THE UNIVERSITY OF UTAH

July 30, 2015

Ruth V. Watkins
Senior Vice President for Academic Affairs
205 Park Bldg.
Campus

RE: Graduate Council Review
Department of Mathematics

Dear Vice President Watkins:

Enclosed is the Graduate Council's review of the Department of Mathematics. Included in this review packet are the report prepared by the Graduate Council, the Department Profile, and the Memorandum of Understanding resulting from the review wrap-up meeting.

After your approval, please forward this packet to President David Pershing for his review. It will then be sent to the Academic Senate to be placed on the information calendar for the next Senate meeting.

Sincerely,

David B. Kieda
Dean, The Graduate School

Encl.

XC: Peter E. Trapa, Chair, Department of Mathematics
Henry S. White, Dean, College of Science

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The Graduate School - The University of Utah

GRADUATE COUNCIL REPORT TO THE SENIOR VICE PRESIDENT
FOR ACADEMIC AFFAIRS AND THE ACADEMIC SENATE

April 27, 2015

The Graduate Council has completed its review of the Department of Mathematics. The External Review Committee included:

Lisa J. Fauci, PhD
Pendergraft Nola Lee Haynes Professor of Mathematics
Tulane University

Robert K. Lazarsfeld, PhD
Professor, Department of Mathematics
Stony Brook University

Ronald J. Stern, PhD
Professor Emeritus, Department of Mathematics
University of California - Irvine

The Internal Review Committee of the University of Utah included:

Orly Alter, PhD
Associate Professor
Department of Bioengineering

Katharine A. Coles, PhD
Professor
Department of English

Ross T. Whitaker, PhD
Professor
School of Computing/Scientific and Computing Imaging Institute

This report of the Graduate Council is based primarily on the self-study submitted by the Department of Mathematics, the reports of the Internal and External Review Committees, Department Chair Peter E. Trapa's letter of response to the reports of the Internal and External Committees, and the brief but highly supportive response from the Dean of the College of Science.

The Department was last reviewed by the Graduate Council in 2007.

DEPARTMENT PROFILE

Program Overview

The mission of the Department of Mathematics (hereinafter the "Department"), as described in its self-study report, has three components: "to provide each student at the University of Utah with a rigorous and effective mathematical education, be he or she the general student, the professional for whom mathematics is a tool, the future engineer or scientist, or the future mathematician; to contribute significantly to the creation and development of mathematical ideas and techniques, both within the discipline and for users of mathematics in other disciplines or in industry; and to increase the public understanding of mathematics and of the central role it plays in science and technology."

Faculty

To pursue its mission, the Department employs a large number of faculty members. As of Fall 2014, the Department consisted of 44 tenured and tenure-line faculty, 26 three-year postdoctoral Assistant Professors (Lecturers) and Research Assistant Professors, 12 career-line faculty, and 12 computing and support staff. Largely due to its tenure-line faculty, the Department enjoys an excellent national reputation. According to the 2014 rankings by *US News & World Report*, the University of Utah's Math Department is tied for 34th place among US institutions of higher education. Among PAC-12 schools, only Berkeley, Stanford, UCLA, and University of Washington rank higher. The Department is in the 92nd percentile (18 out of 230) in total grant dollars among math departments nationwide, according to Academic Analytics. Indeed, the Department scores at close to the 90th percentile across all dimensions gauged by Academic Analytics. A further indicator of faculty excellence is the fact that four members of the Department's faculty have achieved the honor of being a University of Utah Distinguished Professor – a rank that requires a high degree of national and international prominence.

Students

By the standards of the College of Science, the Department has a large and increasing number of undergraduate and graduate students. The self-study report mentions 380 enrolled undergraduate majors plus 175 graduate students (114 of whom are fully funded). Importantly, the Department provides large numbers of nonmajors with math instruction, ranging from engineering students (who enjoy a specially-designed set of courses) to undergraduates seeking to fulfill general education requirements. The Department also provides students with opportunities to be actively engaged in faculty-guided research, whether through its Honors track for students enrolled in the University's Honors College or its Research Opportunities for Undergraduates (REU) program.

Curriculum and Programs of Study

The Department offers students four undergraduate degree options: bachelor of mathematics, honors mathematics, applied mathematics, and math education. It offers three options at the master's level – master of statistics, mathematics, and mathematics teaching – as well as a PhD in mathematics. All tenure-line faculty members are actively engaged in the teaching mission of the Department, but due to high student demand, the Department relies heavily on career-line faculty (12) and postdoctoral faculty (26) to teach and mentor students.

Curricular outreach is an additional area to which the Department devotes considerable resources. In addition to training students to teach math at the high school level, the Department offers summer classes for high school students (most notably a three-week program at Monument Valley High School on the Navajo reservation) and public lectures.

Diversity

The Department's self-study report notes that diversity and gender equality are major issues within the field of mathematics as a whole. The need to increase faculty and student diversity is evident in the University of Utah's Department of Mathematics as well. The level of faculty diversity is modest but trending upward: Over the past seven years, the Department has hired eight new faculty members, three of whom are women or from underrepresented groups. Effective mentoring will be important for retaining these new faculty members. Overall, only 9% and 4.5% of the Department's tenure-line faculty is comprised of females and members of underrepresented groups, respectively. Both percentages are up from the previous Graduate Council review in 2007 but remain low. The External Review Committee described as "jarring" the absence of even a single female when the Committee met with the faculty in pure mathematics, the Department's largest subarea. In short, the Department has made only limited progress toward providing students with diverse faculty role models.

Diversity among undergraduate majors is commendable but tenuous with respect to gender. Roughly a third of majors were women in 2013, but this percentage is down slightly rather than up since 2008. At the graduate level, there was a four-year upward trajectory in terms of female students, but the percentage of female students dropped sharply in 2013. As a result, the proportion of female students in the graduate program actually declined between 2008 and 2013.

Representation of Hispanic students among undergraduates has increased during this same period. Majors who are identified as Native American or African American are extremely rare. The same general pattern exists with respect to graduate students. The percentage of women is stable at around 30 percent, and the vast majority of students are either White or from abroad.

Program Effectiveness and Outcomes Assessment

The Department uses multiple measures of the effectiveness of its undergraduate and graduate programs, but the self-study report provides little in the way of specific data (with the notable exception of

information obtained from exit interviews with undergraduates), nor does the self-study report describe ways in which the Department uses its outcomes assessments to improve its various programs.

Facilities and Resources

The Department is housed in two buildings (John Widtsoe and LeRoy Cowles) that are connected underground via the Rushing Center. The Cowles Building was remodeled in 2001, but the Widtsoe Building is in need of renovation. Space is generally at a premium. The Department's mathematics library collection was moved to the Marriott Library to free up more space for graduate student offices. The Department's computing facilities for faculty and students are described as impressive by the Internal Review Committee.

The Department's internal budget (base and productivity funds) is $7.62 million. This represents a 22% increase from FY2007-8, but student enrollment during this period has increased at a higher rate than this among both undergraduates and graduate students. Similarly, the Department has taught a substantially increased number of students without increasing the number of its tenure-line faculty. Recently, however, the Department has obtained funding to hire several new faculty members specializing in "Statistical Science and Big Data" under the University's Transformative Excellence Program. (Not all of the faculty members hired under this program will necessarily be members of the Math Department.)

COMMENDATIONS

The members of the Internal and External Review Committees offered numerous commendations, the most important of which are:

1. The Department enjoys enviable national stature. It is scored highly in the mainstream media, such as *US News & World Report*, by Academic Analytics, and by the American Mathematical Society. The areas of pure and applied mathematics are particularly well regarded. Graduates of the Department's PhD program in all areas of mathematics are highly sought after because of the excellent training they receive.

2. The Department has successfully built a two-pronged approach to mathematics in which departmental strength in pure mathematics is complemented with growing expertise in applied and interdisciplinary aspects of math.

3. The Department trains a large and growing number of undergraduate majors, and it is an excellent university citizen by virtue of meeting the curriculum needs of students across the campus. The model it has developed for teaching undergraduate engineering students is especially noteworthy.

4. The Department has built an excellent cultural climate of openness, warm collegiality, and transparency. This climate is apparent to undergraduates, graduate students, postdoctoral fellows, faculty, and staff. A particularly important aspect of this positive organizational culture is effective mentoring of junior faculty.

5. To address growth in the number of students relative to the tenure-line faculty, the Department is pursuing ways to innovatively leverage resources via the Transformative Excellence Programs and partnerships with other departments.

6. The Department provides rich educational opportunities for undergraduate students who wish them. In particular, it has aligned its Honors track with the University's Honors College and provides research opportunities for approximately 20 undergraduate students per year.

7. The Department has expended its own funds to renovate the office space in the Widtsoe Building and, given the pressures created by a growing number of graduate students, has done an admirable job of prioritizing its use of physical space.

8. In the person of Peter Trapa, the Department appears to have an effective leader who is interested in responding constructively to the recommendations offered by the Internal and External Review Committees.

RECOMMENDATIONS

Based on the view that an already-robust department can nevertheless still be made more so, the Internal and External Review Committees offered numerous recommendations – 7 and 10, respectively. Moreover, there was little overlap in the recommendations made by the two committees, thereby creating a long list of ideas to consider for potential action. The response by the Department Chair, Peter E. Trapa, suggests that the Department is already well on its way to implementing some of these recommendations, but greater detail from Professor Trapa regarding the Department's plans to address the various recommendations would have been helpful. The Graduate Council views the following recommendations as especially important:

1. The Department's self-study report has a substantial section (1.2) on program planning. Nevertheless, we concur with the recommendation made by the External Review Committee that "a crisp and prioritized 10-year strategic plan" would be helpful if the Department intends to maintain and even raise its already-high national stature.

2. The Department should continue and strengthen its commitment to interdisciplinary aspects of mathematics, especially with respect to the natural and medical sciences. One aspect of this commitment is taking a leadership role in developing a university-wide vision for research and teaching of statistics even if, as Chair Trapa correctly notes, formulation and implementation of such a plan is not entirely within the purview of the Department.

3. Despite important strides over the past several years with respect to increasing diversity, additional pursuit of faculty diversity would strengthen the Department. Additional efforts with respect to undergraduate and graduate student diversity are warranted as well.

4. In recent years, the Department has admirably accommodated a substantial increase in the number of undergraduate and graduate students. As the level of instructional responsibility stabilizes, the Department is encouraged to examine its curriculum structure, as it has already done successfully with respect to the engineering math sequence. Some undergraduates were concerned that not all students in the lower division courses were receiving the programming and computational skills necessary for the upper division classes, so this is an area that may be ripe for additional attention during this self-examination process.

5. The Department should continue its work to narrow the salary gap between graduate students who are supported by National Science Foundation grants and those supported as teaching assistants.

6. Whereas all graduate students serving as instructors should be well trained and carefully supervised, this is especially important if the Department continues to deem it necessary to have some courses taught by first-semester graduate students.

7. With respect to employment of undergraduate and graduate students, the Department should expand existing programs and, where appropriate, create new programs that prepare students for employment outside of school and higher educational settings. With respect to employment within elementary and secondary schools ("mathematics education"), the Department should continue its efforts to clarify its role vis-à-vis the College of Education and collaborate effectively.

8. Finally, the Department should improve its activities with respect to assessment of student learning. Important and appropriate data are currently being collected, but these data need to be more extensively used to improve the learning of students, especially undergraduate majors.

Submitted by the Ad Hoc Committee of the Graduate Council:

Robert N. Mayer (Chair)
Professor, Department of Family and Consumer Studies

Connie Bullis
Associate Professor, Department of Communication

Timothy Formosa
Professor, Department of Biochemistry

Gerrie V. Barnett (Undergraduate Council)
Associate Professor (Clinical), College of Nursing

Mathematics

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-2014
FACULTY: With Doctoral Degrees Including MFA and other terminal degrees							
Full Time Tenured Faculty	34	32	34	32	32	32	35
Full Time Tenure Track	6	6	3	6	7	5	5
Full Time Career-Line/Adjunct	13	16	18	19	19	19	21
Part Time Tenure/Tenure Track	3	4	4	4	3	3	2
Part Time Career-Line/Adjunct	1	1	2	1	1	1	1
With Masters Degrees							
Full Time Tenured Faculty	0	0	0	0	0	0	0
Full Time Tenure Track	0	0	0	0	0	0	0
Full Time Career-Line/Adjunct	1	3	3	3	0	0	2
Part Time Tenure/Tenure Track	0	0	0	0	0	0	0
Part Time Career-Line/Adjunct	0	0	0	0	0	0	0
With Bachelor Degrees							
Full Time Tenured Faculty	0	0	0	0	0	0	0
Full Time Tenure Track	0	0	0	0	0	0	0
Full Time Career-Line/Adjunct	1	0	0	0	0	0	1
Part Time Tenure/Tenure Track	0	0	0	0	0	0	0
Part Time Career-Line/Adjunct	0	0	0	0	0	0	0
Total Headcount Faculty							
Full Time Tenured Faculty	34	32	34	32	32	32	35
Full Time Tenure Track	6	6	3	6	7	5	5
Full Time Career-Line/Adjunct	15	20	21	22	19	19	24
Part Time Tenure/Tenure Track	3	4	4	4	3	3	2
Part Time Career-Line/Adjunct	1	1	2	1	1	1	1
FTE from A-1/S-11/Cost Study Definition							
Full-Time Salaried	61	57	60	61	59	62	68

Mathematics

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-2014
FTE from A-1/S-11/Cost Study Definition							
Part-Time or Career-Line/Adjunct	4	7	5	5	3	4	3
Teaching Assistants	15	7	14	17	18	20	23
Number of Graduates							
Bachelor's Degrees	53	81	63	64	60	66	70
Master's Degrees	21	12	11	28	11	17	33
Doctoral Degrees	9	4	10	13	10	11	8
Number of Students Based on Fall Third Week Semester Data							
Undergraduate Pre-Majors	48	49	41	55	48	52	53
Undergraduate Majors*	183	197	192	177	214	226	242
Enrolled in Masters Program	42	33	39	51	59	62	39
Enrolled in Doctoral Program	51	67	75	68	72	75	103
Department FTE Undergrad	1,338	1,460	1,585	1,673	1,767	1,927	1,862
Department FTE Graduate	92	98	97	99	98	112	133
Department SCH Undergrad	40,152	43,792	47,557	50,183	53,004	57,806	55,857
Department SCH Graduate	1,830	1,966	1,948	1,986	1,966	2,230	2,666
Undergraduate FTE per Total Faculty FTE	21	23	24	25	29	29	20
Graduate FTE per Total Faculty FTE	1	2	2	2	2	2	1
Cost Study Definitions							
Direct Instructional Expenditures	9,451,861	9,696,102	9,528,855	9,285,015	9,375,591	9,961,788	11,682,813
Cost Per Student FTE	6,610	6,223	5,663	5,240	5,027	4,887	5,855
Funding							
Total Grants	3,178,791	3,591,764	3,785,906	3,673,671	3,043,614	3,396,119	3,429,511
Appropriated Funds	7,748,161	1,827,756	8,710,551	8,598,957	9,257,267	9,409,116	11,392,509
Teaching Grants	1,072,181	1,038,074	702,855	420,355	129,345	283,718	832,716

*Only the chronologically first declared major for students with multiple majors is recorded in the Undergraduate Majors section of this OBIA report. Thus, for a department such as Mathematics with large numbers of double and triple majors, the figures reported in the Undergraduate Majors are lower than the actual numbers of students in the undergraduate program. For example, the total number of Undergraduate Majors in 2013-14 was 373, as opposed to 242 reported here.

Memorandum of Understanding
Department of Mathematics
Graduate Council Review 2014-15

This memorandum of understanding is a summary of decisions reached at a wrap-up meeting on June 25, 2015, and concludes the Graduate Council Review of the Department of Mathematics. Ruth V. Watkins, Senior Vice President for Academic Affairs; Henry S. White, Dean of the College of Science; Peter E. Trapa, Chair of the Department of Mathematics; David B. Kieda, Dean of The Graduate School; and Donna M. White, Associate Dean of The Graduate School, were present.

The discussion centered on but was not limited to the recommendations contained in the review summary report presented to the Graduate Council on April 27, 2015. At the wrap-up meeting, the working group agreed to endorse the following actions:

Recommendation 1: The Department's self-study report has a substantial section (1.2) on program planning. Nevertheless, we concur with the recommendation made by the External Review Committee that "a crisp and prioritized 10-year strategic plan" would be helpful if the Department intends to maintain and even raise its already high national stature.

The Chair and Dean are committed to maintaining and raising the Department's already high national stature. The Chair has already convened a planning committee to address this recommendation. After receiving the new budget model for activity funds, the plan is for the Chair to meet with the committee periodically, as needed in the next year, to consider and formulate strategies on creating a 10-year strategic plan.

Recommendation 2: The Department should continue and strengthen its commitment to interdisciplinary aspects of mathematics, especially with respect to the natural and medical sciences. One aspect of this commitment is taking a leadership role in developing a university-wide vision for research and teaching of statistics even if, as Chair Trapa correctly notes, formulation and implementation of such a plan is not entirely within the purview of the Department.

This recommendation is linked to Recommendation 1, as taking leadership in developing a university-wide vision for research in and teaching of statistics is directly linked to the 10-year strategic plan. The Sr. VPAA and the Dean of the College of Science are already involved in working with the Department to explore options for creating a new, institutional vision for the role of statistics. Since the review, the Chair noted in his response:

The Department is already deeply involved in the planning of the interdisciplinary Program in Data Science to strengthen its connections to modern statistics. The Department is also working closely with the leadership of Cell Center for Genomic Science with a view toward joint faculty appointments. Finally, beginning in 2016, a new faculty member, Akil Narayan, will join our faculty, and will also hold an appointment in the interdisciplinary Scientific Computing and Imaging Institute. The Department will remain opportunistic when pursuing other interdisciplinary connections.

Recommendation 3: Despite important strides over the past several years with respect to increasing diversity, additional pursuit of faculty diversity would strengthen the Department. Additional efforts with respect to undergraduate and graduate student diversity are warranted as well.

The Chair and Dean agree with this recommendation and the Dean offered his assistance to address it. In his response, the Chair reported that, "The Department has convened a new committee to fund visits of promising young and mid-career mathematicians from diverse backgrounds, with a view toward cultivating relationships ultimately ending in successful recruiting efforts." All parties recognize the benefits of increasing the number of diverse faculty and students. The Sr. VPAA noted the institution's new initiative to assist departments in their efforts to increase numbers of underrepresented faculty (by sharing financial commitments). The Chair will explore the available options. It was noted that increasing gender diversity is also a diversity goal for this department that can be pursued through the Sr. VPAA's new initiative. In terms of increasing undergraduate and graduate student diversity, the Chair acknowledged that more work needs to be done. The Graduate Dean pointed out that important opportunities exist to invite diversity within the Department's large and successful summer Math Institute. Also, it was recommended that the Department capitalize on the High School Math Teachers program where there are already well-developed relationships with area high schools that are becoming increasingly diverse. The Assistant Dean for Diversity in the Graduate School offers numerous resources for departments to recruit and retain qualified historically underrepresented graduate students.

Recommendation 4: In recent years, the Department has admirably accommodated a substantial increase in the number of undergraduate and graduate students. As the level of instructional responsibility stabilizes, the Department is encouraged to examine its curriculum structure, as it has already done successfully with respect to the engineering math sequence. Some undergraduates were concerned that not all students in the lower division courses were receiving the programming and computational skills necessary for the upper division classes, so this is an area that may be ripe for additional attention during this self-examination process.

The Chair agrees with this recommendation and has taken action to expand the effective engineering/math model, but that model is expensive. The Dean has committed some funding but it might be necessary to consider the implementation of differential tuition. The Chair has appointed a new Director of Undergraduate Studies and has already taken action on the concern about students receiving programming and computational skills at the appropriate time. Changes will probably be implemented during the 2015/16 academic year.

Recommendation 5: The Department should continue its work to narrow the salary gap between graduate students who are supported by National Science Foundation grants and those supported as teaching assistants.

This is a difficult recommendation to address due to the reality of funding constraints on teaching assistantship amounts. However, the gap has been narrowed somewhat (over the last three years, the Department has increased its graduate student stipends 13-21%) and the Dean is committed to continuing to move in that direction even if the progress is incremental. The Department has been conscientious in its efforts to distribute the higher grant support to as many students as possible over the years they are in the program. The Graduate Dean encouraged the Chair to assist deserving students in their applications for NSF Graduate Research Fellowships, which are funded at substantially higher levels than TAships.

Recommendation 6: Whereas all graduate students serving as instructors should be well trained and carefully supervised, this is especially important if the Department continues to deem it necessary to have some courses taught by first-semester graduate students.

The Chair agrees and has implemented a two-week training course requirement for all graduate student instructors and noted that the Department only utilizes first-semester graduate students to be lead teachers when absolutely necessary. All student instructors are closely supervised by tenure-line faculty.

Recommendation 7: With respect to employment of undergraduate and graduate students, the Department should expand existing programs and, where appropriate, create new programs that prepare students for employment outside of school and higher educational settings. With respect to employment within elementary and secondary schools (“mathematics education”), the Department should continue its efforts to clarify its role vis-à-vis the College of Education and collaborate effectively.

The Department will continue to expand its career seminar series for both undergraduate and graduate students, and with the restructuring of the Center for Science and Math Education, the Chair sees opportunities to increase collaborative efficiencies with the College of Education. Consideration will also be given to conducting systematic exit interviews and to making improvements in tracking the employment of alumni via LinkedIn and Facebook.

Recommendation 8: Finally, the Department should improve its activities with respect to assessment of student learning. Important and appropriate data are currently being collected, but these data need to be more extensively used to improve the learning of students, especially undergraduate majors.

The Dean and Chair agreed that the value of degrees should be reflected, in part, in job placements. In the Chair's response, it is reported that, "The Department has recently revised its assessment plan, providing more direct feedback between data collected and curriculum revisions." This is the type of "closing the loop" approach being asked for by the institution for accreditation purposes but also as a best practice. Regular progress reports will provide updates to the Graduate School on this and the other recommendations.

This memorandum of understanding is to be followed by regular letters of progress from the Chair of the Department of Mathematics to the Dean of The Graduate School. Letters will be submitted until all of the actions described in the preceding paragraphs have been completed. In addition, a three-year follow-up meeting will be scheduled during AY 2017-18 to discuss progress made in addressing the review recommendations.

Ruth V. Watkins
Henry S. White
Peter E. Trapa
David B. Kieda
Donna M. White

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David B. Kieda
Dean, The Graduate School
July 30, 2015