

Gateway Exams in Mathematics & Statistics: An Instructor's Guide

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January 4, 1999

1 Introduction

Starting with an experiment in the Fall of 1996, the department has been giving on-line Gateway Exams to an increasing number of students. There are now Gateway Exams in Math 102, 103, 106, and 107 so that in Fall 1998 almost 2,000 students will take on-line exams in our department. The purpose of this document is to provide an introduction to the Gateway Exams for instructors who are unfamiliar with them, and to outline departmental policies on administering these exams.

Sections 2 and 3 describe Gateway Exams and how they are given. Instructors should read Section 4 for information on using a Gateway Exam in their class, and Convenors should read Section 5 for important scheduling and organizational information.

2 What Are Gateway Exams?

The purpose of a Gateway Exam is to test students' abilities in the core computational skills of a course. Thus in Math 106 the Gateway covers techniques of differentiation and in Math 107, the Gateway covers techniques of integration.

Because the skills tested are those which "no-one should pass the course without having reasonable competency at," the Gateway Exam is taken pass/fail. Students may retake the test an essentially unlimited number of times, but to gain credit for the test, they must reach the passing grade, which is typically at least 80%. The Gateway Exams provide a counterbalance to the worry that computational skill is being squeezed out of reform courses by "softer" material.

The Gateway Exams are given over the web using software developed in our department. Students can practice tests over the web from any location, but for security, they must come to the Math Resources Center or the Mathlab to take the test for credit. Although the Gateway Exams hold students to a high standard, while they are working on the tests students have the benefit of immediate feedback to their tests and unlimited practice and makeups. Eventually most students realize that if they work hard then they can pass.

The exams themselves are a mixture of multiple choice and free-form questions. Free-form questions ask the students to enter their answers as formulas in a text box on the screen. The computer compares the values of the formula the student typed with the correct answer at a number of points to determine if the two formulas are equal. This means that however the student presents their formula, it will be graded correctly, whether it is in the same form as the answer given by the instructor or not. So the answers “ $(x-1)(x+1)$ ”, “ (x^2-1) ”, and “ $-1 + x^2$ ” will all be graded the same. (There are a few restrictions where needed, though: the questions in our precalculus exam which ask things like “What is $\sin(\pi/4)$?” will accept “ $1/\sqrt{2}$ ” or “ $\sqrt{2}/2$ ” but not “ $\sin(\text{Pi}/4)$ ”.)

3 How Do We Administer Gateway Exams?

3.1 Paper Tests

Students take makeups of the tests in the MRC or the Mathlab. In order to reduce the demand for the computers in these rooms, a paper version of the exam is usually given one time in class or recitation. This removes the students who are already well-prepared from the pool, so that the computer system only has to deal with those students who need makeups. There is a small burden associated with grading the paper gateway tests, but since the questions are graded all-or-nothing, grading can be done very quickly.

Paper tests can be generated automatically from the test banks by accessing the page at:

<http://calculus.unl.edu/gateway/modules/paperTest.PaperTest>

3.2 On-Line Makeups

Students take makeups for the Gateway Exams at either the Mathlab (Bessey 105) or the Math Resources Center (Burnett 106). When a student goes to one or other of these sites, the attendant will help her get started on a test (i.e. logging on, opening the browser, etc). Once she has completed her test the system notifies her that she must get authorization from the attendant to have her test graded. The attendant verifies her identity from her student ID photo, and enters a secret password to confirm that the test can be graded. The student receives immediate feedback, seeing both her grade and the corrections to the questions she got wrong. Students taking the test in the Math Resources Center have the opportunity to consult with one of the attendants about their test immediately.

There is a policy that students should not retake a Gateway Exam more than once in a day. The policy is not rigorously enforced, however, in that the software does not absolutely block a student from taking the exam twice in one day. Also, with two locations where students can take the exam and changes in the staff at each location throughout the day, there is no way that attendants can prevent someone from coming back later in the day to retake an exam.

The attendants do prevent students from taking exams head-to-tail. And, if you access the daily report of student results for your section, you will be able to tell if a student has tried the exam more than once in one day. We ask that you stand behind the policy and make exceptions only in situations where you are persuaded by the merits of a particular student's situation.

3.3 Practice Tests

There are practice tests available for all of the tests which are given as Gateway Tests. The requirement of authorization by a proctor prevents students from taking the tests for credit from anywhere other than the MRC or the Mathlab, but they can take practice tests from any location.

The questions that appear in a practice test are drawn from the same large pool of questions as the tests for credit. This serves as a strong motivation for the students, who know that the test they practice on at home might be the test they get given when they take it for real. In practice, however, the test bank is quite large, and the order of questions is mixed up each time a test is set, so the only advantage a student gains from having seen some of the questions before in practice tests is most likely the same advantage she would get from *any* practice the night before.

4 Gateway Exams In My Class

4.1 What Are They Worth?

The final decision on how highly to value the Gateway Exam rests with the individual instructor. However, people using Gateway Exams in their classes have (as far as I know) followed the guideline of making them worth between 5% and 10% of the final grade. Instructors using Gateway Exams are also encouraged to stick with the policies of “all-or-nothing” and “no partial credit” on these exams.

4.2 Seeing Student Results

Instructors are given a password which they can use to access an on-line gradebook of student results. You get to the gradebook by going to the instructors' homepage at:

<http://calculus.unl.edu/gateway/html/instructors>

and selecting the link for “Class Statistics”. Once you've logged on with your password, click on the button marked “List All Student Records” to see a list of the students who have taken makeup tests and whether they have passed or not. You can click on an individual student's name to see the results of a particular test.

(Of course the system has no way of knowing which students passed the paper version of the test and therefore never took an on-line makeup. You need to keep track of those students in your own gradebook.)

The Class Statistics page also lets you see a list of student results listed by day, and an overview of the class results, including the average score on each of the topics in the test.

As well as accessing the on-line gradebook, Rex can arrange for the system to send you email notification each time one of your students passes a test. Let him know if you would like this feature enabled. (Convenors of multi-section courses, please find out from the other instructors who would like to use this feature, and pass those names to Rex.)

4.3 Student Appeals

The electronic system provides you with grade information on a student's tests but, as instructor, the final decision on whether or not to pass a student rests with you. Not surprisingly, students will come to you with print-outs of Gateway Exams and

argue either that their test was misgraded, or that the mistake they made was so small that they deserved to pass.

If there has been a glitch in the system resulting in a question being misgraded (and that question resulted in the student failing) then you will probably want to pass the student. In this situation, *please* also let me (John Orr) know about the fault so that I can correct it!

On the other hand, the Gateway Exams are premised on having one part of the course in which accuracy of the student's answer is assessed very highly. There are many other parts of the course assessment in which partial credit is given. Moreover, the ability to produce an accurate answer (and to accurately communicate with a computer) *will* be an important component of our students' working lives. Thus, I'd urge you to be very sparing in raising grades which have been correctly graded but which contain only small glitches.

If a student is appealing a grade given by the system, you can access the student's user record and view the details of each test the student took. See Section 4.2 above for details.

Students sometimes complain that they gave the wrong answer because of a small slip in parentheses (typing something like $\frac{1}{x} + 1$ when they should have typed $1/(x + 1)$). Although slips like this are frustrating for the student, they can be avoided if the student makes use of the preview feature for questions which ask for formulas.

4.4 Customizing the Exams

I firmly believe that we're just beginning to skim the surface of on-line testing, and that there are many creative and useful ideas waiting to be tried with this system in our department.

For example, without needing to write any new questions, you could use the test banks from one course to give review assignments in another course. Someone teaching Math 208, for example, might put together a review assignment¹ with questions on differentiation and integration, and give his/her students a period of time in which to record scores of 80%. For an assignment like this, one can arrange for the students to take the test from anywhere, without the need for proctors.

On the other hand, while I urge you to be creative in thinking of new uses of on-line tests, I also ask you to avoid changing the content of the Gateway Ex-

¹Mike Ira is doing just this, in Fall 1998.

ams. Because these are cross-section, cross-semester tests, they give us a valuable opportunity to track student performance over time. I would urge you to regard the Gateway Exams in the same way we do a course textbook: as something that should only be changed after a significant discussion with all the interested faculty.

5 So What Do I Need To Do?

If you're teaching a multi-section course that uses a Gateway Exam but are not the convenor then probably all you need to do is:

- Explain the Gateway Exam policies to your students, remind them of the dates, help them to understand the expectations of the test, and encourage them to keep studying and retaking the test until they pass. The document "*On-Line Gateway Exams in Math & Stat*" prepared as a hand-out for students may be another helpful source of information for you.
- Answer some questions from your students on grading decisions they don't understand/agree with.
- Access your electronic gradebook and record your students' grades.

If you are the convenor of a multi-section course that uses a Gateway Exam, or are using a Gateway Exam in a course without a convenor (such as summer session courses) then you need to carry out a couple of organizational tasks:

- Decide on start and stop dates for the exam (see the table below).
- Tell Rex the dates for the exam. If possible you should let Rex know at the start of the semester, but, at any event, no less than 2 weeks before the start of the exam.
- Prepare a paper test for the initial version of the Gateway Test. Paper tests can be generated automatically from the page at:

<http://calculus.unl.edu/gateway/modules/paperTest.PaperTest>

- Arrange for the paper test to be given and graded (usually TAs handle this in recitation).

- Tell Rex which of the instructors in your class do or do not wish to receive automatic email notification of student passes.

<i>Class</i>	<i>Start</i>	<i>Stop</i>
Math 102	6	8
Math 103	11	14
Math 106	11	14
Math 107	4	7

Beginning and ending weeks for Gateway Exams.