UNIVERSITY OF TORONTO SCARBOROUGH

OFFICE OF THE CAMPUS COUNCIL

FOR INFORMATION **PUBLIC** **OPEN SESSION**

TO: UTSC Academic Affairs Committee

SPONSOR: Prof. William A. Gough, Vice-Principal Academic and Dean
CONTACT INFO: 416-208-7027, vpdean.utsc@utoronto.ca

PRESENTER: Prof. Katherine Larson, Vice-Dean Teaching, Learning & Undergraduate Programs
CONTACT INFO: 416-208-2978, vdundergrad.utsc@utoronto.ca

DATE: May 20, 2021 for May 27, 2021

AGENDA ITEM: 4 (a)

ITEM IDENTIFICATION:

Review of Academic Programs and Units, UTSC - Department of Computer and Mathematical Sciences and its undergraduate programs

JURISDICTIONAL INFORMATION:

Under section 5.6 of the Terms of Reference of the University of Toronto Scarborough Academic Affairs Committee (UTSC AAC) provides that the Committee shall receive for information and discussion reviews of academic programs and units consistent with the protocol outlined in the University of Toronto Quality Assurance Process. The reviews are forwarded to the Committee on Academic Policy and Programs for consideration.

GOVERNANCE PATH:

UTSC Academic Affairs Committee [For Information] (May 27, 2021)

PREVIOUS ACTION TAKEN:

- Committee on Academic Policy and Programs (AP&P), October 27, 2020 [For Information]. The Committee was satisfied with the Dean's Administrative Response.
- Academic Board, November 18, 2020 [For Information]. The Board was satisfied with the Report from AP&P.

HIGHLIGHTS:

The *Cyclical Review Protocol* "is used to ensure University of Toronto programs meet the highest standards of academic excellence" (UTQAP, Section 5.1). The *Protocol* applies to all undergraduate and graduate degree programs offered by the University, and the University's full complement of undergraduate and graduate degree and diploma programs are reviewed on a planned cycle. Reviews are conducted on a regular basis, and the interval between program reviews must not exceed 8 years.

The external review of academic programs requires:

- The establishment of a terms of reference;
- The selection of a review team;
- The preparation of a self study;
- A site visit;
- Receipt of a report from the external review team;
- The preparation of a summary of the review report;
- The Vice-Provost, Academic Programs' formal request for an Administrative Response;
- The Dean and Vice-Principal Academic's formal Administrative Response; and
- Preparation of a Final Assessment Report and Implementation Plan.

In accordance with the *Protocol*, an external review of the Department of Computer and Mathematical Sciences (CMS) and its undergraduate programs, was conducted in the 2019-20 academic year. The review team met with a wide array of stakeholders including UTSC senior academic administrators, the Department Chair, and faculty, staff and students in the Department. The reviewers were extremely impressed by the Department's operations, and the strong collegiality of the faculty. In particular they lauded the highly effective collaboration among the different disciplines of Computer Science (CS), Mathematics (MAT) and Statistics (STA). The reviewers also identify a number of challenges and make a series of recommendations.

The reviewers raise concerns about the highly competitive admissions process in CS programs, and recommend the Department consider ways to "reduce uncertainty and stress." The Department agrees with the reviewers' assessment and is introducing changes to the enrolment requirements in CS, MAT and STA programs, effective Fall 2021. The revised enrolment requirements mirror those introduced by the Faculty of Arts and Science. Under these requirements, UTSC students will be admitted from high school into a specific CS, MAT, or STA admissions category, and these students will be admitted to the corresponding programs, as long as they complete the required A-level CS, MAT and STA courses, and achieve the required minimum grades in selected courses. These new criteria focus on establishing an aptitude to succeed in the program, rather than creating a detrimental competitive environment for students. The Department anticipates that the vast majority of students who are admitted to the CS, MAT and STA admission categories prior to their first year of studies will be able to achieve the minimum grades needed to be admitted to a program associated

with the admission category upon completion of their first 4.0 credits. Students who are not admitted to the CS, MAT, or STA admission categories will also have the chance to apply for CS, MAT, or STA programs after the completion of first year courses; admission through this route will be competitive and, admittedly, will be more difficult to achieve.

The reviewers comment on the heavy use of sessional instructors, and suggest hiring post-doctoral fellows to contribute to teaching and research supervision. CMS acknowledges it has made heavy use of sessional instructors for teaching, however, the Department does not wish to rely on postdocs to solve their teaching problems, and the Dean's Office supports their position. CMS notes that, at the time of review site-visit, searches were underway for 8 faculty positions in the Department. They anticipate that some of these searches will be successful, which will reduce the reliance on sessional instructors; the Department will continue to search for any remaining outstanding faculty lines over the medium term. New faculty hires will be considered alongside other campus needs. The Faculty Complement Committee (FCC) was established in 2019-20 to provide recommendations to the Vice-Principal Academic and Dean regarding the distribution of faculty positions each year. The FCC provides a consultative, inclusive and transparent process that involves all academic units in determining the complement submission at UTSC.

The reviewers recommend increasing students' opportunities for research experiences across all three disciplines, and encourage co-supervision of students' by research and teaching-stream faculty. The Department notes that the review team may have gained an incomplete picture regarding undergraduate research opportunities in CMS. They identify project courses such as CSCD94H3 and CSCD95H3, and the Undergraduate Research Group as venues that offer undergraduate students the opportunity to engage directly in research. CMS also notes that it will continue to provide new opportunities for students to engage in research. With regard to the recommendation for co-supervision by research and teaching-stream faculty, CMS notes this already takes place in the Department.

The reviewers noted that the high student/staff ration in the Department places an additional administrative burden on faculty members, and recommend engaging course coordinators to handle administrative aspects of teaching large courses, and training/supervising TAs. The Department agrees with the reviewers' assessment, and notes that a position for a new academic advisor has been funded. They further note that they are reviewing their additional needs and will work with the Dean's Office to ensure staffing needs are met.

The reviewers recommend a detailed assessment of the Co-op model, including an assessment of career outcomes for students. The Department agrees that a review of the Co-op model will be beneficial. The Academic Advising & Career Centre has engaged in a survey and data analysis of career outcomes for UTSC students, and a report was to be delivered at the end of 2020. An assessment of the career outcomes for students in CMS's Co-op programs has been folded into this project.

The reviewers highlight the need for a more varied set of advanced undergraduate courses to support a "comprehensive stream" in the Statistics program. The Department notes that this process is already in progress, and new D-level courses on the Machine Learning Theory (STAD78H3) and Analysis of Big Data (STAD80H3) have been approved, effective Fall 2021. In addition, CMS has moved forward with the introduction of a new stream in Statistical Science in the Specialist/Specialist (Co-operative) programs in Statistics (HBSc), also effective Fall 2021.

The implementation timeline for departmental action is given in the Dean's Administrative Response.

FINANCIAL IMPLICATIONS:

There are no net financial implications to the campus' operating budget.

RECOMMENDATION:

This item is presented for information only.

DOCUMENTATION PROVIDED:

1. Review Report (March 20, 2020)
2. Provostial Request for Administrative Response (June 12, 2020)
3. Dean's Administrative Response (September 21, 2020)
4. Chair's Administrative Response (September 16, 2020)
5. Provostial Final Assessment Report and Implemental Plan

Cyclical Review Report

As Commissioning Officer, I confirm that:

- ✓ The review report addresses all elements of the terms of reference, which reflect the requirements outlined in the University of Toronto Quality Assurance Process (UTQAP), including the program evaluation criteria
- ✓ I have brought to the attention of the reviewers any clear factual errors in the report and the reviewers have corrected these.

Commissioning Officer: William Gough, Vice-Principal Academic and Dean	Report Accepted as Final on March 20, 2020

Reviewers are asked to provide an Appraisal Report that:

- Identifies and commends the program's notably strong and creative attributes
- Describes the program's respective strengths, areas for improvement, and opportunities for enhancement
- Recommends specific steps to be taken to improve the program, distinguishing between those the program can itself take and those that require external action
- Recognizes the institution's autonomy to determine priorities for funding, space, and faculty allocation;
- Respects the confidentiality required for all aspects of the review process; and
- Addresses all elements of the terms of reference, which reflect the requirements outlined in the University of Toronto Quality Assurance Process (UTQAP), including the program evaluation criteria

Division/unit under review:	**University of Toronto Scarborough (UTSC): Department of Computer and Mathematical Sciences**
Program(s) under review:	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)
Commissioning officer:	Professor William Gough, Vice-Principal Academic and Dean
Date of scheduled review:	February 20-21, 2020
Reviewers 'names and affiliations:	• Professor Anne Condon, Department of Computer Science, University of British Columbia • Professor Richard A. Davis, Department of Statistics, Columbia University • Professor Craig Evans, Department of Mathematics, University of California, Berkeley

1. Review Summary

We are in general extremely impressed with the CMS Department's operations and indeed were quite surprised to find so well functioning a group comprising the rather different disciplines of Computer Science (CS), Statistics and Mathematics. 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.

We stress the key points that (a) the research component must continue to rely upon strong collaboration with the St George campus, and that (b) many additional resources will be needed in continued support of the vast and expanding teaching and service responsibilities of CMS.

SUMMARY OF MAJOR RECOMMENDATIONS

We recommend **immediately**
1) increasing the staff of CMS by at least 2 (and providing for them additional office space);
2) redesigning the criteria for admission to CMS and to the individual programs (to alleviate the current extreme student stress);
3) hiring more faculty, in both the tenure- and teaching-streams;
4) hiring additional course coordinators;
5) enhancing undergraduate research opportunities across all three disciplines.

We discuss these issues in more detail below.

2. Program Evaluation Criteria

The Computer Science (CS), Statistics and Mathematics programs in CMS are overall very well aligned with UTSC's goals of promoting academic excellence and of supporting both international and Canadian students.

Curriculum: The academic programs seem to be set up quite well: for example, program requirements and learning outcomes in CS are consistent with recommendations of the Association for Computing Machinery while the Statistics specialist and major follow the curriculum guidelines of the American Statistical Association and the Statistical Society of Canada. The course offerings in mathematics likewise are also well designed.

The CS curriculum offers strong breadth of coverage, and significant depth in key areas. Course curricula and delivery modes are frequently updated, although the capacity to do this is limited by the relatively high number of sessional instructors. One nice recent

example of curricular change is the redevelopment of the introductory programming course (CSCA08H3) to ensure that students with no prior programming background are not disadvantaged, and revision also to the follow-on second year course (CSCA48H3). One area where changes would be valuable is the minor program; this program is currently used more as a "back door" into the department, rather than as a true minor, and does not serve students well who have a major or specialization in another field.

The Statistics curriculum is also relatively broad. The newly formed double degree program, the first of its kind at UT, between Management (BBA in Management and Finance) and Statistics (BSc in statistics-quantitative finance stream) is seen as a positive development. The department should consider incorporating emerging trends in quantitative finance (QF). In particular, there appears to be opportunities to include CS faculty on certain aspects of this program, e.g., machine learning for QF. The Statistical Machine Learning and Data Science stream has grown considerably in popularity. The department would also like to offer a "comprehensive stream" that would mirror the corresponding stream in CS. This stream is intended to serve as the standard *Statistics major* offered at most universities. Unfortunately, due to resource constraints, the department is unable to offer a wide selection of electives at the junior/senior levels to fully support this stream. Students often look to the course offerings at St. George in order to pursue a more varied set of advance undergraduate courses in statistics.

Admissions: A major problem has been that because of the extremely strong demand for the CS program and significant enrollment increases, admission to CS is highly competitive (3.2 average over five courses taken in the first year). The result has been 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. This has led to a competitive, grades-focused orientation amongst students, and accordant stress, and as interest in CS continues to rise, admissions challenges will become even more intractable. One of our main recommendations is to ameliorate admissions challenges, see below.

Assessment: Homeworks, projects and tutorials are components of many courses, while assessment in many courses is primarily through exams. This seems appropriate to ensure fairness and manage workload, given the large class sizes. We are unclear about what resources are available for the grading of homework assignments, an extremely important part of the educational experience in the mathematical sciences.

The Co-Op program. Beyond the classroom, the co-op program is a big draw, and positively perceived by faculty and students alike. Given how central this program is to the CMS program, a more detailed assessment of its value to students would be useful to have. For example, is there a difference in career trajectory or early success between students who participate in co-op versus those who do not? Several of the students we met noted that they participated in co-op initially, but once they have had the initial experience they opted out of the program in later years. We do note however that the

co-op placement effectiveness is very program specific, with for instance extremely few math students finding interesting opportunities.

Extracurricular Experiences: The student-run Association of Math, Computer Science and Statistics (AMACSS), as well as the Enrichment Club, offer valuable extra-curricular experiences; and there is also an annual Hackathon event, which is a major recruitment opportunity. Student leaders would appreciate and benefit from more mentoring and guidance from department faculty and staff in delivering these activities.

Recommendations: It is an urgent problem to reduce uncertainty and stress in the admissions process, handling admissions fairly and transparently and keeping overall enrollment numbers under control. This problem is particularly tricky because it is difficult to assess, based on high school performance, how students will do in the program: an inflexible process may exclude students, particularly women, who only discover their aptitude for CS after getting to university. Options may include admitting fewer students initially to CMS; a direct admissions process; or no "second chance" admissions via the Minor program. While there are no easy solutions, the problem must be tackled soon and decisively.

3. Faculty/Research

Research Faculty: Research activities are situated primarily at the St. George campus, in collaboration with labs and research groups there. This model works extremely well for the CMS disciplines, where collaborations and close interactions among groups of researchers in related subfields is the norm, and is critical to hiring excellent research faculty members. It is very important that this model continues to be supported by both campuses, e.g., by ensuring that UTSC faculty have offices at UTSG. There is strong evidence of faculty research excellence, in terms of awards and funding. We were also extremely impressed in our conversations with recently-hired research faculty. It is clear that the cross-disciplinary nature of CMS is an attraction to many of the newly hired faculty

Teaching Faculty: We were also quite impressed with the dedication and leadership of teaching stream faculty members. A major concern currently is the large reliance on sessional faculty for teaching. This makes it difficult to ensure teaching quality given the short-term nature of these appointments. In addition, the constant hiring and onboarding of new sessional faculty poses a huge burden on permanent faculty. To make it attractive for both contractually limited as well as permanent teaching stream faculty members to work at UTSC, it is fundamentally important that salaries for teaching faculty members are competitive with salaries at the St. George campus. Also, to ensure that faculty members can focus on teaching quality, given the large class sizes,

course coordinators could be hired to handle administrative aspects of teaching large classes and/or to deliver tutorials.

Undergraduate Research: There is a highly-engaged group of teaching stream faculty and students engaged in research pertaining to CS education, with a track record of publication in top conferences. Research faculty also do some research supervision through supervised study courses, and some students do research at the St. George campus in the summer. However, given the increase in the number and quality of students and the research stature of faculty members, more opportunities for research experiences are definitely needed.

Recommendations: We strongly support hiring more postdocs, who will contribute to both teaching and research supervision at UTSC. (There is much appreciation for the funds to hire two incoming math postdocs; this initiative could be expanded to all areas of CMS)

We also suggest expanded research supervision through co-supervision of students by faculty in the research and teaching streams (as the latter are often more connected to other departments at UTSC). The department should collaborate with the St. George campus and the Fields Institute to facilitate delivery of research colloquia using teleconferencing resources at UTSC.

We recommend that the department communicate proactively and transparently with undergrad students about research opportunities, and create more funding and research opportunities for them. In particular, students at UTSC would benefit from more opportunities to do research at the St. George campus.

4. Relationships

Morale: The CMS faculty is comprised of a multitude of constituencies that is unlike most comparable departments at major research universities. First, the department is essentially 3 departments in 1, and second there is a large proportion (40%) of teaching stream faculty. Much to our surprise, we did not detect any hint of dissatisfaction or unease between the three disciplines or between the tenure and teaching streams. This is a cohesive group that works well together across disciplinary boundaries and job descriptions; and most enjoy being in an interdisciplinary department. The teaching stream faculty are an integral part of the department and appear to be full partners in developing the curriculum in the three subunits. The staff appear to work well together and are fully vested in the department. In an effort to keep channels of communication open, there is a department meeting that includes both staff and faculty every Monday morning. Overall, the morale is high and aside from a shortage of space, the work environment is excellent.

Among the students we met, there is strong comradery that crosses disciplinary boundaries. The students are generally quite satisfied with their respective programs and are appreciative of the efforts of faculty (tenure and teaching stream) to assist on research projects. However, as mentioned earlier, these opportunities could be more plentiful. The students are also quite aware and sympathetic of the stresses in the department due to large enrollments—they experience this first hand in their own classes and also while serving as TAs.

Partnerships: There are a few collaborative research projects between faculty in CMS and faculty from other departments, notably psychology and political science. The research faculty are positive about their relationships with their research homes at UTSG, which also offers plenty of research opportunities with other departments. There is limited interaction between the teaching stream faculty and their counterparts at UTSG and UTM. The double major between the QF stream in Statistics with the BBA degree in finance offered by Management has just begun.

Recommendations: Currently, the CMS Department is in a good place in terms of morale and harmony. However, one cannot help but sense there is extreme pressure percolating just below the surface, mostly due to enrollment pressures and a lack of resources to meet the demand, which could easily alter this balance. In addition to increasing the size of the faculty (tenure and teaching stream) and staff, recommended earlier, here are some other suggestions:

- In Statistics and perhaps in CS and Mathematics, the tenure-stream faculty are either extremely young or quite senior. It might be advisable in the future to consider hiring mid-career researchers to provide a bridge between the senior and junior faculty.
- The graduate teaching at UTSG is limited—for the junior statistics faculty it amounts to .5 courses/year. This limits the opportunity to teach a full term course or even a year-long sequence. One should consider models which can accommodate these young researchers to have more opportunity to teach graduate courses at UTSG.
- TAs for courses at UTSC are almost exclusively undergraduates. The training of these students is minimal and reviews of their performance is virtually non-existent. Additional course coordinators should be hired to train and review TAs, which serves two clear purposes: to improve the quality of the undergraduate learning experience and to enhance professional development of the TAs.

5. Organization and Financial Structure

Organizational Structure: The organizational structure of CMS supports a highly complex operation that delivers three undergraduate programs, each with specialization streams as well as a major, minor, and co-op option, all situated within the tri-campus

structure. This seems to us a rather complicated educational operation, but it seems to work amazingly well in practice.

In addition to the department Chair, there are two Associate Chairs and three Program Supervisors. This cohort works effectively together, but comprises a considerable fraction of the overall faculty complement (especially since the research faculty spend just a fraction of their time at the UTSC campus). Perhaps streamlining the programs, offering a single overarching CMS program rather than three different programs, could reduce the administrative overhead.

Staff: In light of the already very large and growing undergraduate cohort and the complexity of the degree programs, the size of the staff is much too small, with just seven people. A consequence is that faculty in leadership positions, or with large class sizes, handle routine administrative tasks that could ably be handled by staff. We are very concerned that this administrative load detracts from the central teaching and research work of faculty members. Moreover, several staff members noted that their ability to perform their work efficiently is hampered by bureaucratic constraints at the (tri-)university level. For example, staff have limited access to the centralized undergraduate database, and to the financial system, and cannot schedule classes at certain times.

Space: Available space is well used and managed. We noted that several rooms have recently been thoughtfully repurposed to improve the effectiveness of labs, support student interactions with peers and TAs, and support student clubs and societies.

Department members eagerly look forward to the planned new space, expected in 2022, which can accommodate additional faculty and staff.

Our biggest concern is that the lack of additional space currently is hampering the department's ability to address pressing challenges in a timely fashion. The department must address the staffing issues now, and cannot afford to just wait for the new building

Recommendations: University and department members should work together to immediately create temporary space that could house additional staff, faculty, and postdocs in the short term. Failing this, there will definitely be a deep erosion in program quality for the coming years. In terms of best practices, it would be wise for the department to draw up a set of by-laws that govern how the department operates. This might include succession of the chair, selection of program directors, formation of standing committees, etc.

6. Long-Range Planning Challenges

Long range planning for CMS is particularly difficult as the current organization (comprising three distinct disciplines) is so unusual, quite outside what we have seen elsewhere. Assuming the continued demand for teaching and research in the mathematical sciences, we expect that CS, Statistics and Mathematics will each grow substantially, and consequently that CMS will probably want to break up into 2 or 3 individual departments at some point. However, the details of this are impossible to foresee.

As discussed elsewhere in this report, there is currently a major problem with enrollments in CMS, which are causing extreme student distress. This must be resolved soon, and certainly before any other long term enrollment considerations.

The leadership in CMS seems to have been very good (although we heard some grumbling that Computer Scientists have been holding the chair position for quite a while). We continue to be amazed by the comity in the department and the outstanding cooperation amongst the faculty. It is unclear to us that this will continue to prevail as the department expands in the future, but for now this modus vivendi seems to be working.

7. International Comparators

Assessment of the unit and the program(s) under review relative to the best in Canada/North America and internationally, including areas of strength and opportunities

The research faculty in CMS are quite strong, and the new hires in particular seem quite impressive. That these faculty participate in the research environment at the St George campus for three days each week is extremely unusual, but is apparently effective. And indeed it would be impossible to hire research faculty of such eminence at UTSC if the opportunities to conduct research downtown were curtailed.

Considered as part of the greater University of Toronto, this is one of the best research groups in North America, comparable to all but the very best US universities. The UTSC faculty in CMS of course represent only a small, but a distinguished, fraction of the eminence of the full UT faculty. (It would currently be highly inappropriate, and indeed impossible, to try to force a move of any significant part of the research activities to the UTSC campus.)

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PROVOST,
ACADEMIC PROGRAMS

June 12, 2020

Professor William Gough
Vice Principal Academic and Dean
University of Toronto Scarborough

Dear Professor Gough:

Thank you for forwarding the report of the February 2020 External Review of the Department of Computer and Mathematical Sciences and its programs. The following programs were reviewed: Computer Science, H.B.Sc., Specialist, Specialist Co-op, Major, Major Co-op, Minor; Mathematics, H.B.Sc., Specialist, Specialist Co-op, Major, Major Co-op; Statistics, H.B.Sc., Specialist, Specialist Co-op, Major, Major Co-op, Minor; Applied Statistics, Minor (Science).

As indicated in our *Statement of Institutional Purpose*, the University of Toronto is committed "to being an internationally significant research university, with undergraduate, graduate and professional programs of excellent quality." This quality is assessed through the periodic appraisal of programs and units, which considers how our research scholarship and programs compare to those of our international peer institutions and assesses the alignment of our programs with established degree-level expectations. The University views the reports and recommendations made by external reviewers as opportunities to celebrate successes and identify areas for quality improvement.

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. They found that the cohesive faculty enjoys the department's interdisciplinary nature, and noted the strong evidence of research excellence, particularly in their awards and funding record. They also found that teaching stream faculty are an integral part of the department and appear to be full partners in developing the curriculum in all three subject areas. Finally, the reviewers commented on the high morale in the department, and on the good communication and relationships between staff and faculty.

I am writing at this time:

1. to request your administrative response to this report, which should include a plan for implementing the recommendations;
2. to request your feedback on the review summary component of the draft *Final Assessment Report and Implementation Plan*; and
3. to outline the next steps in the process.

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1. Request for Administrative Response and Implementation Plan:

In your **Administrative Response**, please address the following areas raised by the reviewers and their impact on academic programs, *along with any additional areas you would like to prioritize*.

For each area you address, please provide an **Implementation Plan** that identifies actions to be accomplished in the immediate (six months), medium (one to two years) and longer (three to five years) terms, and who (Department, Dean) will take the lead in each area. If appropriate, please identify any necessary changes in organization, policy or governance; and any resources, financial and otherwise, that will be provided, and who will provide them.

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

Please prepare this response in consultation with the unit under review. As part of this consultation, please request a brief administrative response from the unit that focuses on items within their control. Please reflect this consultation and respond to the key elements of the unit's response in your response.

Finally, please confirm the **date of the next review** and your plans for **monitoring the implementation of recommendations** until then. I will ask you to provide a brief report to me

midway between the 2019-20 review and the year of the next site visit.

2. Draft of Final Assessment Report (including Review Summary)

In June 2020, my office will provide a draft version of the *Final Assessment Report and Implementation Plan* (FAR/IP), which will include a summary of the review of the Department of Computer and Mathematical Sciences. At that time we will request your feedback regarding tone or accuracy of the summary component, and your response to any information that is requested in the comments. This document becomes part of the governance record.

3. Next Steps

Reviews of academic programs and units are presented to University governance as a matter of University policy. Under the University of Toronto Quality Assurance Process (UTQAP), the Vice-Provost, Academic Programs prepares a report on all program and unit reviews and submits these periodically to the Committee on Academic Policy and Programs (AP&P).

The review of the Department of Computer and Mathematical Sciences will be considered by AP&P at its meeting on **October 27, 2020. Please plan to attend this meeting, and ensure that the unit leadership also attends.** Your presence is important and will allow you to respond to any questions the committee may have regarding the report, and your administrative response and implementation plan. An overview of what happens at AP&P is available on our website.

I would appreciate receiving your completed administrative response and plan for implementing recommendations, as well as a copy of the unit's response, and any comments on the draft FAR/IP by **September 21, 2020.** This will allow my office sufficient time to prepare materials for the AP&P meeting.

The review summary and the Dean's administrative response are the two key components of the FAR/IP, which will be finalized after the AP&P meeting and distributed to you, the unit leads, the Governing Council secretariat, and the Quality Council, and posted on our website, as required by the UTQAP.

Please feel free to contact me or David Lock, Coordinator, Academic Planning and Reviews, should you have any questions.

Sincerely,

Susan McCahan
Vice-Provost, Academic Programs

cc.
Annette Knott, Academic Programs Officer, University of Toronto Scarborough
Daniella Mallinick, Director, Academic Programs, Planning and Quality Assurance
David Lock, Coordinator, Academic Planning and Reviews
Emma del Junco, Assistant Coordinator, Academic Planning and Reviews

UNIVERSITY OF TORONTO SCARBOROUGH

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,

Professor William A. Gough
Vice-Principal Academic and Dean

cc.
Professor Michael Molloy, Chair, Department of Computer and Mathematical Sciences, UTSC

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

UNIVERSITY OF TORONTO SCARBOROUGH

Department of Computer and Mathematical Sciences

September 16, 2020

Professor William Gough
Vice-Principal Academic and Dean
University of Toronto Scarborough

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

Dear Bill,

I am pleased to provide the departmental administrative response to the external review of the Department of Computer and Mathematical Sciences (CMS). I 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 in-person site visit on February 20 and 21, 2020, and for their report, which was received on March 24, 2020 and shared with our faculty, staff and students.

We deeply appreciate the reviewers largely very positive assessment of CMS; e.g., they note how deeply impressed they were by the Department's operations, and the strong collegiality of the faculty. They also give attention to some of the well-known challenges the Department currently faces, and make a number of recommendations. Where changes are within departmental control, a fulsome response is given below.

- *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."*

We agree with the concerns raised by the reviewers. CMS has been reviewing and revising the admissions criteria for our Computer Science (CS) programs every year for the past several years. Some changes have been small – for example, gradually increasing CGPA requirements each year; and some have been more substantial – for example, establishing methods for students to qualify for a program based on B-level grades. More recently, however, we have been engaged in a thorough re-evaluation of our entire admissions process. The impetus for this re-evaluation has been three-fold: first, and most importantly, we want to address the needs of our students by significantly reducing, if not entirely eliminating, uncertainty and stress regarding admissions criteria; second, we want to ensure that our admissions criteria support our academic goals; and finally, the admissions criteria must in line with the resources available within the Department. Following extensive discussion within CMS, review of the admissions process in place in cognate programs at our sister campuses, and consultation with the Offices of the Registrar and the Vice-Principal Academic and Dean at UTSC, we will be changing our admissions process, to be effective Fall 2021.

Under the current admissions process, new UTSC students are admitted from high school into a general CMS admissions category. After completing their first 4.0 credits, students are able to apply to specific programs, and those who achieve the minimum criteria established each year are guaranteed admission. This process creates uncertainty and stress for students since the minimum criteria are always changing, and it is problematic for the Department since it inevitably leads to programs and courses that are oversubscribed.

Under the new admissions process, which mirrors the process adopted by the Faculty of Arts and Science on the St. George campus, new 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 that will be much lower than the criteria currently in place. The crucial difference is that the existing admission criteria are determined by the level of competition to get into our program, but the new criteria will focus on establishing an aptitude to succeed in the program.

The Department anticipates that the vast majority of students who are admitted to the Computer Science POSt prior to their first year of studies will be able to achieve the minimum grades needed to select a Computer Science program upon completion of their first 4.0 credits. Students who are not admitted to the Computer Science admission category will also have the chance to apply for Computer Science programs after the completion of first year courses; admission through this route will be competitive and, admittedly, will be more difficult to achieve. We believe this new process 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 will 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.

- *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.*

We acknowledge that CMS currently makes heavy use of sessional instructors for teaching. We appreciate the reviewers' recommendation, and note that we have recently established three new attractive post-doctoral positions in Mathematics who may contribute to teaching in the Department. However, we believe strongly that we cannot rely on postdocs to solve our teaching problems.

Clearly there is a need to hire new faculty in CMS. Unfortunately, we have experienced a number of failed searches in recent years, as hiring excellent faculty in our fields has become highly competitive. CMS has 8 outstanding faculty lines (3 in CS, 4 in Mathematics, and 1 in Statistics), and our goal is to conduct searches for all of them over the next academic year. Filling these positions will partially decrease our reliance on stipend teaching. Of the 8 outstanding faculty lines, 4 are replacement and 4 are new. Adding additional new faculty lines in the future is possible; however, we currently feel somewhat constrained by a lack of appropriate office space in the Department. Thankfully, UTSC has plans in place to complete the construction of a new Instructional Centre 2 building, by 2023; CMS will be allocated more space than it currently has in this new building, and we will be in a better position to add new faculty.

- *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.*

We thank the reviewers for their recommendation, but believe they have gained an incomplete picture regarding the undergraduate research opportunities that exist in CMS. We note that more than 30 of our undergraduate students have participated in research projects during the past year: for example, in project courses such as CSCD94H3 and CSCD95H3. We've also introduced the "Undergraduate Research Group," which encourages undergraduate students to participate in a research project. Going forward, CMS will continue to provide opportunities to engage in research, and we will encourage our students to take full advantage of these opportunities.

The recommendation that we broadcast research seminars from other campuses is something we are already considering. Indeed, we are looking into equipping space in our new building for this purpose.

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

- *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.*

We thank the reviewers for this recommendation, and note that a position for a new academic advisor in the Department has already been funded, and we are currently seeking to fill this position.

In general, we agree that CMS needs additional administrative staff support. Although the constraints on office space, described above, limits the number of staff that can be hired in the short-term, we are currently reviewing our needs and will establish a list of priorities; it is likely that a new course coordinator will be high on the list. Once CMS moves to our planned new space in IC2 (in 2023), we will be in a better position to hire more administrative staff.

- *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.*

We thank the reviewers for their comments, and agree that we need a more varied set of advanced courses in Statistics. We have some new junior faculty 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 (Sun). As such, our current goal is to introduce a new comprehensive stream to our Specialist in Statistics, to be effective Fall 2021. When CMS moves to the new IC2 building (in 2023), we will be able to hire more Statistics faculty which will enable us to develop more new courses.

Regards,

Professor Michael Molloy
Chair, Department of Computer and Mathematical Sciences
University of Toronto Scarborough

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
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

UTQAP Cyclical Review: Final Assessment Report and Implementation Plan

1. Review Summary

Program(s) Reviewed:	• 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):	Professor Anne Condon, Department of Computer Science, University of British Columbia Professor Richard A. Davis, Department of Statistics, Columbia University Professor Craig Evans, Department of Mathematics, University of California, Berkeley
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

UNIVERSITY OF TORONTO SCARBOROUGH

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,

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.