Program Self-Assessment: BA and BS in Mathematics

Department of Mathematics and Statistics

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Preamble

The University of Alaska Fairbanks requires all degree programs to undergo periodic review. The BA and BS degrees in mathematics will be reviewed in the 2005-2006 academic year. The following document was produced by the Department of Mathematics and Statistics in compliance with this review process. It is a summary of the department's view of these degree programs.

Undergraduate Mission Statement

The Department of Mathematics and Statistics serves the undergraduate academic community at UAF by providing a large number of mathematics service courses for other disciplines and departments, by offering majors the opportunity to learn challenging and important mathematics in upper level courses, by preparing interested students with the mathematical and analytical skills sufficient for embarking on a quantitative career, and advising non-majors and majors alike about appropriate mathematics placement and courses of study. The Department seeks to offer excellent instruction at all levels of the curriculum and to meet the diverse mathematical needs of a large comprehensive university.

Strengths

Quality Undergraduates

Our outcomes assessment suggests that the department produces math majors who compare favorably with math majors from other colleges and universities. For the past seven years, all math majors have been required to take the ETS Major Field Test in Mathematics. Our students have scored in the top 76% percentile every year and scored in the top 95% percentile in four out of seven years.

Year	1999	2000	2001	2002	2003	2004	2005
Number of Students	6	13	10	6	12	7	14
Overall Score (percentile)	174.7 (97%)	162.2 (84%)	161.0 (86%)	170.3 (95%)	175.2 (99%)	185.6 (99%)	160.1 (76%)

Table 1: ETS Major Field Test In Mathematics Institutional Mean Score

Our graduates are ambitious -- over the past seven years, 58% of our graduates have indicated they plan to attend graduate school. And though we have only just begun to track our graduates (and thus our sample size is small), our initial results are positive. Of those surveyed one in three is in graduate school in math or a math related field and 78% are employed in a math related field.

Quality Faculty

Our department adeptly maintains a balanced load of research and teaching responsibilities. We have an especially flexible faculty, teaching a large variety of courses. It is not unusual for a department member to teach, over a two-year period, six or seven distinct courses.(In fact, of the PhD holding faculty who have actually been at UAF for at least two years, the average number of *different* courses taught over Fall 2003, Spring 2004, Fall 2004 and Spring 2005 was 6.66.) The department is committed to high teaching standards and has a formal peer review of teaching.

We also maintain active research programs in such diverse fields as graph theory, mathematical glaciology, mathematical biology, mathematics education, quantum physics, and general relativity.

University Service

Department members teach a diverse student population, including non-majors from liberal arts to the physical sciences and engineering, as well as our own undergraduate mathematics majors. For example, in each of the past six semesters the department has offered a

minimum of 18 sections of 100- or 200-level service courses ranging from a 100-level modern concepts of mathematics course to a 200-level calculus for business majors. In addition, we have a significant service role at the 300-level as can be seen in Table 2.

Course	Enrolled	Non-math major	Percentage
Math 302	45	42	93%
Math 307	39	30	77%
Math 310	29	19	66%
Math 314	27	23	85%

Table 2: Non-math majors in 300-level Math courses for Fall 2005

Furthermore, the department provides this service efficiently. For each semester between Fall 1999 and Spring 2004, mathematics has produced around 23% of the credit hours for CNSM. During this same time period, the math permanent faculty FTE as a percent of CNSM permanent faculty FTE has ranged from 20% in 1999 to around 15% today (see Appendix 2).

Weaknesses

Curriculum

Exit surveys of our graduating classes conducted as part of our Outcomes Assessment have listed the department's curriculum, especially its bias towards applied mathematics and its lack of elective courses, as a weakness.

The department's curriculum is indeed currently biased towards analysis and applied mathematics. These are important areas of mathematics that also fit well with the department's service role within the university. But we also have a mission to train mathematics undergraduates more broadly, possibly in preparation for graduate school, and to reflect the true diversity of our discipline to future teachers. Our curriculum is particularly deficient in the fields of algebra and discrete mathematics. We do not teach courses in Combinatorics, Number Theory, a second semester of Algebra (including Galois theory), or Dynamical Systems all of which are standard at other institutions. We also do not teach a Linear Algebra course targeted at math majors. Finally, our existing electives are offered infrequently. There is interest among faculty members for teaching such courses, but currently there are too few faculty members to enrich our curriculum with the service needs of the university requiring a large proportion of faculty teaching energy. While some of these shortcomings, especially the lack of electives, could be met by instituting a rotating topics class, we need to increase the diversity of our regularly offered courses.

In addition to considering the number of courses offered, there is consensus in the department that the undergraduate curriculum is broadly in need of reassessment. Some needed areas of consideration include:

- Frequency of course offerings: (Eg. Calculus for the Biological Sciences and Topology should be taught more frequently).
- Prerequisites for courses (Eg: Linear Algebra should be a prerequisite for other courses, including Differential Equations, though this will require collaboration and cooperation with the Engineering and Physics departments. The role of Mathematical Proofs should be enhanced beyond its current status as a prerequisite for two upper division courses).

- Course development and modernization, (Eg. splitting Linear Algebra into a 200 level Matrix Algebra course and a 400 level Linear Algebra class).
- Degree requirements for math majors and minors. (Eg. streamlining the elective package so faculty approval is not required and to decrease student confusion and adding additional electives for the math minor.)
- Alignment of UAF's mathematics curriculum with the Mathematical Association of America's Curriculum guide for mathematics instruction. (The MAA is the professional organization for university mathematics teachers.)
- Integration of appropriate uses of technology in mathematics instruction.

Undersized Faculty and Turnover

Our relatively sparse undergraduate mathematics curriculum is, at least in significant part, a consequence of an undersized department. At our current staff levels we are unable to offer all the mathematics courses listed in the UAF catalog for 2005-2006, much less expand the curriculum.

Although we are at nearly full strength this year (we have a single faculty member on sabbatical in the spring), and even though we have hired two adjunct professors for this year, we did not offer Math 460 (Mathematical Modeling) this fall and we will not be able to offer Math 402 (Advanced Calculus II) in the spring. We are also experiencing a teaching shortage in our 100 level courses. As discussed below in the Recent Changes section, the department increased the number of credits for Math 107 (Functions for Calculus) from 3 to 4. This change has effectively cut the number of sections of Math 107 we are able to offer. This fall we had to cancel one section of Math 107.

An illustration of our department's small size is given by the informal survey of department sizes given in **Error! Reference source not found.** Ten departments were chosen for comparison, either by virtue of past comparisons in our outcomes assessment, or at random from the American Mathematical Society's tier three PhD granting departments and MSc only granting departments. The number of remote UAF campuses together with the significant TVC population present difficulties for making a fair comparison. We chose as a measure the ratio of the total number of mathematics majors (graduate and undergraduate) to the number of permanent mathematics faculty indicated on the department's home page. UAF has a ratio of 4.7 students per faculty member, which compares unfavorably with the average of 3.2 for other schools. Of the schools surveyed, only the University of Washington and the University of Southern Maine have worse averages, and the poor UW average can be partly explained by the number of graduate students there with teaching responsibilities.

The department size makes us more vulnerable to the effects of periodic reductions to our faculty numbers from sabbaticals, retirements, and of faculty turnover. Turnover has been an especially difficult challenge for the department. Currently, we have a single mathematics faculty member who has been with the department longer than 8 years. Fully one third of the department's tenure-track faculty was hired last year. The rapidly changing faculty adversely affects our undergraduate program, both in terms of inconsistent academic advising, and in terms of course offerings.

Technology

In any mathematics department in the United States, there are widely differing opinions about the extent to which technology (graphing calculator, mathematical software, etc.) should be used by students and in course instruction. This diversity may have a pedagogical advantage, in that different students may also have these slants and gravitate towards more formal or more computational classes and instructors.

Nonetheless, for mathematics faculty interested in using software packages in classes and providing their students with access to software, the situation at UAF is not easy. Briefly, some of the difficulties include:

- There is no open access computer laboratory with mathematical software on campus. Currently, the only place a student may use a mathematical software package on campus is in the Chapman 103 Lab. However, this lab is generally only available for use by students enrolled in certain courses that require a technology fee. Reserving time in the lab for a class meeting can be difficult, since the lab is in high demand for statistics and computer science courses during the day.
- There is no mathematical software on public computers, including SmarteCartes. This poses a particular problem in Gruening, where many mathematics courses are taught. A SmarteCarte will not have the software loaded that an instructor needs. Recently, the Department of Mathematics and Statistics purchased two laptops for use in instruction, which can have mathematical software packages loaded. Still, an instructor would have to carry a laptop to Gruening each class day for use. This is possible, of course, but inconvenient and may discourage using software in instruction, potentially resulting in diminished learning opportunities.
- Decentralization of software licensing: UAF has few, if any, site licenses for mathematical software packages at this time, and in general departments operate autonomously for purchasing software licenses. This is intimately related to the items above, in that it does not create a culture conducive to integrating technology into teaching and learning, since software is not available in a widespread fashion. At other universities, engineering, science, and mathematics faculty may work more closely to determine appropriate use of technology and software in mathematics service courses, with the goal of developing an integrated technology thread throughout four years of undergraduate study.

Recent Significant Changes

Assessment

In Spring 2004, the department redesigned the assessment protocols for the undergraduate degrees. Among other changes, we began tracking our graduates and comparing our program to other similar institutions.

Math 107

We have made three significant changes to Math 107 in the past five years. Starting this fall (Fall 2005), Math 107 became 4-credit hours, up from 3-credit hours. Also, the curriculum now includes a "ramp-up" time to help get struggling students up to speed. Finally, we raised the prerequisite from a C or better in DEVM 105 to a B or better in DEVM 105. These changes were motivated by the high failure rate in this course. (For more details, see the next section.) We do not yet have data on whether these changes will increase student success. However, there is an immediate impact on our teaching resources. Our instructors can now cover fewer courses, exacerbating the problem of having too few faculty. The proposed course change for Math 107 indicated that an additional faculty member would be required to implement it. The change was approved and is now a part of the UAF catalog, but no additional positions have been created.

A list of some of the curriculum changes over the past five years are listed in Appendix 3.

Service Course Issues

Placement and Failure Rates

In many of the lower level service courses, grades of D or below (D, F, W, I, AU) are all too common. Class sizes also tend to run large in such courses. Data from the last three semesters (Spring 2004, Fall 2004, Spring 2005) have been tabulated for three representative courses to illustrate these trends.

	Avg # students per section	Spring 2004 Enrolled	% < C	Fall 2004 Enrolled	% < C	Spring 2005 Enrolled	% < C
MATH 103X	36.2	112	37.5%	84	27.4%	77	35%
MATH 107X	33	188	51%	214	55%	210	45.7%
MATH 200X	49.4	118	60%	154	40%	102	55%

Table 3: Unsuccessful Course Completions

As the section on recent significant changes shows, the department has taken some measures to address these problems.
One common problem for students in math courses, and a significant contributing factor to poor student success, is not having the prerequisite mathematical skills for the course in which they are enrolled. It is departmental policy to give a placement test to all students in Math 107 and Math 200 at the beginning of the semester. However, we believe a better solution is to ensure students are placed correctly in the first place. One approach that has been adopted by many universities is to require all students to take a placement exam and enforce that placement by preventing a student from registering for a course for which he is unprepared.

Consistency and Continuity

The 100 level math courses (that is, 103,107,108,161) are offered in many different methods, at many different locations, and by many non-DMS faculty. For example, most 100 and 200 level courses are offered both as regular lecture courses and as distance delivery courses as managed by the Center for Distance Education, frequently with instructors outside of DMS. Math 107 and Math 103 are offered not only on the main UAF campus, by DMS and TVC faculty, but also at the downtown TVC campus, Eielson Air Force Base, Northwest Campus (Nome), and Kuskokwim Campus. Finally, the only way DMS can cover the many sections of 100 level courses for which it is responsible is to hire many temporary teachers in the form of graduate students and adjuncts.

These diverse modes of course delivery pose a challenge for course consistency. Since successful completion of a mathematics class requires successful mastery of prerequisite material, consistency of instruction is related to success rates. If a particular section of Math 107 does not adequately prepare students for Math 200, those students are at an unfair risk of failure. It should also be noted that several 100 level Math courses have DEVM classes as *their* prerequisites, and hence coordination with DEVM is a related challenge. We do not currently have an individual responsible for overseeing course consistency and coordination with DEVM. This is an enormous task and deserves being singled out in a faculty member's workload.

Math Lab

The department funds and runs a Math Tutoring Lab where students can get free drop-in tutoring. Here, any UAF student can get help in developmental math; all 100, 200 and 300 level mathematics and statistics courses; as well as informal help on 100 and 200 level physics classes. The lab itself is a departmental strength. For example, we offer tutoring in an unusually large number of classes; other institutions typically only address developmental math through calculus. We believe the lab also has potential for improvement, in the form of data gathering, staff scheduling, staff training, and lab promotion.

We know that students are using the lab, and even that it is occasionally so crowded that students are seated on the floor. Anecdotally, we know that for many students, it is a crucial tool for learning math and passing a given course. But we do not have any usage statistics or a formal method for getting student feedback. So, for example, we don't know what courses students ask about or when they are coming. We don't know what percentage of Math 107 students come to the lab at least once during the semester and whether students who come to the lab are more likely to pass the course. And we don't have a formal feedback mechanism from students regarding the lab. Such information would be significant asset for staff hiring, training, and scheduling, which is currently done by the department chair in the absence of sufficient data. Feedback from students will allow us to identify and, hopefully, remedy any problems.

The lab does not currently have any form of permanent TA training. Although there has been at least one TA training session in the past five years, training is not an ongoing activity. Also, the lab is only informally promoted by individual instructors.

Management of the lab currently falls among the various responsibilities of the department chair, and the lack of a targeted math lab coordinator inhibits our ability to offer consistent, permanent TA training. Additionally, a permanent math lab champion would be able engage in more effective advertisement (for example, by visiting classes at the start of each semester to promote its services). The coordinator would track data showing the lab's benefits, information useful for promoting the lab and for obtaining additional funding for it. As recently as 1999, coordinating the math lab was a formal part of a faculty member's workload, but this is no longer the case.

Needs

Faculty and Curriculum

The department is in need of additional faculty to ensure we can reliably cover our minimum offerings and provide our students with an adequate number of elective courses. In light of the ongoing faculty shortage, the department also needs to review the curriculum being offered, reprioritize its offerings, and perhaps drop some courses from the catalog to allow new elective courses to be taught. A periodic review of the curriculum should be added to the department's assessment plan. Finally, the department needs to decide on measures it should take, in cooperation with CNSM, to address its problems with turnover.

Technology

UAF needs an open access computer laboratory with mathematical software. This need could be met by installing software (e.g. Matlab and one of Maple or Mathematica) via site licenses on the existing open access labs, or by creating a new mathematics open lab. Although there is not yet a consensus within the department about the best mechanism for funding this improvement, one possibility is to institute an additional fee on mathematics courses.

Placement Exam

We believe that a mandatory placement exam and enforcing prerequisites at registration would increase the success rates of students in lower level math courses and decrease the frustration of students who register for the wrong course.

Math Lab Coordinator

The Math Tutoring Lab can be enhanced by creating a permanent coordinator. This position would be responsible for all aspects of maintaining, enhancing, and promoting the lab. To allow for a suitable amount of energy to be directed towards the lab, the position should be suitably compensated by means of a teaching release.

100 Level Math Coordinator

We believe the department needs to have a designated 100 level coordinator. The coordinator would be responsible for ensuring consistency across the many different sections, implementing assessment across all sections of 100 level courses, and coordinating with DEVM.

Outcomes Assessment Summary

	Academic Year			
	2002-2003	2003-2004	2004-2005	2005-2006
Assessment information collected	ETS Field Test; Survey in Math 490 Transcript review	ETS Field Test Survey in Math 490 Transcript review Compare to like institutions	ETS Field Test Survey in Math 490 Survey of alumni Transcript review	ETS Field Test Survey in Math 490 Survey of alumni Transcript review (all conducted in Spring 2006)
Conclusions drawn	The summary of scores on the Field Test showed our students placed in the top 6% in all areas.	Our students continue to perform well on the Field Test in Math. The old assessment plan (written in 2000) needs to be rewritten including new survey in Math 490. The transcript review reveals some issues with the order in which students take courses. Some majors struggle to satisfy the W requirement.	Our students continue to perform well on Field Test in Math. Both alumni and Math 490 students indicated concern about too few electives.	
Changes made	None	Department discussion of the importance of prerequisites. We wrote a new assessment plan including new surveys.	Department discussion of what electives are lacking and how to improve sequencing of courses. The discussion in on-going. Lack of faculty will be a problem here.	

Recent assessment reports for the BS and BA in math and for the core math courses can be found in Appendices 7 and 8.

Appendix 1: Informal Survey of Department Sizes

	Total Students	Undergraduate Math Majors	Math Graduate Students	Math Faculty Size	Math Students/ Math Faculty
Howard University	10,623	47	35	45	1.8
Jackson State University	7783	55	0	14	3.9
Mississippi College	3588	24	6	8	3.8
San Francisco State University	27435	93	0	63	1.5
SUNY, College at New Paltz	7908	67	2	30	2.3
Univeristy of Wyoming	13207	39	30	25	2.8
University of North Dakota	13187	73	18	23	4.0
University of South Alabama	13340	30	0	26	1.2
University of Southern Maine	11007	46	0	9	5.1
University of Washington	39199	259	83	56	6.1
Non UAF Average					3.2
University of Alaska Fairbanks	8693	39	13	11	4.7

Student counts obtained from each university's institutional research office. Faculty sizes were estimated by counts from departmental homepages. These counts include all permanent mathematics faculty (professors and instructors), but not statistics faculty.

Appendix 2: Credit Hours Generated and Department Size

	Mathematics Student Credit Hours	CNSM Student Credit Hours	Percent Mathematics Student Credit Hours	Mathematics Permanent Faculty (FTE)	CNSM Permanent Faculty (FTE)	Percent Mathematics Permanent Faculty (FTE)
Fall 1999	3,459	13,642	25%	10.5	51.9	20%
Spring 2000	2,688	12,131	22%	10.5	52.0	20%
Fall 2000	3,066	13,511	23%	8.5	53.0	16%
Spring 2001	3,132	12,909	24%	8.5	56.0	15%
Fall 2001	3,197	13,746	23%	9.5	60.0	16%
Spring 2002	3,004	12,901	23%	10.5	61.0	17%
Fall 2002	3,316	14,596	23%	10.5	67.0	16%
Spring 2003	3,302	13,399	25%	10.5	67.0	16%
Fall 2003	3,604	15,092	24%	10.5	67.0	16%
Spring 2004	3,218	13,724	23%	10.5	68.0	15%
Fall 2004	3,466	15,172	23%	10.5	Not Available	-
Spring 2005	3,143	13,739	23%	10.5	Not Available	-

Data obtained from UAF Planning, Analysis and Institutional Research.

Appendix 3: Recent Major Changes to Mathematics and Statistics Courses

Fall 2005

1. At the request of the Department of Developmental Education, a toughening of prerequisite requirements in MATH 107X: Functions for Calculus. (pending Senate approval)
2. At the request of the School of Education, changing the prerequisite requirements for MATH 205: Mathematics for Elementary Teachers, I. The new prerequisite allows includes MATH 161X as an allowable prerequisite. (status **** unknown)

Spring/Summer 2005

1. Updating current course descriptions
   * drop W and O designations from MATH 460: Mathematical Modeling
   * drop W from MATH 404: Topology

Spring 2004

1. effective fall 2005, MATH 107X: Functions for Calculus is changed from three hours to four hours. This was suggested as a means to improve retention and completion rates in MATH 107X and better prepare students for subsequent courses.
2. effective fall 2005, MATH 131X has become MATH 103X: Concepts and Contemporary Applications of Mathematics. This change was to facilitate correct placement of students in Mathematics courses. Historically, many students registering for MATH 107X should have been in the lower class, but did not realize this because of the number scheme.
3. catalog changes for Calculus courses. Calculus 200X, 201X, 202X course descriptions and contact hour catalog listings have been changed to reflect the number of contact hours. There had been questions about advising and whether or not recitation sections were optional in 200X that confused the registrar.

Fall 2003

1. STAT 680 is dropped from the catalog, though the course is still offered in its cross-listed forms as BIO 680 and WLF 680.. This course was not attracting graduate students in statistics.

Fall 2002

1. MATH 422 was changed from a four hour elective course to a three hour elective course. This was designed to update both the course content as outlined in the catalog course description and to make the course more attractive to majors and science majors who need to learn Complex Analysis.

Appendix 4: Math BS/BA Assessment Plan

Date: February 2004

Certificate or Degree Program: Bachelor of Science and Bachelor of Arts in Mathematics

Mission: We shall provide quality education responsive to the needs of individual students and the diverse population of Alaska.

Goal: To assure that our graduates are adequately prepared to succeed in the job market in mathematics or a closely related field.

INTENDED OUTCOMES/ OBJECTIVES	ASSESSMENT CRITERIA	IMPLEMENTATION PROCEDURES (what, when, who)
1) Our curriculum will be comparable to national standards.	Compare our program to University of Washington, University of Wyoming, and University of North Dakota.	The math assessment committee will compare the curriculum at UAF to that of the three specified institution (all state research universities) every three years and will include their findings and recommendations in the annual assessment report.
2) Our students will master a core of mathematical concepts comparable with that of other institutions.	All majors will be required to take the ETS Major Fields Test in Mathematics.	Every spring, the instructor of Math 490, a required course for all math majors, will require all students to take the Major Fields Test in Mathematics. The results will be summarized by the assessment committee in the annual report the following spring.
3) Our students will have the opportunity to develop the skills necessary to achieve their career goals in mathematics.	A) exit survey B) alumni survey	A) Every spring, the instructor of Math 490, a required course for all math majors, will give all students an exit survey at the end of the course. The results will be summarized by the assessment committee in the annual report the following spring. B) Every May, alumni surveys will be sent to all students who graduated with a degree in mathematics two years prior. The returned surveys will be summarized by the assessment committee in the annual report the following spring.
4) Students will gain a broad background in liberal arts, fine arts, science, and ethics.	A) university core requirement fulfilled	A) Checked automatically by graduation office. These classes are separately assessed at the University level.
5) We will monitor the effectiveness and implementation of our program requirements.	A) transcript check of recent graduates	A) Every Spring the chair of the department will review the transcripts of students graduating with degrees in Mathematics and communicate any problems or surprises to the assessment committee.

Appendix 5: Data from Math 490 Exit Surveys

Raw Data from Math 490 Survey Spring 2005

The survey was given to the 14 students in Math 490 Senior Seminar in Spring 2005 at the end of the semester. This was the first year this particular survey was used.

Expected Graduation Date

Spring 2005	Summer 2005	Fall 2005
7	2	5

Plans after Graduation

graduate school	8
work in math related field	5
work in non-math related field	0
Other	0
Unsure	4

Note, some students checked both graduate school and work in a math related field.

Responses to the statement:
I'm confident the UAF Math program adequately prepared me in _____ .

	Strongly agree	agree	neutral	disagree	strongly disagree	not applicable	total
Calculus	7	3	2	0	0	2	14
Proofs	5	7	0	0	0	2	14
Abstract Algebra	5	6	1	1	0	1	14
Linear Algebra	2	6	4	0	0	2	14
Advanced Calculus	2	5	2	0	1	4	14

Responses to the statement:
I'm satisfied with (each item) in the UAF Math program.

	strongly agree	agree	Neutral	disagree	strongly disagree	not applicable	total
Advising	4	5	3	1	0	1	14
Availability of math elective courses	1	6	1	5	1	0	14
Course scheduling	2	8	0	4	0	0	14

Appendix 6: Data from Alumni Survey

Raw Data from Alumni Surveys 2005

We began tracking our graduates for the first time in 2005. In May of 2005, 22 surveys were sent to those students with a BS or BA in mathematics received between 2000 and 2003. Nine surveys were returned for a response rate of 40%.

date degree was earned

2000	1
2001	2
2002	1
2003	3
no response	2

Responses to the question:
Are you _____ ?

employed in a math related field	5	3 at UAF; 2 teaching high school in Alaska
employed in a non-math related field	1	army
in graduate school in mathematics	1	
in graduate school in an area other than mathematics	2	1 in CS, 1 in Statistics
Other	1	unemployed

Note, one person checked both graduate school and work in a math related field.

Answers to the question:
I'm confident the UAF Math program adequately prepared me in _____ .

	Strongly agree	agree	neutral	disagree	strongly disagree	not applicable	total
Calculus	5	3	0	0	0	1	9
Proofs	5	3	1	0	0	0	9
Abstract Algebra	3	2	3	0	0	1	9
Linear Algebra	4	5	0	0	0	0	9
Advanced Calculus	2	3	3	1	0	0	9

Responses to the statement:
The quality of teaching in the math courses I took was _____.

excellent	very good	good	fair	poor	very poor
5	3	1	0	0	0

Appendix 7: 2003-2004 Assessment Report

Department of Mathematical Sciences
Assessment Report
for the
Bachelors Degree in Mathematics
2003-2004

Introduction

The Department of Mathematical Sciences (DMS) has collected information as directed by the department's Student Learning Outcomes Assessment Plan. This includes a comparison to other institutions, the Major Fields Test in Mathematics, surveys of graduating seniors, and the chair's review of transcripts. We have included some additional material such as basic statistics on our student body and student participation in national contests. The report concludes with a list of suggested actions for the department to pursue in the coming academic year.

Assessment Facts and Analysis

I. Comparison to Other Institutions

We examined the undergraduate mathematics course offerings at the University of Wyoming, the University of North Dakota, and the University of Washington. We found the programs at the University of Wyoming and the University of North Dakota to be very similar to that at UAF. The program at the University of Washington is clearly stronger.

University of Wyoming. The University of Wyoming offers an undergraduate course in partial differential equations that looks stronger than what we offer in Math 421. They also have a course aimed at preparation for the Putnam exam, which we do only informally and sporadically. On the other hand, they seem to offer no topology or differential geometry, whereas we do, at least on an as-demand-warrants basis. Overall their offerings appear comparable to ours.

University of North Dakota. The UND program also appears comparable to ours. Notable differences: They offer a course in set theory and logic that looks more demanding than what we offer in Math 215. They also offer a cooperative education course. They do not seem to offer any differential geometry.

The University of Washington. The UW program is clearly stronger than ours. Because of their numbers, they are obviously able to offer a wider variety of courses than we can. Examples of courses offered at UW but not at UAF:

Several separate honors courses, offered at various levels.
Computer lab for mathematics, offered at various levels.
Optimization.
Dynamical systems.
Math enrichment for the schools. (More than what we do in Math 205-206.)
Mathematical communication.

Moreover, UW has a separate department for applied mathematics, which offers courses in fluid dynamics, mathematical biology, and much more.

II. Summary of Major Fields Test in Mathematics

The Major Fields Test is given each spring in Math 490, Senior Seminar. This is a required course for all math majors. Despite the name, not all students in the course are necessarily seniors. However, all students must have passed at least one Math 401 Advanced Calculus or Math 308 Abstract Algebra. Thus, all students have completed the majority of the core math courses and at least one of the two most advanced courses. The exam is usually given near the end of the semester, thus the scores from this year (2003-2004) will not be received and summarized until next year.

As the chart below indicates, our students have consistently scored well. The scores from last year (2002-2003) are particularly high placing the department in the 99th percentile. It should be noted that the universities and colleges taking the exam are not, in general, the very best in the nation, but there are many like institutions in the group.

ETS Major Field Test in Mathematics Institutional Mean Score					
Year	1999	2000	2001	2002	2003
Number of Students (^transfers)	6 (2)	13 (5)	10 (7)	6 (3)	12 (5)
Calculus mean % correct (*percentile)	56.7 (86%)	50.3 (74%)	40 (81%)	45.5 (92%)	51.6 (97%)
Linear and Abstract Algebra mean % correct (*percentile)	65.5 (93%)	49.2 (47%)	48.2 (65%)	54.5 (88%)	59.6 (94%)
Routine mean % correct (*percentile)	69.2 (NA)	57.6 (NA)	55.7 (86%)	65.5 (97%)	66.5 (99%)
Non routine mean % correct (*percentile)	47.8 (NA)	31.2 (NA)	26.1 (57%)	30.0 (82%)	36.2 (97%)
Applied mean % correct (*percentile)	46.3 (NA)	47.0 (NA)	47.7 (84%)	52.0 (92%)	60.3 (99%)
Overall score (*percentile)	174.7 (97%)	162.2 (84%)	161.0 (86%)	170.3 (95%)	175.2 (99%)

^ number of students transferring from other institutions
* Percentile among other institutions giving the Major Field Test

We also have the following information about the students taking the exam.

Gender Distribution Major Field Test participants					
Year	1999	2000	2001	2002	2003
Males	4	8	6	3	6
Females	2	5	4	3	5
No response	0	0	0	0	1

Ethnicity Distribution Major Field Test Participants					
Year	1999	2000	2001	2002	2003
American Indian	0	0	1	0	0
Asian/Pacific Am.	0	0	0	0	1
Black/African Am.	0	1	0	0	0
Mexican Am.	0	0	0	0	0
Puerto Rican	0	0	0	0	0
Other Hispanic	0	0	0	0	0
White	4	10	7	6	8
Other	2	2	0	0	1
No Response	0	0	2	0	2

III. Exit Survey

An exit survey is given each spring to all students in Math 490 Senior Seminar. The complete results and copies of the survey are in Appendix 5. Below we have summarized the results that deal specifically with DMS. These results are averaged from the 21 surveys that have been returned over the past five years. The scale is as follows:
1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree.

Question	average score
I would enthusiastically recommend my degree program to another student.	1.95
I feel prepared for the next step in my professional life.	2.10
The quality of instruction in my department is high.	2.05
I was pleased with the curriculum within my major.	2.05
Faculty in my department were closely involved in my education.	2.00
Faculty in my department provided me with intellectual stimulation.	1.71

The results show that the students have a generally positive to very positive view of the degree program, the faculty, and the curriculum.

Though we have data starting in 2000, it has not been summarized carefully until now and several problems are evident. First, the questionnaire changed over the five year period which explains the two separate charts in the appendix. Second, the questions on the questionnaire really need to be changed altogether. Third, the form has the year the students expect to graduate but not the year in which they filled out the survey, so we can't tell how many were returned in a particular year. Finally, the manner in which the surveys have been distributed has been inconsistent which has resulted in gaps in the data. For example, this spring (2004) students were allowed to take the survey home and told to turn them in on their own. Only one survey was returned.

IV. Transcript Review

The Department Chair reviews the transcript of each student graduating each semester as part of the graduation review process. Although the primary purpose of this review is to certify students for graduation, the Chair notes unusual course sequencing, repeated courses, and other features of student programs. This year the Chair made two observations. First that a student may get a minor in mathematics with a grade or grades of D in the courses required. The chair has requested that a program change proposal be submitted requesting the requirement of grades of C or better in all courses counted toward a minor in mathematics. Second, at least some students are taking junior level differential

equations, linear algebra and/or discrete mathematics without completing the calculus prerequisites. Students doing this often fail or do poorly in these courses. As a result, the chair has recommended better enforcement of the prerequisites to help ensure student success in these courses.

V. List of Graduates

The following are the students who graduated during the past academic year (03-04).
Justin N. Carstens
Edward M. Eckles
Joel D. Eichler
Jennifer E. Erland
Vaughn T. Ewig
Paloma Harbour
Andrew S. Johnston
Jed Kallen-Brown
Mathew S. Moore
Tony Perkins
William M. Robb
Melanie R. Wagoner

VI. Student Activities

The department had two teams compete in the Mathematical Contest in Modeling this spring. The MCM is an international competition. This year 599 teams participated. One of our teams received a rating of Honorable Mention for their solution. This rating was given to only 27% of the teams.

In addition, 6 students took the Putnam Exam this fall. The organizer of this contest at UAF, Ed Bueler, wrote the following summary.

> The team did well on this very hard exam, taken voluntarily on a Saturday by 3615 math majors in US and Canada. The median score for individuals was 1 out of 120 (no typo). Only the top forty individuals continent-wide earned half the points (60 points); the high score was 110.
>
> Our designated team of three received a total of 23 points out of a possible 360, placing 115 out of 401 such teams (again, no typo!).

Actions Taken

Below is a list of actions taken the academic year by the department in response to the assessment activities listed in the previous section and in response to other issues.

- A new assessment plan for the undergraduate program in math has been written and is being implemented as this report shows. A copy can be found in the appendix.
- The exit survey has been rewritten. The questions focus on the math department and target curricular issues specific to our department. A copy can be found in the appendix.
- Based on data collected by the chair of DMS, Dana Thomas, the department voted to raise the AP Calculus requirement for Math 200X Calculus I from a 3 to a 4. We

hope this will increase the success rate of students in Math 200. The data collected can be found in the appendix.

- The department voted to change the W courses in Math. Specifically, we decided to change Math 308 Abstract Algebra to a W and to delete the W from all other courses except Math 401 Advanced Calculus. As a result of this change, all students who complete our math core will automatically get the two W's needed for the core curriculum and eliminate the struggle of some students to satisfy this requirement.

Suggested Actions

Below is a list of issues raised by the assessment process or other activities that we suggest the department address in the Fall if not sooner.

- Based on the Chair's analysis of transcripts, the department should change the requirements for a math minor such that a grade of C or better is required in all math courses.
- Based on the Chair's analysis of transcripts, the department should be made aware of the consequences for students of ignoring prerequisites.
- Based on several conversations between faculty concerning advising undergraduate students, the department should discuss the nature and requirements of the math elective package. One specific issue should be how many courses and of what type outside Math, CS, and Stat should be allowed. Another is issue is can we agree upon a complete list of allowable courses within Math, CS, and Stat. This will make advising easier and more consistent.
- Because of the problems with consistency of execution of the Senior Exit Survey, we suggest that it be departmental policy that the administrative staff add this survey to the packet of student evaluations given in Math 490.
- Because of problems with consistency in Senior Exit Survey and the change in Math 308 to a W, we suggest that the department produce a short one-page description of the administrative requirements for each of Math 308, Math 401, and Math 490. These can be posted on the department web page and be given to the instructors so that they will know what is expected of them.

Summary

For the first time we have an assessment plan for the undergraduate degree program in mathematics that has been honestly and completely implemented. This process has motivated changes in the department and suggested areas of further discussion within the department.

The quantitative scores of our students on both the Fields Test and the Exit Survey are quite positive. The department has made changes to improve this process. Further evidence that our students have a solid knowledge of mathematics is their success in national and international contests.

We hope to increase the success of our students by better enforcement of prerequisites, raising the standard to enter Math 200, and changing the curriculum to ease the W requirement.

Jill Faudree
Dana Thomas
Walt Tape

Appendix 8: 2004-2005 Core Curriculum Assessment Report

Core Curriculum Assessment Report
For
Core Classes
In the
Mathematical Sciences

June 2005

Committee Members

Kathleen Gustafson (Chair)
David Maxwell
Tony Rickard
Alexei Rybkin

Outline

I. Introduction

The Department of Mathematical Sciences has completed its review of the core mathematics courses for 2005. A special committee, formed for the purpose of assessing the mathematics core, met in May 2005 to gather the data presented in this report. The Mathematical Sciences Department currently offers eight core courses, of which four were reviewed by the committee. The personnel resources of the committee made it difficult to include more courses and at the same time have an equitable allocation of assessment duties. However, we were able to give a more thorough coverage to Math 107 than has been given in the past.

The core mathematics curriculum was designed in order that students will achieve "advanced literacy in mathematics." The description of the Core Curriculum as in The UAF Baccalaureate Experience: The Philosophy asserts that "advanced literacy in mathematics implies a solid grasp of quantitative reasoning and appreciation of mathematical applications. Most important is acquiring the knowledge necessary for informed judgement on the uses of mathematical and statistical interpretations confronting us in everyday life." Our assessment of the core mathematics courses will address this goal. Each core class is unique and will address mathematical literacy in a unique way.

II. Methodology

Our methodology was driven by four documents. The first is the philosophy of the core (as stated in the introduction). The second is the Core Curriculum Review Process for Core Classes in the Mathematical Sciences. The latter outlines a basic approach that focuses on syllabi and final exams in each course. The 3rd and 4th are the assessment reports on the core mathematics courses completed in May 2001 and May 2003. The 2001 report assessed all core math courses except Math 161. The 2003 report assessed all core math courses except Math 262 and 272.
The four courses reviewed in this assessment are Math 107, 161, 262 and 272. Exams were sampled from one or more of the Fall 2002 through Spring 2005 semesters. Each final exam was reviewed in light of the desired outcomes for the course. There are three outcomes common to each of the courses.

1. Students master problem-solving skills.
2. Students learn to manipulate abstract symbols
3. Students learn a broad spectrum of mathematical applications.

The third outcome concerns content related objectives that are unique to each individual course. Thus, this outcome will be split into several specific concepts listed under the separate courses.

In addition, we included a fourth criterion for Math 107 and 161.

4. Students have mastered the prerequisite material for the course.

While this does not directly address student outcomes for the core courses, it does address the problem of incorrect student placement, which has been recognized as a problem for our courses.

For each outcome, including the various content related objectives, we chose one or two problems from the final exam that illustrate it. A random sample of exams from each course was chosen, or where possible, all exams were reviewed. Only the final exams of students who passed the exam with a 60% or better were included in the review. The student's response to each of the targeted questions was given a rating of 0 to 4, with 4 being highest. We then summarized these scores to arrive at estimates of student performance in each area. This summary is given at the end of the report.

III. Discussion of Specific Courses

Math 107- Functions for Calculus

Introduction

The primary goal of this course is to prepare students to take Calculus, although it is also a terminal course for some. It covers a wide range of topics such as algebra, operations on functions, graphing, logarithms and exponential functions. Because of the large number of topics covered, the syllabus for this course is fairly rigid. This fixed syllabus is our way to ensure that the course meets the spirit of the Core. In addition, the departmental assessment committee plans to review final exams periodically to ensure students are learning material in sufficient depth.

Action from 2003 Assessment

An outcome from the 2003 assessment review was eliminated. It was decided that assessing whether or not "students learn and appreciate the rigorous use of deductive arguments in mathematics" was untenable for the final exams we reviewed. As quoted from the 2003 report, "The reviewer of the Math 107 finals deemed...rigorous use of deductive arguments...to have been insufficiently represented on 35 of the 56 assessed exams. That is, one or more of the individual sections lacked a question addressing (this) particular item. (The) absence of "rigorous use of deductive arguments" generally implies there was no mathematical proof appearing as a question on that particular final exam." Most of our core math courses do not involve deductive proofs. If we are to reinstate this outcome, we must first clarify what this category means in the context of each individual course. This issue will be addressed by the department.

Observations from 2005 Assessment

The committee assessed the four criteria listed under section II on methodology. Outcome 3 was split into the following objectives specific to Math 107.

a) Understanding the nature of functions
b) Solving equations
c) Graphing basic functions (polynomial, rational, exponential, and logarithmic functions, and functions containing radicals)
d) Understanding the properties of exponential and logarithmic functions

We reviewed the finals with the following results. The students performed relatively well on manipulating abstract symbols, solving equations, and prerequisite material. The weakest area was mastering problem solving skills.

As in the 2003 assessment, we found graphing to insufficiently represented on the Math 107 finals. Students should be able to graph a function given its algebraic definition, but this cannot be assessed on an exam that permits graphing calculators. Currently, graphing calculator use is allowed by some but not all instructors on the final exam, so alternate approaches to graphing questions must be implemented. We believe a consensus should be made about whether or not a common final exam should allow the use of a graphing calculator. Since there are a number of teachers in the department who believe students should be able to demonstrate an ability to graph basic functions given their algebraic definition (see section on "Graphing & Calculators" in conclusion of report), this issue will be addressed by the department.

The Math 107 performance, as a whole, was lower than we would like in all areas. All outcomes except 2 and 4b are lower than in the 2003 assessment. Some of these differences can be attributed to several factors. First, individual reviewers will most likely give different results. Second, the final exams have become progressively more rigorous in the past few semesters. But it should be noted that one reviewer of this course observed that 17 of the 46 exams he assessed were D's. It is likely that the outcome scores from these exams are lower and thereby affected the average outcome scores.

	Math 107	90 exams assessed							
		Scores					average	average	% at
	Outcome	4	3	2	1	0	out of 4	out of 100	3 or 4
1	Problem solving skills	23	15	26	21	5	2.3	58	42
2	Manipulate abstract symbols	20	31	27	10	2	2.6	66	57
3a	Nature of functions	22	20	32	13	3	2.5	63	47
3b	Solving equations	31	29	27	2	1	3.0	74	67
3c	Graphing basic functions	19	27	24	19	1	2.5	62	51
3d	Exponents & logarithms	15	30	33	11	1	2.5	63	50
4	Prerequisites	42	19	20	9	0	3.0	76	68
					Averages		2.6	66	54

This course typically has a poor success rate. We are currently working on mandatory placement for this course. Also, Math 107 is moving to 4 credits beginning Fall 2005. The reasoning for this change is twofold. First, the syllabus can include additional topics to

further prepare students for Calculus. Second, we can allow more time for students to review the prerequisites for the course as well as more time for students to learn and absorb the new material.

The exams from the College of Rural Alaska were once again underrepresented this year. We received only two small samples of Math 107 exams from a single College of Rural Alaska instructor. Though the outcome scores were consistent with the overall Math 107 scores, the sample size is too small to adequately conclude anything from these numbers.

Math 107 College of Rural AK — 12 exams assessed

	Outcome	Scores 4	3	2	1	0	average out of 4	average out of 100	% at 3 or 4
1	Problem solving skills	6	1	1	1	3	2.5	63	58
2	Manipulate abstract symbols	4	2	3	2	1	2.5	63	50
3a	Nature of functions	2	1	7	1	1	2.2	55	25
3b	Solving equations	9	2	1	0	0	3.7	93	92
3c	Graphing basic functions	5	4	1	1	1	2.9	73	75
3d	Exponents & logarithms	2	2	7	1	0	2.4	60	33
4	Prerequisites	2	3	4	3	0	2.3	58	42
					Averages		2.6	66	53

From Center for Distance Education, we received all final exams of students who finished in 2004 and spring of 2005. Of the four courses assessed, Center for Distance Education only offers Math 107, and we received 27 final exams from this course. Unfortunately, 25 of these exams are from students who enrolled in the course prior to its revision in 2004, and these exams do not reflect the outcomes we are trying to assess. Therefore, exams from the Center for Distance Education were not included in this assessment.

Math 131X Concepts and Contemporary Applications of Mathematics

Introduction

The content of Math 131 is chosen in an attempt to make a more relevant and meaningful mathematics course for a student majoring in a non-technical field. As a core course, it is expected that the enrollment will include most majors in the liberal arts, the fine arts, and other disciplines where analytical skills such as Calculus have not traditionally played an important part. With emphasis on management science, statistics and data management, and social choice and decision-making, the topics covered in Math 131 are a good representation of the logical and computational needs of a modern college graduate.

This course is viewed as a terminal mathematics course. As a result, it is not the aim of the Department of Mathematical Sciences to create a rigidly standardized syllabus. Our current textbook contains more material than can be discussed in one semester and therefore the instructors retain some flexibility in choosing topics to cover. Presently, the syllabus consists of some mandatory chapters and several optional chapters.

Action taken

Math 131 will be changed to Math 103 beginning Fall 2005. This action is expected to reduce the confusion among students about the level of difficulty among the 100 level math courses. Many students have enrolled in Math 107 thinking it is of lesser difficulty than Math 131, solely based on the numbers. Since Math 131 is meant for students who do not plan to go on to Calculus, it is thought that the course should have a lower number than that of Math 107, the Precalculus course.

Observations from 2005 Assessment

For reasons stated in the introduction, we did not review Math 131 for this Assessment Report.

Math 161- Algebra for Business and Economics

Introduction

The primary goal of this course is to prepare students to take Calculus for Business and Economics. It covers a wide range of topics such as algebra, graphing, logarithms and exponential functions, mathematics of finance, and linear algebra. Because of the large number of topics that must be covered the syllabus for this course is fairly rigid. This fixed syllabus is our way to ensure that the course meets the spirit of the Core. Math 161 is a business counterpart to Math 107, and final exams are reviewed periodically by the departmental assessment committee to ensure students are learning material in sufficient depth.

Observations from 2005 Assessment

The committee assessed the four criteria listed under section II on methodology. Outcome 3 was split into the following objectives specific to Math 161.

a) Understanding the nature of functions
b) Solving equations
c) Graphing basic functions (polynomial, rational, exponential, and logarithmic functions, and functions containing radicals)
d) Understanding the properties of exponential and logarithmic functions
e) Applications of exponential and logarithmic functions
f) Math of finance

Final exams of students who failed *were included* in the survey. This is due to the fact that only two sets of exams were submitted; one set was photocopies of exams prior to being graded by the instructor, and the other set had an average score of 51% in which only 8 out of 29 received a score of 60% or better. This is significantly lower than the other courses we looked at this year in which the averages on final exams ranged between 61.4% and 67.4%.

Math 161 34 exams assessed

		Scores					average	average	% at
	Outcome	4	3	2	1	0	out of 4	out of 100	3 or 4
1	Problem solving skills	5	10	12	5	2	2.3	58	44
2	Manipulate abstract symbols	6	11	13	4	0	2.6	64	50
3a	Nature of functions	5	9	15	4	1	2.4	60	41
3b	Solving equations	7	10	10	5	2	2.4	61	50
3c	Graphing basic functions	5	12	11	3	3	2.4	60	50
3d	Exponents & logarithms	5	13	12	4	0	2.6	64	53
3e	Applications of exp. & logs	4	13	11	3	3	2.4	59	50
3f	Math of finance	5	11	11	5	2	2.4	59	47
4	Prerequisites	7	12	12	3	0	2.7	67	56
						Averages	2.4	61.2	49.0

Math 200X, 201X, 202 - Calculus I, II , III

Introduction

Math 200 is the first course in a three-semester calculus sequence for the physical sciences. Math 201 is the second course, and Math 202 is the third. These courses must cover a lot of ground and the syllabi are fairly rigid. Individual instructors are required to adhere to the syllabus, which is our main tool in assuring that the course meets the spirit of the Core. To further assure this, the department periodically reviews the final examinations to ensure material is covered in sufficient depth and to assure that the students develop competence in the subject matter.

Observations from 2005 Assessment

For reasons stated in the introduction, we did not review these three calculus courses for this Assessment Report.

Math 262 - Calculus for Business and Economics

Introduction

Math 262X is a one-semester calculus for the business major. This course must cover a lot of ground and the syllabus is fairly rigid. Individual instructors are required to adhere to the syllabus and hence the syllabus is our main tool in assuring that the course meets the spirit of the Core. To further assure this, the department periodically reviews the final examinations to ensure material is covered in sufficient depth and to assure that the students develop competence in the subject matter.

Action from 2003 Assessment

The overall impression from both 1999 and 2001 was good, so this course was not reviewed in the 2003 Assessment Report.

Observations from 2005 Assessment

The committee assessed the four criteria listed under section II on methodology. Outcome 3 was split into the following objectives specific to Math 262.

a) Limits and continuity
b) Differentiation and integration – calculations
c) Maximization/minimization problems
d) Analysis of functions of one variable and their graphs
e) Applications of integration and differentiation
f) Partial derivatives

Student outcomes were best in the areas of manipulating abstract symbols, limits, analysis of functions and their graphs, and differentiation. The weakest areas were outcomes 1 (problem solving skills), 3c (maximization/minimization problems) and 3e (application of integration and differentiation). This type of problem was low scoring on the previous assessment as well. This is not terribly surprising, as these all involve solving some type of

word problem or application, which are often the most difficult problems on a final and used to differentiate between the A and B students.

The two different sections of 262 assessed this year have extremely different scores for two of the above low-scoring outcomes, namely outcomes 1 (problem solving skills) and 3e (application of integration and differentiation). The main reason for the different scores is the type of problem used for assessing these outcomes.

A word problem was used from the Spring 04 exam, while an application problem was used from the Spring 05 exam.

Assessment of individual sections of Math 262

		S05	15 exams assessed out of 37						S04	8 exams assessed out of 26					
			70.4 average % on final exam							63.1 average % on final exam					
		Scores							Scores						
	Outcome	4	3	2	1	0	average out of 4	% at 3 or 4	4	3	2	1	0	average out of 4	% at 3 or 4
1	Problem solving skills	5	4	5	1		2.9	60.0			1	4	3	0.8	0.0
3e	Apps of integrals & derivatives	5	2	8	1		2.9	48.7		1	5	1		1.8	12.5

There is a large difference in students' ability to set up word problems versus solving application problems. Word problems require the student to derive the equation or function that will be used in solving, while an application already comes with the function and the student merely has to know how to use it appropriately. The Spring 05 exam did not contain any word problems to assess, whereas the Spring 04 exam did. This accounts, in part, for the difference in the average final exam scores shown above.

Math 272X - Calculus for the Life Sciences

Introduction

Math 272X is a one-semester calculus for majors in the life sciences. This course must cover a lot of ground and the syllabus is fairly rigid. Individual instructors are required to adhere to the syllabus and hence the syllabus is our main tool in assuring that the course meets the spirit of the Core. To further assure this, the department shall periodically revue the final examinations to ensure that the material was covered in sufficient depth and to assure that the students developed competence in the subject matter.

Action from 2003 Assessment

The overall impression from both 1999 and 2001 was good, so this course was not reviewed in the 2003 Assessment Report.

Observations from 2005 Assessment

The committee assessed the four criteria listed under section II on methodology. Outcome 3 was split into the following objectives specific to Math 272.

a) Limits and continuity
b) Differentiation and integration – calculations
c) Maximization/minimization problems
d) Analysis of functions of one variable and their graphs
e) Applications of integrals and derivatives
f) Differentiation and integration – concepts
    -knowing how derivatives and integrals are related to graphs
    -having the ability to discern whether differentiation or integration is involved
    -understanding how a derivative and an integral relates to the original function

Student outcomes were best in the areas of manipulating abstract symbols, limits, and differentiation and integration. The weakest area was part (e), applications of integrals and derivatives. This type of problem, typically an optimization problem or a related rate problem in story form, was also low scoring on the previous assessment. Again, this is not terribly surprising, as these are often the most difficult problems on a final and used to differentiate between the A and B students.

IV Conclusions

Regularly distributing a clear, specific syllabus is an effective way to maintain consistency between sections and to ensure a smooth transition between different classes in a sequence.

The problem of incorrect student placement has not yet been resolved. This situation is being worked on and we hope to have some sort of placement system by Fall 2006. We have had an ACT assessment course placement service report done to help us with this process.

Another problem brought up in the 2003 report is the method of data collection. The problems on the final exams are, naturally, written with a focus on representing the material covered in class. The problems are deliberately varied in difficulty to produce an accurate overall analysis of student knowledge. They are not necessarily designed to evaluate or isolate the areas or skills targeted in assessment. This makes it difficult to produce an accurate comparison of student performance even within a particular course. It was suggested that we might abandon the strategy of assessing eight or nine different outcomes for every course every two years and instead focus on one or two problematic areas in each class. These problematic areas would be easy to identify given the data from the past four assessments. Thus, while it would not be reasonable to expect all instructors for a particular course to include on their finals eight problems designed for assessment, incorporating a single medium-difficulty problem from one or two problematic areas is feasible. This would also focus instructors on these weak areas of the curriculum. This would have the additional advantage of making assessment across several semesters, including summer terms, a realistic amount of work. By including several semesters, we take the focus off a particular instructor and onto the flavor of the course over time.

The 2005 report followed up on the suggested action of including Core Math final exams given in the College of Rural Alaska and the Center for Distance Education. Unfortunately, the exams from the College of Rural Alaska were once again underrepresented this year (only 12 exams from 2 sections of Math 107), and the Center for Distance Education exams did not reflect the outcomes we are trying to assess (due to the fact that 25 of the 27 exams were from a pre-updated Math 107 course). We will put more effort into retrieving CRA exams and undoubtedly include appropriate exams from the Center for Distance Education on the next assessment.

As noted previously, of the two sets of Math 161 exams assessed, one had not yet been graded by the instructor, and the other had an overall average of 51%. Because of this, we feel that Math 161 should be included in the next assessment.

Math 107 regarding Graphing & the Calculator

A survey was conducted in order to ascertain the expectations professors had on students entering calculus. Four UAF professors who teach calculus were asked the following:

1. Do you (or would you) let your students use calculators in your calculus class?

1 said **YES**
3 said **NO**

2. If you do (or would) let your students use calculators in your calculus class, can they use a graphing utility?

1 said **YES**

2. Should Math107 students learn to graph using a graphing utility *or* by knowing basic curves, transformations, and polynomial behavior?

0 said **graphing utility**
3 said **knowing basic curves & polynomial behavior**
1 said **both**

All 4 professors felt that students should be able to graph the basic curves learned in Math 107, as well as handle basic curves that have had a sequence of transformations and/or absolute value applied to them. They also felt students should be able to graph polynomial functions by recognizing the basic polynomial pattern.

This survey was motivated in part by the difficulty in creating Math 107 final exam problems that contain graphing. Graphing is an important component to the Math 107 curriculum, and the students' ability to graph should be sufficiently represented by appropriate questions on a final exam. However, this cannot be properly assessed on an exam that permits graphing calculators. As mentioned earlier, the issue of graphing calculator use on final exams will be addressed by the department.

Recommendations from 2005 Assessment

1. Put more effort into retrieving exams from the College of Rural Alaska.
2. Implement placement testing.
3. Come up with a consensus on calculator use for Math 107 final exams.
4. Determine 2 or 3 specific outcomes to be assessed for next Assessment Report and ensure that they are well represented on the final exams.
5. Clarify what is meant by the outcome "students learn and appreciate the rigorous use of deductive arguments in mathematics" in the context of each course.
6. Include Math 161 in the next assessment.

Outcome Data for 2005 Assessment

ⓘ We must caution the reader not to infer comparisons *between* courses based on these numbers since each course was reviewed by a different committee member. It *is* valid to compare the average scores *within* courses and this is what we have done.

Math 107 — 90 exams assessed

	Outcome	Scores 4	3	2	1	0	average out of 4	average out of 100	% at 3 or 4
1	Problem solving skills	23	15	26	21	5	2.3	58	42
2	Manipulate abstract symbols	20	31	27	10	2	2.6	66	57
3a	Nature of functions	22	20	32	13	3	2.5	63	47
3b	Solving equations	31	29	27	2	1	3.0	74	67
3c	Graphing basic functions	19	27	24	19	1	2.5	62	51
3d	Exponents & logarithms	15	30	33	11	1	2.5	63	50
4	Prerequisites	42	19	20	9	0	3.0	76	68
						Averages	2.6	66	54

Math 161 — 34 exams assessed

	Outcome	Scores 4	3	2	1	0	average out of 4	average out of 100	% at 3 or 4
1	Problem solving skills	5	10	12	5	2	2.3	58	44
2	Manipulate abstract symbols	6	11	13	4	0	2.6	64	50
3a	Nature of functions	5	9	15	4	1	2.4	60	41
3b	Solving equations	7	10	10	5	2	2.4	61	50
3c	Graphing basic functions	5	12	11	3	3	2.4	60	50
3d	Exponents & logarithms	5	13	12	4	0	2.6	64	53
3e	Applications of exp. & logs	4	13	11	3	3	2.4	59	50
3f	Math of finance	5	11	11	5	2	2.4	59	47
4	Prerequisites	7	12	12	3	0	2.7	67	56
						Averages	2.4	61.2	49.0

Outcome Data for 2005 Assessment

Math 262 — 23 exams assessed

	Outcome	Scores 4	3	2	1	0	average out of 4	average 100	% at 3 or 4
1	Problem solving skills	5	4	6	5	3	2.1	53	39
2	Manipulate abstract symbols	16	6	1	0	0	3.7	91	96
3a	Limits & continuity	9	10	3	1	0	3.2	79	83
3b	Differentiation /Integration	8	5	9	1	0	2.9	72	57
3c	Maximization/Minimization	5	1	6	7	4	1.8	46	26
3d	Analysis of functions & their graphs	12	6	3	2	0	3.2	80	78
3e	Applications of integrals & derivatives	5	3	13	2	0	2.5	62	35
4	Partial derivatives	12	8	3	0	0	3.4	85	87
						Averages	2.8	71.1	62.5

Math 272 — 25 exams assessed

	Outcome	Scores 4	3	2	1	0	average out of 4	average 100	% at 3 or 4
1	Problem solving skills	14	7	2	2	0	3.3	83	84.0
2	Manipulate abstract symbols	18	3	4	0	0	3.6	89	84.0
3a	Limits & continuity	16	5	3	1	0	3.4	86	84.0
3b	Differentiation /Integration - calculations	10	9	5	1	0	3.1	78	76.0
3c	Maximization/Minimization	14	8	0	0	0	3.2	80	88.0
3d	Analysis of functions & their graphs	9	15	1	0	0	3.3	83	96.0
3e	Applications of integrals & derivatives	14	7	2	2	0	3.3	83	84.0
4	Differentiation /Integration - concepts	10	10	5	0	0	3.2	80	80
						Averages	3.3	82.8	84.5

Outcome Averages

	average out of 4	average out of 10(	% at 3 or 4
272	3.3	82.8	84.5
262	2.8	71.1	62.5
107	2.6	66.0	54.0
161	2.4	61.2	49.0

Comparison of 2003 vs 2005 Outcome Scores

	Math 107	Assessment 2005			Assessment 2003		
	Outcome	average out of 4	average out of 100	% at 3 o 4	average out of 4	average out of 100	% at 3 o 4
1	Problem solving skills	2.3	58	42	2.2	55	32
2	Manipulate abstract symbols	2.6	66	57	3.3	82	79
3a	Nature of functions	2.5	63	47	2.6	65	48
3b	Solving equations	3.0	74	67	3.0	75	68
3c	Graphing basic functions	2.5	62	51	3.3	83	76
3d	Exponents & logarithms	2.5	63	50	3.3	82	79
4	Prerequisites	3.0	76	68	3.6	90	88
		2.6	66	54	3.0	76	66

	Math 161	Assessment 2005			Assessment 2003		
	Outcome	average out of 4	average out of 100	% at 3 o 4	average out of 4	average out of 100	% at 3 o 4
1	Problem solving skills	2.3	58	44	2.4	59	54
2	Manipulate abstract symbols	2.6	64	50	2.0	50	41
3a	Nature of functions	2.4	60	41	3.0	75	59
3b	Solving equations	2.4	61	50	3.3	82	80
3c	Graphing basic functions	2.4	60	50	2.4	60	54
3d	Exponents & logarithms	2.6	64	53	1.9	48	43
3e	Applications of exp. & logs	2.4	59	50	3.3	82	74
3f	Math of finance	2.4	59	47	2.5	63	48
4	Prerequisites	2.7	67	56	2.4	61	50
		2.4	61.2	49.0	2.5	64.4	54.0