Department of Mathematics – Self-Review

Introduction

The centrality of Mathematics in any reputed academic institution is not questionable. Mathematics is central to all endeavors in sciences, engineering and business and a strong Department of Mathematics is essential to the mission of a world-class research university. At Washington State University, the Department of Mathematics plays the vital role of providing quality instruction in mathematics at both undergraduate and graduate levels, and promoting and conducting high-level research in cutting edge areas in order to advance the frontiers of knowledge and produce future leaders in business, education and industry who are analytically minded.

The Department, at present, has sixteen full professors, eight associate professors, four assistant professors and a clinical assistant professor. In addition, we have three instructors and a senior instructor. Members of the faculty are in the forefront of research in areas such as Mathematical modeling, Optimization, Partial differential equations, Matrix algebra, Mathematical education, Discrete mathematics and Environmental mathematics.

At the undergraduate level, a bachelor of science in mathematics degree is offered with six different options. At this time, we have 62 majors and 51 pre-majors in mathematics.

The Department of Mathematics is also a major provider of service courses at Washington State University. We offer four different calculus sequences (biological sciences, business, physical science/engineering/math, and architecture), two pre-calculus courses, a mathematics content sequence for elementary education majors, and a general mathematics course designed to promote critical thinking and quantitative and symbolic reasoning in students majoring in non-technical disciplines.

The Department currently offers three graduate degrees: MS in Mathematics (which also has an Applied Mathematics Option and a Mathematics Teaching Option), Ph.D. in Mathematics, and a Ph.D. in Mathematics with Teaching Emphasis. The first Ph.D. in Mathematics at Washington State University was awarded in 1962. The number of graduate students in mathematics fluctuates around 30 from year to year and on average we graduate 3 MS students and 2 PhD students every year.

The Department also has strong links and works closely with secondary schools in Washington, particularly Central and Eastern Washington, through former graduates and several funded projects. A long-term collaboration exists between the Washington State University’s Department of Mathematics and the Colville Confederated Tribe and the school districts serving the reservation.

A detailed picture of the Department and its activities in relation to student learning, graduate student training, research and outreach can be gathered by browsing our website at http://www.math.wsu.edu

Undergraduate Education

The Mathematics Department expects students to obtain a sound foundation in mathematics, technology, and communication of mathematics that will prepare them for either graduate school in mathematics or a related field or for a career related to the option in which they majored. The course work associated with the six undergraduate options was created based on consultation with industry and education advisors. WSU’s Six Learning Goals of the Baccalaureate are woven throughout the required course work for our majors. Critical and creative thinking is emphasized in every course taught in the Mathematics Department, as is quantitative and symbolic reasoning. Information literacy and communication are emphasized throughout as well, but are thoroughly developed in the upper division and writing in the major courses. The learning goal Self in Society is cultivated throughout our degree program and becomes more evident in student behavior and communication by the senior year. Finally, each option is designed to prepare graduates to contribute to their community, employer, and society at large immediately.
Undergraduate math majors have many enrichment opportunities during their undergraduate years including undergraduate research assistantships provided by the Department, college, and grants; competitions including the Mathematical Modeling Competition and the Putnam exam; and secondary mathematics majors host a day of math activities for middle and high school students as part of their methods class, as well as attend and make presentations at the Inland Northwest Mathematics Experience meeting. The Department provides the students and the faculty with funds to prepare and participate in these activities.

An important aspect of judging the effectiveness of math courses is to track the success of students in downstream courses based on their performance in prerequisite courses. Some of that is being done currently on an ad hoc basis, but a plan is being developed for systematic assessment that can inform future improvements to mathematics education at WSU.

Last year, formal liaisons were appointed from the Math Department to work with other colleges and departments across campus including the College of Business, College of Engineering and Architecture, the College of Education, and the School of Biological Sciences. These individuals will communicate regularly with these other units to make sure any concerns they have regarding the mathematical preparations of their students are addressed.

Additionally, we offer extensive help for students in our lower division courses through a tutor-assisted study hall that is staffed five evenings and four afternoons a week. The Department spends around $10,000 every semester in order to provide this free help for students. Further, we continually review our course offerings, the effectiveness of different teaching styles and classroom environments and make adjustments and modifications in order to enhance the learning experience for our students.

According to WSU Student Data, with the current resources, the Department of Mathematics is doing a great job in teaching around 10,000 students every academic year. Nearly 3,000 of these students are GER students. As can be gathered from the Delaware Study, WSU’s institutional teaching expenditure (per student FTE) for Mathematics is $3,424 and this amount is rather small compared to either the 25th percentile of the peer amount ($4,080) or the national average amount ($4,168). This clearly shows what a small funding base the Department has for its teaching activities. However, even with this small funding base, we are able to contribute to the high (freshman and transfer student) retention rate of the College of Sciences and are able to have a 62% total degree to completion that compares really well with the 75th percentile of the peer number, which is 66%. Also, it is very gratifying to find out that a significant number of the alumni (68.7%) in WSU’s Alumni Survey are very/considerably satisfied with WSU’s education with regard to understanding and applying quantitative principles, i.e., their mathematics education at WSU. Our hope is that the institutional teaching expenditure for Mathematics will increase significantly in the coming years and that in turn will allow us to provide an even better undergraduate experience for our students. At the undergraduate level, we would like to provide the students with small classroom learning experience, involve more students in undergraduate research activities and create opportunities for industrial internships & entrepreneurial experience.

Research/Graduate Training

The Department’s faculty hiring plan has been based on the following:
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The hire’s research expertise should be in an applied area or an applicable area of mathematics that advances knowledge.
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The hire should be able to contribute to the teaching of the core courses in mathematics.
?
The hire’s research is such that it should attract extramural funding.
?
It is ideal if the hire’s area of expertise can relate to any national or state needs.
?
It is desirable if the hire can carry out interdisciplinary activities in terms of research and scholarship.

The faculty are supported by Departmental resources in terms of start-up funds at the time of hire, computing help, matching funds as part of grant proposals and funds for research travel and conference presentations. In addition, we make funds available for graduate students and even research-active
undergraduate students to participate and present their research at conferences. The amount of financial support that the Department can provide is limited by how much funds we have in terms of permanent funding and indirect cost recovery from external grants. However, within these financial constraints, our faculty are doing a remarkable job with regard to research (national and international recognition and research publications) and graduate student training. The number of graduate students that we have is somewhat limited by the number of TA allocations we get for the Department. One should point out that, unlike for lab-based disciplines, the National Science Foundation does not provide funds for research assistantships (RAs) on individual research grants in Mathematics. Therefore, unless funds become available to increase the number of TA allocations, it will be difficult for the Department to increase the graduate student number in Mathematics. It should be noted that, at times, research grants from other funding agencies, other than NSF, provide funds for RAs in Mathematics and at present, two of our graduate students are on RAs supported by funds from the Department of Energy and the Office of Naval Research. An increase in the number of TAs can help with our undergraduate teaching at the introductory level and give us the opportunity to enhance research activities in some of our selected areas of excellence (that relate to WSU’s areas of preeminence) such as Mathematical Biology, Environmental Mathematics and Modeling in Composite Materials.

In the last few years, the composition of our graduate program has changed from a mix of 50/50 Ph.D. to MS students to a mix of 84/16 Ph.D. to MS students. This is a conscious move on our part in order to grow our doctoral program and elevate the Department’s research profile a couple of notches higher. With a recent restructuring of our doctoral program, we hope to produce Ph.D.s with strong theoretical background who can carry out cutting-edge research that is interdisciplinary and who can play important roles with regard to mathematics education at both state and national arenas.

Our faculty regularly publish in top tier journals in their areas of research and have been active participants giving invited and contributed presentations at various international and national meetings. It should be noted that in the recent years, a couple of our faculty members’ research papers have won “best paper” awards from a quality journal (Technometrics, 2000) and at a prestigious conference (ASME’s Computers and Information in Engineering Conference, 2001). The citation impact of papers authored by faculty researchers in the Department of Mathematics is better than either the peer median or the 75th percentile number; especially, since 1998, the impact rate has been on an upward trend (WSU’s Institutional Research Data). In addition to high quality researchers, we have some excellent instructors among our faculty. Our faculty have won teaching awards such as the Mathematical Association of America’s Regional Award, WSU’s Sahlin Faculty Excellence Award and Naval ROTC Faculty Excellence Awards.

Our faculty receive extramural funding to support their research and scholarly activities from various federal agencies such as the National Science Foundation, National Institutes for Health, Air Force Office of Scientific Research, Department of Energy, Office of Naval Research and the U.S. Department of Education. At present, 44% of our faculty have funded research. Two to three graduate research assistants are supported by some of these funds. In terms of dollar amount, the total funding for the Department per year may look rather modest. However, it should be emphasized that, unlike in a lab-based discipline, doing research in mathematics does not cost much. Also, one should point out that, based on the Delaware Study, WSU Mathematics’ research expenditure is $18,510 and it is far better than the national (mathematics) research expenditure amount of 16,236. Further, our research expenditure amount lies between the peer amounts for the 25th percentile ($16,109) and the 50th percentile ($21,570).

Over the years, research in the Department has become multidisciplinary. In fact, several of our faculty members have joint appointments in other departments either within the College of Sciences or in other Colleges. Two have joint appointments in the School of Biological Sciences (College of Sciences), four in the Department of Statistics (College of Agricultural, Human, and Natural Resource Sciences) and one in the Department of Teaching & Learning (College of Education). In addition to graduate research activities, our faculty have been active in undergraduate research training too. The Department has hosted an NSF-funded REU site program (Research Experience for Undergraduates) and a CompuResearch program funded by the Boeing Company. Also, at present, in partnership with faculty researchers in the School of Biological Sciences, some of our faculty are working with undergraduates, providing them with research training at the interface of mathematics and biosciences as part of an NSF-funded program.
Several of our faculty collaborate with researchers from other disciplines within Washington State University, other academic institutions (in the U.S.) or federal research laboratories and such collaborations have been extremely productive in generating joint research publications and research funding. Our faculty have either authored or co-authored research papers that have been published in various top-notch journals in disciplines other than mathematics. In fact, one could argue that a significant portion of the research that is carried out at Washington State University’s Mathematics Department is interdisciplinary. This has led the Department into instituting an Applied Mathematics Option in our Ph.D. in Mathematics. Also, at the undergraduate level, work is underway (in collaboration with the School of Biological Sciences) to institute an interdisciplinary Certificate in Quantitative Biology. Some of our faculty regularly serve on the doctoral committees of students in disciplines other than mathematics. Similarly, at times, faculty members from other disciplines serve on the doctoral committees of math students. Therefore, the Department’s interdisciplinary activities extend to graduate students’ research training too.

The Department’s interdisciplinary and cross-institutional collaborations are not limited to researchers within the U.S. Several of our faculty have established research collaborations with researchers abroad and have spent their professional leaves working at academic institutions in Europe, Asia and the Americas. Also, a number of researchers from Europe, Asia and the Americas have visited our Department for extended periods of time in order to collaborate with our faculty. It should be noted that some of these international research activities were supported by the National Science Foundation (for Sri Lanka and France) and the European Union (for Greece). The Department has a Memorandum of Understanding with the Department of Mathematics at Mahidol University (Thailand) that allows for collaborative research and student training. Also, one should point out that a number of our former doctoral (international) students have gone back to their countries and hold various academic positions at universities there. Overall, the Department of Mathematics contributes a fair amount towards global education and research.

Also, it is noteworthy that a number of our faculty members serve on the editorial boards of international journals and some have been active within their research communities and professional organizations in hosting short courses, workshops and symposia. In addition, a few of our faculty have written sought-after text books and have edited special issues of journals and books. The national and international recognition of our faculty members is derived from their research/scholarly publications as well as their service to the research communities.

For the near future, one of our goals will be to increase the number of faculty who will have funded research to a level above the 50th percentile level of our peer institutions. The Department has pockets of research excellence and a number of our faculty have individual national and international recognition. However, as a Department we are not known for particular areas of research in the national scene. Therefore, an important goal for us is to inject vitality into our research program and expand our pockets of research excellence in order to create a few world-class research clusters that will tie in with WSU’s research areas of preeminence.

**Engagement/Outreach/Service**

Several members of the mathematics faculty are directly involved with mathematics education in the State of Washington. Examples of the type and level of engagement include the following:

- **WA State Math Panel** - The committee is working to revise the Washington State Mathematics Standards
- **WaToToM (Washington Teachers of Teachers of Mathematics)** - An organization of Washington higher education faculty who train future educators that collaborates to establish criteria for teacher education programs, make recommendations related to mathematics education within the state of Washington, and provide experts on issues related to mathematics education
- **Professional Education Advisory Board** - This is a board established by the State Board of Education to ensure that representatives of recognized professional organizations and local school districts, in a collaboration with higher education, would regularly participate in decisions related to professional teacher preparation programs
- **Math Science Partnership Grant** - A state-funded collaboration between UW, WSU, EWU, and several WA school districts to improve the WASL preparation of middle school students
NSF GK-12 grant- Culturally Responsive Engineering Applications in Mathematics (CREAM) - A National Science Foundation funded project which places graduate students in middle or high schools for a year to work with mathematics teachers to develop and use culturally responsive engineering applications in the class to increase the motivation of students, expose them to some of the uses of the mathematics they learn, and introduce them to the engineering disciplines

Northwest Math Conference- A regional mathematics conference held every October. As part of the Secondary Mathematics Methods course our students participate in this conference

On-going collaboration with the Colville Confederated Tribes and the school districts serving them

CompuTeach- A Boeing sponsored initiative that introduces school teams involving teachers and students (both high school and WSU) to technology based mathematics instruction

The use of technology and the types of technology used in mathematics instruction has increased over the past five years. The newest innovation is the purchase of a SMART Board. Instead of just having students attend professional meetings, they are now required to make presentations there. Several new courses have been developed and offered to meet the state endorsement competencies. The course alignment to the new competencies was completed in Fall 2007.

Conclusion

The Department of Mathematics feels that it is contributing significantly towards the strategic goals of WSU with regard to undergraduate experience and world-class research given the current resource limitations. However, as described above, we can do a whole lot better in every area of educational, research and scholarly activity if funds are made available to hire additional faculty, improve computer resources and increase TA allocations.

The centrality of Mathematics as a discipline in any world-class university can not be over-emphasized. If Washington State University is to aspire to become an AAU institution and play a vital role in the national arena by producing the future engineers, business leaders, scientists and educators of the highest caliber, without question, the university should have and support a strong and vibrant Mathematics Department. We understand the critical role that we play in the university and as described in these pages, are continuously reviewing and invigorating our undergraduate, graduate and research programs in order to meet the state and national needs and produce the future leaders in all walks of life.

(This is a condensed version of the self-report that was submitted as part of WSU’s accreditation review.)