Final Assessment Report

Mathematics/Information Technology Management (BMath), Mathematics/Business Administration (BMath), Business Administration and Mathematics (BBA/BMath) (Double Degree with WLU), Mathematics/Chartered Professional Accountancy (BMath), Mathematics/Financial Analysis and Risk Management (BMath), Mathematical Economics (BMath)

November 2024

Executive Summary

External reviewers found that the Information Technology Management (BMath), Mathematics/Business Administration (BMath), Business Administration and Mathematics (BBA/BMath) (Double Degree with WLU), Mathematics/Chartered Professional Accountancy (BMath), Mathematics/Financial Analysis and Risk Management (BMath), and Mathematical Economics (BMath) programs delivered by the Mathematics Business and Accounting Programs (MBAP) Unit were in good standing.

"The Co-op component of the programs is unique and creative. Significant efforts are placed in online delivery of the programs. Running of the programs jointly with Laurier University provides the necessary flexibility and diversity in course offerings and expertise... The accreditation received from two international professional organizations suggests that professional standards are being maintained and it is also reflective of the good performance of the programs at national and international levels."

Effective May 1, 2023 the administration of Math/CPA and Math/FARM moved to the Department of Statistics and Actuarial Science.

A total of four recommendations were provided by the reviewers, regarding administration, curriculum, teaching capacity, and co-op. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2029-2030.

Enrollment over the past three years

	Math/IT Mgmt. (BMath)	Math/Bus. (BMath)	Bus./Math (BBA/BMath) Double Degree	Math/CPA (BMath)	Math/FARM (BMath) *(All Specializations included)*	Math/Eco. (BMath)
2024-2025 (CURRENT YR)	28	139	366	113	808	19
2024-2024 (LAST YR)	27	179	384	129	879	15
2022-2023 (THREE YRS)	29	178	472	162	960	22

*Based on Active Student extract from Quest on November 15, 2024.

Background

In accordance with the University of Waterloo's Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Information Technology Management (BMath), Mathematics/Business Administration (BMath), Business Administration and Mathematics (BBA/BMath) (Double Degree with WLU), Mathematics/Chartered Professional Accountancy (BMath), Mathematics/Financial Analysis and Risk Management (BMath), and Mathematical Economics (BMath) programs delivered by the Mathematics Business and Accounting Programs (MBAP) Unit and Department of Statistics and Actuarial Science. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic on June 27, 2023. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the data collected from a student survey, along with the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the program(s) were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academic: Professor George Yanev, School of Mathematical and Statistical Sciences, University of Texas Rio Grande Valley; and Professor Balakrishan Narayanaswamy, Department of Mathematics and Statistics, McMaster University.

Reviewers appraised the self-study documentation and conducted a site visit to the University on November 27 – December 1, 2023. An internal reviewer from the University of Waterloo, Professor Michael Dixon, Department of Psychology, was selected to accompany the external reviewers. The visit included interviews with the Associate Vice-President, Academic; Dean of the Faculty of Mathematics; Faculty Associate Dean of Undergraduate Studies; Director of the Math and Business Accounting MBAP) Unit; Chair of the Department of Statistics and Actuarial Science; Directors of the different programs; as well as faculty members, staff and current undergraduate

students. The Review Team also had an opportunity to conduct a virtual tour of the facilities and meet with representatives from the library, and Co-operative Education.

Following the site visit, the external reviewers submitted a report on their findings, with recommendations. Subsequently, the program responded to each recommendation and outlined a plan for implementation of the recommendations. Finally, the Dean responded to the external reviewers' recommendations, and endorsed the plans outlined by the program.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report, the program response and the Dean's response.

Program Characteristics

Mathematics/Information Technology Management

The Information Technology plan (regular and co-op) was available for the first time in 2008 for the Mathematics/Business students to select the program in second year. The program as a second-year entry plan focuses on the application of computers to difficult business issues. Students receive a strong and broad-based education in mathematics, business, and information technology.

Mathematics/Business Administration

The Business Administration Option was available for the first time in 1972, to those students enrolled in the Co-operative Mathematics Program and who wanted to combine a minor in Business Administration with their mathematics program. The option moved to the Mathematics/Business Administration degree program (regular and co-op) in 1983. The Business Administration courses in the program are given by professors in the Lazaridis School of Business and Economics at Wilfrid Laurier University.

Mathematics and Business Administration Double Degree (BBA/BMath)

The BBA/BMath Double Degree program was created in 2001 as a direct entry program – meaning that students are admitted into the program in their first year of studies. The program is co-op only and is administrated jointly with Wilfrid Laurier University. The home of the program is the Faculty of Mathematics, Mathematics Business and Accounting Programs (MBAP) at Waterloo and the Lazaridis School of Business & Economics at Laurier.

Mathematics/Chartered Professional Accountancy

The Chartered Accountancy Option was available for the first time in 1970, when it became possible for students enrolled in the Co-operative Mathematics Program to choose their non-mathematics elective courses in such a manner that they may be able to write their final

chartered accountancy examinations within a few months of graduation. Today the Math/CPA co-op program is a direct entry co-op program offered by the Faculty of Mathematics, in co-operation with the School of Accounting and Finance. This program combines mathematics with accounting and business-related disciplines while giving students the opportunity to gain up to 16 months of CPA-approved work-experience through co-op work terms.

Mathematics/Financial Analysis and Risk Management (FARM)

The FARM program was created in 2008 as a direct entry program meaning that students are admitted into the program in first-year studies. About 70% of the students enrolled in the Program are in the co-op program. The home of the program is the Dean's Office and it is managed by the MBAP unit. The program has a strong quantitative flavour and is intended for students interested in a career in Financial Analysis or Risk Management. Starting in the third year, FARM students choose one of the following specializations: Financial Analysis that helps students prepare for the highly desirable Chartered Financial Analyst (CFA) designation, administered by the Chartered Financial Analyst Institute (CFAI), and Risk Management specialization that prepare the students for the popular Professional Risk Management (PRM) designation offered through the Professional Risk Managers' International Association (PRMIA). Some of the Economics and Accounting courses required for this plan are given by professors in the Faculty of Arts Department of Economics.

The following specializations are offered:

- Chartered Financial Analyst Specialization
- Professional Risk Management Specialization

Mathematical Economics

This program is jointly offered by the Faculty of Mathematics and the Department of Economics in the Faculty of Arts. The program was available in both regular and co-op forms for the first time in 2010. The Mathematical Economics as a second-year entry program is designed to be excellent preparation for graduate school either in economics or various areas of mathematics and statistics. Students who take Math Econ get exposed to economic theory like industrial organization, game theory, Welfare Economics, Information Economics (in Microeconomics), public policy, monetary economics, Development Economics (in Macro) and a lot more. All of these need substantial math knowledge (for the theory) and statistics (for analyzing data). This is the reason why students with a strong interest in economics and economic theory find this program very rewarding.

Summary of Strengths, Challenges and Weaknesses based on Self-Study

Strengths

- Math Business and Accounting programs have a long history with many successful graduates and continue to be in high demand, drawing a consistent number of student applications from across Canada and around the globe.
- The programs have some of the best high school graduates with strong intake averages. Almost all of our students feel passionate about their program and are strong advocates for the programs. The students are generally happy with their coop placements. Honours Math degree combined with business, finance and accounting makes this a unique program, both in Canada and the US. Students take traditional math courses at an honours level from the only math faculty in North America, plus math courses applied to business settings (e.g., MATBUS 470/471/472, ACTSC 371/372; STAT 371/372, CO 370/372/454).
- The program is cost effective from a student perspective (tuition fees reasonable compared to other business programs). The Math/CPA students are exempt from the CPA Professional Education Program upon completion of the 8-month Masters of Accounting (MAcc) program at Waterloo. Math/FARM-PRM specialization students are eligible for exemption from PRMIA Professional Risk Manager (PRM™) Exams I and II.
- Under pressure from the CPA firms, the CPA profession is currently modifying its course requirements to force all CPA students to complete courses in data science and data analytics. Fortunately, the UW Math faculty is well positioned to take advantage of this change. We have modified the math component of the Math/CPA program which will make the program significantly more attractive to both students and employers.
- The Math Business and Accounting programs provide flexibility for students in terms of job applicability; students can apply for jobs in all the functional areas of business (finance, marketing, accounting, HR, IT, etc.,).

Challenges

- Administration of programs shared between universities is a challenge. Coordination of the programs across the two universities (Waterloo and WLU), the UW School of Accounting and Finance and five departments requires frequent communication.

While relations have been good, different priorities exist at institutions and departments.

- The BBA/BMath Double Degree program administration in terms of scheduling and students' reconciliations is a challenge. There is currently very little coordination between the scheduling systems of the two universities to ensure that course and exam schedules are conflict-free for the BBA/BMath students. The Director of MBAP is solely responsible for all these areas. A particular concern is the misalignment of calendar dates around holidays which are not the same at both universities. Improved compatibility of the registration systems (Loris & Quest) would increase student satisfaction by improving the quality and speed of processes.
- There has been a decrease in the number of applicants entering the Math/Chartered Professional Accountancy (CPA) program. Students interested in pursuing CPA might be exploring alternative pathways that offer more flexibility or quicker entry into the workforce. We need to ensure that Math/CPA continues to meet the evolving goals, objectives, and standards of both the Faculty of Mathematics and the School of Accounting and Finance.
- Another challenge of the MBAP programs continues to be their enormous success. The programs have been successful in building buzz amongst parents and influencers in the lives of applicants. This means that some students apply for and accept this program even though they have no interest in the business component of the programs. These students face academic rigor over and above what is required to succeed in the programs. Some of the MATH/BBA Double Degree students change their program to a single degree after they have lost interest in one of the degrees.

Weaknesses

- A weakness of the program is that students lack professional competence to promote or comfortable defend their position in a group of peers. That said, only a small fraction of our students has developed these abilities by graduation. One reason is that the programs do not support this sort of learning. The Faculty offers two communications courses required for the programs but classes in business communications (oral and written) as well as building professional habits amongst the students would help to improve the programs. There are not many social programs for the students enrolled in the programs.

- Admissions to the BBA/BMath Double Degree program. Because each school admits students to the program, there have been discrepancies between the two admissions policies. We are working together each year to minimize the discrepancies.
- The Math/BBA Double degree students have only four free choice electives during their study and are not therefore able to pursue many of the Waterloo majors and/or WLU concentrations without taking additional academic terms.
- Only UW-based students can participate in the Waterloo co-op system and vice-versa for WLU-based students. In general, Waterloo has stronger co-op opportunities in math/CS and Laurier has stronger opportunities in business and finance. This has been a source of frustration for students who may want to pursue co-op postings in both areas. A three-year pilot co-op exchange started in 2017 allowing students at one university to enroll in the other's co-op system for a term. Unfortunately, the exchange was pretty unbalanced, and we had more WLU students each semester who have participated in the coop exchange. That was a concern about opening it up further meaning much more work on Waterloo side than on WLU's. Allowing more robust exchange of co-ops would be desirable.

Summary of Key Findings from the External Reviewers

"The distinctive attributes are common for all programs and include:

i. Co-op component of the programs gives valuable work/practical experience to the students.
ii. The choice of courses from two universities (UW and WLU) and different programs/departments offers excellent opportunities and great flexibility to the students to enhance their knowledge and skills.
iii. Excellent computing facilities as well as computer science-oriented courses are available for students to take advantage of.
iv. The training in both mathematics and business/management prepares the students to get exposed to both disciplines and increases the job opportunities upon graduation…

We feel that the administration should hire suitably qualified people to teach the core courses… While 70% of Math Business students participate in Co-op program, it will be preferable for the administrative staff to maintain a good balance between the needs and interests of the students and the employers."

Program Response to External Reviewers' Recommendations

1. **Administrative Structural Changes and their Effectiveness:** Effective 1 May 2023 the administration of Math/CPA and Math/FARM moved to the Department of Statistics and Actuarial Science. This change in the administrative structure is an attempt to address a recommendation in the previous external review of the Mathematics Business programs. A Program Committee within the Department of Statistics and Actuarial Science oversees these two programs. Clearly, it is too soon to assess the impact of this change to the Math/CPA and Math/FARM programs as well as to the coordination of all Mathematics Business programs. Since many of the changes implemented are recent, it is impossible to evaluate their effects at this time. Therefore, we strongly recommend another review in two-three-year time-period should be conducted.

   Program Response
   A Program Committee has been formed within the Department of Statistics and Actuarial Science to oversee these two programs. The committee is empowered to move program changes for vote at department meetings. The current directors of these two programs continue in their respective role and their appointment is held in Statistics and Actuarial Science (SAS) Department. The SAS Department has also hired a staff advisor to benefit the FARM program by providing expert guidance, support, and mentorship to the students. To evaluate the effectiveness, efficiency, and impact of these particular programs' move to the SAS Department, the Faculty will conduct an internal program review and prepare a report summarizing the evaluation findings, conclusions, and recommendations.

   Dean's Response
   Indeed, we have asked a faculty member from SAS with extensive program administration to initiate the internal review mentioned in this recommendation.

2. **Curriculum Review:** The students need more help in improving their interpersonal communication skills. The class activities must include more opportunities for the students, for instance to give in-class individual presentations based on group projects. The current approach in developing "soft skills" is too holistic focusing on English writing courses. We recommend that a better approach be adopted towards developing "soft skills" of the students along the lines of practices used by Laurier University. In addition, our recommendation is to introduce more industry relevant software training, e.g., Python and Panda, starting in the first year.

   Program Response
   The Faculty of Mathematics places a particular emphasis on the development of strong communication skills that are essential to academic, professional, and personal success. All Math students are currently expected to successfully complete two communication courses

as a part of their degree requirement. All students take a communications course in their first term of study except for double degree and Math/CPA students who take it in their second term of study. Many students in Math Business Programs take COMM 223 -Public Speaking as their first communications course. This workshop course involves design and delivery of various kinds of speeches, and the development of organizational, vocal, listening, and critical skills. The BBA/BMath Double Degree students must complete the Laurier course BUS362W - Applied Marketing as their second required communications course. Through the use of cases and experiential exercises in this course, students develop the analytical and communication skills necessary in effective product, services and brand marketing strategy.

We agree that the modern workplace requires a lot of "soft skills", teamwork and collaboration, but students are not typically given instruction in how to do teamwork effectively. To Improve Math Students' Teamwork Skills there is a 3-year pilot program of the Math Strategic Plan Implementation Working Group approved by the Dean. According to the proposal, the following experiential modules on Teamwork will be integrated to the Math context and made available to Math instructors:

- Introduction to Team Membership
- Team Communication
- Introduction to Team Conflict Management
- Giving and Receiving Feedback
- Conflict Resolution
- Team Health Assessment

We believe some (or all) of these six modules on Teamwork could fairly easily be adapted to the Math context by the Faculty of Mathematics, the Student Success Office, and the Centre for Teaching Excellence and made available to Math instructors who have group projects to use. We also believe that these modules could be more fully integrated, through Math/CS core courses having each module attached to a different term of study.

The recommendation also suggests adopting Laurier's approach to soft skills development. Given that our programs already incorporate structured communications training, including public speaking, public communication and interpersonal communication, we believe our approach is aligned with best practices. However, we recognize the value of further embedding interpersonal communication skills into coursework and will explore additional in-class opportunities, such as individual presentations within group projects, to enhance students' engagement in verbal communication.

To address this, we will focus on the following areas in courses, particularly in COMM and MATBUS courses, that involve group project, presentations or problem-solving:

- Individual Presentations in Group Projects: Students will present their work clearly to the class justifying their choice using logical arguments and real-world examples.

- Peer Feedback: After presentations, students will give and receive feedback to improve communication and critical thinking skills.
- Small-Group Discussions: Expanding group discussions to help students articulate and explain ideas more effectively.

Dean's Response

The response is appropriately mentioning existing resources to address those recommendations.

3. **Teaching Capacity:** Core courses (e.g., commerce, taxation for FARM and investment for CPA) have been taught by a few faculty members. This is a vulnerability that needs to be addressed as soon as possible by providing the necessary teaching capacity (instructor's backup) for any contingency (e.g. retirement). Our recommendation is for the administration to hire suitably qualified people to teach the core courses listed above rather than hiring only when somebody retires. It will also be good to establish close collaboration with Faculty of Arts, so that coordination between courses offered by the different faculties can be achieved.

   Program Response

   It is true that the SAS Department needs to develop a succession plan to ensure continuity in course delivery for COMM courses. There are currently no potential expert faculty members in the department who can take over these courses in case of faculty turnover or changes in availability. We may consider hiring a DTL instructor to teach these specific courses or fill temporary gaps in faculty availability in the UW School of Accounting and Finance.

   Dean's Response

   The SAS department has since then been actively exploring leveraging one of the teaching stream professors originally hired into the Mathematics Business group to take over some of these courses. They are providing adequate resources to support this transition. Nevertheless, we encourage the continued exploration of partnering with the School of Accounting and Finance to help support these courses, as it is not robust to rely on one person.

4. **Co-op Administrative Issues:** While 70% of Math Business students participate in Co-op program, we recommend that the administrative staff try to maintain a good balance between the needs and interests of the students and the employers. We also recommend that a better application and recruitment on-line system be developed for the benefit of all concerned.

   Program Response

Co-operative and Experiential Education (CEE) continues to review and update processes and resources to better facilitate the recruitment and employment process for both students and employers. The goal is to strike a balance that meets the needs of all stakeholders and recognize that we have work to do communicating and demonstrating a student centric approach. CEE has recently made changes the co-op process based on student feedback and have pilot projects exploring an enhanced student support model.

- New student support model: Students are now paired with a consistent, faculty-aligned co-op advisor throughout their co-op degree.
- Employer-Student Direct Job board: Available on WaterlooWorks, this board features pre-approved co-op positions outside the traditional rank/match process, giving students more opportunities and flexibility in their job search.
- Streamlined Pathway for Full-Cycle Service: A new process allows students to remove themselves from Full-Cycle Service job board applications and interviews after securing their own job or employment through the Employer-Student Direct job board.
- Enhanced Accommodation Support: A simplified process for accommodation support, along with the hiring of a Co-op Student Experience Manager focused on Equity, Diversity, Inclusion, Anti-Racism, and Indigenous Relations.

<u>Additional recent changes:</u>

- The search and apply processes and overall functionality have been updated after consultations with students. Updates will continue based on ongoing feedback.
- AI Project: The JADA (Job Aggregator Digital Assistance) Project is being tested with current students. It is a additional tool to get more jobs in front of students.

CEE will continue to solicit student feedback through various channels, including the co-op student experience survey, student/co-op advisor consultations, co-op student council, CEE's student equity advisory and student societies to ensure that student voices are heard and opportunities to enhance the experiences of our students are constantly explored.

Dean's Response

This recommendation has been correctly redirected to our Associate Dean Co-op.

Recommendations Not Selected for Implementation

N/A

Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	Administrative Structural Changes and their Effectiveness	There will be an internal review specifically focused on the move of the two academic programs to the SAS Department to assess the effectiveness of the move, identify any areas for improvement and make adjustments as necessary to ensure the ongoing success of the programs.	Dean's Office, Chair of the SAS Department, FARM and Math/CPA Programs Directors, Director of MBAP	2025/2026
2.	Curriculum Review	Based on the success of the pilot project, we will consider scaling up the integration of experiential modules on teamwork across additional courses within the Math Faculty.	Office of Associate Dean Undergraduate Studies, Michael Liu, Implementation lead	2025/2026 – in progress
3.	Teaching Capacity	SAS Department will develop a succession plan to ensure continuity in course delivery for COMM courses.	Dean's Office, Chair of SAS Department, Director of MBAP	2025/2026
4.	Co-op Administrative Issues	Co-operative and Experiential Education (CEE) will continue their review and update processes and resources to better facilitate the recruitment and employment process for both students and employers. CEE has also pilot projects exploring an enhanced student support model.	Co-operative and Experiential Education (CEE)	2025/2026

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for the Implementation Plan.

Date of next program review **2029-2030**

Date

Signatures of Approval

Please keep this document in Word version. We do require you to sign it or demonstrate your approval. If you have issues with signing a Word document, please confirm your approval by adding the following wording when you send back the document by email "I hereby approve the attached document." We will collect formal signatures at a later stage on a pdf version.

Jan 31, 2025

Chair/Director Date

AFIW Administrative Dean/Head (*For AFIW programs only*) Date

Faculty Dean Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

Jan. 15, 2025

Associate Vice-President, Academic Date
(For undergraduate and augmented programs)