Change to Program/Graduate Diploma Academic Requirements Proposal Template

The following information is required for all proposals involving a change to program/graduate diploma academic requirements, including admission requirements. To facilitate the review/approval process, please use the headings below (and omit the italicized explanations below each heading).

1. Program/Graduate Diploma: Mathematics and Statistics Ph.D.

2. Effective Session of Proposed Change(s): Fall 2015

3. Proposed Change(s) and Rationale

   The description of and rationale for the proposed change(s) should provide information with respect to each of the following points. Please provide:

   a) A description of the proposed change(s) and rationale, including alignment with academic plans.

   This document outlines changes to the degree program requirements for the Ph.D. They are meant to improve times to completion and clearly outline the timeline for students to complete their degree in a reasonable time length.

   Some of the changes are cosmetic and involve clarifying the list of requirements and when they should be completed. In addition, there are two major changes to the Ph.D. requirements.

   The comprehensive examination requirement is reduced from 6 exams completed in 5 terms to 4 exams completed in 3 terms. For the statistics stream, the 'practicum requirement' is moved from the comprehensive exams to a separate requirement that is completed in the second year of study.

   The course requirement for the doctoral degree is not changing in this document. Students must complete 24.0 credits of course work. These courses may or may not be on the list of comprehensive exams.

   What is changing in this document is the number of comprehensive exams and it is decreasing from 6 to 4 for the students in the pure and applied mathematics doctoral streams. Some of the courses that we teach have been decided to be fundamental and they have been designated as comprehensive exam courses. Taking a comprehensive exam is not the same as a taking course. Passing a course is not equivalent to passing a comprehensive exam. Taking an exam does not give you credit for taking a course. Usually passing a comprehensive exam in a subject is considered to be an achievement which is more difficult than passing the final exam in the corresponding course. This situation is typical in mathematics and statistics departments across North America. Most have a comprehensive exam requirement and sometimes these comprehensive exams are related to the final exam for the course and sometimes they are separate.

   A student with a masters degree may begin his or her doctoral degree with a very strong background in the basics of a subject (e.g. 'algebra'). That student may not feel that it is necessary to take the course in the subject (e.g. MATH 6120 6.0: Algebra) and may choose just to take the comprehensive exam in the subject at the end of the year. The comprehensive exam system in the mathematics and statistics doctoral program at York is very similar to those at almost all universities across North America, but every mathematics and statistics department has its own practice and distinct goals behind the comprehensive requirement.
Historically, the comprehensive exams and the courses they are associated with have been more separated than they are now. At some universities, it could be the case that a course on a given subject (e.g. MATH 6120 6.0: Algebra) was given by one instructor and then at the end of the year the comprehensive exam (the Algebra Comprehensive Exam) was given by a second instructor. At York, the practice has evolved and a closer link was established between the exams and courses in order to improve passing rates.

A student in the masters program might take the course and just take the final exam for the course. A doctoral student might take the exact same course and complete the final exam and the comprehensive exam at the end of the term (or there might be some relationship between the comprehensive exam and final exam since the comprehensive exam is usually considered to be more difficult than the final exam). For this reason, the comprehensive exams and courses are still considered separate in the minds of the students and faculty members. It is the practice that instructors of courses that will offer a comprehensive exam make available a syllabus that outlines the material that will be covered on the exam. This comprehensive exam syllabus is separate from the course syllabus and course description.

The topics that can be used to satisfy the comprehensive exam is changed. The number of courses in the current list is 17 and this is changing to 22 (there are 2 deletions and 7 insertions). The enumerated list is also being separated from groups of half courses to single half courses. It was always the case that not every course was offered every year and this will not be different with the new list. The expansion of the list allows the department to increase the variety of subject matter that it is offering and be responsive to the needs of the students and the resources of the department.

The other change is the removal of the language exam requirement. This requirement has not met the pedagogical reasons for it being a part of the Ph.D. since the existence of online translation software.

b) An outline of the changes to requirements and the associated learning outcomes, including how the proposed requirements will support the achievement of program/graduate diploma learning objectives.

(a) Add language which clearly indicates normal time to completion of the graduate degree. This is not a change in regulation or practice, it only indicates the time that we would normally like students to take to finish their degree requirements. Of course by clearly indicating the timeline, we adjust the other regulations (e.g. the number of comprehensive exams) so that the requirements may be reasonably accomplished according to this schedule.

(b) Remove the “language requirement” as part of the requirements for completing the Ph.D. This sort of degree requirement was part of the Ph.D. from a time when mathematics articles published in other languages and the articles were not available in English. This is now rare and language translation software works sufficiently well to determine the meaning of a mathematics article. It was at one time a common practice to have this requirement in mathematics Ph.D. programs across North America, but most have abolished this requirement. This change was approved by the graduate executive committee and the Ph.D. committee.

(c) Clearly make the progress report and advising appointment required by adding it to a checklist of requirements. The progress report was always required and reviewed by the PhD committee but it was not necessarily discussed with the student. Advising appointments were always required but some students have not been following up on this requirement.

(d) The completion of the Dissertation Subject Oral (D.S.O.) has always been required “one year following the completion of the comprehensive exams.” Language will be added indicating that we will be stricter in
the application of this rule by declaring that the requirement will be completed "in the second year of study."

(e) Only the algebra course Math 6120 6.0: Modern Algebra is 6.0 credits. All of the other courses offered for our M.A. and Ph.D. programs are 3.0 credits. We propose separating this course into two 3.0 credit courses and put the material that has more of an appeal to an applied mathematics student in one course and the remainder in a course titled Algebra II. The hope is that the reducing the commitment will increase the appeal of both courses to a larger audience. This change also allows us flexibility about who can teach the courses.

(f) The comprehensive exam topics seemed to follow groups consisting of two courses. These groupings seem to exist mainly because at one time graduate courses were 6.0 credits. Over time this has changed, yet the groupings of the exams still remain. With potential changes to the courses that we will need to offer, to the changes to the M.A. streams in pure, applied and probability streams, it seems more practical to stop considering these exams as grouped in pairs.

(g) comprehensive exams - With the goal of reducing the length of time to completion of the comprehensive exam requirement from 5 terms of study to 3 terms of study we propose reducing the number of comprehensive exams for the pure and applied stream Ph.D. candidates from 6 to 4. The statistics stream candidates will still be required to take 4 comprehensive exams in the first year and then will complete the practicum exam requirement during the second year (which is no longer declared to be a comprehensive exam, it is just a separate requirement). The purpose of the comprehensive exam is to ensure that students have a breadth to their field of study and to establish that students have the tenacity to learn new mathematics to complete a thesis. In all of the discussions about how to formulate the regulations, this was clearly stated as the goal of the final requirement. With this in mind, we would like our students to finish this requirement earlier.

(h) The list of courses that could be used to satisfy the comprehensive exam requirement (Commutative Algebra, Differential Geometry, Probability Theory, Set Theory, Number Theory) was increased. This change in the list does not indicate that we will offer every course every year because the exams can be taken independently from the course if necessary. Math 6120 6.0 was split into Math 6121 3.0 and Math 6122 3.0 and is now two separate exams. Comprehensive exams in Stochastic Processes (Math 6602 3.0) and Probability Models (Math 6604 3.0) were removed from the list of possible exam topics because the courses are integrated with undergraduate courses (Math 4430 3.0 and Math 4431 3.0 respectively) and faculty members felt that they should not serve as a basis for a comprehensive exam.

(i) The main change with respect for students that specialize in statistics is that the 'practicum' requirement will normally be completed in second year. The requirement was always completed within the first two years, now we suggest that it be completed in the second with the expectation that there will be variation. Faculty members expressed strong support for continuing this requirement as part of a statistic student's professional development. However, some noted that some students (particularly those that had English as a second language) found it difficult to complete the requirement in the first year.

c) An overview of the consultation undertaken with relevant academic units and an assessment of the impact of the modifications on other programs/graduate diplomas. (Where and as appropriate, the proposal must include statements from the relevant program/graduate diplomas confirming consultation/support.)

Face to face meetings were held with interested faculty members September 17, 24 and October 22 and several online discussions were held. The comments and suggestions were brought to the graduate executive meeting September 30, the Ph.D. Committee meeting on October 16, the graduate executive meeting October 21, the Ph.D. committee meeting November 6. The final changes were then brought to

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the whole graduate membership and voted on by email by November 6-11. This proposal was sent to APPC in November through April and additional changes were requested.

d) A summary of any resource implications and how they are being addressed. (Attention should be paid to whether the proposed changes will be supported by a reallocation of existing resources or if new/additional resources are required. If new/additional resources are required, the proposal must include a statement from the relevant Dean(s)/Principal.)

All of the proposed changes are not expected to impact resources. We hope that streamlining the requirements and adding language to the text will help reduce the time to completion for the students in the Ph.D. program. The removal of the language requirement will reduce a minor administrative burden. The changes are expected to reduce the number of courses that we are required to offer each year slightly and allow us more flexibility. We currently have no plans to change our course offerings. This should provide students with more options and a better experience in completing their degree requirements.

e) A summary of how students currently enrolled in the program/graduate diploma will be accommodated.

Students who have not completed the language exam requirement will not be required to complete it after Fall 2015.

The schedule to complete the D.S.O. has not been adhered to strictly in the past. Supervisors and students will be advised that they have one year to comply with this requirement. In subsequent years, failure to complete the requirements on time will be considered by the Ph.D. committee as failure to meet satisfactory progress towards the Ph.D.

Students who are currently in their second year of Ph.D. will be expected to complete the comprehensive exam requirements of those prior to these changes. If changes in course offering restrict the ability of current students to complete their requirements accommodations will be made on a case by case basis.
4. Calendar Copy

Using the following two-column format, provide a copy of the relevant program/graduate diploma requirements as they will appear in the graduate Calendar.

<table>
<thead>
<tr>
<th>Existing Program/Graduate Diploma Information (change from)</th>
<th>Proposed Program/Graduate Diploma Information (change to)</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are four components of the degree requirements for a Ph.D. These are:</td>
<td>Five major components make up the degree requirements for the Ph.D. in Mathematics and Statistics. These are 1) coursework 2) comprehensive exams 3) dissertation subject oral 4) dissertation proposal 5) dissertation oral exam (preceded by the dissertation colloquium).</td>
</tr>
<tr>
<td>(a) course requirement, followed by comprehensive examinations;</td>
<td>Students can complete these degree requirements in 4 years and the following is the projected timeline and checklist for completion.</td>
</tr>
<tr>
<td>(b) requirement in the field of specialization of the student, followed by an oral examination;</td>
<td>Projected Timeline/Checklist for Completion</td>
</tr>
<tr>
<td>(c) a dissertation (thesis), followed by two oral examinations on the dissertation (Program Dissertation Colloquium, and Dissertation Defense);</td>
<td></td>
</tr>
<tr>
<td>(d) language requirements.</td>
<td></td>
</tr>
</tbody>
</table>

Previous graduate work taken as a Master’s student may be used to meet at most 12.0 credits of this requirement on request and approval. This request should be made in the
request and approval.

A doctoral candidate must satisfy their comprehensive exam requirement by completing a certain set of comprehensive topics. Each such topic will be completed by satisfactory performance on a set of final examinations in certain prescribed courses. Students need not enrol in the course nor attend lectures in order to write the exam for comprehensive credit. The comprehensive topics, and the course examinations needed for each are as follows:

1. **Analysis** [Any two of Complex Analysis (Math 6300), Measure Theory (Math 6280), Functional Analysis I (Math 6461)].
2. **Algebra** [Modern Algebra (Math 6120)].
3. **Topology and Geometry** [Any two of Group Theory and Geometry (Math 6202), General Topology I (Math 6540), Algebraic Topology I (Math 6550)].
4. **Probability Theory** [Stochastic Processes (Math 6602), Probability Models (Math 6604)].
5. **Differential Equations** [Ordinary Differential Equations (Math 6340), Partial Differential Equations (Math 6350)].
6. **Numerical Analysis** [Advanced Numerical Methods (Math 6651), Numerical Solutions to Differential Equations (Math 6652)].
7. **Mathematical Statistics** [Mathematical Statistics (Math 6620), Advanced Mathematical Statistics (Math 6621)].
8. **Statistical Methods** [Generalized Linear Models (Math 6622), Applied Statistics I (Math 6630)].
9. **Mathematical Methods** [Mathematical Modeling (Math 6931)]

Candidates must declare themselves to be in one of these three streams: applied mathematics, pure mathematics, or statistics streams.

Pure mathematics students have two options: (a) Complete topics 1 and 2. The third topic must be chosen from 3-8, or topic 9 plus one other course chosen from topics 3-8; or (b) Complete topics 1, 4, and 7.

Applied mathematics students must complete three topics, which must include at least two chosen from topics 1, 5, 6. The third topic must be chosen from 1-8, or topic 9 plus

first term of study.

A doctoral candidate must satisfy their comprehensive exam requirement by completing the exams in the first year of study. Students need not enrol in the course nor attend lectures in order to write the exam for comprehensive credit. The comprehensive exams are as follows:

1. Complex Analysis (Math 6300)
2. Measure Theory (Math 6280)
3. Functional Analysis (Math 6461)
4. Applied Algebra (Math 6121)
5. Algebra II (Math 6122)
6. Commutative Algebra (Math 6130)
7. General Topology (Math 6540)
8. Algebraic Topology (Math 6550)
9. Ordinary Differential Equations (Math 6340)
10. Partial Differential Equations (Math 6350)
11. Number Theory (Math 6110)
12. Probability Theory (Math 6605)
13. Category Theory (Math 6180)
14. Differential Geometry (Math 6530)
15. Set Theory (Math 6040)
16. Advanced Numerical Methods (Math 6651)
17. Numerical Solutions to Differential Equations (Math 6652)
18. Mathematical Modeling (Math 6931)
19. Mathematical Statistics (Math 6620)
20. Advanced Mathematical Statistics (Math 6621)
21. Generalized Linear Models (Math 6622)
22. Applied Statistics I (Math 6630)

Note: While not all courses will be offered annually, course offerings will be responsive to student need. Exams may be taken in a year in which the course is not offered.

Candidates must declare themselves to be in one of these three streams: applied mathematics, pure mathematics, or statistics streams. Candidates will decide which
one other course chosen from topics 1-8.
Statistics students must complete topics 7 and 8. In addition, statistics students must fulfill a practicum requirement. This requirements consists of two parts. The first part is the completion of MATH 6627 3.0 or an equivalent consulting course from another university, approved by the Graduate Program Director. The second part is the comprehensive exam in consulting.
All of the above named courses will count as 3 credits, except for Modern Algebra (Math 6120) which will count as 6 credits. During the first year of enrolment in the Ph.D. Program, pure and applied students will have to pass sufficient credits of exams so that they have no more than 9 credits of remaining exams to pass in order to complete the requirements. Statistics students will have to pass either 9 credits of exams or 6 credits of exams plus the practicum. All full-time students will then have to complete the comprehensive exams by the end of their second year of enrolment.

Students in the doctoral Program must demonstrate depth of knowledge in their field of specialization. The candidate must pass an oral examination (Dissertation Subject Oral), which will occur within one year after the comprehensive examinations have been passed.

Language Requirements
A candidate in the doctoral Program must demonstrate the ability to read mathematical text in one language other than comprehensive exams to complete with the approval of their supervisor and the graduate program director.
Pure mathematics students must complete at least one exam from 1-3, one exam from 4-6, one exam from 7-11, plus one additional exam.
Applied mathematics students must complete exam 18, at least one exam from 9 or 10, at least one exam from 16 or 17, plus one additional exam.
Statistics students must complete exams 19, 20, 21 and 22. In addition, statistics students must fulfill a practicum requirement. This requirement is usually completed in the second year of study.

Practicum requirement for statistics stream
The purpose of the practicum is to prepare students for the transition from statistics theory to the application of statistics through consulting and collaboration. The requirement for statistics students consists of two parts. The first part is the completion of MATH 6627 3.0 or an equivalent consulting course from another university, approved by the Graduate Program Director. Further details regarding the requirements for the course can be found in the course description for MATH 6627 3.0. The second part is the comprehensive exam in consulting.

Students in the doctoral Program must demonstrate depth of knowledge in their field of specialization. The candidate must pass an oral examination (Dissertation Subject Oral), which will occur within the second year of study.

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English. The choice of language must be approved by the student’s supervisory committee. The language should be a language in which a significant amount of research of mathematics is published, particularly in fields related to that of the student’s dissertation.

(iii) Progress Report
During the second year of registration and once a year thereafter, all students enrolled in a Ph.D. Program are required to complete an annual research progress report detailing the achievements of the previous year and the objectives for the next year. Permission to continue to register in the program depends on a satisfactory report. Report on Progress forms are available in N519 Ross.

(iv) Deadlines for Meeting Requirements
Students are expected to take most of their comprehensive examinations in their first year and are required to complete the exams by May of their second year of Ph.D. studies. The Dissertation Subject Oral should be taken within one year of passing the comprehensive examinations. The Dissertation itself should be completed within two years of the Dissertation Subject Oral, although one additional year may be allowed by permission.

Graduate studies

LANGUAGE REQUIREMENTS
A candidate must demonstrate the ability to read mathematical text in one language other than English. The choice of the language must be approved by the student’s supervisory committee.