# Faculty of Arts & Science
## Major Modification to Program Form

<table>
<thead>
<tr>
<th>Program Title</th>
<th>POST Code</th>
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<tbody>
<tr>
<td>Actuarial Science Major</td>
<td>ASMAJ 0608</td>
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### Division
Associated with (Division)  
Arts & Science  
n/a

### Unit
Associated with (Unit)  
Department of Statistical Sciences  
n/a

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<tr>
<th>Effective Date</th>
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<tr>
<td>March 1, 2018</td>
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## Program Information

### Current Calendar Copy

### Enrolment Requirements
This is a limited enrolment program. All students who request the program and obtain at least the specified mark(s) in the required course(s) will be eligible to enrol. Courses required in either the major or specialist programs in actuarial science may not be taken as CR/NCR.

Required courses: MAT137Y1 with a final mark of at least 65% and ECO101H1 + ECO102H1, both with a final mark of at least 70%. Note that the Mathematics Department enforces MAT223H1/MAT240H1 as a prerequisite for MAT237Y1.

### Completion Requirements

(8.5 courses or their equivalent, including at least two full-course equivalents at the 300+-level, of which at least one is a the 400 level)

#### First Year:
1. MAT137Y1 (65%)/MAT157Y1  
2. ECO101H1 (70%), ECO102H1 (70%)  
3. MAT223H1/MAT240H1 (should be taken in first year, enforced prerequisite for MAT237Y)  
STA130H1 is strongly recommended.

#### Higher Years:
1. MGT201H1  
2. ACT240H1, ACT245H1, ACT247H1, ACT348H1, ACT370H1  
3. MAT237Y1/MAT257Y1  
4. STA257H1, STA261H1  
5. Two of: ACT349H1, ACT371H1, ACT372H1, ACT451H1, ACT452H1, ACT455H1, ACT460H1, ACT466H1, ACT470H1, ACT473H1, ACT475H1, STA302H1, STA347H1, STA457H1

### NOTES:
1. In order to enroll in ANY 300- or 400-level ACT course, the minimum grade of C must be obtained in each of ACT240H1, ACT245H1 and ACT247H1. The enrolment requirements and the prerequisites for all ACT courses will be strictly enforced.
2. Students who have an interest in pursuing studies in mathematical finance should consider taking MAT244H1, MAT336H1/MAT337H1 and APM346H1.
Enrolment Requirements

This is a limited enrolment program. All students who request the program and obtain at least the specified mark(s) in the required course(s) will be eligible to enrol. Courses required in either the major or specialist programs in actuarial science may not be taken as CR/NCR.

Required courses: MAT137Y1 with a final mark of at least 63%. Note that the Mathematics Department enforces MAT223H1/MAT240H1 as a prerequisite for MAT237Y1.

Completion Requirements

(8.5 full courses or their equivalent)

First Year:
1. MAT137Y1 (63%)/MAT157Y1 (60%)
2. MAT223H1/MAT240H1 (should be taken in first year, enforced as a prereq for MAT237Y1)

To be completed before the end of Second Year:
1. STA130H1 (students should complete this course by the end of the Fall Semester of Second Year)
2. CSC108H1/CSC120H1/CSC121H1/CSC148H1

Higher Years:
1. ACT240H1, ACT245H1, ACT247H1, ACT348H1, ACT370H1
2. MAT237Y1/MAT257Y1
3. STA257H1, STA261H1
4. ACT451H1, ACT452H1, STA302H1

STA314H1 is strongly recommended.

NOTES:
1. In order to enroll in ANY 300- or 400-level ACT course, the minimum grade of C must be obtained in each of ACT240H1, ACT245H1 and ACT247H1. The enrolment requirements and the prerequisites for all ACT courses will be strictly enforced.
2. Students who have an interest in pursuing studies in mathematical finance should consider taking MAT244H1, MAT336H1/MAT337H1 and APM346H1.
3. Students interested in actuarial practices should consider taking ACT371H1, ACT372H1, ACT470H1, ACT471H1, ACT473H1, ACT475H1.

Proposal Questions - General

Brief Description of the Proposed Changes (Provide a brief summary.)

We propose to add STA130H1 (Intro to statistical reasoning) and a first-year computer science course to be required courses to be completed before the end of the second year, and changes to 1st and 2nd year required courses. We propose to change the higher year program from a “choose-two-from-a-list” structure to a mandatory set of courses. The total number of required courses does not change. These changes emerge from discussions in the Department of Statistics self-study and align the program with changes in the profession toward data science concepts.
## Details of the Proposed Changes

*Changes to program description, requirements, and program learning outcomes.*

1. Add STA130H1 (intro to statistical reasoning) and a first-year CSC course as mandatory courses to be completed before the end of second year.
2. Higher year requirements: we propose to eliminate the current elective list and replace it with a mandatory list of three core courses.
3. Remove MGT201H1 as a required course.
4. Remove ECO101H1 & ECO102H1 as required courses.

## Rationale

*Explain why the changes have been proposed, providing any additional information that may be helpful for review, or of relevance for Curriculum Committees. This may include connections to the unit’s priorities, recent reviews or institutional planning, or alignment with other programs.*

The actuarial profession is marching into the age of Big Data. Increasingly, employers in various actuarial fields are requiring new actuarial hires to have sophisticated knowledge in statistics and data science. To meet the new demands from the industry and the profession, the Society of Actuaries (SOA) - the education and credentialing body of North American actuaries - recently released its new curriculum effective from July 2018. One of the key additions to SOA’s new curriculum is a new exam in Statistics for Risk Modeling (SRM) which includes modern statistical and data science techniques. There will also be a new five-hour proctored project on predictive analytics, as a capstone requirement following the completion of the SRM exam. Casualty Actuarial Society (CAS), the credentialing body for actuaries working in the Property and Casualty fields, has also published their new curriculum for 2018 entailing similar changes in direction. The proposed changes to the existing Actuarial Science Major program at UofT aim to stay current with new trends and demand from the profession and in line with SOA and CAS new curriculum.

These goals emerged in the recent self-study within the Department of Statistics, to adapt Actuarial Science programs in this direction. This report also noted the importance of better integration of actuarial science and data science and anticipated the current proposal: “From discussions with industry partners we have learned of a growing need in industry for actuaries who also have a strong background in data science. We are currently in the preliminary stages of developing an undergraduate program in our department that will be a combination of actuarial science and data science.”

Detailed rationale for each proposed change:

1. **Add STA130H1 and first-year CSC course as mandatory first-year courses:** STA130H1 is a new course offered by the Statistics program, first offered in 2016-17. This is an introductory course on statistical learning, including basic concepts in data science and an introduction to the program R (which is required for many STA courses in the second and higher years). STA130H1 and a first-year CSC course will become the prerequisites for another new course STA314H1, which will be offered for the first time in 2018-19. STA314H1 will be a strongly recommended higher-year course for the Major students, as it covers much of the new modern statistical techniques and data science topics, which had been added to SOA and CAS new curriculum. Due to limits on the number of required courses in a Major program, we cannot require STA314H1 for the Major program. Nevertheless, it will be a strongly recommended course especially for students who intend to prepare for accreditation. Its prerequisites - STA130H1 and a first-year CSC course are required - for their own merits and importance in the actuarial core curriculum, as well as in anticipation of students electing STA314H1 in their higher years.

2. **Higher year requirements:** we propose to eliminate the current elective list and replace it with a mandatory list of three core courses. These three courses, along with the currently required higher-year courses, cover the fundamental knowledge of key branches of actuarial science. We believe all students graduating with an actuarial Major should have studied those fundamentals (e.g. loss models, statistical regression models), in anticipation of further graduate-level or on-the-job trainings in a chosen actuarial field.

3. **Remove MGT201H1 as a required course:** With the shift to emphasise modern statistics and data science concepts in first year and higher year required courses, this introductory accounting course is not at the core of an undergraduate actuarial curriculum. However, MGT201H1 will be added to SOA’s Validation by Educational Experience (VEE) database for students to fulfill their credits for accounting. Remove ECO101H1+ECO102H1 as required courses: Macro and Micro-economics are useful background knowledge for actuarial students. However, they are not at the core of an actuarial curriculum. Given the growing number of actuarial core courses, we decided to remove the economics courses as program requirements, in order to prioritize data science concepts as a core
direction identified in the department self-study as well as in the new professional curriculum.

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<tr>
<th>Impact (Specify the impact the changes will have on students, and on other units/programs. If courses listed in the program are offered by other units, include a letter of support from the head of that unit, speaking to enrolment controls and priority enrolment, if applicable.)</th>
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<tr>
<td>There is no anticipated impact on other units, with the only exception of potential impact on a first-year CSC course as it becomes required in the actuarial science major program. In the cases of ECO101H1, ECO102H1, and MGT201H1, since these courses are still used for the purpose of obtaining SOA’s Validation by Educational Experience (VEE) credits for Economics and Accounting, we don’t expect any significant change in enrollment in those two courses from actuarial students. Department advising will guide students planning to professionalize as actuaries. For students who enroll in the Major to explore actuarial curriculum, these changes, especially the mandatory core courses in the higher years, will provide them with a better idea of key branches of knowledge in actuarial science. They will be better prepared should they choose to professionalize in the future.</td>
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<th>Consultation (Describe consultation that has already been done with students, faculty, and other units.)</th>
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<td>Within the Department of Statistical Sciences, we have consulted with the Statistics program regarding adding STA130H1 as required and STA314H1 as highly recommended course, and the Associate Chair of Statistics endorses those changes. In developing the proposed changes, we began consultation with the Office of the Dean and the Office of the Registrar in Summer 2017. We have consulted with the Department of Economics regarding the proposed changes to remove ECO101H1 &amp; ECO102H1 from the Major program requirements. Since these courses are still used for the purpose of obtaining SOA’s Validation by Educational Experience (VEE), we expect students who opt for accreditation to continue to enroll in these courses. We also expect that students who opt for accreditation will also continue to enroll in MGT201H. We do not expect enrolment in these courses to be severely affected.</td>
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<th>Diversity (How does the proposed program or modification support diversity? E.g. through curriculum design supporting different learners, accommodation, etc.)</th>
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<td>The proposed changes do not affect Diversity.</td>
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<th>Resource Implications (Provide a statement of the resource requirements for the program, and an indication of whether you can meet these requirements through your existing resources, or have received additional resources from the Dean.)</th>
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<td>There is no anticipated impact on resource. We expect to meet these requirements through existing resources.</td>
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<th>Faculty and TA Support</th>
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<th>Arts &amp; Science - Divisional Data: For further definition of these objectives, see the Degree Objectives Guidelines (July 2008).</th>
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<th>Academic Context (Outline the context that explains why the program is designed this way, e.g. relation of program to discipline, students’ interests, career paths, etc.)</th>
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<td>The actuarial profession is marching into the age of Big Data. Increasingly, employers in various actuarial fields are requiring new actuarial hires to have sophisticated knowledge in statistics and data science. To meet the new demands from the industry and the profession, which includes modern statistical and data science techniques, the proposed changes aim to stay current with new trends and demand from the profession and in line with new curriculum from the Society Of Actuaries and Casualty Actuarial Society. The introduction of STA130H1 as a mandatory course and STA314H1 as a strongly recommended course accomplish these changes as they are core courses to cover much of the new modern statistical techniques and data science topics. Those courses are key expansions of our core actuarial specialist curriculum at UofT. Modifying requirements in the higher year program to a mandatory set of courses, covers the fundamental knowledge of key branches of actuarial science. We believe all students graduating with an actuarial major should have studied...</td>
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those fundamentals, in anticipation of further graduate-level or on-the-job trainings in a chosen actuarial field. We would prefer to include more courses, but there is no space in the Major program. The mandatory set we chose are the most important ones to bring the program in line with the current academic context.

**Learning Outcomes** *(Explain how the change affects the program learning outcomes, including disciplinary goals, relevant methodologies and skills acquired upon program completion.)*

UofT’s actuarial science program is recognized as one of the most rigorous academic program in Canada. In the past, the program (as well as the profession) has a focus on “long-term” coverages (life, annuities, pension). With the proposed changes, the program will achieve further balance between long-term and short-term coverages (property and casualty). More importantly, students will have better statistical foundation and be better at working with data. They will acquire knowledges in data science and modern statistical methods which can be extremely valuable in their future careers. Changes to required courses in first and second year shift the learning outcomes away from more general background toward focused concepts in actuarial analysis.

The shift to mandatory courses in the higher years, rather than a set of options with more flexible choice, will ensure all students graduating with an actuarial Major have studied foundational courses covering key knowledge in different branches of actuarial science, with an emphasis on loss models and data analysis. While some flexibility may be lost by replacing a list of elective courses with a set of mandatory courses, the program gains in the balance by ensuring consistency for our Major graduates outweigh the drawback.

**Depth of Knowledge** *(Explain how particular courses allow students to achieve depth of knowledge, relating to the proposed change.)*

The introduction of data science concepts as required through STA130H1 and as strongly recommended in STA314H1 promotes depth of knowledge through development of statistical reasoning, data science concepts, and modern statistical techniques. The reduction of flexibility in higher year requirements, with the change to require ACT451H1 and ACT452H1 instead of a long list of courses shifts development of depth of knowledge to topics in loss models, credibility theory, and simulation, which is key for future actuaries. At the same time we propose that all Major students be required to take STA302H1, which contributes to depth of knowledge in regression models, which is crucial for students choosing to work in “short-term” actuarial fields.

**Competencies:** For these five categories, describe how each competency is developed within the program to the degree relevant to the area/discipline. If the program does not address a particular competency, explain why that competency is not relevant to your area/discipline and how students in your program are expected to attain that competency within their overall degree program.

**Critical and Creative Thinking**

Proposed changes to the Major are not expected to affect competency in Critical and Creative Thinking. Students have an opportunity to develop this in both the required courses and a variety of elective courses that continue to be available to them.

**Communication**

Proposed changes to the Major are not expected to affect competency in Communication. This is developed in all our practicum courses (ACT371H1, ACT372H1, ACT471H1, ACT470H1, ACT473H1, ACT475H1) which will continue to be available to Major students. The newly required course STA130 also has a strong communication component in its curriculum.

**Information Literacy**

Proposed changes to the Major are not expected to affect competency in information literacy. Identifying, evaluating and effectively using needed information and data to problem solve is a core component of actuarial curriculum.

**Quantitative Reasoning**

The Actuarial Science Major is a highly quantitative program including in-depth courses in loss models and data science. The proposed changes develop existing competencies within a more streamlined higher year curriculum.

**Social and Ethical Responsibility**
Our practicum courses (specifically ACT473H1, ACT475H1) address social and ethical responsibility and will continue to be available to Major students.

**Integrative, Inquiry-based Activity**

Our practicum courses (ACT371H1, ACT372H1, ACT471H1, ACT470H1, ACT473H1, ACT475H1) all use case studies and inquiry-based learning activities as part of the pedagogy and they will continue to be available to Major students.

| UTQAP Process |
|---|---|
| **Steps** | **Approvals** |
| Consultation with Dean’s office (and VPAP) | January 2018 |
| Undergraduate Curriculum Committee | February 2, 2018 |
| Faculty of Arts & Science Council | February 14, 2018 |
| Reported to the Provost and included in annual report to AP&P | May 10, 2018 |
| Ontario Quality Council – reported annually | Summer 2018 |