

2006 Program Review
MATH; STAT
Final

UAF Academic Program Review

Department of Mathematics and Statistics


**Mathematics: B.A., B.S., M.S., Ph.D., M.A.T.
Statistics: B.S., M.S.**

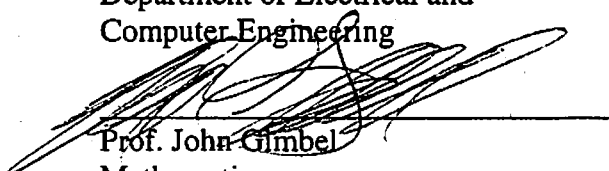
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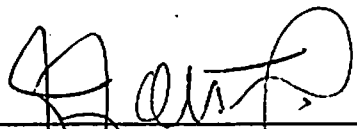
College of Natural Science and Mathematics (CNSM)


April 21, 2006

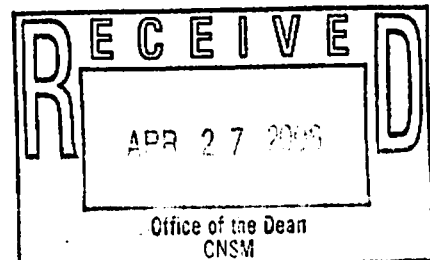
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1. Introduction

A committee has been convened in response to a request by UAF Provost Paul Reichardt to provide an academic review of seven degree programs within the Department of Mathematics and Statistics (DMS) in the UAF College of Natural Science and Mathematics (CNSM). The committee is composed of three UAF faculty members (two external and one internal to the programs being reviewed) and one member external to UAF. The degree programs are the B.A., B.S., M.S., Ph.D., and M.A.T. in Mathematics and the B.S. and M.S. degrees in Statistics.

Materials required for this academic review were created by DMS and submitted to the committee by the Dean of CNSM. The materials received from CNSM include: 1) the 2004 DMS Notebook from the NWASC Self Study including a one page annual addendum in 2005 as required by CNSM and 2) the 2005 Program Evaluation Self Study for the Mathematics and Statistics programs. Information concerning outcomes assessment activities, national perspectives, and self-assessment is provided within the 2005 Self Study. At the committee's request the DMS also provided additional documentation which includes a brief summary of the faculty and space needs of the department and three documents related to software access and course fees for math and statistics students. During the evaluation process, the committee also interviewed the department chair of DMS and some of their faculty in order to discuss with them critical points related to space, faculty, budgets, and laboratory access, and also to inquire about their future perspective of the DMS department and its degree programs. During the evaluation process, the committee also interviewed the department chair of DMS and some of their faculty in order to discuss with them critical points related to space, faculty, budgets, and laboratory access, and also to inquire about their future perspective of the DMS department and its degree programs.

The Introduction in the 2005 Program Evaluation Self Study for the Mathematics and Statistics programs identifies four major themes that surface across all the program evaluations. These themes offer a good summary of the overall programs and provide the basis for this evaluation. The four major themes are:

- 1) A flexible cooperative faculty that works closely with other departments.
- 2) Elective offerings for majors are sparse.
- 3) Low faculty numbers and high turnover rates.
- 4) Instructional and lab space is limited and problematic.

Extending from these major themes and discussions with the DMS faculty, the committee sees the following five items listed in order of priority as the major needs for the Mathematics and Statistics programs:

- 1) More SPACE is absolutely necessary for faculty, staff, and instructional labs.
- 2) Increased FACULTY numbers and reduced turnover.
- 3) Higher SALARIES to attract and retain top notch faculty.
- 4) Improved ACCESS to computer laboratory and software.
- 5) Increased BUDGETS for faculty travel and hiring teaching assistants.

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The rest of this review will focus on these five primary needs by first providing supporting information and an overall evaluation of the degree programs and then highlighting individual recommendations for each of the seven degree programs.

2. Supporting Information

The DMS is within CNSM at UAF. The department was formerly called the Department of Mathematical Sciences which included computer science and software engineering until the department officially separated into the Department of Mathematics and Statistics (DMS) and the Department of Computer Science on July 1, 2005. The two departments still share the Chapman building and its sole academic computer laboratory. The seven degree programs within DMS reviewed herein include the B.A., B.S., M.S., Ph.D., and M.A.T. in Mathematics and the B.S. and M.S. degrees in Statistics. There are no research laboratories specific to the department. DMS currently has 15 full-time positions including 2 mathematics instructors, 9 (8.5 FTE) tenure-track mathematics faculty, and 4 statistics tenure-track positions.

DMS is comprised of faculty with research interests in a number of areas which not only serve the mathematics and statistics major programs, but also serve to complement research in many of the science and engineering programs at UAF. Research interests in mathematics range from theoretical to applied math including several topics: algebraic statistics, analysis, combinatorics, computational algebra, control theory, geometric analysis, graph theory, inverse problems, mathematical biology, mathematical physics, mathematics education, numerical analysis, partial differential equations, and optics. Research interests in statistics include sampling design, biostatistics, geophysics, quality control, and design of experiments. Mathematics and statistics service courses are prominent in many of the academic degree programs at UAF, particularly in the sciences and engineering. Therefore, the service component provided by DMS is extremely important to the success of the university and plays a pivotal role in the UAF 2010 Strategic Plan. The vision statement of the UAF 2010 Strategic Plan states that the University of Alaska Fairbanks will:

- 1) Be the university of choice for Alaska scholars
- 2) Offer distinctive opportunities in undergraduate and graduate education that take advantage of our location in the far north
- 3) Provide excellent educational services at the point of need for Alaska Native and rural populations
- 4) Spearhead integrated research, emphasizing our complex high latitude physical, biological, and social systems
- 5) Link research discoveries with teaching, service and community engagement
- 6) Create innovative collaborations with communities, businesses and governments that meet state, national and global needs
- 7) Demonstrate ways in which gender, racial and cultural diversity strengthen the university and society

The DMS programs play an important role in Items 1-5 as they apply to student scholar retention in Alaska, the promotion of quality degree programs in the far north, and research related to high latitude systems. Statistics is of particular importance in research which serves many of the sciences and engineering. The MS and PhD in Mathematics are also important for creating prestige as well as national and international collaborations in the department.

3. Primary Needs Common to all Degree Programs

Based on the DMS Self Study, discussions with DMS faculty, and the additional information requested from DMS, the committee clearly identified five primary needs common to all DMS degree programs as outlined at the end of Section 1. These needs are addressed in the same order of priority as listed in Section 1.

3A. Space

The Introduction of the Self Study, the additional summary of space requirements requested from DMS by the committee, and discussions with the DMS department chair and some of the DMS faculty clearly addressed the short and long term space needs of the Mathematics and Statistics programs. The review committee concluded with two strategic plans for short and long term space needs which are summarized as follows.

Short-term SPACE needs:

- Create more faculty offices with adequate privacy and more shared office space for research staff and graduate students.
- Move the Math lab to the first floor to increase visibility.
- Continuous access to computer laboratory facilities for instructional needs.

Long-term SPACE needs:

- Mathematical science is part of the instructional core requirements in almost every other degree program at UAF. Therefore, increasing enrollments at UAF will directly impact the need for additional space for the mathematical sciences as the department grows to keep up with UAF demands.
- Computer science and software engineering are now a separate department, but they still share the computer laboratory and space in the Chapman Building. In fact, all the computer science courses and all the statistics courses have a fee associated with the use of the computer lab. Math courses which require the use of the computer laboratory on a regular basis must have the additional course fee as well. If not, then access to the laboratory for these courses is limited to once or twice per semester. The committee agrees with the idea of relocating the Computer Science department closer to the Arctic Region Supercomputing Center which has been proposed in the Self Study.
- Various scenarios have been proposed by the Math Department which would involve the construction of an addition to the Chapman building. These include adding a 4th floor, adding a new section to the north on Cooper Lane, and a lateral addition to the northwest. The first two scenarios are not possible due to earthquake ratings and space respectively, but the third scenario is possible provided that funding is appropriated and available for the construction. This committee strongly recommends that one of these options be pursued as a long term solution for DMS space needs.
- A Chapman Annex building on Cooper Lane has also been proposed to provide additional space in close proximity for faculty and/or graduate students.

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3B. Faculty

There is a need for additional faculty and retention in DMS. Additional faculty are necessary to support the increasing demand for service courses in mathematics and statistics for other degree programs at UAF as well as to support the major courses as the department grows to keep up with UAF demands. Retention of faculty is also imperative to create a strong and stable program. DMS has seen a turnover of 7.5 out of 8.5 tenure track Mathematics faculty since the Spring 1998. While the introduction of RIP and faculty deaths have played a role in the faculty retention problems, there are many other factors that contribute to faculty turnover. Three major factors in retention are hiring faculty for the far north environment, workload and salary. While our unique arctic environment can be an attraction for some mathematical scientist, the harshness of the winter and the small faculty environment can become a deterrent. The low faculty numbers in DMS are distressing because of the burden (workload) placed on the current faculty without additional salary compensation. UAF must provide an environment to attract high quality faculty in DMS and foster education and research based on the science of high latitude science systems and the far north.

3C. Salaries

Higher salaries are not only necessary for supporting and retaining current faculty in DMS, but also necessary for attracting and retaining new faculty members. UAF must offer salaries that are at a minimum commensurate with the national averages in order to retain and attract DMS faculty who can compete on the national and international level. In the past couple of years UAF has taken the first steps in bringing DMS faculty salaries closer to national averages. However, it may take more than national average salaries to attract and retain faculty in DMS.

3D. Computer Laboratory and Software Access

In any mathematical sciences program it is imperative to have unlimited access to computer laboratory facilities and software. Based on information in the DMS Self Study, discussions with DMS faculty, and current facilities it is evident that DMS has very limited access to a computer laboratory. The Department of Computer Science which is now a separate department from DMS maintains the computer laboratory in Chapman which has 21 computers. Math courses which require the use of the computer laboratory on a regular basis must have an additional course fee, otherwise, access to the laboratory and software for these courses is limited. Under the current system of course fees and lab management, seniors majoring in mathematics typically do not have access to the specialized software in the Chapman computer lab because they are no longer taking courses which require the computer use fee. Access to general laboratory study space for administering tests and conducting small lab classes is also an issue here since the computer lab currently serves that purpose also.

3E. Department Budgets

It is important that faculty within DMS have the opportunity to travel for faculty development workshops and conferences. Since research faculty within DMS generally perform research which involves abstract mathematical theories and concepts for which external project funding is not normally available and do not generally have joint appointments with research institutes on campus, there is not a large departmental research fund for faculty travel. According to the chair of DMS, the department supplements 5 or 6 faculty per year at a maximum of \$1000 each for airfare and registration to conferences and workshops. This is much less than commensurate considering today's airfare to and from Alaska.

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It is also important that a larger budget be allocated to DMS for hiring teaching assistants to help with grading in mathematical science courses. This is of particular importance in the large enrollment service courses such as Calculus which has 4 lectures per week and daily assignments. According to information provided by the DMS chair, DMS has received the same \$3277 per year over the last 20 years for undergraduate student hires. These undergraduates grade papers and serve as tutors in the math lab. DMS has 7 graduate teaching assistants who receive about \$12000/yr each. Three TAs have sole responsibility for a course section, 3 have recitation and grading duties related to calculus sections, and one serves as a grader for a faculty member with large enrollments in junior level courses.

4. Academic Review of the Mathematics Programs

The Department of Mathematical and Statistics offers five degree programs in Mathematics. These degree programs include the B.A., B.S., M.S., Ph.D., and M.A.T. in Mathematics. It is important to note that the B.S. and M.S. degree programs constitute the major portion of the workload for the Mathematics faculty. The undergraduate Mathematics program serves a large campus community and enrollment in service courses is strongly influenced by the mathematical science requirements in other degree programs on campus. While some service courses are applicable to the undergraduate and graduate Mathematics program, these programs require more advanced courses recognized within the Mathematics profession as necessary for accredited degree programs. Accordingly, additional DMS faculty resources are needed to maintain the curriculum for the undergraduate major and graduate Mathematics courses.

4A. B.A. and B.S. in Mathematics

The B.S. in Mathematics program is vital to UAF since it serves both undergraduate Mathematics majors and the mathematical science requirements in several other degree programs on campus. DMS faculty generally teach 6 or 7 different courses in a two-year period and their teaching responsibilities for service courses comprise a major portion of the DMS faculty teaching workload. With the service teaching workload and an undersized department, the DMS has not been able to offer some of the advanced mathematics courses and has even had difficulty covering the service courses without hiring additional adjunct faculty. For fall 2006 DMS currently has 7 CORE math sections with no one to teach them. This is after making arrangements with 2 adjuncts to teach 3 sections. An increase in faculty and a decrease in turnover are necessary in order to establish stability with current program offerings and to offer all of the courses within the undergraduate Mathematics major that are listed in the UAF catalog.

The undergraduate Mathematics degree programs have had increasing enrollment over the last 4 years. According to the DMS chair, there are currently 15 students enrolled in the senior seminar course as a requirement for the B.S. in Mathematics degree. Based on the table on page 9 of the Undergraduate Math section of the DMS Self-Study, the student to teacher ratio for the BS and MS in Mathematics programs at UAF at the time of the Self Study was roughly 4.7:1 which is higher than the average of 3.2:1 for ten other undergraduate mathematics programs surveyed throughout the US and only lower than two of the mathematics programs, stressing the need for additional faculty. The UAF ratio is based on 2005 enrollments of 39 undergraduate Mathematics majors and 13 graduate Mathematics students.

Although additional faculty are needed to support the B.A. and B.S. in Mathematics program and allow the curriculum to expand, additional space is an absolute priority. Additional space is needed for faculty, staff, and students. The space is necessary in order for the DMS to expand to allow for

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increasing enrollments in mathematical science courses which serve both undergraduate Mathematics majors and other degree programs at UAF. An expansion or annex of the Chapman building is absolutely necessary to provide space for current faculty, staff, and the student computer laboratory and testing/study facilities. Also, access to the computer laboratory for undergraduate Mathematics majors is currently limited since Mathematics courses do not have a computer laboratory use fee.

Although additional space, additional faculty, and computer laboratory access are a priority for the B.A. and B.S. in Mathematics programs, increased departmental budgets for faculty development and teaching assistants are also necessary to support service course workloads. The undergraduate programs in Mathematics will continue to grow as enrollments in undergraduate mathematical science courses increase across UAF degree programs, therefore it is important that additional space, additional faculty, computer laboratory access and increased departmental budgets be allocated for the DMS undergraduate degree programs.

4B. M.S. in Mathematics

The M.S. in Mathematics program serves to enroll and graduate students who bring research and teaching assistant capabilities to DMS. DMS actively promotes the M.S. in Mathematics program through advertising (posters) regionally and nationwide. Additional space and faculty are needed to support graduate students and extend the course offerings for this program. Based on the Graduate Math section of the DMS Self Study, the program currently has 12 graduate students and there have been 7 M.S. graduates since the Fall 2000 which is in contrast to no students enrolled in any graduate mathematics program in the Fall 1999. DMS currently offers five 600-level graduate courses in mathematics (Applied Numerical Analysis, Advanced Algebra, Real Analysis, Complex Analysis, and Topology) on a regular two-year cycle and two 600-level graduate courses (Mathematical Physics I/II) on a one-year cycle by alternating teaching responsibilities with the Physics department. In addition DMS has offered six other graduate courses listed in the UAF catalog since the Fall 2000 as well as three graduate seminar courses, two special topics courses and three independent study courses. Based on the table in Appendix 10 on page 46 of the Graduate Math section of the DMS self study, enrollment in these graduate mathematics courses has ranged from 4 in Real Analysis in the Fall 2000 and the Fall 2001 to 18 in Mathematical Physics in Fall 2003. This table also shows that there has been an overall increase in graduate enrollment over the past five years.

Graduate students in Mathematics are generally well supported. Graduate students in this program are generally funded by a combination of internal and external fellowships and teaching assistantships. Internal funding includes graduate school fellowships and teaching assistantships, while external funding includes NSF, NASA and DARPA fellowships. However, an increased departmental budget is necessary for hiring additional teaching assistants to support faculty course workloads, particularly in the mathematical science service courses. Furthermore, additional space is necessary for graduate student offices, particularly for those graduate students who serve as teaching assistants and need to maintain office hours.

4C. Ph.D. in Mathematics

The Ph.D. in Mathematics program was initiated in the mid 1980s to help recruit world-renowned faculty in Mathematics and to provide prestige for the M.S. in Mathematics program. The program serves students with M.S. degrees in Mathematics, currently has 6 students enrolled, and has produced six graduates in the past 22 years. The Ph.D. program has some degree of impact on DMS faculty and budget resources. DMS faculty member Sergei Avdonin has been working to build up the graduate program. Based on discussions with the DMS Chair, the majority of the faculty in DMS

support the Ph.D. in Mathematics. The Ph.D. in Mathematics program is needed to attract new faculty in Mathematics and to provide prestige for the graduate Mathematics program.

4D. M.A.T. in Mathematics

The M.A.T. in Mathematics program is designed to offer a graduate degree to students who have a B.A. or B.S. in Mathematics and are interested in teaching mathematics in K-12 schools. This program currently has one student enrolled, effective in the Spring 2006 term. However, this is the only student enrolled in the MAT program in the past eight years. DMS currently has a faculty member, Tony Rickard, who does research in Math Education, has a 50/50 joint appointment with the School of Education, but already teaches a full load with Math 205 and Math 206 each year. Currently, the majority of the credits required for this program are from Mathematics, including the comprehensive exams. As a step toward restructuring the program, DMS would like to see that credits are more evenly distributed between Mathematics and Education. Additional faculty in Mathematics Education and a collaborative agreement between DMS and Education would be required in order for this program to grow and succeed.

5. Academic Review of the Statistics Programs

The Department of Mathematics and Statistics offers two degree programs in Statistics. These degree programs include the B.S. and M.S. in Statistics. At the outset it is important to note that the B.S. and M.S. degree programs constitute very important, but relatively minor parts of the workload of the Statistics faculty. The Statistics program, like the Mathematics program, serves a large campus community. Course selection and enrollment are strongly influenced by the needs of the client communities. Many such courses are applicable to B.S. and M.S. Statistics programs and, in principal, the Statistics program need only to supplement these offerings with courses recognized within the Statistics profession as necessary for accepted degree programs. However, difficulties arise in several areas in implementing this strategy.

5A. B.S. in Statistics

The importance of this program must not be judged solely on the number of majors enrolled. It is a necessary program. The program is relatively inexpensive, and although the BS degree in statistics is not a terminal professional degree by its presence, it fleshes out statistics course offerings and feeds the MS program which is a terminal professional degree program.

Because of the limited number of faculty and their workload, only a few of the additional statistics courses desirable for a well-rounded B.S. statistics degree can be taught. Students are often quite late into their general undergraduate studies before recognizing statistics as a desirable degree program. Those undergraduate students who ultimately pursue a statistics degree often do so after entering other programs which require some statistics courses as part of their degree program. Consequently, the number of undergraduate statistics majors tends to be low. Although, this combination of few undergraduate majors and heavy faculty workloads limits the course offerings available, through innovations such as undergraduate research projects, the result is an acceptable though lean B.S. statistics degree program. To increase course offerings and to strengthen the BS program, more statistics faculty are needed.

Additional Needed Course Offerings. The Statistics faculty have identified courses needed as: an elective course in Bayesian statistics, and courses in data mining, exploratory data analysis, and

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statistical graphics. This Review Committee concurs with these course selections and realizes that more faculty are needed before these courses can be given.

5B. M.S. in Statistics

This is a strong program whose graduates are professional statisticians many of whom are employed in Alaska often as biometricians in the Alaska Dept. of Fish and Game, and now some within Institutional Research at the University of Alaska. A testament to the quality of this program is the number of M.S. graduates who go on to obtain Ph.D.'s in statistics from renowned programs of statistics elsewhere. Or who, because of their statistical expertise, obtain Ph.D.'s in scientific disciplines such as fisheries studies, AIDs research, and marine ecology.

As noted in the program self evaluation, the program enrolls from 4 to 6 students per year, has adequate enrollment to support its graduate offerings, graduates 1 to 5 students per year and has good credit hour production. The graduate students are well supported. Currently there are two TA's and three RA's funded by the UAF's Planning, Analysis and Institutional Research and by researchers such as Scott Rupp in UAF's Forest Science.

Although the M.S. program is strong it is fragile. Improvements are needed. These involve adding needed courses at the upper division and graduate level to provide greater choice of emphasis available to students and to stress the strengths of the existing program to reflect the strengths of University of Alaska and its northern setting. The problem of fragility arises because there are too few faculty. The Statistics program has four statistics positions. Over the past five years, because of retirement and two faculty members leaving for positions elsewhere turnover has been large and vacancies have resulted in two of the four positions being vacant. One of these positions has been filled in January 2006, the other remains open and a faculty search continues. Additional faculty and faculty retention are clearly needed and are vital to the success of the Statistics graduate program.

6. Evaluation and Recommendations

It is clearly evident from the committee's evaluation of the B.A., B.S., M.S., Ph.D., and M.A.T. in Mathematics and the B.S. and M.S. degrees in Statistics within DMS that the department has five priority needs:

- 1) additional space
- 2) additional faculty
- 3) higher salaries
- 4) access to computer labs and software
- 5) increased departmental budgets for faculty travel and teaching assistants.

Clearly, more faculty are urgently needed and those here must be retained. The key to resolving this difficulty is that the space problems within the Chapman Building must be addressed and faculty salaries must be increased. The appropriate space to house all current and additional faculty and staff is urgently needed. Access to computer laboratories and software must also be improved for undergraduate Mathematics majors as well as students in mathematical science service courses. And without an increase in the budget that has been allocated for faculty travel and teaching assistants, DMS will continue to fall behind the increasing costs of faculty development and graduate assistantships. Faculty travel to conferences and workshops is absolutely necessary for dissemination

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of knowledge and faculty development which translates to growth and prestige for DMS faculty at UAF.

The undergraduate major programs in Mathematics and Statistics have experienced cyclical enrollments. There is a much larger impact on DMS due to continually increasing enrollments in mathematical science service courses. Additional faculty, space, and teaching assistantships are necessary in order to maintain course offerings in the major option while serving the growing enrollments in mathematical science courses required for other degree programs.

The graduate programs in Mathematics have grown with yearly student enrollment increasing from zero to 13 in the past 5 years, while the graduate program in Statistics has seen fairly steady enrollment over the years. The M.S. and Ph.D. programs in Mathematics are currently seeing the largest number of students enrolled in their history. There has been discussion of the added DMS resource allocation for the Ph.D. program, but the committee agrees that it is needed to attract new faculty and for the prestige of the graduate Mathematics and Statistics programs. On the other hand, the M.A.T. program currently has only one student enrolled and needs to be restructured for the needs of Alaska K-12 Mathematics teaching credentials. Additional space, additional faculty, and increased departmental budgets are extremely important for the continued growth and success of these programs as the graduate Mathematics and Statistics programs expand.

Without resolution of these issues, UAF risks losing a strong department which is vital to the general academic goals, research, and technology of the University of Alaska.