

UTQAP Cyclical Review: Final Assessment Report and Implementation Plan

1. Review Summary

Program(s) Reviewed:	<ul style="list-style-type: none"> • Computer Science, HBSc: Specialist and Specialist Co-op; Major and Major Co-op; Minor • Mathematics, HBSc: Specialist and Specialist Co-op; Major and Major Co-op • Statistics, HBSc: Specialist and Specialist Co-op; Major and Major Co-op; Minor • Applied Statistics: Minor (Science)
Division/Unit Reviewed or Division/Unit Offering Program(s):	Department of Computer and Mathematical Sciences University of Toronto Scarborough
Commissioning Officer:	Vice-Principal (Academic) & Dean University of Toronto Scarborough
Reviewers (Name, Affiliation):	<p>Professor Anne Condon, Department of Computer Science, University of British Columbia</p> <p>Professor Richard A. Davis, Department of Statistics, Columbia University</p> <p>Professor Craig Evans, Department of Mathematics, University of California, Berkeley</p>
Date of Review Visit:	February 20-21, 2020
Date Reported to AP&P:	October 27, 2020

Previous UTQAP Review

Date: November 10-12, 2011

Summary of Findings and Recommendations

Significant program strengths:

- High level of faculty research activity
- Well thought out programs
- Faculty dedication to student learning

Opportunities for program improvement and enhancement:

- Increasing the emphasis on mathematical and scientific communication in all programs
- Increasing the number of upper-level courses available to students
- Allowing greater flexibility in course selection in the computer science program
- Creating one or more additional streams in the statistics program to respond to student demand and capitalize on the department's unique strengths
- Enhancing the co-op option and opportunities for student research and engagement outside the classroom

Current Review: Documentation and Consultation

Documentation Provided to Reviewers

1. About the University and UTSC: UTSC Strategic Plan (2014/15 – 2018/19); UTSC Academic Plan (2015-20); UTSC Admissions Viewbook (2020-21).
2. About the Review: Terms of Reference; Review Report Template; Site Visit Schedule.
3. About the Department: Previous External Review Report (2011); Previous External Review Final Assessment Report; Unit Academic Plan, April 2015; Unit Self Study, February 2020.
4. About Programs and Courses: Description of all programs (2019-20 Academic Calendar); and description of all courses (2019-20 Academic Calendar); Course Enrolments from 2008 to 2019.
5. Course Syllabi (all courses).
6. Faculty CVs (all faculty).

Consultation Process

The reviewers met with the following: the decanal group, including the Vice-Principal Academic and Dean, Vice-Dean Faculty Affairs and Equity, Vice-Dean Undergraduate, Vice-Dean Graduate,

Assistant Dean Academic, and Academic Programs Officer; the Vice-Principal Research; the Chair of the Department of Computer and Mathematical Sciences; Associate Chairs and Program Supervisors; Computer Science faculty – tenure- and teaching-stream; Mathematics faculty – tenure- and teaching-stream; Statistics faculty – tenure and teaching-stream; the Director and staff from the Arts & Science Co-op Office; departmental administrative staff; and undergraduate students.

Current Review: Findings and Recommendations

1. Undergraduate Program

Unless otherwise noted, all bulleted comments apply to all programs reviewed.

The reviewers observed the following **strengths**:

- Overall quality
 - ▶ Impressive, high-functioning unit despite the combination of three different disciplines in a single department
 - ▶ Collaboration among disciplines is a strength that benefits the campus
 - ▶ Program goals well aligned with UTSC's goals of promoting academic excellence and supporting both domestic and international students
 - ▶ Attractive Co-op program is positively perceived by both faculty and students
- Curriculum and program delivery
 - ▶ Well-designed program requirements often align with recommendations or curriculum guidelines from professional associations in each discipline
 - ▶ Programs offer strong breadth of coverage and significant depth in key areas
 - ▶ Some research opportunities exist for students, either through supervised study courses or through summer experiences at the St. George campus
 - ▶ Computer Science course content and delivery modes are frequently updated
- Innovation
 - ▶ New double degree program in Management & Finance (BBA) and Statistics — Quantitative Finance Stream (BSc), “the first of its kind” at the University, is a positive development
 - ▶ Considerable growth in popularity of the Specialist in Statistics — Statistical Machine Learning and Data Science stream
- Assessment of learning
 - ▶ Use of exams as primary method of assessment in many courses is appropriate to ensure fairness and manage instructor workload
- Student engagement, experience and program support services
 - ▶ Student associations offer valuable extra-curricular experiences; annual Hackathon event provides significant recruitment opportunity
 - ▶ Students are generally quite satisfied with their respective programs
 - ▶ Strong comradery among students across disciplinary boundaries

The reviewers identified the following **areas of concern**:

- Admissions requirements
 - ▶ Extremely competitive admission process for entry into Computer Science programs is “a major problem,” causing high levels of student stress and a heavy focus on achieving high grades
 - ▶ “A majority of students who were initially admitted to the CMS department with the intention of pursuing a CS program are rejected from CS”
- Curriculum and program delivery
 - ▶ Computer Science Minor program is used as a “back door” into the department’s Major and Specialist programs; does not serve well as a supplement to specializations in other fields
 - ▶ Resource constraints have prevented the department from offering a more varied set of introductory and advanced undergraduate courses in Statistics, which could form the basis of a “comprehensive stream” Statistics program at UTSC; students often take such courses at the St. George campus
 - ▶ Teaching Assistants are “almost exclusively undergraduates” who receive minimal training, performance feedback, or professional development
 - ▶ Several students reported having opted out of the Co-op program in upper years
- Quality indicators — undergraduate students
 - ▶ Students report a limited number of “interesting” Co-op opportunities in the Mathematics Co-op program

The reviewers made the following **recommendations**:

- Overall quality
 - ▶ Departmental resources will need to increase to support expanding programs
- Admissions requirements
 - ▶ Computer Science admission criteria should be redesigned immediately to alleviate the current extreme student stress; redesigned process should be fair, transparent and equitable
 - ▶ Consider lowering initial admission rates for Computer Science stream, admitting students directly to a Computer Science program, and eliminating the “second chance” for admission via the Minor program
- Curriculum and program delivery
 - ▶ Hire course coordinators to handle administrative aspects of large courses to allow instructors to focus on teaching quality
 - ▶ Course coordinators could also train and review course TAs to improve undergraduate learning experience and provide professional development for TAs
 - ▶ Immediately enhance undergraduate research and funding opportunities across all three disciplines, with proactive and transparent communications to students
- Innovation
 - ▶ Statistics programs should consider incorporating emerging trends in Quantitative Finance, possibly with participation of Computer Science faculty

- Student engagement, experience and program support services
 - ▶ Student leaders would appreciate and benefit from more mentoring and guidance from faculty and staff in delivering extracurricular activities
- Quality indicators — alumni
 - ▶ Undertake a detailed assessment of the value of the Co-op program for students, including an assessment of career outcomes for students who complete the department’s Co-op programs versus those who do not

2. Graduate Program (N/A)

3. Faculty/Research

The reviewers observed the following **strengths**:

- Overall quality
 - ▶ Faculty in CMS department represent a small but distinguished part of “one of the best research groups in North America, comparable to all but the very best US universities.”
- Research
 - ▶ Research activities are situated primarily at the St. George campus in collaboration with labs and research groups there; this model, while unusual, works “extremely well for the CMS disciplines”
 - ▶ Strong research faculty in CMS; particularly impressive new hires
 - ▶ Computer Science teaching stream faculty “highly engaged” in research pertaining to Computer Science education, with a strong publication track record
- Faculty
 - ▶ Strong evidence of faculty research excellence in terms of awards and funding
 - ▶ Impressive recently hired research faculty
 - ▶ Cross-disciplinary nature of the department is appealing for faculty hires
 - ▶ Impressive dedication and leadership among teaching stream faculty members; teaching stream faculty form an integral part of the department with full partnership in curriculum development

The reviewers identified the following **areas of concern**:

- Faculty
 - ▶ Large reliance on sessional faculty for teaching is a major concern
 - Difficulty ensuring teaching quality
 - Burden on permanent faculty of frequently hiring and onboarding new sessional instructors
 - Capacity to update course curricula and delivery modes is limited by the relatively high number of sessional instructors

- ▶ Department's tenure-stream faculty seem for the most part to be either extremely young or quite senior
- ▶ Limited opportunity for Statistics junior faculty members to teach graduate courses

The reviewers made the following **recommendations**:

- Research
 - ▶ Continue supporting strong research collaboration model between UTSC and St. George campus faculty
 - ▶ Ensure that UTSC faculty continue to have offices at UTSG for research purposes
 - ▶ Collaborate with the St. George campus and the Fields Institute to facilitate delivery of research colloquia using teleconferencing resources at UTSC
- Faculty
 - ▶ Immediately increase both tenure-stream and teaching-stream faculty complement
 - ▶ Ensure that salaries for teaching stream faculty in CMS are competitive with cognate positions at the St. George campus
 - ▶ Prioritize expanded hiring of postdoctoral fellows, to contribute to both teaching and research supervision
 - ▶ Expand research supervision, through co-supervision of students by faculty in the research and teaching streams
 - ▶ Consider hiring mid-career researchers to provide a bridge between the senior and junior faculty members
 - ▶ Consider offering more graduate Statistics courses at the St. George campus

4. Administration

The reviewers observed the following **strengths**:

- Relationships
 - ▶ CMS Department is "in a good place in terms of morale and harmony"
 - ▶ Outstanding cooperation across disciplines among departmental faculty
 - ▶ Faculty have positive relationships with research partners in other UTSC departments as well as with their "research homes" on the St. George campus
 - ▶ Staff work well together and are fully vested in the department; high morale and good communication between staff and faculty
- Organizational and financial structure
 - ▶ Faculty form a cohesive group, working well together across disciplines and between teaching and tenure streams; most faculty members enjoy interdisciplinary nature of the department
- Long-range planning and overall assessment
 - ▶ Good use and management of available space, including recent spaces that have recently been "thoughtfully repurposed to improve the effectiveness of labs, support student interactions with peers and TAs, and support student clubs and societies"

The reviewers identified the following **areas of concern**:

- Relationships
 - ▶ Current positive relationships across disciplines may become strained as department continues to expand and face resource limitations
 - ▶ Some reports of dissatisfaction with how long the Department Chair role has been held by faculty from Computer Science
- Organizational and financial structure
 - ▶ Leadership structure, including department Chair, two Associate Chairs, and three Program Supervisors works effectively together but comprises a considerable fraction of the overall faculty complement and may create administrative overhead
 - ▶ Staff complement is too small for a department of this size and complexity; resulting increased administrative load for faculty detracts from their teaching and research work
 - ▶ Constraints on staff members' access to certain administrative systems affect efficient performance of work duties
- Long-range planning and overall assessment
 - ▶ Current space constraints may create difficulty increasing staff complement to a more appropriate level
 - ▶ Unique interdisciplinary nature of the department may make long range planning difficult; possible future split into individual disciplinary departments if program growth continues

The reviewers made the following **recommendations**:

- Organizational and financial structure
 - ▶ Increase staff complement to better align with department size and complexity
 - ▶ Consider streamlining programs to reduce administrative overhead related to departmental leadership structure
- Long-range planning and overall assessment
 - ▶ Consider ways to address issues related to staff and space shortage in the short term; waiting for completion of major capital projects may result in erosion of program quality
 - ▶ Develop departmental guidelines and by-laws to govern operations such as chair succession, selection of program directors, and formation of standing committees

2. Administrative Response & Implementation Plan



Office of the Vice-Principal Academic and Dean

September 21, 2020

Professor Susan McCahan
Vice-Provost, Academic Programs
Office of the Vice-President and Provost
University of Toronto

Dean's Administrative Response: External Review of the Department of Computer and Mathematical Sciences

Dear Susan,

Thank you for your letter of June 12, 2020 requesting my administrative response to the external review of our Department of Computer and Mathematical Sciences (CMS). We want to thank the review team – Professor Ann Condon, Department of Computer Science, University of British Columbia; Professor Richard Davis, Department of Statistics, Columbia University; and Professor Craig Evans, Department of Mathematics, University of California, Berkeley – for their consultation with us during the site visit on February 20 and 21, 2020, and for their report, which was finalized on March 20, 2020.

I appreciate the seriousness with which the reviewers approached the external review process, as well the thoughtful consideration given to CMS and its undergraduate programs. I am very pleased by the overall positive review of the Department. In particular, the reviewers state that they were extremely impressed by the Department's operations and the strong collegiality of the faculty; they also praise the highly effective collaboration among the different disciplines of Computer Science, Mathematics and Statistics; in fact, they note: "This collaboration is a huge strength for the UTSC campus and we strongly advise the administration to do everything possible to maintain its continued success."

The external review report was sent to the Chair of the Department, Professor Michael Molloy, on March 24, 2020, with a request to share it widely among the faculty, staff and students. The decanal group (including myself, the Vice-Dean Teaching, Learning and Undergraduate Programs (VDTLUP), Vice-Dean, Recruitment, Enrolment and Student Success (VDRESS), Acting Associate Dean Undergraduate Programs and Curriculum (ADUPC), the Director of the Office of the Vice-Principal Academic and Dean, and the Academic Programs Officer) met with the Chair of CMS and the Associate Chairs for Computer Science, Mathematics, and Statistics, on August 6, 2020 to discuss the external review report and administrative response; I am pleased with the depth of the discussion that took place.

My administrative response to the points raised in your letter is given below. This response has been developed in close consultation with the Chair of CMS, and reflects the key elements of the unit response letter, dated September 16, 2020. It also includes responses to points raised in the Request for Administrative Response that are outside departmental control.

Let me address the specific points raised in your letter:

- *The reviewers raised concerns about the highly competitive Computer Science admission process, observing that it causes stress and uncertainty for students and that "a majority of students who were initially admitted to the*

CMS department with the intention of pursuing a CS program are rejected from CS.” They noted the urgent need to “reduce uncertainty and stress in the admissions process, handling admissions fairly and transparently and keeping overall enrollment numbers under control.”

As the Chair outlines in his response, CMS has been actively engaged in a thorough re-evaluation of the admissions process for its Computer Science (CS) programs. The impetus for this re-evaluation has been three-fold: first, to address the needs of students by significantly reducing, if not entirely eliminating, uncertainty and stress regarding admissions criteria; second, to ensure that admissions criteria support the Department’s academic goals; and finally, to ensure the admissions criteria are in line with the resources available within the Department. Following extensive discussion within CMS, review of the admissions processes in place at the other undergraduate divisions of the University, and consultation with my Office and the Office of the Registrar, CMS is proposing changes to the admissions process, to be effective as of Fall 2021. The Dean’s Office strongly supports these changes.

The new admissions process will mirror the process adopted by the Faculty of Arts and Science on the St. George campus. UTSC students will be admitted from high school into a specific Computer Science, Mathematics, or Statistics admissions category, and every student admitted to each of these admissions categories will be admitted to the corresponding program, as long as they achieve a minimum grade in selected courses (this minimum grade will be lower than the criteria currently in place). The crucial difference is that the existing admission criteria drive, and possibly exacerbate, student competition to get into CS programs, while the new criteria will allow CMS to focus on establishing students’ aptitude to succeed in CS programs. Students who are not admitted to the Computer Science admission category will also have a chance to apply for Computer Science programs after the completion of first year courses, although admission through this route will be competitive and consequently more difficult to achieve.

Under the new admissions process, CMS believes that the vast majority of students who are admitted to a Computer Science POST will achieve the minimum grades needed to select a Computer Science program; this will greatly mitigate the stress students experience since it will eliminate much of the uncertainty around whether they will be accepted into a Computer Science program. Every student who enters CMS as a first-year student can feel confident that they will be admitted to the program corresponding to their admission category, as long as they achieve the very reasonable grade requirements. It will also ensure that CMS accepts only as many students as it has the resources to properly support. My Office will provide ongoing support to CMS to assess the outcome of these changes to the admissions process, including providing relevant data as needed and requested.

- *The reviewers commented on the heavy use of sessional instructors for teaching, noting difficulty ensuring teaching quality as well as the burden on permanent faculty of frequently hiring and onboarding new sessional instructors. They suggested hiring post-doctoral fellows to contribute to both teaching and research supervision.*

CMS acknowledges that it currently makes heavy use of sessional instructors for teaching. Regarding the reviewers’ recommendation, they note that three new attractive post-doctoral positions in Mathematics were recently established, and these postdocs may be able to contribute, in a limited way, to teaching in the Department. However, the Department does not wish to rely on postdocs to solve their teaching problems, and the Dean’s Office supports their position.

As the Chair outlines in his response letter, CMS currently has 8 available faculty positions to be searched – 3 in CS, 4 in Mathematics, and 1 in Statistics. Of these lines, 4 are replacements and 4 are new. The Department is planning to conduct all of these searches in this academic year, but it is important to acknowledge that it is unlikely all 8 will result in success, in no small part because there is very strong competition for excellent faculty in all three of the CMS disciplines. A more realistic outcome is that the Department will successfully fill some of these positions this year, which will reduce the reliance on sessional instructors; the Department will continue to search for the remaining outstanding lines over the medium term.

In addition to filling all of the outstanding faculty lines, adding new faculty lines in the future will be considered seriously, alongside other campus needs. The Faculty Complement Committee (FCC) was created during the academic year 2019-20 to provide recommendations to me regarding the distribution of faculty positions sought by academic units in the yearly recruitment cycle, within the context of strategic multi-year departmental and campus faculty complements. The FCC provides a consultative, inclusive and transparent process that involves all academic units in determining the complement submission at UTSC. Going forward, the Dean's Office recognizes the need to increase faculty complement in CMS.

In the Chair's response, he notes that CMS has felt constrained by a lack of appropriate office space in the Department in making decisions to request new faculty. Space issues are endemic at UTSC; however, I can confirm that there are plans in place to complete the construction of a new Instructional Centre 2 building by 2023. Bearing in mind the space needs of other academic units, CMS will be allocated space sufficient to allow for growth.

- *The reviewers recommended increasing students' opportunities for research experiences across all three disciplines, and encouraged co-supervision of students by tenure and teaching stream faculty.*

The Department believes the review team may have gained an incomplete picture regarding the undergraduate research opportunities that exist in CMS. As the Chair notes in his response, over 30 undergraduate CMS students have participated in research projects during the past year in project courses such as CSCD94H3 and CSCD95H3. They have also recently introduced the "Undergraduate Research Group," which encourages undergraduate students to participate in a research project. Going forward, CMS will continue to provide opportunities for undergraduates to engage in research, and encourage students to take full advantage of these opportunities. In addition, the Office of the Vice-Principal Research and Innovation, in collaboration with my Office, will continue to work with CMS to develop new opportunities, and to find new ways to communicate with students about these opportunities.

With regard to the recommendation for co-supervision by tenure and teaching stream faculty: as the Chair notes, this is already happening in the Department. For example, there have been recent cases in which a teaching-stream faculty member and a tenure-stream faculty member have jointly supervised a USRA student; this has been important because faculty without NSERC grants are not eligible to be sole Principal Investigators.

- *The reviewers noted that the high student/staff ratio places an additional administrative burden on faculty members, and recommended engaging course coordinators to handle administrative aspects of teaching large courses and training/supervising TA's.*

The Department agrees that additional administrative support is needed. As the Chair notes, a position for a new academic advisor in the Department has been funded, and they are currently seeking to fill this position. The Chair argues that constraints on office space limits the number of staff that can be hired in the short-term, however, they are currently reviewing their needs and will establish a list of priorities, including the hiring of a new course coordinator. My Office will work with the Department to ensure staffing needs are met, including attention to the related allocation of space.

- *The reviewers noted that given the centrality of the Co-op model to the department, "a more detailed assessment of its value to students would be useful to have, "including an assessment of career outcomes for students who complete the department's Co-op programs versus those who do not.*

We agree that a review of the Co-op model for the Department is important. The Academic Advising & Career Centre, which falls within the portfolio of the Dean of Student Experience and Wellbeing at UTSC, is currently engaging in a survey and data analysis of career outcomes for UTSC students, which is due to be completed by the end of this

academic year. The Arts and Science Co-op Office, which falls within my portfolio, is participating, and an assessment of career outcomes for students in CMS's Co-op programs has been folded into this project; the report from this review should allow us to assess how effective Co-op is in providing academic and career opportunities, and develop longer-term plans.

- *The reviewers commented that resource constraints have prevented the department from offering a more varied set of advanced undergraduate courses, which would normally be part of a "comprehensive stream" program in Statistics.*

The Department agrees that they need to develop a more varied set of advanced courses in Statistics, however, this process is already in progress. There are new, junior Statistics faculty in the Department who are beginning to develop such courses, for example: D-level courses on the Theory of Machine Learning (introduced by Roy) and Analysis of Big Data (introduced by Sun). As such, the Department will be moving forward with their plans to introduce a new comprehensive stream in the Specialist in Statistics, to be effective Fall 2021. My Office will be working with the Department on the development of this proposal, including ensuring there are sufficient resources in place.

The Dean's Office will monitor the implementation of recommendations through ongoing meetings with the Chair. A brief report to the Office of the Vice-Provost, Academic Programs, midway between the February 2020 site visit and the year of the next site visit, and no later than Winter 2024, will be prepared. The next external review of the Department has been scheduled for 2027-28.

Regards,

A handwritten signature in black ink, appearing to read 'WAG', written in a cursive style.

Professor William A. Gough
Vice-Principal Academic and Dean

Implementation Plan

Action	Timeline	Lead
Introduce and implement changes to the admissions process (for Fall 2021)	short term (6 months to 1 year)	Chair, Department of Computer and Mathematical Sciences
Complete faculty searches and appoint new faculty	medium- to long-term (1 to 5 years)	Chair, Department of Computer and Mathematical Sciences
Review and prioritize administrative staff needs; when appropriate, hire additional administrative staff support	medium- to long-term (1 to 5 years)	Chair, Department of Computer and Mathematical Sciences
Conduct an assessment of career outcomes for students who complete the department's Co-op programs versus those who do not	medium-term (1 to 2 years)	Assistant Dean, Student Success and Vice-Dean, Teaching, Learning and Undergraduate Programs
Develop new upper-level courses in Statistics, in support of the introduction of a proposed new "Comprehensive" stream in the Specialist in Statistics (for Fall 2021)	short- to medium term (6 months to 2 years)	Chair, Department of Computer and Mathematical Sciences

3. Committee on Academic Policy & Programs (AP&P) Findings

The spokesperson for the Reading Group reported that the summary covered the full Review. The Group agreed that the Dean's administrative response fully addressed the issues identified.

No follow-up report was requested.

4. Institutional Executive Summary

The reviewers observed that the department is a “huge strength for the UTSC campus”, and praised its well-designed programs for providing both breadth and depth of coverage in each area; they noted strong comradery and satisfaction among students in each program, and found the faculty cohesive and appreciative of the the department's interdisciplinary nature, and noted strong evidence of research excellence; they found teaching stream faculty to be an integral part of the department and apparent full partners in developing the curriculum in all three subject areas; finally, the reviewers commented on the high morale in the department, and good communication and relationships between staff and faculty. The reviewers recommended that the following issues be addressed: responding to concerns about the highly competitive Computer Science admission process, which causes stress and uncertainty for students; decreasing reliance on sessional instructors for teaching by hiring postdoctoral fellows to contribute to both teaching and research supervision; increasing students' opportunities for research experiences across all disciplines; engaging course coordinators to handle administrative aspects of teaching large courses and training/supervising TA's and lighten the burden on faculty members; conducting a more detailed assessment of the co-op model and its value to students; and addressing resource constraints that have prevented the department from offering a more varied set of advanced undergraduate courses.

5. Monitoring and Date of Next Review

The Dean's Office will monitor the implementation of recommendations through ongoing meetings with the Chair. The Dean will provide an interim report to the Vice-Provost, Academic Programs no later than Winter 2024 on the status of the implementation plans.

The next review will be commissioned in 2027-28.

6. Distribution

On June 30, 2021, the Final Assessment Report and Implementation Plan was posted to the Vice-Provost, Academic Programs website and the link provided by email to the Vice Principal Academic & Dean of UTSC, the Secretaries of AP&P, Academic Board and Governing Council, and the Ontario Universities Council on Quality Assurance. The Dean provided the link to the Chair of the Department.