UNIVERSITY OF REGINA
Department of Mathematics and Statistics

External Review

June 6, 2023

External Reviewers

Dr. Jennifer Hyndman, Professor, Mathematics and Statistics,
University of Northern British Columbia

Dr. Monica G. Cojocaru, Professor, Mathematics and Statistics, University of Guelph

Internal Reviewer

Dr. Kathy Nolan, Professor, Mathematics Education, University of Regina

In-person Site Visit

April 3–4, 2023

Introduction

The Review Team for the Academic Unit Review of the Department of Mathematics and Statistics consisted of two external reviewers and one internal reviewer. The external reviewers were Dr. Jennifer Hyndman, Professor, Mathematics and Statistics (University of Northern British Columbia) and Dr. Monica Cojocaru, Professor, Mathematics and Statistics, and Associate Dean Research and Graduate Studies in the College of Engineering and Physical Sciences (University of Guelph). The internal reviewer was Dr. Kathy Nolan, Professor, Mathematics Education.

The Review Team was provided with a self-study report which included information on staff, the Federated Colleges, resources, scholarly output, and degrees. The committee conducted a site visit on April 3 and 4, 2023. The site visit included meetings with faculty associated with the various degrees, several senior administrators, Federated College faculty, undergraduate and graduate students, and meetings with representatives of other departments.

The Review Team has divided this report into the following sections:

- Undergraduate Teaching and Learning,
- Graduate Teaching and Learning,
- Research,
- Service,
- Staffing,
- Financial Resources,
- Role in Meeting University's Vision.

Where appropriate, within each of these sections the areas of focus of the Academic Review Unit were considered. Recommendations are stated within the relevant section and are then repeated at the end of the document.

Executive Summary

It was a pleasure to visit the Department of Mathematics and Statistics to complete the external review. The department is clearly well respected across the university, by faculty, staff and students.

Undergraduate Teaching and Learning

As is typical for a department of Mathematics and Statistics, the undergraduate courses range from large section service courses in lower levels through to highly specialized small sections in upper years. There are dozens of degrees that require one or more MATH or STAT courses. The Federated College structure allows for students to have choice on where they take a course.

The most pressing need in undergraduate teaching and learning is to make the fourth year courses both easier to access for more students and to provide opportunities for research experiences for those who might be strong graduate students.

Graduate Teaching and Learning

The department is doing a good job in managing class sizes by cross-listing some graduate courses with fourth year courses. The combined sections have a reasonable number of students. Funding for graduate students is an ongoing concern that needs to be addressed.

Research

The department has a very good research profile in the theoretical mathematics and statistics disciplines, with solid grants, while funded research is encouraged typically via a course relief. However, the external research funding is solely dependent on three sources (NSERC Discovery grants, MITACS and PIMS), thus the department needs to broaden and implement external funding diversity in the Tri-Agency landscape and infrastructure.

Service

The department members are engaged in service, some of it exceptionally valuable to the Canadian mathematics community. Visibility of the service could be improved both by making information about the service more available and by doing more University-level committee service that gives a voice to the department (such as more Senate involvement, program committees representation, student affairs committees and initiatives, etc.). Last but not least, department faculty could get involved in national level reviewing committees for grants and funding calls, which bring University-wide recognition.

Staffing

The faculty in the Department of Mathematics and Statistics at University of Regina have research focus primarily in the four areas: linear algebra, analysis, topology and geometry, and statistics. Given current societal needs and directions, the department should, in the next 2-4 years, consider new hires in applied mathematics and applied statistics areas to broaden course audiences and to offer students experiential learning opportunities in preparation for the job market. In the next 1-2 years however, the most pressing need is expanding lab space and hiring staff to support the growing demand from lab courses. These courses are fundamental for the new Data Science degree and the influx of students this should bring.

Financial Resources

The most immediate need with financial implications is a computer lab room to support the new Data Science degree and to support any growth in existing degrees. As indicated, the people to staff those labs are also needed. In the short term, the department should consider marketing the Statistics Consulting Center, and should further explore "revenue shared agreements" with the University for course-based masters or similar programs.

Role in Meeting University's Vision

The department has primarily been a theoretical research unit. With the introduction of the new Data Science degree and the Actuarial Science degree, they are moving toward the university's vision of a more applied group. As expressed in the unit review meetings, the administration would like the department to be more engaged and visible within the university. This should begin with investment in proper signage and branding so that students can see that the department exists when they walk through the campus buildings. The department serves a wide community of the university in their numeracy role, while supplying an excellent pipeline of fundamental research in mathematics and statistics. The University desires to see department faculty engage in cross-discipline research support, in collaborative grants and indigenization.

Highlights of Recommendations

There are numerous recommendations provided throughout this document. They are summarized on page 30 The most pressing concerns are related to:

1. University support for the Data Science degree via lab course infrastructure and staffing. See FN-1.
2. Visibility of the department. See VS-1 and VS-2.
3. Clarity on content and degree structure to support undergraduate recruitment in department programs, as well as undergraduate level experiential learning. See UG-1, UG-7, UG-8, etc.
4. Research funding and faculty hiring diversification to support growth in graduate student numbers and graduate funding. See RS-1 through RS-4.

Undergraduate Teaching and Learning

Degrees and Enrolment

The department has eight distinct undergraduate degrees, not including honours or minors. They are Actuarial Science, Applied Mathematics and Statistics, Data Science, Mathematics, Mathematics and Computer Science, Mathematics and Mathematics Education, Statistics, and Statistics and Economics. At first glance, this appears to be too many degrees for a department this size. However, these degrees are either innovative degrees that (will) draw students or are traditional degrees that are expected within a Mathematics and Statistics department.

The 78 students graduating in the last 10 years with the Actuarial Science degree is second only to the 84 who graduated with a Mathematics degree. The new Data Science degree should match these numbers since understanding and analyzing data is now a hugely important activity in society.

Class sizes vary from large 1st and 2nd year service course to modest sizes in all years. In the last five years twenty-two sections of lower level courses (3 STAT courses and 2 MATH courses) have had between 150 and 200 students. While sections at the Federated Colleges tend to be smaller than those associated with University of Regina, it is not always the case.

Third year class sizes are primarily under 30 with many around 20 but include small reading classes. Most fourth year classes are cross listed with graduate courses. The combined courses tend to be between 5 and 20 students. The experience of an undergraduate working with graduate students is simultaneously beneficial for both groups and challenging for the undergraduates. Having some fourth year courses that are designed for students who are interested in mathematics but not intending to go on to graduate school could be useful.

Many first and second year courses are service courses, geared toward students in other majors or disciplines, while the third and fourth are more for students in the Mathematics and Statistics disciplines. Fourth year have generally mathematics majors and honours mathematics students (about 4-5 students a year).

The department offers 4 mathematics courses and 3-4 statistics courses every semester at fourth year level, and in Spring/Summer they offer some reading courses. Some appear to have very low enrolment but the cross listed courses in total are fine.

It is difficult to determine which courses are cross listed. Recommendation UG-7 suggests remedying this.

All of the degrees have a common set of courses. Recommendation UG-1 suggests that the calendar entry makes it clear which courses are common and how, starting with this common core. Students then have the flexibility to choose their degree after first semester or even after first year.

Most undergraduate students in Mathematics and Statistics are local. In some ways this is not surprising as every university has a department that offers a Mathematics degree. However, the strength and relative uniqueness of the undergraduate Actuarial Sciences degree could be used as a strong draw from a larger catchment area. See Recommendation UG-6.

Mathematics degree: The existing degree is tailored to students who are interested in doing further theoretical work at the graduate level. This is an important component of an undergraduate mathematics degree. This focus can be enhanced with a fourth year research project (see Recommendation UG-10). A fourth year project course that is directed at more applicable problems would help broaden the appeal of the degree to students who are not focused on theoretical graduate work. See Recommendation UG-12.

Five year Mathematics and Mathematics Education degree:

While the BEd Secondary Mathematics Major graduates over 10 students per year, the Mathematics and Mathematics Education BSc/BEd degrees only completed 8 students in the last ten years. Teachers with these degrees have the skills to increase mathematical literacy within society. The straight BEd has a strong core of 200 to 400-level course from the mathematics dept as well as similar level high school mathematics pedagogy courses from the Faculty of Education. However, the BSc/BEd pair of degree provides both broader and deeper perspectives on mathematics. This knowledge can be effectively used to motivate students to continue in STEM areas. Recommendation UG-2 is to work with the Faculty of Education to promote the value of this degree more.

Mathematics and Computer Science Fifteen students in 10 years for the Mathematics and Computer Science degree is also smaller than expected given the large numbers of students in Computer Science. This number will likely be influenced by the new Data Science degree. Students who like the idea of the Data Science degree but who do not want all of the statistics are likely to take this degree. However, students may also move out of this degree to Data Science. Recommendation UG-3 is to review, in five years, the number of students in this degree.

Data Science The new Data Science degree is a combination of mathematics, statistics, and computer science. It is a very relevant degree and has the potential for rapid student growth. It should be fully supported.

Statistics degrees The Statistics and Economics degree has only had 4 students complete in the last 11 years but 9 in the 6 previous years. The Statistics degree has had 12 students complete in the last 10 years whereas 34 graduated in the 8 previous years. The department could consider turning these two degrees into a single degree with concentrations.

The newer Applied Mathematics and Statistics degree has had 12 students complete in the last 8 years. This degree relies on Federated College faculty to teach the primary applied mathematics courses. Until the department has more applied mathematics faculty this degree should also be changed to a concentration under the Statistics degree. See Recommendation UG-8.

Actuarial Science Program: During the last 10 years 78 students completed the Actuarial Science degree which leads to professional designation. The degree is one of the very few accredited programs like this in Canada. Accreditation is very important, as performing students with certain grades in certain courses qualify for professional exam exemptions after the completion of program. The program started in 2001 with first graduated class in 2005. The program is unique, as it has an internship component, paid by employer, which is 16 months in duration during the course of the program.

The original teaching faculty for the Actuarial Science program used to do no research. Now the faculty members also do research and supervise graduate students in Statistics. In general, the Actuarial Science program feels very supported by department, Head and Deans. Faculty members have indicated that they would like to grow the enrolment in the program. Existing classes could hold more students. During the unit review meetings, interest was expressed in recruiting international students for this program. However, given the limited number of similar programs in Canada, it might be worthwhile focusing recruitment initiatives on Canadian communities that are similar in size to Regina. See Recommendation UG-9.

Another task is to expand the employers' market for students from the local economy to Ontario and Manitoba (Winnipeg area). University of Winnipeg is a competitor in this market, but the extended internship program is an advantage for University of Regina.

Quality of Program

The Department of Mathematics and Statistics has good relations with the Department of Computer Science and they share a couple of undergraduate programs (Applied Mathematics and Computer Science) and the new Data Science program. Data Science is expected to become successful due to the rising need for data scientists in the job market.

Traditionally, the ACSC program was and is a flagship program of the department, while the honour in Mathematics program produces very strong, award winning students, but is on the small side. The mathematics and computer science program is a worthwhile collaboration, however it has not grown in numbers as much as the University desired. It is hoped that the Data Science undergraduate program will foster more collaborations between the department and the rest of the Faculty units. The department is seen as as a collaborative department in a number of new initiatives, and is certainly seen as a unit fully committed to the well-being and well-training of their students. Last but not least, the department collaborates with the Faculty of Science in discussing an audit program of courses offered, to try and catch "problem students" in programs and get them help as needed.

Quality of Instruction

There were very few concerns expressed about the quality of instruction provided by faculty.

The need for an undergraduate research project courses is evident. The department struggles with recruitment of new graduate students, mostly because the faculty are primarily in theoretical areas (not including the Statistics faculty and programs).

Introducing a Research Project in Mathematics course at 4th year level and gearing it towards encouraging students with minors in Mathematics, or students in Engineering, Computer Science, Physics, etc. to take this course would allow faculty to: 1) train talented students for graduate work in mathematics; 2) foster a sense of mathematics community within the Faculty.

The course should be ”opt-in” (interested students should proactively find a potential faculty member to work with them, and should have a course coordinator to balance the grading). Having student presentations public and advertised widely in the department and Faculty will make it a ”mini-event”, able to help the department be more interactive and visible in Faculty and University. See Recommendation UG-10

The department faculty and their colleagues at Federated Colleges are pleased with their current collaboration, with collegiality and helpfulness noted throughout. It is the committee’s opinion that the department can do more in enhancing the students experience in the discipline. For instance, running an undergraduate seminar (on a pass/fail structure) for all students in 4th year (from the department and all 4th year students at the Federated Colleges) would further diversify the student body in the discipline and enrich current collaborations, UG-13.

Meeting Students’ Learning Needs and Goals

More students than ever have jobs while studying and the University of Regina has a higher than average number of hours worked by students. This leads to a number of problems for the students. Class times are more likely to conflict with when students want to be working and the amount of time they have for studying outside the classroom is greatly reduced. Discussions with the students on the effect of work on their academic success can be helpful. The introduction of online and hybrid courses has given students a taste of having more control over their time and many like this. Unfortunately, many do not understand the value of physically being in the room with others while learning is occurring.

Science Academic Hub oversees all academic affairs of students. International students (making up approximately 16% at University of Regina) get routed through the Hub and receive help from science advisors and 2 enrollment specialists. The Hub also helps students who are on academic probation - due to poor performance. There are challenges associated with streamlining students into mathematics courses, as when, for instance, they lack preparedness. In these cases they are routed to a PREP course (called PMATH 092). Faculty of Science also offers training in both Mathematics and Statistics via tutoring in the department.

The Student Success program offers tutoring in these disciplines for a total of 16 hrs a week.

The Hub usually interacts with the department Head and with Dr. Volodin (Statistics Consulting Center) for co-op and internship placements (for instance in the ASCS program). The Hub states that there is demand for students in mathematics and statistics to apply to more co-op and internships, so there is room for this training component to grow. Challenges: admissions happen in programs before high school grades are released, thus checking requirements for program admissions is somewhat long and complicated. Admissions and Registrar are looking into this issue university-wide currently.

The department serves several mathematics majors as well as many minors, and provides a large service teaching component to the university community, ensuring numeracy goals are being met as a solid foundational basis for many programs. In particular, the department serves the teaching needs of engineering programs, thus being an integral part of the engineering disciplines. One area of improvement here may be that the department could initiate a conversation about the way the fundamentals of mathematics are presented to an Engineering audience, and how to incorporate some examples of applications of fundamental mathematics to everyday problems. While the quality of instruction is noted, generally, of being excellent, the above is the only point where perhaps improvement may be needed (see UG-11.

This committee had the opportunity to meet with both undergraduate and graduate students of the department. All students, at all levels, expressed satisfaction and had excellent words for the value of their instruction and instructors, as well as for what they call a ”value added of a smaller program”: the fact that they can interact and get to know all faculty, and they feel like they are being valued and heard.

There were two aspects on the student instruction side which are worthy of being discussed, as to bring them to the faculty agenda: first, the undergraduate students (with the exception of the ASCS program) refer to their degrees as less employable; there is a pervasive view that if you want a job, you cannot pursue a pure mathematics degree (see UG-12). This is concerning coming from students educated in mathematics, as they seem to not realize how fundamental their training is in problem solving in general. Second: students would like to see more computational courses being taught in the degrees (including in Actuarial Science).

This can be ensured by including Computer Science courses in the core courses for multiple degrees, and rearranging some of the content of differential equations and linear algebra courses to include numerical implementation components. The advent of R and Python, both free to use, as well as the presence of cloud computing and sharing platforms (such as Google Collab and GitHub) should help (see UG-10).

Recommendations

UG-1 The calendar entry for mathematics, and other appropriate places, should make it clear that there is a common core of courses for all of the degrees.

UG-2 Work with the Faculty of Education to promote the Mathematics and Mathematics Education 5 year degree.

UG-3 Review enrolment in the Mathematics and Computer Science degree in 5 years to determine the impact of the Data Science degree.

UG-4 The pandemic has lead to a loss of a sense of community for the overall student body. Social events every semester hosted by faculty members will help facilitate the re-creation of a sense of student community that supports a long-term commitment to the department and the university.

UG-5 Any restructuring of degrees should take into account what information can be included on the University Parchment. Students want the Parchment to represent the focus of their degree. The External Review Team believes that Concentrations can be included on parchment but that there are other labels which cannot be included.

UG-6 The department, with the support of the university, should develop a promotion and advertizing campaign to support the undergraduate Actuarial Science degree.

UG-7 Review all cross-listed courses and ensure that titles match. Where possible, the numbers should match. This applies across the ASCS, MATH, and STAT labels and across 4XX to 8XX numbers.

UG-8 Merge the Combined Major in Statistics and Economics and the Applied Mathematics and Statistics into the Major in Statistics. Then introduce Concentrations within the Statistics degree.

UG-9 Recruit students to the Actuarial Science degree from communities of similar size to Regina where local universities do not have the degree.

UG-10 Develop a fourth year undergraduate research course. Rearrange some content in 3rd and 4th year courses to include scientific computing components. Require additional Computer Science courses in certain majors.

UG-11 The Head of the department can strike a committee between mathematics and statistics faculty usually teaching courses to the engineering program and the Undergraduate Curriculum Committee in Engineering. The aim: produce a maintainable, yearly updated examples bank for any mathematics and statistics instructors who teach engineering students.

UG-12 The development of the fourth year project course (as above) will reinforce the experiential learning and will provide students with more employable transcripts.

UG-13 Organize a yearly (one semester) 4th year seminar with department and Federated Colleges undergraduates. This will foster mutual collaboration and help recruit/retain talented Indigeneous students in graduate programs.

Graduate Teaching and Learning

Degrees and Enrolment

The department has 57 graduate students (MSc and PhD) with 33 in Statistics and 24 in Mathematics.

A recent decline in graduate enrolment is a challenge that could be addressed by widening the pool of potential applicants. One way the pool is increased is by lowering the entrance requirements to the MSc programs to a minor degree in discipline, rather than a major in discipline. This would allow students in other scientific disciplines to transition into Mathematics or Statistics. See Recommendation GR-1.

The current course-based and thesis MSc degrees are described as 2 years in length. However, the purpose of a course-based degree is to address a broader pool of recruits and train them for the job market, not necessarily for research. Thus the most appropriate duration for this is 4 semesters given that: a) 16 months addresses the requirement of international students to be here long enough to get a temporary work permit; b) domestic students can currently get jobs directly after a BSc, so they do not see the benefit of another two years in school; c) 16 months lightens the burden of funding required per student vs a 2 year degree.

The Statistics graduate program, outside of Actuarial Science, has about 10-15 students. The department is doing some course streamlining for their course-based masters in Statistics to bring the students' knowledge up to par. Pre-pandemic the program was bigger. This is a 2 year program, 9 courses and essay - but quality of undergraduate training is a concern for the program.

Currently, the course based masters does not require a supervisor assigned at the beginning of the program. Students in this degree would be better supported if they had a degree supervisor, even if that person was different than the essay supervisor. See Recommendation GR-9.

There are Faculty of Science level graduate recruitment grants (10,000 CAD per student) for recruitment of current talented undergraduate students. These funds can also be used for recruiting international graduate students in thesis programs in the department. One direction that is encouraged at the Faculty level is the consideration, by the department, of the fast-track MSc to PhD program, in the hope of retaining talented current MSc students in the local PhD program. Partnerships with MITACS and PIMS for funding Highly Qualified Personnel (HQP) are appreciated and noted, specifically at the Faculty level, as value-added from the department.

Knowledge translation skills, career workshops and EDI training and indigenization are asynchronous modules that can be accessed by all graduate students of the department via the School of Graduate Studies. All graduate students are required to take GRADTHRIVE+: a course teaching them about academic integrity, academic teaching responsibilities, etc. However, it is noted that the department does not necessarily collaborate in developing such initiatives, for instance the new Certificates in ”Digital Research and Data Science”, or ”G-TECH” GR-10.

Quality of Program

The faculty and the degrees are primarily focused on theory and research. There is plenty of strength in the department for this approach. With the need for more enrolment and the current interests of students, it would be beneficial to broaden the scope of the MSc degrees to a more application-friendly approach. Some of the existing 800 level graduate courses could be made more attractive to students who enjoy mathematics but are not interested in proving theorems, rather they want a more computational mathematics viewpoint. This is not a loss, as if such student stays on for PhD, they can catch up with the needed theory in their field, but may attract students from computer science, physics and engineering. This also increases a student’s ability to discuss mathematical content with non-mathematicians. See Recommendation GR-3 and GR-4.

Table 1 shows a possible way to do this (modifications/additions are in underlined blue font).

Although it is necessary to have topics courses that allow specialized instruction for individual students, courses with the name ”Topics” and vague descriptions will not attract graduate students to take the courses or be in the program. A course description should simultaneously invite students to take the course and provide sufficient information for an expert in the area to know what is in the course.

Current: MATH 809 Foundations of Mathematics (3) Development of the real numbers, axioms for set theory, Gödel's theorem Suggested: MATH 809 Foundations of Mathematics (3) Development of the real numbers, axioms for set theory, Gödel's theorem including the implications of limitations in formal axiomatic systems.
Current: MATH 819 Topics in Analysis (3) Advanced study of selected areas of analysis Suggested: MATH 819 Topics in Analysis: Convex and nonlinear analysis Study of analysis used in robotics and control theory
Current: MATH 821 Number Theory (3) Topics from analytic and algebraic number theory Suggested: MATH 821 Number Theory and Cryptography(3) Topics in ~~from analytic and algebraic~~ number theory used in cybersecurity
Current: MATH 827 Graph Theory (3) (Cross-list: MATH 427) Advanced study of selected areas of graph theory Suggested: MATH 827 Graph Theory (3) (Cross-list: MATH 427) Advanced study of selected areas of graphy theory including applications to airline scheduling and travel routing
Current: MATH 828 Combinatorics (3) Advanced study of selected areas of combinatorics Suggested: MATH 828 Combinatorics and applications to optimization Advanced study of selected areas of combinatorics and optimization
Current: MATH 869 Numerical Analysis (3) (Cross-list: MATH 461) Advanced study of selected areas of numerical analysis Suggested: MATH 869 Numerical Analysis and scientific computing (3) (Cross-list: MATH 461) ~~Advanced study of selected areas of numerical analysis.~~ Use of numerical methods and their analysis in simulated solutions for real-world models.
Current: MATH 882 Topics in Applied Mathematics (3) (Cross-list: MATH 482) Advanced study of selected topics in applied mathematics. Suggested: MATH 882 Topics in Applied Mathematics (3) (Cross-list: MATH 482) Advanced study of selected topics in applied mathematics Topics will be chosen from: Green's function in nano research, calculations in the science of nanoscale materials in nanotechnology, etc.
Current: MATH 885AA-ZZ Lecture course in various specialized areas of Mathematics Suggested: MATH 885AA-ZZ Special Topics in Mathematics (3) Lecture course in various specialized areas of Mathematics. Primary focus developed jointly by instructor and students. Possible topics include ....

Table 1: Concept of revisions of graduate course descriptions

Meeting Students' Learning Needs and Goals

Students expressed satisfaction with the degree experience.

Funding for graduate students is always a challenge. There are internal and external sources that could be tapped. Recommendation GR-6 states that potential graduate students should be made aware of the full range of NSERC scholarships. Students need to know that they will have sufficient funds to complete their degrees. Recommendation GR-7 suggests a guaranteed minimal funding for PhD students. This funding can be a mix of research grant, scholarhsip, and teaching assistantships. This type of guarantee can be complicated for a theoretical mathematician as our NSERC grants are smaller than many lab based grants. This means that the university will need to have a source to support guaranteed funding. Otherwise the department risks having the number of students dependent on external funding sources that might fluctuate.

Many institutions are looking for increased numbers of graduates and are looking to both Canadian and international students. As the pool of students increases, the difficulties in assessing the level of preparation of students increases. There is also a need for more student support. This can be everything from making sure a new student understands what the weather in Regina is, to building community, through to developing understanding of what research is. The pandemic has decreased the amount of non-classroom activities shared between graduate students and faculty. Recommendation GR-8 is to support the graduate student community through regular activities. For example, these could be pizza lunches, panel discussions, or talks about being a mathematician.

Graduate students in the department uniformly flagged their perception that the graduate programs of their department are "invisible" to the wider research community. While this is generally a pervasive view from students in pure disciplines, it should be brought to the forefront. The graduate programs were described as good quality (in terms of supervisor-student-department relationship), but as being "insulated". No doubt, the upcoming membership of the Department in the Fields Institute family of Affiliates will help students to access more courses at Fields, travel to workshops and generally keep in better touch with the Ontario-based math community, which is arguably the largest in Canada. Our recommendation here GR-11 would be that department and supervisors increase funding for travel for their HQP.

Recommendations

GR-1 Revise the graduate entrance requirement to: "The entrance requirement for the MSc program is at least a ~~BSc~~ minor degree in mathematics or statistics, with a grade average of at least 75%. Applicants to the PhD program should have an MSc degree or its equivalent, and show strong evidence of research potential."

GR-2 Revise the course-based MSc so that it can be completed within 16 months.

GR-3 Revise some 800 level graduate course descriptions so that they are more attractive to students who are not destined for research careers.

GR-4 Review the naming and description of the 800 level Topics courses.

GR-5 In order to bring in needed applied mathematics content, leverage teaching resources outside the department by having courses co-taught with faculty in Computer Science, Engineering, or most easily, the Federated Colleges.

GR-6 Ensure all senior undergraduates know about the full range of NSERC graduate scholarships in time for them to apply.

GR-7 Work towards guaranteed minimal funding for PhD students. Some of this will be from individual faculty members but much of this will need to be from the department or university.

GR-8 Introduce regular social activities for students in the department where faculty interact with the students and discuss the social and cultural aspects of being a mathematician or statistician.

GR-9 Introduce a course-based masters Degree Supervisor or Coordinator. This person will likely be different than the student's essay supervisor.

GR-10 Ensure the department faculty and graduate students participate in the creation and facilitation of knowledge translation microcredentials (such as certificates and diplomas) that may be developed at university level through the School of Graduate Studies.

GR-11 The department and graduate faculty should make strong efforts to ensure their graduate HQP is applying for travel funding at national and regional conferences, as well as at summer schools, in Canada, US, EU etc. With decreased success rates in NSERC Discovery grants, the Faculty and university must increase their funding travel awards for graduate HQP and PDF to allow for their trainees to connect and be part of the wider research community. Graduate HQP who are members of IEDI communities should be advised to participate in Canada-wide committees and outreach events, bringing their excellent regional experience forward.

Research

For the last 10 years the Department has had one or more Pacific Institute for the Mathematical Sciences (PIMS) Postdoctoral Fellows every year. This is an excellent leveraging of resources and effectively increases the research profile and output of the department.

The research profile of the statisticians in the department is a mixture of theoretical and applied. The research profile of the mathematicians in the department is quite theoretical. These are very common profiles for departments of Mathematics and Statistics. The department sets its own goals and vision for the future. At the moment, the research faculty are in 4 groups: 5 in linear algebra, 5 in analysis, 5 in topology and geometry and 5 in statistics.

No member of the department holds an NSERC RIT, or NSERC Alliance grant, and there is no participation in SSHRC or CIHR grants. There was continued success in getting PDF funding from PIMS Institute, and they will become a Fields Institute Affiliate in July 2023, which will help with both faculty and graduate students participation in workshops, conferences, etc.. There was success as well with getting MITACS funding. There is no mention of infrastructure grants, such as CFI (JELF or IF) - as collaborators or co-applicants. While conducting theoretical basic research in Mathematics may not be a costly proposition, individual faculty, especially in Statistics, could strive to have a broader research grant participation in the Faculty and University RS-1 and RS-5.

The Faculty does not appear to have a Research Manager, so while there is a process to encourage NSERC Discovery Grants internal review for instance, there is no specific help from the Faculty or University with any other grant writing and opportunities for faculty in the department. Our recommendation RS-5 views the addition of a Research Manager at Faculty level a huge needed support for the department (and all other units).

Given the presence of Statistics faculty and researchers, cooperation with wider university communities in co-applicant roles for Statistics faculty can be pursued strongly (see our RS-3). While CIHR and SSHRC funding streams are not traditionally a venue for the disciplines in the department, faculty can get involved in supporting roles. The Head is encouraged to approach and explore a relation with the Perimeter Institute (in the quantum operators area), with the Vector Institute (given the Data Science program) and with AARMS Institute, a place with excellent fully funded or semi-funded summer schools for graduate students on the East Coast of Canada RS-4.

With the strong connection between the department and the First Nations University, faculty should be looking at ways to increase the training of Highly Qualified Personnel (HQP) who are Indigenous. The NSERC USRA program is very useful for introducing students to the idea of research. See Recommendation RS-6. Faculty with NSERC grants could co-supervise with faculty from First Nations University.

Faculty members indicated that access to data from the Regina Research Data Centre is very, very slow which delays students' research projects to the point where they cannot do required work. See Recommendation RS-7.

Recommendations

RS-1 Initiate funding proposals for a new Data Lab and data Lab staff salaries via the NSERC RTI and CFI programs. These initiatives should be built on the Mathematics and Statistics and the Computer Science Department collaboration.

RS-2 The department should expand the Statistics Consulting Center to the wider university community, as well as to the municipal, infrastructure and professional communities via a per-service fee.

RS-3 Faculty in both Mathematics and Statistics should be encouraged to participate as co-applicants in university-wide grant initiatives. The Head should reach out and advertise the collaborative opportunities of faculty in the wider university community.

RS-4 The Head should explore 1-1 collaborative opportunities with: Perimeter, Vector and AARMS Institutes.

RS-5 The Faculty and the Dean of Science should hire a Research Manager which in turn can help all departments (Mathematics and Statistics included) strategize their grant applications and research funding opportunities, and help coordinate larger, multidisciplinary grants.

RS-6 Encourage Indigenous students connect with First Nations University to apply for NSERC USRA.

RS-7 Determine what is restricting ease of access for faculty and students to the data available through the Regina Research Data Centre.

Staffing

The Department of Mathematics & Statistics has a faculty profile that is slightly skewed towards more senior academic positions with 11 Professors, 7 Associate Professors, 3 Instructors and only 2 at the Assistant Professor level. There are also 6 Associate Faculty and Instructors at the Federated Colleges (Luther College, Campion College, and First Nations University of Canada). For the ongoing effectiveness of the unit, it is important to have a continuous stream of new people at the Assistant Professor level. This is only partially addressed by the new hire in Topology starting July 1, 2023.

Each faculty member with a research grant teaches 3 courses each year. No use of grants to buy out courses is practiced. People active in research but without grants teach 4 courses each year. People not active in research, and not holding a grant typically teach 5 courses each year.

Table 2 reflects the various distribution of effort profiles in the Faculty, viewed through the lens of teaching load.

Balance Profile.	4 courses each year (3 if NSERC DG holder)
Teaching profile	$>$ 4 courses/year
Research profile	for large research grants or awards
Service Profile	people serving in admin

Table 2: Distribution of Efforts Profiles viewed through teaching load assignments

There are well-established theoretical mathematics groups of faculty who work collaboratively. The department has had a few new hires into these groups. However, in light of their stated desire to "piggy-back" on the impressive 2,000+ numbers of Computer Science undergraduates, the department should focus on hiring mathematics faculty who work in a blended way between theoretical and applied, in areas of mathematics that will produce excitement and recruitment possibilities from students who are interested in proving theorems and in using those results to solve real-world problems. Strategic hires that specifically do NOT complement existing faculty research will support this. Examples would be numerical analysis (more excitedly branded scientific computing), partial differential equations and modelling (more in the modelling side), numerical optimization and analysis (with applications to machine learning and AI, and quantum computation in the true computational side). These changes will allow for a diversification of third and fourth year courses and increase the pool of potential graduate students. See Recommendation STF-3.

Discussions occurred around the different categories including that of Lecturer and Instructor. The external reviewers strongly recommend that, aside from Laboratory Instructors, all new hires be tenure-track at the Assistant Professor or higher level.

The department makes a compelling case for hiring a second teaching lab assistant, with the introduction of the Data Science program. This staff position should be supported by the Faculty and Provost, as it is in support of growth in students numbers. As this has financial implications, it is discussed in the Financial Resources Section.

Faculty members in Federated Colleges are also considered faculty in Mathematics and Statistics. There is constant and fruitful communication between the Head and Chairs in the Colleges; however, the department could do more to foster a true spirit of collaboration, as the Head of Mathematics and Statistics is responsible for setting the courses at the Colleges. Colleges feel supported by both the Head and by the Dean of Science, and are excited about the indigenization initiative from the Dean of Science.

Financial Resources

A possible solution to teaching graduate courses that includes more students (and that broadens the recruitment roster) may be to leverage teaching resources outside the department. For instance, some of the revised courses proposed above could be taught jointly by a pair of Mathematics and Statistics and Computer Science faculty, or Mathematics and Statistics and Engineering faculty, Mathematics and Statistics and Faculty of Education colleagues, or (last but not least) taught in cooperation with colleagues at the Federated Colleges. This will bring much needed applied content in the MATH courses without a huge investment and without compromising the mathematics content the students need to acquire. Another option for joint teaching is with members of the Faculty of Education. See Recommendation STF-4.

To exemplify, the Head could allow assignment of a half course per year (0.5) for a faculty teaching in the above model, with a 2.5 courses/3.5 courses assignment model in alternating years (instead of 3 courses per year). "Lighter" assignment years can work well with faculty who want to develop/maintain their research portfolio.

Recommendations

It is important to look more deeply into recruitment of more graduate students. Widening the pool of recruits can only be achieved by hiring more faculty who work at the interface of theoretical yet applied mathematics, who can teach courses in areas of complex theory from an applications perspective.

The department has a need for junior Statistics faculty, to maintain critical mass for their Actuarial Science program, and that needs to be addressed in the immediate future. However, the department also needs new members who work more in both theoretical and applied fields in Mathematics. Clearly, any budget considerations will not allow for so many new positions.

STF-1 All new positions should be considered with respect to balancing the distribution of Associate and Assistant Professor positions.

STF-2 New faculty positions should be tenure-track or tenured at the Assistant Professor or higher level.

STF-3 Consider hiring in more applied areas that will facilitate stronger connections with Computer Science, Engineering, and other less theoretical areas.

STF-4 Explore co-teaching options with members of other Departments and Faculties.

Service

The department is involved in a number of service activities, the most significant being teaching of fundamental mathematics and statistics at first and second year levels to support many university degrees.

One of the few places that there seemed to be a mismatch between the perspective of administration and the department was on visibility of the department.

The faculty in Mathematics and Statistics are organizing events and conferences, both in discipline and in outreach. The department does considerable outreach in the community, such as:

- Mathematics demonstrations at treaty celebrations;
- the Women in STEM event - led by Physics, Mathematics and Statistics and the Actuarial Science student associations;
- participation in the Faculty of Science learning lunches with Indigenous, Equity, Diversity and Inclusion (EIDI) presentations.

An item that was not high-lighted in the self study report was the work Karen Meagher is doing as the Chair of the Committee of Women in Mathematics for the Canadian Mathematical Society. This committee has been quite active under her leadership and has been successful in bringing together women and other minorities in both online and in-person activities.

Faculty at Federated Colleges in mathematics are involved in creating "zero-cost" textbooks (for example: the Teaching Circles at Luther), in order to improve students' accessibility to learning material.

The department hosted the 2019 Summer meeting of the Canadian Mathematical Society. This is an important national and international annual meeting.

Many of the expected external service activities are found in the CVs of the members. An activity that would lead to more visibility for the unit and the university is more involvement on review committees at the national level. See SER-1.

Recommendations

SER-1 Increase participation in national level reviewing committees for grants and funding calls.

Financial Resources

Most institutions have a desire for more students. The international student body is viewed as a potential source of new income. It is important to keep in mind the differing needs of international students. They often have a very different understanding of Canadian university culture and need substantially more supports than a domestic student. In addition, they sometimes have very strong transcripts that do not translate to academic success in the Canadian context. This means that when the students do not have appropriate institutional support, the workload of a faculty member is often much higher for international students than for domestic students.

Physical space can be one of the most costly resources for a unit. The degrees offered require computer lab space. The current situation of one lab and one lab instructor is insufficient for the needs of the degrees. Computer space at the university appears to be in high demand in general. A second computer lab must be made available immediately. See Recommendations FN-1 and FN-2.

An ongoing concern of the department (and elsewhere in the mathematical community) is the fact that NSERC funding for basic research in disciplines has not increased in the last 6-8 years while success rate seems to have decreased. There are faculty who are in danger of losing their grant, even at the Established Researcher levels, although NSERC Discovery Grant success in the department in on par with University of Regina success (see FN-3).

The Dean of Science assured the committee that there are funds (5,000 per year) for NSERC URA/USRA summer students, as well as some funds (16K a year x 3 years) for graduate student supervision. There is consideration for faculty who had interruptions to slowly get them back up to speed - smaller teaching classes, summer research funds (above) for gearing up HQP.

The department wishes to implement strategies to recruit more graduate students and to fund them better. They are planning to become an Affiliate Member of the Fields Institute, and in 3-5 years time, an Affiliate Member of the MSRI Institute. This would be a welcome international profiling within the North American research community (see our recommendation FN-4). The department is expected to benefit from increased funding available to thesis-based graduate students such as Thesis-Only Scholarships and Women in STEM Scholarships, and to actively participate in future discussions regarding minimum funding levels for graduate students.

The Statistics Centre is currently bringing in a small amount of money. It is primarily run by one faculty member. This centre is both a challenge and an opportunity as it can provide both a valuable service to the community and income but it would need to be more fully staffed to reach its full potential. Our recommendation FN-5 gives a potential way to achieve this.

Recommendations

FN-1 The new degree in Data Science will put new demands on resources within the department. The reasonable expectation that it will have high enrolment means that plans must be created and immediately implemented around the physical space requirements for computer labs.

FN-2 The Canada Foundation for Innovation (CFI) has an Innovation Fund to support infrastructure for research. This fund should be accessed to help support development of the new computer lab.

FN-3 In light of drastic decreases in funds and success rate nationally in Tri-Agency funding, the University is expected to invest heavily in graduate student funding accross the board, this department included.

FN-4 The Faculty and University should partner with the department to partially support membership fees and affiliations of the department in various Institutes and Associations in the research community.

FN-5 The department should expand the Statistics Consulting Center to the wider university community, as well as to the municipal, infrastructure and professional communities via a per-service fee. To ensure the Center's logistical operations are met, the use of co-op students from the various department programs, paired with MITACS funding, could lead to the addition of needed staff to increase revenue.

Role in University's vision, etc.

Members of the administration indicated a desire for the department to be more engaged and visible within the institution. This was one of the few places where there was a mismatch between comments from administration and comments from faculty members; faculty members indicated that they felt they were not viewed as an integral part of the university's success.

The lack of signage in the campus buildings is a substantial detriment to student awareness of the department and associated degrees. See VS-1.

Greater faculty member visibility within the university would enhance the department's reputation within the University of Regina. Activities such as Senate and Senate committees allow idea exchanges and the promotion of the value of fundamental research. More specific activities such as research talks aimed at a general university audience would help promote awareness of the research and funding that is occurring in the department. See VS-2.

Recommendations

VS-1 The lack of signage within the buildings makes it very difficult to find offices of the Mathematics and Statistics faculty. This also indicates a lack of support by the institution for the department.

VS-2 Increase departmental visibility by increasing membership on high profile Senate committees and participating in research talks aimed at a general university audience.

Summary of Recommendations

This is a compilation of all recommendations discussed in this document.

UG-1 The calendar entry for mathematics, and other appropriate places, should make it clear that there is a common core of courses for all of the degrees.

UG-2 Work with the Faculty of Education to promote the Mathematics and Mathematics Education 5 year degree.

UG-3 Review enrolment in the Mathematics and Computer Science degree in 5 years to determine the impact of the Data Science degree.

UG-4 The pandemic has lead to a loss of a sense of community for the overall student body. Social events every semester hosted by faculty members will help facilitate the re-creation of a sense of student community that supports a long-term commitment to the department and the university.

UG-5 Any restructuring of degrees should take into account what information can be included on the University Parchment. Students want the Parchment to represent the focus of their degree. The External Review Team believes that Concentrations can be included on parchment but that there are other labels which cannot be included.

UG-6 The department, with the support of the university, should develop a promotion and advertizing campaign to support the undergraduate Actuarial Science degree.

UG-7 Review all cross-listed courses and ensure that titles match. Where possible, the numbers should match. This applies across the ASCS, MATH, and STAT labels and across 4XX to 8XX numbers.

UG-8 Merge the Combined Major in Statistics and Economics and the Applied Mathematics and Statistics into the Major in Statistics. Then introduce Concentrations within the Statistics degree.

UG-9 Recruit students to the Actuarial Science degree from communities of similar size to Regina where local universities do not have the degree.

UG-10 Develop a fourth year undergraduate research course. Rearrange some content in 3rd and 4th year courses to include scientific computing components. Require additional Computer Science courses in certain majors.

UG-11 The Head of the department can strike a committee between mathematics and statistics faculty usually teaching courses to the engineering program and the Undergraduate Curriculum Committee in Engineering. The aim: produce a maintainable, yearly updated examples bank for any mathematics and statistics instructors who teach engineering students.

UG-12 The development of the fourth year project course (as above) will reinforce the experiential learning and will provide students with more employable transcripts.

UG-13 Organize a yearly (one semester) 4th year seminar with department and Federated Colleges undergraduates. This will foster mutual collaboration and help recruit/retain talented Indigeneous students in graduate programs.

GR-1 Revise the graduate entrance requirement to: "The entrance requirement for the MSc program is at least a ~~BSc~~ minor degree in mathematics or statistics, with a grade average of at least 75%. Applicants to the PhD program should have an MSc degree or its equivalent, and show strong evidence of research potential."

GR-2 Revise the course-based MSc so that it can be completed within 16 months.

GR-3 Revise some 800 level graduate course descriptions so that they are more attractive to students who are not destined for research careers.

GR-4 Review the naming and description of the 800 level Topics courses.

GR-5 In order to bring in needed applied mathematics content, leverage teaching resources outside the department by having courses co-taught with faculty in Computer Science, Engineering, or most easily, the Federated Colleges.

GR-6 Ensure all senior undergraduates know about the full range of NSERC graduate scholarships in time for them to apply.

GR-7 Work towards guaranteed minimal funding for PhD students. Some of this will be from individual faculty members but much of this will need to be from the department or university.

GR-8 Introduce regular social activities for students in the department where faculty interact with the students and discuss the social and cultural aspects of being a mathematician or statistician.

GR-9 Introduce a course-based masters Degree Supervisor or Coordinator. This person will likely be different than the student's essay supervisor.

GR-10 Ensure the department faculty and graduate students participate in the creation and facilitation of knowledge translation microcredentials (such as certificates and diplomas) that may be developed at university level through the School of Graduate Studies.

GR-11 The department and graduate faculty should make strong efforts to ensure their graduate HQP is applying for travel funding at national and regional conferences, as well as at summer schools, in Canada, US, EU etc. With decreased success rates in NSERC Discovery grants, the Faculty and university must increase their funding travel awards for graduate HQP and PDF to allow for their trainees to connect and be part of the wider research community. Graduate HQP who are members of IEDI communities should be advised to participate in Canada-wide committees and outreach events, bringing their excellent regional experience forward.

RS-1 Initiate funding proposals for a new Data Lab and data Lab staff salaries via the NSERC RTI and CFI programs. These initiatives should be built on the Mathematics and Statistics and the Computer Science Department collaboration.

RS-2 The department should expand the Statistics Consulting Center to the wider university community, as well as to the municipal, infrastructure and professional communities via a per-service fee.

RS-3 Faculty in both Mathematics and Statistics should be encouraged to participate as co-applicants in university-wide grant initiatives. The Head should reach out and advertise the collaborative opportunities of faculty in the wider university community.

RS-4 The Head should explore 1-1 collaborative opportunities with: Perimeter, Vector and AARMS Institutes.

RS-5 The Faculty and the Dean of Science should hire a Research Manager which in turn can help all departments (Mathematics and Statistics included) strategize their grant applications and research funding opportunities, and help coordinate larger, multidisciplinary grants.

RS-6 Encourage Indigenous students connect with First Nations University to apply for NSERC USRA.

RS-7 Determine what is restricting ease of access for faculty and students to the data available through the Regina Research Data Centre.

STF-1 All new positions should be considered with respect to balancing the distribution of Associate and Assistant Professor positions.

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