure. I graded harshly, and returned without comment papers prepared with insufficient care. By the end of the course, the students were consistently turning in comparatively well written assignments.

Special Concerns for Night Students and Instructors

Be sure the night instructors are kept informed about course issues during the semester, and be sure that they get copies of the projects and preliminary versions of the final in timely fashion. Remember that the night instructors teach only two nights/week, so they may only see their mailboxes twice weekly. Have Rex Dieter create computer accounts for the night instructors and orient them to the calculus home page on the web.

Night students fall into two classes: regular and non-traditional students. Regular students are day students taking a night class. Non-traditional students are usually part-time students with full-time jobs.

Non-traditional students have time constraints which do not allow them to attend sessions outside the assigned class time. They cannot go to the calculus (or computer) lab except immediately before or after class. They are usually older and more apprehensive than day students. They are not as confident and thus need more help and encouragement. They generally work well in groups

and are not afraid to spend a lot of time studying.

Use of the calculus and/or math lab

Regular use of the calculus lab is generally impossible for night students, and they tend to complain that day students have an unfair advantage because of this. Night instructors are not available to proctor labs, even before or after night class. These factors suggest that lab work for night classes may be impossible.

Group Projects and the Night Student

Night students have particular difficulties with group projects, mainly due to difficulties with scheduling meeting times. The instructor can help alleviate this by allotting time immediately before or after class to work in groups. Or the instructor can use some class time for group work. A combination of these approaches seems to work best. Another possibility is to reduce the number of projects in 106 from three to two.

Availability of Solutions

Night students rely more on written solutions and instructor examples. Thus the availability and accessibility of solutions is a serious issue for night students. Each night instructor should have a set of solutions, together with instructions not to duplicate them for the students.

Details of Semester Planning

There are several things to worry about before the semester starts.

The Calculus Lab

Conveners should be sure to organize the calculus lab: figure out hours, staffing, room, etc.. This should be coordinated with the 106-107-208 instructors and the Vice-Chair. In the past, we asked each faculty member and TA to participate in the lab 1 hour per week, and hired additional undergraduate staff as needed.

The calculus lab is used rather heavily at times, so plan to have at least two people staffing it at all times, and perhaps use three or more at peak times (before exams or project due dates).

Be sure to communicate with all concerned how solution books will be transported between the lab and their storage place.

Calculator Orientations

It is a good idea to provide times during the first two weeks of class for calculator orientation sessions. Typically, these are 1-hour long sessions which give the student some information about how to use their calculator, so that a minimum of class time is used for calculator instruction.

You need to arrange for rooms and staffing. See the calculator orientation manual produced by Cheryl Olsen and Stephanie Fitchett for ideas on what the sessions should cover. You should have received this document during the orientation session the week before classes begin.

Communication with Other Instructors

During the first year of using the Harvard materials, we found it useful to have more communication between instructors than was typically done previously. There are a couple of good reasons for this. First, in order to spread the project writing around and to make life easier on the calculus lab staff, it is desirable to have each instructor assign the same project with the same due dates. Second, regular discussions between instructors gave useful insights into the topics to be covered, ideas for overheads, calculator programs, TA issues, dealing with groups, and classroom strategies.

Probably the easiest way to have decent communications is through a weekly meeting, so the convenor should consider arranging this.

Email seems most useful for reminders about various things rather than discussions.

Calculator Programs

You will need to get the various calculator programs and instructions for their use to the TAs and faculty teaching the course several days before the programs will be needed. This way the TAs can give the programs to the students in recitation before they are needed.

Here is a list of the 106 programs and approximate times you'll want them. A fuller description, with complete instructions for use, and examples can be found on the department's calculus home page in the department's www site, or in the Blue Binders located in the secretaries office.

Main Programs:

Secant: Calculates difference quotients and (optionally) draws graphs of the secant lines. The graphics are useful for classroom demonstrations, the numeric-only function is useful for the students when constructing tables of difference quotients. *Needed by Section 2.1.*

Riem: Calculates Riemann sums of functions, with optional graphs showing the rectangles of the approximating sum. *Needed by Section 3.1.*

Additional Programs

Circumsc: Same as Riem, but uses circumscribed or inscribed rectangles. *You might want it for Chapter 3.*

FEVAL Prints the value of y_1 at the value of x you enter *Needed in Section 1.1.*

Integ Integration package. Comprises all the features of Circumsc, Riem, and Trap(see below). *Needed in Section 7.6, but you might want it in Chapter 3.*

Newton: Root-finding package using Newton's rule. You have to enter f and its derivative. *Needed in Section 5.7.*

Ratios: Calculates the ratios of successive terms of a sequence of numbers. You have to enter these as a list called R before running. *Useful in Section 1.3.*

Trig: Rotates a radius around a circle in real time, to illustrate the behavior of sine and cosine, when they are defined in the terms used in the book. *Useful for Section 1.10.*

Here is a list of the 107 programs and approximate times you'll want them:

Trap: Same as Riem, but trapezoidal rule. *Needed by Section 7.6.*

Slpfield: Draws a slopefield for the differential equation $y' = f(x, y)$. The green instructor's manual (produced by the Harvard consortium) has a complete description of this program. *Needed in Section 9.2 and useful in section 7.10*

Timing of Projects and Exams

Past experience has shown that students become highly stressed (and irate) if the due dates of the projects are too close to an hour exam. So check over the syllabus and make sure that you have at least 1 week, and preferably 10 days between the due date for a project and the next exam.

Resources

There are significant resources available: those produced by the Harvard consortium listed in the outline above and those produced by UNL. The Harvard consortium materials may be obtained from Susan when you get your text.

The UNL resources include: old exams, syllabi, course policy sheets, projects, TI-85 programs, transparencies, and welcome to calculus documents.

These materials are available both in hardcopy and electronically. The hardcopy items are in two binders, one for 106 and one for 107, located in the bookshelf on the north wall of the secretaries office. Please use the sign-out sheet when you remove them from the office, so we know where they are.

The electronic copies may be obtained by going to the Calculus Home Page on the World-Wide-Web. To access the Calculus Home Page, go to the math department's home page at <http://www.math.unl.edu> and click on the link to the calculus page.

The best way to download programs from the electronic program archives into your calculator is using the TI-LINK. These are installed on the MACINTOSH computers in the 8th floor computer room and in the Mathlab in Bessey Hall. Documentation for the TI-LINK is available on the Calculus Home Page. Text listings of the programs (useful if you want to modify the programs) are also available through the Calculus Home Page on the World-Wide-Web.

If you write or modify a program and you want to see it appear on the web or calculus archive, please let John Orr know. He'll see to it that it appears.