Mathematics
Final Assessment Report

Faculty / Affiliated University College	Faculty of Science
Degrees Offered	Bachelor of Science (BSc)
Modules Reviewed	Honors Specialization in Mathematics Honors Specialization in Mathematical Sciences Honors Specialization in Mathematics In Society Honors Specialization in Integrated Science With Mathematics Specialization in Mathematics Specialization in Mathematics In Society Major in Mathematics Minor in Mathematics
External Consultants	Dr. James Mingo, Professor and Department Head of Mathematics and Statistics, Queen's University Dr. Robert Woodrow, Professor and Department Head of Mathematics and Pure Mathematics, University of Calgary
Internal Reviewers	Dr. John Cuciurean, Associate Professor and Associate Dean (Undergraduate Admissions and Programs), Don Wright Faculty of Music, Western University
Date of Site Visit	March 3, 2017
Evaluation	Good Quality
Approval Dates	SUPR-U: June 7, 2017 SCAPA: September 13, 2017 Senate: September 22, 2017

Executive Summary

On Friday March 3, 2017, the review team met with the Vice Provost (Academic) John Doerksen, a scheduled meeting with the Vice Provost (Academic Planning, Programs, and Faculty) Karen Campbell was canceled due to an unforeseen scheduling conflict, Faculty of Science Associate Dean (Academic) Jeff Hutter, Associate Chief Librarian Jennifer Robinson, Research & Instructional Services Librarian Roxanne Isard, Chair of the Mathematics Department Rick Jardine, Associate Chair of Mathematics (Undergraduate) David Riley, Mathematics Program Advisor (Undergraduate) Adriana Dimova, Human Resources Assistant (Mathematics) Jane Bai, as well as several faculty members and undergraduate students from the department.

The reviewers concluded that the program "is consistent with Western's mission to offer high quality programming that develops skills in critical reasoning, independent learning, and the science of information. The program does conform to the requirements and associated learning outcomes of the undergraduate degree level expectations."

Nonetheless, the reviewers did "offer some suggestions to the department to consider as the program evolves in light of the formation of the School of Mathematics and Statistics." The reviewers noted that

"they are not intended as criticisms of a good program, but possibilities to improve the program and increase its utility for students," to which the Department responded to all recommendations and concerns indicating that they have given serious consideration to the report and its recommendations. These suggestions (and where appropriate, some explanatory information from the Department) are summarized below under "Suggestions for Improvement & Enhancement."

As stated in the summary response to the external reviewers report by Associate Dean, Jeff Hutter, the reviewers "noted several program strengths, and concluded that the students are ensured a 'high quality experience.' They viewed the Department as being 'adequately resourced.' They also commented on a mix of traditional course delivery, along with more innovative methods such as class presentations and the use of video conferencing with participants at other locations." These are summarized below under "Significant Strengths of the Program."

In his response to the external report, the Associate Dean commented on some of the recommendations made by the reviewers, particularly on issues that can be facilitated at the faculty level. "The reviewers noted that the minimum enrolment threshold required by the Faculty for a course to be offered made it difficult for a Department with low program enrolment to offer a wide breadth of courses at the third-year level. This has indeed been an issue, though in recent years, that requirement has been waived for critical third-year courses. It is my hope that the amalgamation of the Department into the School of Mathematical and Statistical Sciences will increase the breadth of courses available for Mathematics students and attract students from other programs into their courses."

The reviewers were concerned that "mathematically gifted students were being disadvantaged by the current admission process, perhaps by a weighting tilted in favour of the business and medical school." The Associate Dean countered by indicating that "I do not believe this to be the case – the HBA program is not entered until third year, and students interested in the BMSc program require both a higher admission average and a more constrained set of high-school courses than do students who wish to come to Western to study math."

Furthermore, the Associate Dean's response shared the reviewer's concern about the low number of students attracted into Mathematics programs, noting that "it is likely that the proposed School of Mathematical and Statistical Sciences will make it easier for students to tailor their program for a variety of career paths by making it easier for them to take courses from Applied Mathematics and Statistical & Actuarial Sciences."

Lastly, the reviewers called for the availability of more research experiences, in addition to the existing summer placements through the NSERC USRA program. The Associate Dean's response concurred, indicating that this "could improve both recruitment into the program and the training of students, but is somewhat reliant on the financial and supervisory capacities of the researchers in the Department." The reviewers also "floated the idea of having a 'capstone experience' for the students." The Associate Dean's response stated that "[a]s pointed out in the departmental response, this would likely take the form of project courses, which are currently available, but not required, for students in the program."

Significant Strengths of the Program

1. Honours specialization in Mathematics represents a very strong classical offering in Algebra and Analysis, with some opportunities for special interest in Topology and topics such as cryptography, number theory, combinatorial mathematics, Discrete optimization and Game theory … The classical methods of assessment that characterize the current offerings is consistent with that of other high quality institutions.

2. A mix of more traditional modes of delivery involving lectures with assessment by assignments, quizzes and examinations, combined with having the students work on aspects of the material which they then present to the class. This mode of presentation does ensure assessment of development of oral communication skills, and also provides a window into understanding.

3. The use of smart board technology to enable professors to offer a course to a group *in situ*, with other participants from other parts of the country, and even in Europe. This offers the possibility of using the expertise present at Western and sharing it with other major institutions.

4. It was evident that students have access to high quality instructors who engage with them to ensure a high quality experience.

5. There are two students per year engaged as NSERC undergraduate student research scholars, providing an excellent and active learning opportunity.

6. The Department has a good number of high quality personnel active in research and engaged in their students' learning with significant strength in areas of modern algebra and analysis, which is reflected in the very classical nature of the degree offerings.

7. The library and information technology support a quality undergraduate program.

8. The Department "is adequately resourced for provision of the program.

9. The Department has space available as a common room for undergraduate mathematics scholars, an enrichment program involving presentations with pizza at lunchtime, and recently implemented a more formal system of mentoring its undergraduates.

Suggestions for Improvement & Enhancement

1. An increase in instruction of probability at all levels as well as a required computer science course. The Department agrees that "probability theory is an important and growing area with many interesting applications" and went on to list which existing courses met this recommendation and how students were counselled to take these courses. The Department's position is "that requiring (instead of merely recommending) too many specific courses in a module unnecessarily restricts a student's academic choice and, hence, may potentially impede their chosen career path." The Department also addressed the inclusion of a Computer Science course by listing which existing courses met this recommendation and how students were counselled to take these courses.

2. Programs have relatively small enrollment, thus some students have difficulty with the breadth of selection of courses at the third year level. The Department responded by indicating that they agreed, with the qualification that "enrolment minimums make it a constant challenge to offer a sufficiently broad selection of courses to undergraduate students studying Mathematics, especially at the 3rd year level."

3. Concerning the strength #5 listed above, it was noted that the Department could probably support more undergraduate student research that many students find attractive, particularly if they wish to gain research experience for entry into graduate school. The Department agreed noting that "there is a local grant resources problem which usually prevents the Department from taking on more than two USRA students per year, but members of the Department consistently attract very high quality participants from across Canada."

4. In spite of having a common meeting room, there was no particular "sense of belonging" to the program. Students also expressed a desire for a time set aside for undergraduate conference talks. The Department responded by indicating that "the idea of an undergraduate conference under the proviso of the new School of Mathematical and Statistical Sciences makes good sense, and will be implemented."

5. There was general concern to raise the numbers of students in the program and that there is a perception that the students are drawn toward larger programs. The Department was in full agreement with this observation.

6. The reviewers noted that the current move to form a School of Mathematics and Statistics offers an opportunity for the programs to evolve. Closer collaboration with the other programs could also improve opportunities for their students by accessing the excellent development in algebra and analysis afforded the current mathematics students such as mathematical finance and medical imaging as areas involving high level mathematics (stochastic calculus, transform theory, and compressed sensing) as well as data science which has connections to probability theory, graph theory, and asymptotic analysis. The Department agreed.

7. A “capstone experience” for students which could include group work on projects and presentations, addressing a clearer connection with ensuring the “soft skills” that form part of the degree level outcomes. Finding some way to consider questions of ethics and the responsibilities of mathematicians to society might also be facilitated. The Department agrees that the “capstone experience” would “likely take the form of a projects course, and a framework for it already exists [in the current course offerings] in the Calendar. This issue will become a matter of discussion in connection with a general program review to be conducted by the School of Mathematical and Statistical Sciences.”

Recommendations Required for Program Sustainability

Recommendation	Responsibility		
With the development of the new School of Mathematical and Statistical Sciences, look for opportunities to enhance curricular offerings and access courses across the School to address suggestions for improvement (especially #1, 2, 4, 6, and 7)	Department, Director of School of Mathematical and Statistical Sciences		