UNIVERSITY OF TORONTO SCARBOROUGH

OFFICE OF THE CAMPUS COUNCIL

FOR APPROVAL **PUBLIC** **OPEN SESSION**

TO: UTSC Academic Affairs Committee

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DATE: March 16, 2021 for March 23, 2021

AGENDA ITEM: 5

ITEM IDENTIFICATION:

Major Modification: Specialist and Specialist (Co-operative) programs in Statistics (HBSc), UTSC

JURISDICTIONAL INFORMATION:

University of Toronto Scarborough Academic Affairs Committee (AAC) "is concerned with matters affecting the teaching, learning and research functions of the Campus" (*AAC Terms of Reference, Section 4*). Under section 5.6 of its terms of reference, the Committee is responsible for approval of "Major and minor modifications to existing degree programs." The AAC has responsibility for the approval of Major and Minor modifications to existing programs as defined by the University of Toronto Quality Assurance Process (*UTQAP, Section 3.1*).

GOVERNANCE PATH:

1. **UTSC Academic Affairs Committee [For Approval] (March 23, 2021)**

PREVIOUS ACTION TAKEN:

No previous action in governance has been taken on this item.

HIGHLIGHTS:

The Department of Computer and Mathematical Sciences (CMS) at the University of Toronto Scarborough (UTSC) is proposing to introduce a new stream called Statistical Science to the Specialist and Specialist (Co-operative) programs in Statistics (HBSc).

The Specialist and Specialist Co-op programs in Statistics are currently programs with two streams:

- **The Quantitative Finance Stream** focuses on teaching the computational, mathematical and statistical techniques associated with modern-day mathematical finance. This stream is aimed at students who are interested in careers or further graduate work in finance with an emphasis on the mathematical/statistical aspects of finance.
- **The Statistical Machine Learning and Data Science Stream** focuses on applications of statistical theory and concepts to the discovery (or "learning") of patterns in data. This stream is aimed at students who are interested in careers or further graduate work in data science with a strong background in the computational aspects of that activity.

Currently, there is no option available to students who are interested primarily in a traditional Statistics Specialist program – one that emphasizes data collection, design and inference. The proposed stream – Statistical Science – will fill this gap in the CMS offerings for students who are primarily interested in the statistical sciences, rather than the study of more abstract mathematics, and/or that do not want to spend a significant amount of their time programming. The proposed Statistical Science stream is aligned with traditional Statistics Specialist programs found at most universities, and will focus on data collection and the appropriate approach to analyzing data to answer questions of interest.

The proposed stream is aimed at students who are interested in careers or further graduate work in statistics, without the heavy emphasis on computational requirements or the algorithmic approach found in the Statistical Machine Learning and Data Science stream.

The proposed stream is aligned with the Department's academic plans to ensure that students are offered program options that support their academic goals and career aspirations. The need for the proposed stream is highlighted in the Department's most recent self-study, and in the review report for the 2019-20 external review, the review team supported the creation of the proposed stream.

This proposal also includes minor modifications to the existing enrolment and course requirements for Specialist and Specialist (Co-operative) programs in Statistics:

- Under the revised enrolment 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 CSC and MAT 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. It is anticipated that 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 CS, MAT, or STA program.
- Changes to the course requirements include adjustments to the core that are designed to strengthen the preparation that students have so that they can successfully complete the upper-level courses and to tailor the courses taken in the first years so that they are more suitable for each of the three streams. For example, students in the Machine Learning and Data Science Stream are required to complete CSCA48H, but this course is not necessary for student success in the other two streams. All streams will now require MATA67H (or CSCA67H), as well as upper-level first year Calculus courses because these courses provide training in the mathematical and logical skills required to effectively learn more advanced statistical, computational and financial concepts.
    - In the Quantitative Finance stream, additional optional courses have been added to a bin of upper-level courses to give students the option of completing Readings courses, or a second Projects course. This change gives students more opportunity to explore areas of interest to them.
    - In the Statistical Machine Learning and Data Science stream, a course that used to be part of the core has been added as requirement (CSCA48H3), and a set of optional courses have been removed and added to the core (MATA67H3 or CSCA67H3).

The proposed changes will not impact continuing students, who will be grandfathered. New students will be required to following the revised enrolment requirements and complete the revised course requirements.

There has been extensive consultation regarding the proposed changes within CMS. There has also been consultation with the Arts and Science Co-op Office and the Dean's Office. The proposal has been reviewed by, and received sign-off from, the Office of the Vice-Provost, Academic Programs. Feedback from all stakeholder groups have been incorporated into the proposal.

FINANCIAL IMPLICATIONS:

There are no net implications to the campus operating budget.

RECOMMENDATION:

Be It Resolved,

THAT the proposed Department of Computer and Mathematical Sciences, undergraduate curriculum changes for the 2021-22 academic year, as detailed in the respective curriculum report, be approved.

DOCUMENTATION PROVIDED:

1. Major Modification: Specialist/Specialist (Co-op) programs in Statistics (HBSc), dated March 3, 2021.

University of Toronto
Major Modification Proposal:

New Stream Within an Existing Undergraduate Program

This template should be used to bring forward all proposals for new streams in existing undergraduate programs for governance approval under the University of Toronto's Quality Assurance Process.

Program name and degree: please specify specialist or major and clarify throughout whether streams are in both or one.	(1) Specialist in Statistics (HBSc) (2) Specialist (Co-operative) in Statistics (HBSc) *note: the Major/Major Co-op programs are undifferentiated, and will remain undifferentiated.
Existing streams, if any:	1. Quantitative Finance 2. Statistical Machine Learning and Data Science
Proposed new stream(s): specify whether this is in the specialist or major or both.	Statistical Science *note: being added to the Specialist/Specialist Co-op programs only
Other Changes	Minor modifications to the programs' enrolment requirements and completion requirements
Faculty/academic division:	Department of Computer and Mathematical Sciences, University of Toronto Scarborough
Faculty/academic division contact:	Annette Knott, Academic Programs Officer: annette.knott@utoronto.ca
Proponent:	Prof. Michael Evans: mevansthree.evans@utoronto.ca
Version date: please change as you edit this proposal.	March 3, 2021

1 Summary

- Please provide a brief summary or overview of how the proposed stream(s) relates to the existing program and any existing streams.

Major Modifications:

The Department of Computer and Mathematical Sciences (CMS) at the University of Toronto Scarborough (UTSC) currently offers the following programs in Statistics, all of which lead to the Honours Bachelor of Science degree:

- Specialist and Specialist Co-op
- Major and Major Co-op
- Minor

In addition, CMS offers a Minor program in Applied Statistics, Specialist/Specialist Co-op programs in Mathematics with a stream in Statistics, and in partnership with the Department of Management, they offer Double Degrees for the BBA, Specialist/Specialist Co-op program in Management and Finance/Honours BSc, Specialist/Specialist Co-op program in Statistics, Quantitative Finance Stream

The Specialist and Specialist Co-op programs in Statistics are programs with two streams:

The Quantitative Finance Stream focuses on teaching the computational, mathematical and statistical techniques associated with modern-day mathematical finance. Students acquire a thorough understanding of the mathematical models that underlie financial modeling and the ability to implement these models in practical settings. This stream is aimed at students who are interested in careers or further graduate work in finance with an emphasis on the mathematical/statistical aspects of finance.

The Statistical Machine Learning and Data Science Stream focuses on applications of statistical theory and concepts to the discovery (or "learning") of patterns in data. This field is a recent development in statistics with wide applications in science and technology including computer vision, image recognition, natural language processing, medical diagnosis, and stock market analysis. This stream is aimed at students who are interested in careers or further graduate work in data science with a strong background in the computational aspects of that activity.

This is a proposal to introduce a third stream called Statistical Science to both the Specialist and Specialist Co-op programs. Currently, there is no option available to students who are interested primarily in a traditional Statistics Specialist program – one that emphasizes data collection, design and inference. The proposed stream will fill this gap in the CMS offerings for students who are primarily interested in the statistical sciences, rather than the study of more abstract mathematics, and/or that do not want to spend a significant amount of their time programming. The proposed Statistical Science stream is aligned with traditional Statistics Specialist programs found at most universities, and will focus on data collection and the appropriate approach to analyzing data to answer questions of interest.

The proposed stream is aimed at students who are interested in careers or further graduate work in statistics, without the heavy emphasis on computational requirements or the algorithmic approach found in the Statistical Machine Learning and Data Science stream.

The proposed stream is aligned with the Department's academic plans to ensure that students are offered program options that support their academic goals and career aspirations. The need for the proposed stream is highlighted in the Department's most recent self-study, and in the review report for the 2019-20 external review, the review team supported the creation of the proposed stream.

Minor Modifications:

Included in this proposal are minor modifications to the Specialist/Specialist Co-op programs' existing enrolment requirements and course requirements as described below. Under the revised enrolment 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 CSC and MAT 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. It is anticipated that 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 CS, MAT, or STA program.

Changes to the course requirements include adjustments to the core that are designed to strengthen the preparation that students have so that they can successfully complete the upper-level courses and to tailor the courses taken in the first years so that they are more suitable for each of the three streams. For example, students in the Machine Learning and Data Science Stream are required to complete CSCA48H, but this course is not necessary for student success in the other two streams. All streams will now require MATA67H (or CSCA67H), as well as upper-level first year Calculus courses because these courses provide training in the mathematical and logical skills required to effectively learn more advanced statistical, computational and financial concepts.

In the Quantitative Finance stream, additional optional courses have been added to a bin of upper-level courses to give students the option of completing Readings courses, or a second Projects course. This change gives students more opportunity to explore areas of interest to them.

In the Statistical Machine Learning and Data Science stream, a course that used to be part of the core has been added as requirement (CSCA48H3), and a set of optional courses have been removed and added to the core (MATA67H3 or CSCA67H3).

Notes:

- The Major/Major (Co-operative) programs in Statistics are undifferentiated programs, and will remain undifferentiated programs.
- The changes to the enrolment requirements for the Specialist in Statistics do not impact the Double Degree: BBA, Specialist/Specialist Co-op Program in Management and Finance/Honours BSc, Specialist/Specialist Co-op Program in Statistics, Quantitative Finance Stream.

2 Effective Date

Fall 2021, for the 2021-22 academic year.

3 Academic Rationale

- What are the academic reasons for the change, the relationship with existing streams and how does the new stream fit with the unit's and division's academic plans?

Major Modifications:

There are many students who are interested in studying statistics, as evidenced by significant increases in enrolments in UTSC Statistics programs over the past few years: from 141 students in the Specialist programs in 2015-16 to 256 students in the Specialist programs in 2018-19, and from 291 students in the Major programs in 2015-16 to 523 students in 2018-19.

The Specialist/Specialist Co-op programs in Statistics currently have two streams:

- Quantitative Finance, and Machine Learning and Data Science: The Quantitative Finance Stream focuses on teaching the computational, mathematical and statistical techniques associated with modern-day mathematical finance. Students acquire a thorough understanding of the mathematical models that underlie financial modeling and the ability to implement these models in practical settings. This stream is aimed at students who are interested in careers or further graduate work in finance with an emphasis on the mathematical/statistical aspects of finance.
- The Statistical Machine Learning and Data Science Stream focuses on applications of statistical theory and concepts to the discovery (or "learning")

of patterns in data. This field is a recent development in statistics with wide applications in science and technology including computer vision, image recognition, natural language processing, medical diagnosis, and stock market analysis. This stream is aimed at students who are interested in careers or further graduate work in data science with a strong background in the computational aspects of that activity.

In addition to the Specialist/Specialist Co-op programs in Statistics, CMS offers students Specialist/Specialist Co-op programs in Mathematics, with a Statistics stream. The overarching Specialist/Specialist Co-op programs in Mathematics give students a sound foundation in the main areas of mathematics such as algebra and analysis, while the stream in Statistics provides a greater exposure to statistics, including data collection, statistical inference, stochastic processes, multivariate analysis and regression analysis.

While each of these options serves the needs of specific groups of students, the existing streams in the Specialist/Specialist Co-op programs in Statistics and the Statistics stream within the Mathematics Specialist/Specialist Co-op programs all have significant components that are not strictly statistical in nature. Moreover, there is currently no option available to students who are interested primarily in a traditional Statistics Specialist program – one that emphasizes data collection, design and inference, and that is most suitable for students interested in graduate education in Statistics, and careers in government, biomedical applications and even commercial sports organizations.

The addition of a stream in Statistical Science to the existing Specialist/Specialist Co-op programs in Statistics will fill this gap in CMS offerings for students who are interested in statistics as an area of study, but are primarily interested in the statistical sciences. This stream is designed for students that do not wish to study more abstract mathematics, and/or do not want to spend a significant amount of their time programming. It is worth noting that the current course offerings in Statistics cover all the major topics that a traditional program in Statistics requires *but they currently cannot be bundled together into an offering that focuses on these topics*.

The proposed stream is aligned with the Department's academic plans to ensure that students are offered program options that support their academic goals and career aspirations. The need for the proposed stream is highlighted in the Department's most recent self-study, and in the review report for the 2019-20 external review, the review team supported the creation of the proposed stream.

Minor Modifications:

<u>Changes to the Enrolment Requirements</u>:

The Department of Computer and Mathematical Sciences (CMS) has been reviewing and revising the admissions criteria for their Computer Science (CS), Mathematics (MAT), and Statistics (STA) 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, CMS has been engaged in a thorough re-evaluation of the entire admissions process. The impetus for this re-evaluation has been three-fold: first, and most importantly, to address the needs of students by significantly reducing, if not entirely eliminating, uncertainty and stress regarding admissions criteria; second, to ensure that the 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.

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 many CMS students are not admitted to the CMS program that they intended to study. It is also problematic for the Department since it inevitably leads to programs and courses that are oversubscribed.

The revised admissions process mirrors the process adopted by the Department of Computer Science in the Faculty of Arts and Science on the St. George campus. Effective Fall 2021, 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 CSC and MAT 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. It is anticipated that 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 CS, MAT, or STA 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.

Changes to the Core:

The following course changes have been made to the core:

- A number of retired courses are being removed from the 0.5 credit writing requirement. These courses have been retired for many years, and removing them from the Calendar is simple housekeeping.
- CSCA48H3 has been deleted as a required course. CSCA48H3 is not essential to all streams of the Specialist/Specialist Co-op programs, and can actually act as a significant hurdle for some students. This change will eliminate this problem.
- [MATA67H3 or CSCA67H3] is being added as a requirement. This change will ensure that students acquire the requisite logical skills necessary for successfully studying higher level statistics courses. Many students have lacked these skills in the past and including this course as a requirement in the core will address this gap.
- MATA30H3 is being removed as an optional course; MATA31H3 becomes a required, rather than an optional course. This change will ensure that students get the best possible training necessary to study and comprehend the mathematical underpinnings for much of statistical, mathematical financial and computational methodology. This requirement sends a much more appropriate message to students about the rigor needed for participating in the Statistics Specialist/Specialist Co-op programs.
- MATA36H3 is being removed as an optional course; MATA37H3 becomes a required, rather than an optional course. Similar to the change for MATA30/A31, this change will ensure that students get the best possible training necessary to study and comprehend the mathematical underpinnings for much of statistical, mathematical financial and computational methodology. This requirement sends a much more appropriate message to students about the rigor needed for participating in the Statistics Specialist/Specialist Co-op programs.

Changes to the Quantitative Finance Stream:

- STAD92H3, STAD93H3, and STAD05H3 have been added as optional courses to complete component 8 of the course requirements (Upper-level courses). Readings and Projects courses are good options for completing this component; adding multiple options allows students to complete more than one Readings or Projects course.

Changes to the Statistical Machine Learning and Data Science Stream:

- [MATA67H3 or CSCA67H3] has been deleted as a requirement for this stream as it is being added a requirement to the core.

- CSCA48H3 is being added as a required course to the stream. This course, which was removed from the core, provides important foundational learning for the Machine Learning and Data Science stream. As such, it is being added to the requirements for this particular stream.

4 Need and Demand

- Provide a brief description of the need and demand for the proposed stream focusing, as appropriate, on student interest, societal need, employment opportunities for prospective graduates, interest expressed by potential employers and accreditational bodies.

Table 1: Enrolments in Statistics Specialist Programs:

Program	2015-16	2016-17	2017-18	2018-19
Statistics Specialist – Quantitative Finance stream	87	93	56	41
Statistics Specialist – Statistical Machine Learning and Data Science stream	36	114	148	153
Statistics Specialist Co-op – Quantitative Finance stream	17	13	15	16
Statistics Specialist Co-op – Statistical Machine Learning and Data Science stream	1	5	19	46
Mathematics Specialist – Statistics stream	34	39	78	61
Mathematics Specialist Co-op – Statistics stream	10	5	6	6

Student Demand:

Many UTSC students are interested in studying statistics. This is evidenced by significant increases in the overall enrolments in UTSC Statistics programs since 2015-16 (see Table 1, above).

Part of impetus for this enrolment growth comes from a broad-based societal interest in data science, and it is expected that this demand will remain strong for many years to come. The Statistical Machine Learning and Data Science stream of the Specialist/Specialist Co-op programs currently are most closely aligned with the field of data science, and consequently it is not surprising that their enrolments have exploded.

However, the Statistical Machine Learning and Data Science stream requires students to complete a full spectrum of Computer Sciences courses that are focused on programming and computation. The proposed stream in Statistical Science will be a more suitable option for students who are interested in data collection and analyzing data, but are not interested in, or prepared for, the Computer Science requirements of the stream in Statistical Machine Learning and Data Science.

It should also be acknowledged that many of the students currently attracted to the Statistical Machine Learning and Data Science stream of the Specialist/Specialist Co-op programs in Statistics are actually seeking an alternate route to the Department's Computer Science programs. As the Department moves forward with implementing additional enrolment caps on the Statistical Machine Learning and Data Science stream, students wanting to pursue their interest in data science will need an appropriate option; the proposed stream in Statistical Science will be ideal in this regard.

Societal Need:

As noted above, there is a growing broad-based societal interest in data science. Many large firms, government agencies, and consulting companies have come to recognize that data science can play a key role in solving the problems they face, and so there has been a sharp increase in demand for graduates of Statistics programs. This state of affairs is expected to continue for many years, and it is anticipated that graduates from all streams of the Specialist/Specialist Co-op programs in Statistics (existing and proposed) will have ample opportunity for employment.

Many positions in data science require training at the Masters level, and the proposed stream will provide the preparation needed to be successful in these programs. It is, perhaps, worth noting that a number of the Department's statistics students have gone on to graduate school at institutions like Columbia, Harvard, Yale, Carnegie Mellon, MIT, Waterloo, Toronto, etc. The success of CMS students in achieving meaningful careers is one way in which the Department will measure the effectiveness of the program.

5 Program Requirements

- Describe the requirements for the stream(s). (In doing so, please ensure that you explain how the requirements for the stream fit into the requirements for the program as a whole and relate to the requirements for the other existing fields.)

The Specialist/Specialist Co-op programs in Statistics currently have two streams – Quantitative Finance, and Machine Learning and Data Science – and students must complete a total of 13.0 credits, regardless of the stream.

Common Core:

Of the 13.0 credits required for the programs, 7.5 credits are common to all streams, including:

- 0.5 credit in a writing focused courses from the humanities or social sciences;
- 2.5 credits in first year introductory computer science, linear algebra and calculus courses;
- 2.5 credits in second year foundational courses in linear algebra, multivariable calculus, linear programming, probability and statistics; and
- 2.0 credits in upper-level courses in numerical computation, probability theory and stochastic processes, and regression and multivariate analysis.

Through this core, students gain a deep understanding of modern statistical theory and methodology. These courses span the full spectrum of skills and knowledge expected of a graduate from a Statistics program. Together with the optional STA courses, they provide an ideal training for employment and for higher level training in the field.

Quantitative Finance Stream:

In this stream, students complete an additional 5.5 credits, as follows:

- 1.0 credit in courses in microeconomics and the fundamentals of investment;
- 1.5 credits in foundational courses in multivariable calculus, differential equations, and financial derivatives; and
- 4.0 credits in upper level courses in differential equations, statistics and finance, time series analysis, etc.

Through these courses, students gain a deep understanding of the mathematics, statistics and financial concepts necessary to understand mathematical finance.

Statistical Machine Learning and Data Science Stream:

In this stream, students complete an additional 5.5 credits, as follows:

- 0.5 credit in introductory computer science;
- 2.0 credits in foundational computer science, including software design, databases and web applications, computation theory, and design and analysis of data structures; and
- 4.0 credits in upper-level courses in computer science and statistics, including machine learning, and statistical inference.

Through these courses, students gain the skills and understanding necessary to function in fields where intensive computation plays a key role in statistical analyses. Students obtain a solid background in computer science, mathematics and statistics.

Proposed Statistical Science Stream:

Students in the proposed stream will complete a total of 13.0 credits, including the 7.5 credits of the core as described above, and 5.5 credits in courses for the stream, as follows:

- 0.5 credit in introductory statistics, focused on data science;
- 1.0 credit in foundational calculus and differential equations;
- 2.5 credits in upper-level courses focused on applied statistics, data collection and analysis, statistical inference, and probability and stochastic processes; and
- 1.5 credits in upper level courses selected from a bin of courses focused on advanced statistics courses in time series stochastic processes, and higher dimensional data analyses.

Through these courses, students gain skills and knowledge in all the major subareas of the field of statistics. This prepares students for immediate employment or further graduate study in the field.

For complete description of the Specialist/Specialist Co-op programs in Statistics, showing the proposed changes, please see Appendix A, below.

6 Degree-Level Expectations (DLEs), Program Learning Outcomes and Program Structure

- Outline the learning outcomes as they relate to the proposed stream, underlining where these are similar to or different from those for existing steams. Indicate the means by which students will satisfy the relevant DLEs.

Degree-Level Expectations	Program Learning Outcomes	How the Program Design/Structure Supports the Degree-Level Expectations
1. Depth and Breadth of Knowledge Depth of Knowledge: is attained through a progression of introductory, core and specialized courses. Specialized courses will normally be at the C and D levels.	Depth and breadth of knowledge in the stream in Statistical Science is reflected in students who are able to: 1.1. Employ mathematical tools from calculus and linear algebra to solve quantitative problems	1.1 The key courses that support this learning outcomes are: MATA22, MATA31, MATA37, MATB24, MATB41, MATB42, MATB44, MATB61, STAB52, and STAB57. These courses comprise the foundations of the mathematical and statistical skills required for mastering the more

Breadth of Knowledge: students will gain an appreciation of the variety of modes of thinking, methods of inquiry and analysis, and ways of understanding the world that underpin different intellectual fields.	encountered in common statistical applications. 1.2. Perform formal reasoning using mathematical arguments, including the ability to comprehend and produce basic proofs. 1.3. Apply probability theory for describing random phenomena and quantifying uncertainty in common statistical applications. 1.4. Recognize the main theoretical paradigms that underlie statistical reasoning, and describe the strengths and weaknesses of different approaches. All Specialist/Specialist Co-op students achieve learning outcomes 1.1, 1.2 and 1.3; however, students in the proposed stream also achieve learning outcome 1.4. This will ensure that students have a sophisticated understanding of the current state of the field.	advanced aspects of the discipline. 1.2 The key courses that support this learning outcome are: MATA67 and STAC62. MATA67 provides training in logical thinking and proof as these are used in the mathematical sciences. STAC62 builds on STAB52 to provide a rigorous development of probability theory and relies heavily on mathematical proof. 1.3 The key courses that support this learning outcome are: STAB52, STAC62, and STAC63. These courses are all concerned with probability theory – both the mathematical development and its use as a modeling tool in practical applications. 1.4 The key courses that support this learning outcome are: STAB57 and STAC58. Both STAB57 and STAC58 are concerned with statistical theory. STAB57 is a mix of practical statistics and theory while STAC58 discusses the major approaches that address the issue of how one is to reason in statistical contexts. Since there is still some debate concerning this in the discipline this issue is addressed through a comparison of the different paradigms.
2. Knowledge of Methodologies Students have a working knowledge of different methodologies and approaches relevant to their area of study. They are able to evaluate the efficacy of different methodologies in addressing questions that arise in their area of study.	Knowledge of methodologies in the stream in Statistical Science is reflected in students who are able to: 2.1. Apply data collection strategies for observational, sampling, and experimental studies, ensuring the necessary conditions for drawing appropriate conclusions concerning relationships among variables. 2.2. Examine data using statistical summaries and visualizations, and explain the	2.1 The key courses that support this learning outcome are: STAC50 and STAC67. STAC50 is directly concerned with the correct methods for data collection and how inferences are affected when this is not possible. STAC67 studies the key analytical methods that used to analyse data obtained in experimental as well as observational contexts. 2.2 The key courses that support this learning outcome are: STAC33, STAC50, STAC51, STAC67, STAC58, STAD37, and STAD57. These

	difference between exploratory and confirmatory data analyses. 2.3. Employ common statistical methods for drawing inferences from data, and check the implicit assumptions of such methods. 2.4. Employ common statistical methods for describing relationships and making predictions, and objectively assess their performance. 2.5. Perform basic computational tasks and calculations in a general-purpose programming language. 2.6. Access, combine, manipulate, and visualize data efficiently using appropriate software. 2.7. Apply and interpret common statistical methods using appropriate software. 2.8. Use simulation to perform probability calculations and to support statistical methodology and inference. All Specialist/Specialist Co-op students achieve these outcomes; however, . learning outcome 2.1 is central to the proposed stream. An important aspect of the role of a professional statistician is to ensure that data is collected, not only correctly, but in the best possible way.	courses cover the major methodological techniques used in statistical analyses. 2.3 The key courses that support this learning outcome are: STAC33, STAC50, STAC51, STAC67, and STAC58. These courses cover the major methodological techniques used in statistical analyses. STAC33 is, in particular, focused on providing training in practical statistical skills. 2.4 The key courses that support this learning outcome are: STAC33, STAC50, STAC51, STAC67, STAC51, STAC58, and STAD37. These courses cover the major methodological techniques used in statistical analyses to analyse relationships among variables. STAC67 and STAC51 are directly concerned with building models for the analysis of such relationships and the other courses make use of these techniques. 2.5 The key courses that support this learning outcome are: CSCA08, CSCC37, STAA57, STAC33, STAC67, STAD37, and STAD57. The CSC courses are concerned with developing programming and numerical computations skills. The STA courses develop these skills in statistical contexts and train students in the use of the R programming language. 2.6 The key courses that support this learning outcome are: STAB57, STAC33, STAC67, STAD37, and STAD57. All of these courses require that students perform extensive computations using the R language. 2.7 The key courses that support this learning outcome are: STAA57, STAC33, STAC67, STAD37, and STAD57. Typically, computations to implement statistical methodology

		must be carried out using software. Each of these courses train in this aspect and, in particular, STAC33 gives students exposure to a variety of such statistical software. 2.8 The key courses that support this learning outcome are: STAB52, STAC62 and STAC63. Simulation is a probabilistic computational technique and training in this is provided in each of these courses.
3. Application of Knowledge Students are able to frame relevant questions for further inquiry. They are familiar with, or will be able to seek the tools with which, they can address such questions effectively.	Application of knowledge in the stream in Statistical Science is reflected in students who are able to: 3.1. Conduct a statistical investigation along the entire process of: problem formulation, study design, data collection, analysis, and conclusion. All Specialist/Specialist Co-op students achieve this outcome, however, training students in the kinds of analyses that a statistician is called upon to carry out is the central focus of the proposed stream. There is far more emphasis on this aspect of the training as compared with the other streams.	3.1 The key courses that support this learning outcome are: STAC33, STAC50, STAC67. These courses typically involve students carrying out statistical projects. This is particularly true of STAC33 where students are extensively involved in practical data analysis projects.
4. Awareness of Limits of Knowledge Students gain an understanding of the limits of their own knowledge and an appreciation of the uncertainty, ambiguity, and limits to our collective knowledge and how these might influence analyses and interpretations.	Awareness of the limits of knowledge in the stream in Statistical Science is reflected in students who are able to: 4.1. Use statistical reasoning to critically assess the merits and limitations of different approaches to the analysis of data. All Specialist/Specialist Co-op students achieve this outcome; however, the existing Machine Learning and Data Science stream focuses on the computational aspects of data	4.1 The key courses that support this learning outcome are: STAC33 and STAC58. STAC33 introduces the practical aspects of this learning outcome while STAC58 is concerned with the theoretical considerations.

	analyses, and the proposed stream focuses much more on the theoretical and interpretational side. The goal in the proposed stream is to educate statisticians who are critical thinkers.	
5. Communication Skills Students are able to communicate information, arguments, and analyses accurately and reliably, both orally and in writing. They learn to read and to listen critically.	Communication skills in the stream in Statistical Science are reflected in students who are able to: 5.1. Communicate statistical ideas, methods, and results orally and in writing to technical and non- technical audiences. 5.2 Demonstrate effective collaboration and reproducible reporting skills, and an understanding of ethical (e.g., privacy) and professional (e.g., objectivity and, accountability) considerations. All Specialist/Specialist Co-op students achieve these outcomes; however, the existing streams focus on computational or financial applications of statistical analyses, while the proposed stream focuses on training students to become statisticians who often function in service capacities in research organizations. These learning outcomes are key aspects of that training.	5.1 The key courses that support this learning outcome are: the 0.5 FCE Writing requirement, STAC33, STAC67, STAD37, and STAD57. Students are required in STAC33 to write up the results of the statistical analyses they carry out in written reports as if they were doing this for a client. The other courses listed also have this as part of the curriculum but not to the same degree. 5.2 The key courses that support this learning outcome are: STAC33, STAC67, STAD37, and STAD57. All of these courses are concerned with practical data analysis and conveying clearly the meaning of statistical results.
6. Autonomy and Professional Capacity The education students receive achieves the following broad goals: • It gives students the skills and knowledge they need to become informed, independent and creative thinkers • It instils the awareness that knowledge and its applications are influenced by, and contribute to, society	Autonomy and professional capacity in the stream in Statistical Science are reflected in students who are able to: 6.1. Employ more advanced probability theory and stochastic processes for statistical modelling and applications. 6.2. Use more sophisticated models and methods for analyzing complex data (e.g. multivariate and time series data).	6.1 The key courses that support this learning outcome are: STAC62, STAC63, and STAD57. These courses are all concerned with advanced probability theory. 6.2 The key courses that support this learning outcome are: STAD37, STAD57, and STAD80. All of these courses are concerned with advanced statistical models. 6.3 The key courses. that supports this learning outcome is: STAC58. Comparative inference is the primary focus of this course.

• It lays the foundation for learning as a life-long endeavour	6.3. Critically assess the theoretical paradigms that have been developed as frameworks for statistical reasoning. 6.4. Comprehend and summarize academic literature and participate in statistical research. The proposed stream is concerned with training students in modern statistical methodology. While this is also true for the existing streams, the Statistical Science stream focuses on learning outcomes 6.3 and 6.4 as these are necessary for students whose primary interest is to become a statistician.	6.4 The key courses that support this learning outcome are: STAD92, STAD93, STAD94, and STAD95. These courses are intended to give students the opportunity to learn about current research topics in statistics.

7 Assessment of Teaching and Learning

- Please describe the methods of evaluation for the various program requirements as they relate to the proposed stream.
- Describe how the methods for assessing student achievement are appropriate and effective relative to established program learning outcomes and DLEs. In other words, how will faculty be able to determine whether students have learned and can do what we expect them to by the end of the program?
- How will the program document and demonstrate the level of performance of students consistent with the University's DLEs?

Most CMS courses have large enrolments, and testing is the primary method of evaluating student performance. In an environment where copying of solutions among students, as well as searching of solutions on the internet are common, the use of midterms and finals is a much fairer and more effective method of evaluation, albeit potentially more stressful for the students.

When tests are used as the sole assessment tool it is helpful to ensure students also engage in self-assessment opportunities. This is accomplished by assigning problems and then subsequently putting up solutions. Also, past exams are made available so that students can test their understanding. In some upper-level courses, particularly at the D-level, enrolments are such that assignments, group projects and oral presentations are used as part of the evaluation. These methods of evaluation are in many ways preferable as there can be more direct interaction between the students

and the instructor but, for the reasons noted, these methodologies are employed in only a small number of CMS courses.

The reading courses (STAD92H3 and STAD93H3) and project courses (STAD94H3 and STAD95H3) are also available as electives in the program. While these are not suitable for average students, for top students they prove excellent opportunities to delve deeper into the material than is covered in other courses.

8 Consultation

- Describe the expected impact of what is being proposed on the nature and quality of the unit's/division's program of study and any impact on other units/divisions.
- Describe any consultation with the Deans of Faculties/divisions that will be implicated or affected by the creation of the proposed stream.

The proposed new stream has been discussed widely within CMS in departmental meetings. There has also been close consultation with the Supervisor of Studies for the Specialist programs in Mathematics, and with all Statistics faculty. The proposed stream was highlighted during the 2019-20 external review of CMS, and the review team has signalled they are generally supportive.

The proposal has been shared with the Arts and Science Co-op Office, and their feedback has been incorporated into this proposal.

9 Resources

- Describe any resource implications of the change(s) including, but not limited to, faculty complement, space, libraries and enrolment/admissions.
- Please specify where this may impact significant enrolment agreements with the Faculty/Provost's office.
- Indicate if the major modification will affect any existing agreements with other institutions, or will require the creation of a new agreement to facilitate the major modification (e.g., Memorandum of Understanding, Memorandum of Agreement, etc.). Please consult with the Provost's office (vp.academicprograms@utoronto.ca) regarding any implications to existing or new agreements.

The proposed stream will not impact faculty or other teaching resources in CMS. In fact, the research and teaching focus of many the current Statistics faculty at UTSC is fully aligned with the new stream, and it is anticipated that the introduction of this stream will help to alleviate some of the burden currently experienced by faculty whose research/teaching is more aligned with the Statistical Machine Learning and

Data Science stream, which is currently over-subscribed. In addition, there are no new resources associated with courses since no new courses are being proposed. There are no resource implications associated with space or libraries.

There will be no impacts on enrolment agreements with the Provost's Office. Overall enrolments at UTSC and in CMS will not change, however, it is anticipated that enrolments in specific CMS programs will shift. This shift is a desired outcome of these changes.

The proposed new stream will not impact any existing agreements with other institutions; however, if there are any changes, the appropriate processes will be followed.

Faculty Complement

- Brief statement to provide evidence of the participation of a sufficient number and quality of faculty who will actively participate in the delivery of the program and the new stream.

Table 2: List of Faculty

Faculty Member and Rank	% Appointment in CMS	Area(s) of Specialization
Ken Butler, Assistant Professor, Teaching Stream	34%	Applied Statistics
Sotirios Damouras, Associate Professor Teaching Stream	100%	Mathematics, Finance and Statistics
Michael Evans, Professor	100%	Statistics
Sohee Kang, Associate Professor Teaching Stream	100%	Biostatistics
Daniel Roy, Associate Professor	100%	Machine Learning
Mahinda Samarakoon, Associate Professor Teaching Stream	100%	Statistics
Qiang Sun, Assistant Professor	100%	Statistics
Balint Virag, Professor	100%	Probability
Linbo Wang, Assistant Professor	100%	Statistics
Leonard Wong, Assistant Professor	100%	Mathematics, Finance and Statistics

There are 11 faculty members in CMS that will actively support the existing Specialist/Specialist Co-op programs in Statistics, and will support the proposed new

stream: two full Professors (Michael Evans, Balint Virag), one Associate Professor (Daniel Roy), three Assistant Professors (Qiang Sun, Linbo Wang, Leonard Wong), and three Associate Professors, Teaching Stream (Sotirios Damouras, Sohee Kang, Mahinda Samarakoon).

Michael Evans is an expert researcher on statistical inference. Balint Virag is an expert researcher in probability theory. Daniel Roy is an expert researcher in machine learning. Qiang Sun is an expert researcher in high-dimensional inference. Linbo Wang is an expert researcher on causal inference. Leonard Wong is an expert researcher on mathematical finance and transportation theory. All of these researchers have published widely in their respective fields.

Sohee Kang and Mahinda Samarakoon have expertise in biostatistics and statistics, respectively while Sotirios Damouras has expertise in mathematical finance and statistics. Ken Butler has expertise in applied statistics and is currently part-time. All have long and distinguished teaching careers in statistics. The department is also currently hiring another Assistant Professor, Teaching Stream in Statistics.

Overall there is ample expertise to mount the Statistical Science stream with no constraints.

10 UTSC Administrative Steps

Administrative Steps Required	Date
Departmental Curriculum Committee	June 16, 2020
Dean's Office Green Light	August 11, 2020

11 UTQAP Process

Levels of Approval Required	Date
• **Decanal Sign-Off** • **Provost Office Sign-Off**	• March 3, 2021 • March 2, 2021
UTSC Academic Affairs Committee	March 23, 2021
Submission to Provost's Office	
AP&P – reported annually	
Ontario Quality Council – reported annually	

Appendix A: Calendar Descriptions, Specialist Programs in Statistics (showing changes)

SPECIALIST PROGRAM IN STATISTICS (SCIENCE)

Supervisor of Studies*:* S. Damouras Email: sotirios.damouras@utoronto.ca (416-287-7269)

Program Objectives
This program provides training in the discipline of Statistics. Students are given a thorough grounding in the theory underlying statistical reasoning and learn the methodologies associated with current applications. A full set of courses on the theory and methodology of the discipline represents the core of the program. In addition, students select one of ~~two~~ three streams, each of which provides immediately useful, job-related skills. The program also prepares students for further study in Statistics and related fields.

The Quantitative Finance Stream focuses on teaching the computational, mathematical and statistical techniques associated with modern-day finance. Students acquire a thorough understanding of the mathematical models that underlie financial modeling and the ability to implement these models in practical settings. This stream prepares students to work as quantitative analysts in the financial industry, and for further study in Quantitative Finance.

The Statistical Machine Learning and Data Science Stream focuses on applications of statistical theory and concepts to the discovery (or "learning") of patterns in data. This field is a recent development in statistics with wide applications in science and technology including computer vision, image understanding, natural language processing, medical diagnosis, and stock market analysis. This stream prepares students for direct employment in industry and government, and further study in Statistical Machine Learning.

The Statistical Science Stream is concerned with giving students a sound grounding in statistical methodology and theory. Students acquire expertise in the proper collection of data, the methods used to analyze data to answer scientific questions of interest, and the theory that underlies these activities. The program provides preparation for employment as a statistician or for further graduate studies in statistics.

Enrolment Requirements

Enrolment in the Specialist Program in Statistics (all streams) is limited. Students may apply to enter the program after completing 4.0 credits, and must meet the requirements described below:

1. Students already admitted to the UTSC Year 1 Statistics admissions category:

Required Courses:

Students must have passed the following ~~all of the A-level~~ CSC and MAT courses: ~~required in the program(~~

- All streams: CSCA08H3, ~~CSCA48H3,~~ [CSCA67H3 or MATA67H3], MATA22H3, ~~MATA30H3/~~MATA31H3 and ~~MATA36H3/~~MATA37H3~~)~~;
- Machine Learning and Data Science stream only: CSCA48H3.

Required Grades:

There are a limited number of available spaces in each stream of the Specialist in Statistics.
Students that meet all of the following requirements will be eligible to be considered for one of the spaces in a Statistics Specialist POSt; admission will be based on academic performance in the required A-level courses, identified above. Students who meet all of the following requirements but are not admitted to the Specialist, will be admitted to the Major in Statistics:

- All streams: a cumulative grade point average (CGPA) of at least 2.5 over the following courses: CSCA08H3, CSC/MATA67H3, MATA22H3, MATA31H3, and MATA37H3; and
- For the Machine Learning and Data Science stream only: A final grade of at least B in CSCA48H3.

2. Students admitted to other UTSC Year 1 admissions categories:

Students that have been admitted to other CMS admissions categories (Computer Science or Mathematics) or any other UTSC Year 1 admissions categories are eligible to apply for a Statistics Specialist POSt. Admission will be based on academic performance in the required A-level courses, identified above. The requirements change each year depending on available spaces and the pool of eligible applicants, and students are cautioned that there is no guarantee of admission; as such, students are strongly advised to plan to enrol in backup programs.

~~Students are admitted on the basis of academic performance in program courses;~~

~~f~~For more information about the admission requirements, please visit the following CMS webpage.

~~Students who are not admitted as above may apply after completing at least 7.5 credits, including the core A-level courses listed above as well as MATB24H3, MATB41H3, MATB61H3, STAB52H3, and STAB57H3. Students are admitted on the basis of academic performance in program courses; for more information about the admission requirements, please visit the following CMS webpage.~~

Program Requirements
To complete the program, a student must meet the course requirements described below.

The first-year requirements of the ~~two~~ three streams are almost identical, except that the Quantitative Finance stream requires MGEA02H3, ~~while~~ the Statistical Machine Learning and Data Science stream requires CSCA48H3, and the Statistical Sciences stream requires STAA57H3 ~~[CSCA67H3 or MATA67H3]~~; these courses need not be taken in the first year. ~~In the second year, the two streams have considerable overlap. This structure makes it relatively easy for students to switch between the two streams as their interests in Statistics become better defined.~~

Note: There are courses on the St. George campus that can be taken to satisfy some of the requirements of the program. STAB52H3, STAB57H3, STAC62H3, and STAC67H3, however, must be taken at the University of Toronto Scarborough; no substitutes are permitted without permission of the program supervisor.

Core (7.5 credits)

1. Writing Requirement (0.5 credit) (*)
0.5 credit from the following: ANTA01H3, ANTA02H3, ~~(CLAA02H3), (CTLA19H3)~~, CTLA01H3, ENGA10H3, ENGA11H3, ENGB06H3, ENGB07H3, ENGB08H3, ENGB09H3, ENGB17H3, ENGB19H3, ENGB50H3, ~~(ENGB51H3)~~, GGRA02H3, GGRA03H3, GGRB05H3, ~~(GGRB06H3)~~, ~~(HISA01H3), (HLTA01H3)~~, ACMA01H3~~, (HUMA01H3), (HUMA11H3), (HUMA17H3), (LGGA99H3)~~, LINA01H3, PHLA10H3, PHLA11H3, WSTA01H3.
(*) It is recommended that this requirement be satisfied by the end of the second year.

2. A-level courses (2.5 credits)
CSCA08H3 Introduction to Computer Science I
~~CSCA48H3 Introduction to Computer Science II~~
MATA22H3 Linear Algebra I or Mathematical Sciences
~~*and*~~
~~*0.5 credit from the following:*~~
MATA31H3~~*~~ Calculus I for Mathematical Sciences
~~MATA30H3 Calculus I for Physical Sciences~~

~~*and*~~
~~*0.5 credit from the following:*~~
MATA37H3~~*~~ Calculus II for Mathematical Sciences
[MATA67H3 or CSCA67H3 Discrete Mathematics]
~~MATA36H3 Calculus II for Physical Sciences~~
~~(*) MATA31H3 and MATA37H3 are recommended; the latter requires the former.~~

3. B-level courses (2.5 credits)
MATB24H3 Linear Algebra II
MATB41H3 Techniques of the Calculus of Several Variables I
MATB61H3 Linear Programming and Optimization
STAB52H3 Introduction to Probability
STAB57H3 Introduction to Statistics

4. C-level courses (1.5 credits)
CSCC37H3 Introduction to Numerical Algorithms for Computational Mathematics
STAC62H3 Probability and Stochastic Processes I
STAC67H3 Regression Analysis

5. D-level courses (0.5 credit)
STAD37H3 Multivariate Analysis

A. Quantitative Finance Stream
This stream requires a total of 26 courses (13.0 credits). In addition to the core requirements, 11 other courses (5.5 credits) must be taken satisfying all of the following requirements:

6. Additional A-level courses (0.5 credit)
MGEA02H3 Introduction to Microeconomics: A Mathematical Approach

7. Additional B-level courses (2.0 credits)
ACTB40H3 Fundamentals of Investment and Credit
MATB42H3 Techniques of Calculus of Several Variables II
MATB44H3 Differential Equations I
STAB41H3 Financial Derivatives

8. Additional Upper-Level courses (3.0 credits)
MATC46H3 Differential Equations II
STAC70H3 Statistics and Finance I
STAD57H3 Time Series Analysis
STAD70H3 Statistics and Finance II
and
1.0 credit from the following:
CSCC11H3 Introduction to Machine Learning and Data Mining

MATC37H3 Introduction to Real Analysis
STAC51H3 Categorical Data Analysis
STAC58H3 Statistical Inference
STAC63H3 Probability and Stochastic Processes II ~~Models~~
STAD68H3 Advanced Machine Learning and Data Mining
STAD92H3 Readings in Statistics
STAD93H3 Readings in Statistics
STAD94H3 Statistics Project
STAD95H3 Statistics Project
APM462H1 Nonlinear Optimization
Note: Students enrolled in this stream should also consider taking complementary courses in economics and finance (e.g. MGEA06H3, MGEB02H3, MGEB06H3, MGEC72H3), or ~~a~~the Minor in Economics for Management Studies.

B. Statistical Machine Learning and Data Science Stream
This stream requires a total of 26 courses (13.0 credits). In addition to the core requirements, 11 other courses (5.5 credits) must be taken satisfying all of the following requirements:

6. Additional A-level courses (0.5 credit)
CSCA48H3 Introduction to Computer Science II
~~[CSCA67H3 or MATA67H3 Discrete Mathematics]~~

7. Additional B-level courses (2.0 credits)
CSCB07H3 Software Design
[CSCB20H3 Introduction to Databases and Web Applications or STAA57H3 Introduction to Data Science]
CSCB36H3 Introduction to the Theory of Computation
CSCB63H3 Design and Analysis of Data Structures

8. Additional Upper Level courses (3.0 credits)
CSCC11H3 Introduction to Machine Learning and Data Mining
STAC58H3 Statistical Inference
[STAD68H3 Advanced Machine Learning and Data Mining or STAD78H3 Machine Learning Theory]
and
1.5 credits from the following (*):
Any C or D-level CSC, MAT or STA courses, excluding: STAC32H3, STAC53H3 and STAD29H3, 1.0 credit must be STA courses.
(*) Some of the courses on this list have prerequisites that are not included in this program; in choosing courses to satisfy this requirement, check the prerequisites carefully and plan accordingly.

C. Statistical Science Stream

This stream requires a total of 26 courses (13.0 credits). In addition to the core requirements, 11 other courses (5.5 credits) must be taken satisfying all of the following requirements:

6. Additional A-level courses (0.5 credit)

STAA57H3 Introduction to Data Science

7. Additional B-level courses (1.0 credit)

MATB42H3 Techniques of Calculus of Several Variables II
MATB44H3 Differential Equations I

8. Additional C-level courses (2.5 credits)

STAC33H3 Introduction to Applied Statistics
STAC50H3 Data Collection
STAC51H3 Categorical Data Analysis
STAC58H3 Statistical Inference
STAC63H3 Probability and Stochastic Processes II

9. Additional C- and D-level courses (1.0 credit)*

1.0 credit from the following:

CSCC11H3 Introduction to Machine Learning and Data Mining
MATC34H3 Complex Variables
MATC37H3 Introduction to Real Analysis (strongly recommended for students who wish to pursue graduate studies)
STAD68H3 Advanced Machine Learning and Data Mining
STAD78H3 Machine Learning Theory
STAD80H3 Analysis of Big Data
STAD92H3 Readings in Statistics
STAD93H3 Readings in Statistics
STAD94H3 Statistics Project
STAD95H3 Statistics Project

*Students should plan ahead when taking these courses to ensure that prerequisites are satisfied and, in the case of STAD92H3, STAD93H3, STAD94H3 and STAD95H3, that a faculty member has agreed to supervise the course (as this is not guaranteed).

10. Additional D-level courses (0.5 credit)

STAD57H3 Time Series Analysis

SPECIALIST (CO-OPERATIVE) PROGRAM IN STATISTICS (SCIENCE)

Supervisor of Studies: S. Damouras (416-287-7269) Email: sotirios.damouras@utoronto.ca
Co-op Contact: askcoop@utoronto.ca

The Specialist (Co-operative) Program in Statistics is a Work Integrated Learning (WIL) program that combines academic studies with paid work terms in the public, private, and/or non-profit sectors. The program provides students with the opportunity to develop the academic and professional skills required to pursue employment in these areas, or to continue on to graduate training in an academic field related to Statistics upon graduation.
In addition to their academic course requirements, students must successfully complete the additive Arts & Science Co-op Work Term Preparation courses and a minimum of three Co-op work terms.

Enrolment Requirements

Enrolment in the Specialist (Co-operative) program in Statistics is limited.

Current Co-op Students:
Students admitted to a Co-op Degree POSt in their first year of study must request a Co-op Subject POSt on ACORN upon completion of 4.0 credits. Students must have completed the required A-level CSC and MAT courses, and achieved the required grades, described in the Enrolment Requirements for the Specialist in Statistics. In addition, they must also have achieved a CGPA of at least 2.5 across all attempted courses. ~~and must have passed all of the A-level CSC and MAT courses required in the program (CSCA08H3, CSCA48H3, MATA22H3, MATA30H3/MATA31H3 and MATA36H3/MATA37H3). Students are admitted on the basis of academic performance in program courses; for more information about the admission requirements, please visit the following CMS webpage. In addition, they must also have achieved a CGPA of at least 2.5 across all attempted courses.~~

~~Students who are not admitted as above may apply after completing at least 7.5 credits, including the core A-level courses listed above as well as MATB24H3, MATB41H3, MATB61H3, STAB52H3, and STAB57H3. Students are admitted on the basis of academic performance in program courses; for more information about the admission requirements, please visit the following CMS webpage. In addition, they must also have a CGPA of at least 2.5 across all attempted courses.~~

Prospective Co-op Students:
Prospective students (i.e., those not yet admitted to a Co-op Degree POSt) must meet the enrolment requirements noted above and have a CGPA of at least 2.75 across all attempted courses.

~~Prospective students (i.e., those not already admitted to a Co-op Degree POSt) may apply to the Co-op Program after completing 4.0 credits, and must have passed all of the core A-level courses required in the program (CSCA08H3, CSCA48H3, MATA22H3, MATA30H3/ MATA31H3 and MATA36H3/MATA37H3). Students are admitted on the basis of academic performance in program courses; for more information about the admission requirements, please visit the following CMS webpage. In addition, they must also have achieved a CGPA of at least 2.75 across all attempted courses.~~

~~In addition to requesting the Co-op Program on ACORN,~~ ~~p~~ Prospective students must request the Co-op program on ACORN. ~~also submit a Co-op Supplementary Application Form, which is available from the Arts & Science Co-op Office website. Submission~~ Request deadlines follow the Limited Enrolment Program Application Deadlines set by the Office of the Registrar each year. Failure to ~~submit both the Supplementary Application Form and~~ make the program request on ACORN will result in that student's application not being considered.

Program Requirements
Students must complete the program requirements as described in the Specialist Program in Statistics.

Co-op Work Term Requirements
Students must satisfactorily complete three Co-op work terms, each of four-months duration. To be eligible for their first work term, students must be enrolled in the Specialist (Co-op) Program in Statistics and have completed at least 7.0 credits.

In addition to their academic program requirements, Co-op students complete up to five Co-op specific courses. These courses are designed to prepare students for their job search and work term experience, and to maximize the benefits of their Co-op work terms. They cover a variety of topics intended to assist students in developing the skills and tools required to secure work terms that are appropriate to their program of study, and to perform professionally in the workplace. These courses must be completed in sequence, and are taken in addition to a full course load. They are recorded on transcripts as credit/no credit (CR/NCR) and are considered to be additive credit to the 20.0 required degree credits. No additional course fee is assessed as registration is included in the Co-op Program fee.

Co-op Preparation Course Requirements:

1. COPB50H3/(COPD01H3) – Foundations for Success in Arts & Science Co-op
- Students entering Co-op from outside of UTSC (high school or other postsecondary) will complete this course in Fall or Winter of their first year at UTSC. Enrolment in each section is based on admission category: Typically, students in Computer Science, Mathematics and Statistics enroll in the Fall semester while all other Arts & Science Co-op admission categories enroll in the Winter semester however this may vary year to

year.
- Current UTSC students entering Co-op in April/May will complete this course in the Summer semester.
- Current UTSC students entering Co-op in July/August will complete this course in the Fall semester.

2. COPB51H3/(COPD03H3) – Preparing to Compete for your Co-op Work Term
- This course will be completed eight months in advance of the first scheduled work term.

3. COPB52H3/(COPD11H3) – Managing your Work Term Search & Transition to Work
- This course will be completed four months in advance of the first work scheduled work term.

4. COPC98H3/(COPD12H3) – Integrating Your Work Term Experience Part I
- This course will be completed four months in advance of the second scheduled work term.

5. COPC99H3/(COPD13H3) – Integrating Your Work Term Experience Part II
- This course will be completed four months in advance of the third scheduled work term (for programs that require the completion of 3 work terms and/or four months in advance of any additional work terms that have been approved by the Arts and Science Co-op Office.

Students must be available for work terms in each of the Fall, Winter and Summer semesters and must complete at least one of their required work terms in either a Fall or Winter semester. This, in turn, requires that students take courses during at least one Summer semester.

For information on fees, status in Co-op programs, and certification of completion of Co-op programs, see Section 6B.5 or the Arts and Science Co-op section in the UTSC *Calendar*.