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Regulations and Guidelines  
for  
Graduate Programs  
in the  
Department of Mathematical  
and Statistical Sciences  
University of Alberta

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**Effective: January 1, 2009**

## **Regulations and Guidelines For Graduate Programs in the Department of Mathematical and Statistical Sciences**

### **1.0 Regulations in Common for All Graduate Students**

1.1 In order to qualify for a degree, a graduate student must satisfy the general requirements of the Faculty of Graduate Studies and Research (FGSR) described in Sections 173-174 of the FGSR Calendar and the Departmental requirements described in Section 175.33 of the FGSR Calendar. This document provides more detailed information on Departmental regulations and guidelines. Further information on general requirements is given in the FGSR Graduate Program Manual, which is available for viewing in the Department's Graduate Office.

### **1.2 Maintenance of registration**

To maintain *full-time* registration status in a particular term, students must be registered in one of the following formats:

- (i) At least three 3-credit courses.
- (ii) MATH 900 A/B, STAT 900, THES 903 (plus at least two courses) or THES 906 (plus at least one course).
- (iii) THES 909/THES 919.

- Notes:
- (a) Normally Ph.D. students will not be allowed to register in THES 903/906 until the second and THES 919 in the third year of registration.
  - (b) Ph.D. students are recommended to take their Candidacy Examination before the end of their fifth term. Starting in their sixth term, Ph.D. students who have not passed the Candidacy exam must register in at least three courses or in THES 906 plus at least one course during each term.
  - (c) A minimum of 3 credits must be obtained in any of MATH 900, STAT 900 or THES 9XX to finish a graduate program.

The maintenance of full-time status is especially important for foreign students with respect to their status with immigration authorities, and for students holding scholarships or GTAs, i.e. for virtually all students.

To maintain an active program the student must register in both Fall and Winter terms in course work and/or thesis research.

### **1.3 English language requirements**

All applicants for graduate programs who do not hold a baccalaureate degree or its academic equivalent from a recognized institution in which the language of instruction is English must obtain a satisfactory score on an approved English language examination (usually TOEFL) before they can be admitted. The minimum TOEFL score of 600 is required in the Department of Mathematical and Statistical Sciences. A list of foreign institutions recognized as having English as the language of instruction is available from FGSR. All applicants from non-English-speaking countries are strongly encouraged to submit their TSE-A (Test of Spoken English) score with their application.

### **1.4 Maintenance of academic standing**

Regardless of the student's category, the pass mark in any course taken while registered in the FGSR is C+/2.3 (letter grade/4-point scale). All students in degree programs (including time spent as a qualifying graduate student) or diploma programs must maintain a minimum cumulative grade point average of B/3.0 throughout the course of their program. In cases where the cumulative grade point average falls between 2.3 and 2.7, the Department may recommend the student be put on academic probation; in any case, convocation may not take place with a cumulative grade point average of less than B-/2.7

A student whose *academic* work is unsatisfactory may at any time be required to withdraw. Unless for medical reasons or other reasons accepted by the Graduate Committee, a graduate student with a GPA below 3.0 for two consecutive terms will be considered unsatisfactory, and the Department TA may be terminated. A graduate student with a GPA below 2.7 for two consecutive terms will be asked to leave the program. The GPA is calculated based on the required courses. Extra to Degree courses or courses that will not be given credit toward their program will be excluded.

#### 1.5 **Time limits**

For an M.Sc. degree, all requirements must have been completed within 4 years of the time that the student first registers as a graduate student. For the Ph.D. degree, the time limit is 6 years from the time that the student first registers for the Ph.D. In the case of master's students who are reclassified for a doctoral degree, all requirements must be completed within six years of the time they first register as a graduate student.

The department expects students to complete the M.Sc. program in 2 years and the Ph.D. program in at most 5 years. A student who is admitted with a full-time assistantship, and who maintains a satisfactory academic standing will normally be supported for at most 2 years in the M.Sc. program and at most 5 years in the Ph.D. program. Support for students who continue in the PhD programs after completing an MSc in the department will not be extended to more than a **total** of 6 years. These limitations apply to the length of the entire program, inclusive of any period spent as a qualifying or probationary student.

For students with NSERC or a major University of Alberta scholarship, support will normally be extended to the maximum time limits outlined above.

**Each student's progress is reviewed annually by the Graduate Committee in the spring. Financial support will be suspended or discontinued when progress is deemed unsatisfactory.**

This commitment is subject to the availability of funds. Support during the months of September to April, for those who are not on scholarships, is usually provided by Graduate Teaching Assistantships. During May to August this support is usually provided by Graduate Teaching Assistantships and Graduate Research Assistantships. Further information on assistantships is provided in the document *Regulations Governing Graduate Assistantships*.

#### 1.6 **Appointment of an advisor**

Each student, on admission to a graduate program, will be assigned an advisor by the Graduate Committee. During the first year, the advisor will guide the student's program until a thesis or project supervisor has been approved.

#### 1.7 **Qualifying admissions**

An applicant who does not satisfy the normal admission requirements (see Sections 2.2 and 3.2 below) may be admitted as a qualifying student. During a qualifying period a student will normally be requested to take certain undergraduate courses with the intention of rectifying deficiencies in the student's background. Students should note that neither the courses taken nor the fees paid during a *qualifying* period will be credited toward a subsequent degree program.

Qualifying students do not normally receive graduate assistantships.

Graduate students on academic probation may not be appointed to Graduate Assistantships to teach, mark, instruct in laboratories or the equivalent. They may be assigned research duties only. If a student on academic probation is not eligible for an appointment as a Graduate Assistant then this period shall not be counted against the student's eligibility for a Graduate Assistantship in subsequent years.

#### 1.8 **Course requirements**

Both the M.Sc. and Ph.D. graduate programs have minimum course requirements. These minimum course requirements are not to be viewed as sufficient for a graduate education. Regardless of whether or not the minimum course requirements have been satisfied, graduate students are expected to take at least one lecture course each academic year.

#### 1.9 **Graduate colloquium**

All graduate students are required to attend the graduate colloquium for at least two full terms. All students in thesis-based programs are required to make at least one presentation of their research at the colloquium. The presentation will normally take place before the final oral examination of the student.

### 2.0 **M.Sc. PROGRAMS**

2.1 The Department offers both thesis-based and course-based programs leading to the degree of Master of Science in Mathematical and Statistical Sciences. Each degree will have a particular field of specialization noted on it. Possible fields of specialization are: Applied Mathematics, Mathematics, Statistics, Biostatistics, Mathematical Finance, and Mathematical Physics.

2.2 Candidates for the M.Sc. degree will normally have a B.Sc. (Honours or Specialization) degree or the equivalent from a recognized university, with a strong background in applied or pure mathematics and/or statistics. Students with strong backgrounds in the area but specializing for the first time may be required to take additional course work. Note Section 1.7 above.

2.3 Programs of courses must be approved by the Graduate Committee. See Sections 2.7 and 2.8 below for minimum course requirements in the course-based and thesis-based programs. The Graduate Committee may, on the recommendation of the supervisor, require more than the minimum number of courses.

2.4 Transfer credit may be allowed by FGSR for courses taken elsewhere provided the courses have not been credited toward a previous degree, were not used to satisfy the admission requirements of FGSR and subject to the limits set out in the Calendar.

2.5.1 Students should select the course-based or thesis-based stream by the end of their first term as candidates for the M.Sc. degree. A project or thesis supervisor must be chosen by the end of their second term.

2.6 The residency requirement in all M.Sc. programs offered by the Department is full-time registration for 2 four-month terms.

#### 2.7 **Thesis-based M.Sc.**

The minimum requirements for a thesis-based M.Sc. are met by completing an approved program of graduate courses with a total course weight of 18, and a thesis. Some students will be required to take such additional course work as is deemed appropriate by the Graduate Committee.

Thesis-based MSc students are normally admitted with a full-time teaching assistantship. If students enrolled in a thesis-based MSc want to switch to a course-based MSc they should do so before the end of their first year of study unless otherwise permitted by the Graduate Committee.

The student must have a thesis supervisor and supervisory committee. The thesis should reveal that the candidate is able to work in a scholarly manner and is acquainted with the principal works published on the subject of the thesis. As far as possible it should be an original contribution. The student must defend the thesis in an oral examination. With the approval of the Graduate Committee, the supervisor will arrange an examining committee consisting of at least three faculty members, one of whom must be from another department. The supervisor will not be chair of the examining committee.

Normally the student will make a short (10-20 minute) presentation outlining the thesis and stressing its major points. Following this presentation, the committee members shall ask a variety of questions mostly pertaining to the thesis. They are free, however, to ask more general questions relating to the entire program and background of the student to ensure that the student has a well-rounded knowledge of the subject. After the completion of these questions, the student is asked to leave the examining room and the examining committee makes its decision on the outcome of the exam. The options the committee has to evaluate the student are as follows:

- i) acceptance of thesis;
- ii) acceptance of thesis subject to revisions;
- iii) examination adjourned;
- iv) thesis rejected.

#### 2.7.1 **Thesis-based M.Sc. with Specialization in Statistics**

For the thesis-based M.Sc. with Specialization in Statistics, the program of courses will normally include:

- At least two of STAT 566 (or 664), 665, 571.
- At least two of STAT 561, 568, 575, 578, 679.

Students who have not previously completed the equivalents of STAT 471 and 472 (resp. STAT 479) will be required to include STAT 580 (STAT 503) in their program. At the request of the advisor or supervisor and at the discretion of the Graduate Committee, certain MATH courses may be accepted, or even required, for graduate credit. Students who are planning to pursue a Ph.D. in Statistics are encouraged to include STAT 664 in their program.

#### 2.8 **Course-based M.Sc.**

The minimum requirements for a course-based M.Sc. are met by completing an approved program of graduate courses with a total course weight of 24, and a project. Some students will be required to take such additional course work as is deemed appropriate by the Graduate Committee. Course-based MSc students are not normally admitted with a full-time Teaching Assistantship.

The student must have a project supervisor. The supervisor and one other faculty member will evaluate the project.

### 2.8.1 **Course-based M.Sc. with Specialization in Statistics**

For the course-based M.Sc. with Specialization in Statistics, the program of courses will normally include:

- At least two of STAT 566 (or 664), 665, 571.
- At least four of STAT 532, 558, 559, 561, 562, 568, 575, 578, 590, 679.

Students who have not previously completed the equivalents of STAT 471 and 472 (resp. STAT 479) will be required to include STAT 580 (STAT 503) in their program. At the request of the advisor or supervisor, and at the discretion of the Graduate Committee, STAT 580 may be substituted for STAT 571. At the request of the advisor or supervisor and at the discretion of the Graduate Committee, certain MATH courses may be accepted, or even required, for graduate credit. Students who are planning to pursue a Ph.D. in Statistics are encouraged to include STAT 571 and 664 in their program.

### 2.8.2 **Project Description for the Course-based M.Sc. with Specialization in Statistics**

Normally, the project component of the course-based M.Sc. with Specialization in Statistics will consist of work on one or more statistical consulting problems with clients from outside the Department of Mathematical and Statistical Sciences. This work will be described in a written report, which will be read by the supervisor and one other faculty member. Students will participate in the *Workshop on Applied Statistics*, where consulting problems will be discussed. They will give an oral presentation of their project at the *Workshop*. During the term in which the project report is being written, students will normally register in STAT 900.

Alternatively, the supervisor may suggest a project of a form different from that described above. Such a suggestion must be approved by the Graduate Committee.

### 2.9 **M.Sc. in Mathematical Finance**

Candidates for the Mathematical Finance program will normally have a four-year degree in Mathematics, Statistics, Physics, Engineering or Finance, with GPA of B/3.0, or better, in the work of the final two years, or its equivalent.

The program consists of a minimum of 24 unit weight of courses at 500 level or higher from the list below. The minimum acceptable grades in courses is C+/2.3 and minimum GPA is B/3.0. The program of courses must be approved by the Graduate Committee, which may, on recommendation of the advisor or supervisor, require more than the minimum number of courses.

Students who have not previously completed the equivalents of MATH 417, 436 and 438 may be required to include these courses in their program. If a student, at the time of entering the program, already has the equivalent of some of the 500 level courses listed below, then up to 6 unit weights of these may be replaced by the 400 level courses listed below towards the required minimum 24 units of course weight. Thus, for instance, a student who has the equivalent of FIN 531, MANEC 501 and STAT 571 when he/she joins the program but does not have the equivalent of MATH 436 and MATH 438, may take these courses for graduate credit and count them towards the 24 unit weight of course requirement.

Courses for the Mathematical Finance Program:

*From inside the Department of Mathematical and Statistical Sciences:*

MATH 417	Honours Real Variables I (3)
MATH 436/438	Intermediate Partial Differential Equations (3/3)
MATH 515	Mathematical Finance I (3)

MATH 520	Mathematical Finance II (3)
MATH 527	Intermediate Partial Differential Equations (3)
MATH 536	Numerical Solutions of Partial Differential Equations (3)
MATH 615	Mathematical Models for The Term Structure of Interest Rates (3)
MATH 625	Advanced Mathematical Finance (3)
STAT 580	Stochastic Processes (3)
STAT 571	Applied Measure Theory for Probability (3)
STAT 671/672	Probability Theory I/Probability Theory II (3/3)

*From outside the Department of Mathematical and Statistical Sciences:*

ACCTG 501	Introduction to Financial Reporting and Analysis (3)
ACCTG 511	Accounting Information and Decision Making (1.5)
FIN 501	Financial Valuation Management (3)
FIN 654	Risk Management (3)
FIN 703	Advanced Seminar in Finance III (3)
BUEC 502	Managerial Microeconomics (3)
BUEC 512	Macroeconomics for Managers (1.5)

## 2.10 M.Sc. in Biostatistics

Students in the thesis-based M.Sc. program are required to take at least \*18 unit weight of courses at the 500 or higher level and to complete a thesis. Students in the course-based M.Sc. program are required to take at least \*24 unit weight of courses at the 500 or higher level and to complete the project course STAT 900. The minimum acceptable grade in any course is C+/2.3 and the student must maintain a minimum cumulative GPA of B/3.0. All students must also complete a Practicum, which is described below.

Students in both the thesis and course-based M.Sc. programs are required to take:

STAT 532	Survival Analysis
STAT 562	Discrete Data Analysis
STAT 566	Methods of Statistical Inference
or STAT 664	Theory of Statistical Inference

*and at least 2 of the following:*

PHS 505	Fundamentals of Public Health
PHS 590	Introduction to Epidemiology
or PHS 596	Epidemiology Methods I
PHS 696	Epidemiology Methods II (prereq is PHS 596)

Students are strongly recommended to take PHS 596 and PHS 696.

.....continued on the next page

Students must fulfill the additional course requirements from the following list:

STAT 561	Sample Survey Methodology
STAT 568	Design and Analysis of Experiments
STAT 575	Applied Multivariate Analysis
STAT 578	Regression Analysis

Other possible elective courses include: PHS 530, PHS 570, PHS 571, SOC 558, SOC 616, INTD 570, STAT 512, STAT 558, STAT 559, STAT 580, STAT 590 and STAT 679.

**Practicum Requirement:** A minimum of 39 hours will be devoted to providing support in statistical consultation as part of the Alberta Provincial Health Research Methods Centre, or its equivalent in the medical and/or public health research areas. Students will *observe*, under the mentorship of a Supervisory Committee member from the Department of Public Health

Sciences, statistical consultations and *participate* in providing support towards resolving/furnishing responses in such settings. The Practicum normally will be established as an Independent Reading Course on a Pass/Fail basis in the Department of Public Health Sciences. The Supervisory Committee will approve the Practicum.

### **3.0 Ph.D. PROGRAMS: GENERAL REGULATIONS**

3.1 The Department offers programs leading to the degree of Doctor of Philosophy in Mathematical and Statistical Sciences. Each such degree will have a particular field of specialization noted on it. Fields of specialization are: Applied Mathematics, Mathematical Finance, Mathematical Physics, Mathematics, and Statistics.

The field of specialization in each particular case shall be largely determined by the student's choice and by the supervisory committee. When necessary, the matter will be decided by the Graduate Committee.

3.2 To be admitted for the Ph.D. program a student must normally hold the equivalent of an M.Sc. degree in Mathematical and Statistical Sciences from the University of Alberta. In special circumstances an M.Sc. student may be allowed to transfer to the Ph.D. program, bypassing the master's degree.

#### **3.3 Course requirements**

Normally 10 single-term graduate courses (not including Thes 9XX) after the B.Sc. degree are required. All graduate courses must be 500-level or above. Students with a M.Sc. degree from outside the department will be required to take at least 6-single term graduate level courses. At least 2 of these graduate courses must be in an area other than that of the student's thesis.

3.4 Programs of courses must be approved by the Graduate Committee. The Graduate Committee may, on the recommendation of the advisor or Supervisory Committee, require more than the minimum number of courses. Certain 400-level courses may also be approved by the Graduate Committee, to a maximum of 6 credits.

#### **3.5 Residency requirement**

The residency requirement for a Ph.D. candidate is full-time registration for 2 academic years.

3.6 The principal requirement for the Ph.D. is an original and substantial contribution to knowledge, embodied in a thesis.

#### **3.7 Supervisory Committee**

A Supervisory Committee will normally be appointed for the student before the end of the entrance year. The supervisor must satisfy the criteria of Section 7. The Supervisory Committee will consist of the student's supervisor as chair and at least two others chosen in consultation with the supervisor. The Supervisory Committee will determine, supervise and modify the student's program of study and research. The Supervisory Committee will meet on a regular basis, at least once per year. The Supervisory Committee will form the core of the candidacy and final examination committees. After the Supervisory Committee has been appointed, the Graduate Committee will act largely on the recommendation of the Supervisory Committee in matters related to the student. All examination committees will consist of the Supervisory Committee and any other members that the Graduate Committee may add.

#### **3.8 Candidacy examination**

Normally within a year of passing the entrance year, the student will take the candidacy examination. This examination shall be under the direction of the Supervisory Committee to which two other members have been added. At least one member of the candidacy examination committee shall be from outside the department. See Section 5 below for candidacy examination procedures.

### 3.9 **Final oral examination**

The thesis shall be approved by an examining committee consisting of the Supervisory Committee and at least two others, one of whom shall be an external examiner. A final oral examination will be conducted. See Section 6 below for final oral examination procedures

- 3.10 The candidacy and final oral examinations shall be scheduled by the Graduate Committee in consultation with the Supervisory Committee. The Graduate Committee requires notification from the Supervisory Committee at least three weeks before the candidacy examination is to take place, and at least three months before the final oral examination. See the *Time Lines for Doctoral Programs* in the *FGSR Graduate Program Manual*.

## 4.0 **ENTRANCE YEAR IN THE Ph.D. PROGRAM**

- 4.1 Normally, all incoming Ph.D. students will be enrolled in the Entrance Year. At the beginning of the first term the student's advisor(s) will recommend a list of courses that the student will need to take in order to improve his/her background in the area of proposed research. For students who have completed a master's degree in Mathematical and Statistical Sciences at the University of Alberta and have completed at least four core courses in their proposed program with an average of at least A-/3.6, the requirement for the Entrance Year may be waived by departmental council with the recommendation of the Graduate Committee.

- 4.2 The Graduate Committee on the advice of subcommittees recommends that, when a student has completed two Winter Session terms for the Ph.D., a decision must be made by the Council of the Department of Mathematical and Statistical Sciences as to whether the student may continue in the program. The Graduate Committee will make the appropriate recommendation to the Departmental Council at the same meeting at which the Honours Committee makes its recommendations. The recommendation would be based on the Graduate Committees' assessment of the student's performance in two full terms of course work.

### 4.3 **Course work**

Ph.D. students are required to take two full terms of course work, which must contain at least 4 core courses. At the discretion of the Graduate Committee, additional courses may be taken aimed at remedying deficiencies in the background of the student.

Students who envisage pursuing research in areas not covered by the categories listed below may take the required number of core courses in different subject areas with the approval from the Graduate Committee on an ad hoc basis. It is required that a student have at least an average of 3.6 in four of the core courses. As a matter of policy, all core courses must include written (classroom) final examinations. The total weighting for in class written exam(s) must be at least 50% of the total mark. The instructors of the core courses will be directly involved in the Graduate Committee's assessment of the student's performance in the Entrance Year.

### 4.4 **Oral examination**

To be held only in cases where the preceding item is insufficient for the Graduate Committee to make a recommendation. Inevitably there will be some cases when a decision cannot be reached by the Graduate Committee, due to ambiguities and uncertainties arising from the

Entrance Year. In such cases the department recommends that an oral examination be given promptly. The student should be advised in advance of the issues to be resolved.

#### 4.5 **Entrance Year in Applied Mathematics**

*The core courses are:*

1. Numerical Analysis (Math 536)
2. Techniques in Applied Mathematics (Math 538)

plus any two courses selected from Ordinary Differential Equations (Math 524), Partial Differential Equations (Math 527), core courses from the Statistics Ph.D., or from the Pure Mathematics Ph.D. program.

#### 4.6 **Entrance Year in Mathematical Finance**

*The core courses are:*

- Math 515 Mathematical Finance I
- Math 520 Mathematical Finance II
- Stat 571 Applied Measure Theory for Probability AND/OR
- Stat 671 Probability Theory I
- Stat 580 Stochastic Processes
- Stat 672 Probability Theory II

The four core courses to be taken in the Entrance year must include Math 515, Math 520 and Stat 580.

It is required that Ph.D. Math Finance students include the following courses in their program:

- Math 615 Mathematical Models for Term Structures
- Math 625 Advanced Mathematical Finance
- Fin 501 Financial Valuation/Management
- Fin 654 Risk Management

#### 4.7 **Entrance Year in Mathematical Physics**

*The core courses are:*

1. Differentiable manifolds (MATH 521)
- and any three of the following, with at least one being a MATH course:
2. Complex Variables (MATH 506)
  3. Linear Analysis (MATH 516)
  4. Partial differential equations (MATH 527)
  5. Ordinary differential equations (MATH 524)
  6. Numerical Methods I (MATH 536)
  7. Group Theory (MATH 581)
  8. Advanced Quantum Mechanics (PHYS 510)
  9. Statistical Mechanics (PHYS 530)
  10. Quantum Field Theory I (PHYS 610)

The student must take a minimum of six single term graduate courses from the Departments of Mathematical and Statistical Sciences and Physics.

#### 4.8 **Entrance Year in Pure Mathematics**

The PhD students in pure mathematics are required to take at least 4 core courses which must be completed by the end of the Entrance year. At least 3 of all courses taken during the

entire graduate program must be from the tables below in areas outside of the area of specialization of the student.

*Core courses:*

<b><i>Algebra/Number Theory</i></b>	<b><i>Analysis/Probability</i></b>	<b><i>Topology/Geometry</i></b>	<b><i>DE's</i></b>
Math 581 Group Theory	Math 516 Linear Analysis	Math 506 Complex Variables	Math 524 ODE's
Math 582 Rings and Modules	Math 542 Fourier Analysis	Math 521 Differential Manifolds	Math 527 PDE's
		Math 530 Algebraic Topology	

*Non-core courses:*

<b><i>Algebra/Number Theory</i></b>	<b><i>Analysis/Probability</i></b>	<b><i>Topology/Geometry</i></b>	<b><i>DE's</i></b>
Math 512 Algebraic Number Theory	Math 518 Functional Analysis	Math 523 Applications of Differential Geometry to Mechanics	Math 536 Numerical Solutions of PDE's
Math 681 Topics in Algebra	Math 519 Operator Algebras	Math 630 Topics in Algebraic Topology	
Math 682 Topics in Algebra	Math 543 Measure Theory	Math 676 Topics in Geometry	
	Math 617 Topics in Functional Analysis I		
	Math 618 Topics in Functional Analysis II		
	Math 620 Topics in Stochastic Analysis and Applications		
	Math 641 Banach Space Theory		
	Math 642 Abstract Harmonic Analysis		
	Math 643 Topics in Analysis		
	Stat 671 Probability Theory		

#### 4.9 **Entrance Year in Statistics**

*The core courses are:*

- STAT 512 Techniques of Mathematics for Statistics
- STAT 532 Survival Analysis
- STAT 561 Sample Survey Methodology
- STAT 562 Discrete Data Analysis

STAT 568	Design and Analysis of Experiments
STAT 664	Theory of Statistical Inference
STAT 665	Asymptotic Methods in Statistical Inference
STAT 571	Applied Measure Theory for Probability
STAT 575	Multivariate Analysis
STAT 578	Regression Analysis

At least 6 of these courses are to be taken by every Ph.D. (Statistics) student with at least 4 of them taken in the Entrance Year. The 6 must include STAT 664, 665, 571.

#### 4.9.1 **Advisory exams**

The PhD students in Statistics must take an Advisory exam at the beginning of the first term of their study. The advisory exams for the Ph.D. in Statistics are:

##### **STAT I**

- based on our more theoretical senior undergraduate courses STAT 466, 472
- to include the following topics: principles of inference, sufficiency, likelihood, completeness, optimal methods of estimation, testing and interval construction, distribution theory; combinatorial probability, conditioning, laws of large numbers, central limit theory, generating functions, Markov chains, martingales.
- the relevant material is contained in the following books. The texts used in the relevant courses may of course change from year to year, but a knowledge of the material in the indicated books and chapters should be sufficient:  
Casella and Berger, *Statistical Inference* (1990), ch. 6 - 10  
Grimmett and Stirzacker, *Probability and Random Processes* (1992), ch. 1, 2, 3.1-3.8, 4, 5, 6.1-6.6, 7.1-7.5, 12.1-12.5

##### **STAT II**

- based on our more applied courses: STAT 479, 361, 368, 378.
- to include the following topics: stationary time series, spectral analysis, filtering, Box-Jenkins methodology; design and analysis of experiments; multiple regression
- the relevant material is contained in the following books:  
Schumway and Stoffer, *Time Series Analysis and its Applications* (2000), ch. 1-3.3, 4.1-4.2. Neter, Wasserman and Kutner, *Applied Linear Statistical Models* (1990), ch. 7, 8, 24, 25. Cochran *Sampling Techniques* (1977), ch. 1-7. Montgomery, *Design and Analysis of Experiments* (1997), ch. 1-7, 11, 12.

#### 5.0 **Ph.D. CANDIDACY EXAMINATION**

The candidacy examination is normally held within 2 years of the commencement of the program when most, if not all, of the course work is complete and the thesis project started or well defined. It must be passed not less than 6 months prior to taking the final oral examination.

The purpose of the candidacy examination is to

- assess the Ph.D. project.
- assess the student's knowledge of the discipline and of subject matter relevant to the thesis.
- assess the student's competence to write and defend a thesis in English.

During the candidacy examination, only minor attention will be given to the work done on the thesis.

The examination will be under the direction of the supervisory committee to which two other full-time members of the teaching staff have been added. At least one member of the examining committee will be a person from a department other than the Department of Mathematical and Statistical Sciences. The examining committee will be chaired by a department member who is not the supervisor. Except for the Dean FGSR (or Associate Dean or the Dean's designee), who may participate fully in the examination, persons other than the examiners may attend only with the permission of the Dean FGSR, or the chair of the committee. Visitors may not participate in the committee's discussion concerning its decision on the student's performance.

The examination will have both written and oral components. At least 7 days prior to the examination the student will submit to the examiners a written presentation (10 pages or less) describing the Ph.D. project. The student will also provide the examiners with a list of graduate-level courses taken. Calendar descriptions and names of texts used should also be provided in the case of courses taken elsewhere.

At the examination, the student will begin by making a brief oral presentation on the Ph.D. project. The student will respond to the examiners' questions relevant to the purposes of the Candidacy Examination and, when this process is completed, will be asked to withdraw.

The examiners will then make their assessment based on the written submission, the oral presentation and the response to questions. They may make one of the following recommendations:

- Pass
- Conditional pass
- Fail

**Pass:** Once the candidacy exam is passed, the department will send a notice to the FGSR indicating successful completion of the candidacy (to be added to a joint candidacy completion/final oral exam completion form).

**Conditional Pass:** If the candidacy examination committee agrees to a conditional pass for the candidate, the chair of the examination committee shall provide in writing to the Associate Dean, FGSR and the student:

- the reasons for this recommendation
- details of the conditions
- time frame for the student to meet the conditions
- the approval mechanism for meeting the conditions, ie, approval of the committee chair or supervisor, or approval of the entire committee, or select members of the committee.
- the supervision and assistance the student can be expected to receive from committee members.

Departments should hold the Recommendation for a Change of Category form in the department until the examination committee has agreed that the conditions have been met.

A student who passes or conditionally passes the Ph.D. Candidacy Exam will be informed of any additional studies or course work considered necessary by the Supervisory Committee.

**Fail:** If the candidacy examination committee agrees that the student has failed, the committee chair shall provide the reasons for this recommendation and the department's

recommendation for the student's program in writing to the Associate Dean, FGSR and to the student. The committee may make one of the following recommendations:

- Repeat the Candidacy
- Change of Category to a Master's Program
- Termination of the Doctoral Program.

## **6.0 PH.D. FINAL ORAL EXAMINATION**

The thesis shall be reviewed by an examining committee which will consist of the Supervisory Committee and at least two other examiners. One member shall be from a department other than that in which the student is working. One member shall be an external examiner who is a recognized authority in the special field of research and should have not had previous association with the candidate. The external examiner shall be nominated by the department and approved and invited by the Dean of the Faculty of Graduate Studies and Research. The supervisory committee members shall each declare in writing to the supervisor that the student proceed to the final examination or that the thesis is unsatisfactory and that the student should not be allowed to proceed to the final oral examination. A final oral examination, based largely on the thesis and the student's ability to defend it, shall be conducted by the examining committee. Members of the staff of the student's major department, as well as members of the Council of the Faculty of Graduate Studies and Research (or their alternates), have the right to attend but should so notify the chairman of the examining committee. Other persons may attend with special permission of the Dean, FGSR, or the chairman of the examining committee. Except for the Dean (or Associate Dean) of the Faculty of Graduate Studies and Research, who may participate fully in the examination, persons who are not members of the examining committee (a) may participate in the questioning only by permission of the chairman of the committee, and (b) are not permitted to participate in the discussion of the student's performance and must withdraw before such discussion commences.

Normally the student will make a short (10-20 minute) presentation outlining the thesis and stressing its major points. Following this presentation, the committee members shall ask a variety of questions mostly pertaining to the thesis. They are free, however, to ask more general questions relating to the entire program and background of the student to ensure that the student has a well-rounded knowledge of the subject. After the completion of these questions, the student is asked to leave the examining room and the examining committee makes its decision on the outcome of the exam. One of the following outcomes of the final oral examination is appropriate:

- Pass
- Pass subject to minor revisions
- Adjourned
- Fail

There is no provision for a final oral examination to be "passed subject to major revisions".

Pass: If the student passes the examination, the department shall complete a Report of Completion of Final Oral Examination form and submit it to the FGSR.

Pass subject to minor revisions: The student has satisfactorily defended the thesis but the thesis requires changes that are minor in substance or of an editorial nature (eg, spelling, punctuation). The department shall complete a Report of Completion on Final Oral Examination form and submit it to the FGSR indicating a pass subject to minor revisions. It is expected that the student will make the changes in time to submit the thesis to the FGSR on or before the deadline for the next convocation. These changes should be checked and approved

by the committee chair or supervisor, who does not sign the thesis until the required changes are satisfactorily completed.

Adjourned: The final oral examination should be adjourned in the following situations: The revisions are more substantial than editorial or minor reworking (i.e. if further research or experimentation or major reworking of sections are required, or if the committee is not satisfied with the general presentation of the thesis). The committee should not propose that the candidate has passed, rather the committee shall adjourn the examination. The committee is dissatisfied with the candidate's oral presentation and defence of the thesis, even if the thesis itself is acceptable with or without minor revisions. Compelling, extraordinary circumstances such as a sudden medical emergency during the examination.

If the examination is adjourned, the committee should specify in writing to the student, with as much precision as possible, the nature of the deficiencies and, in the case of revisions to the thesis, the extent of the revisions required. Where the oral defence is unsatisfactory, it may be necessary to arrange some discussion periods with the candidate prior to reconvening the examination.

Decide upon a date to reconvene. If the date of the reconvened oral examination depends upon the completion of a research task or a series of discussions, it should be made clear which committee members will decide on the appropriate date to reconvene. The final date set for reconvening shall be no later than six months from the date of the examination. A final decision of the examining committee must be made within six months of the initial examination. Make it clear to the student what will be required by way of approval before the examination is reconvened (e.g. approval of the committee chair or supervisor, approval of the entire committee, or of select members of the committee). Specify the supervision and assistance the student may expect from the committee members in meeting the necessary revisions. Advise the FGSR in writing of the adjournment and the conditions (in the points above). When the date is set for the adjourned final oral examination, the department will notify the FGSR. Normally the Dean or designate attends the examination.

Fail: If the final examination committee agrees that the student has failed, the committee chair shall provide the reasons for this recommendation and the department's decision for the student's program in writing to the Associate Dean, FGSR and to the student. For failed examinations, the Associate Dean, FGSR, will arrange to meet with the candidate and with department representatives before acting upon any department recommendation. A decision of the FGSR which affects the student's academic standing (i.e. required to withdraw or transfer to a master's program) is appealable.

## **7.0 CRITERIA FOR SUPERVISION OF GRADUATE STUDENTS IN THESIS PROGRAMS**

- 7.1 The supervisor must be actively engaged in research. Indications of such activity are furnished by such factors as: continued publication in refereed journals, NSERC or other research grants, willingness and ability to teach senior graduate courses and a Ph.D. degree or equivalent. Since new staff members who are recent graduates may not have had time to meet such criteria, their cases are to be decided separately by the Graduate Committee in consultation with the Department Chair.
- 7.2 A co-supervisor must be selected in the case of students who plan to work under the supervision of an Adjunct Professor, a faculty member of another department, or a faculty member who expects to retire or leave the Department before the likely completion of the student's program. Such a co-supervisor must be a member of the Department of Mathematical and Statistical Sciences, meet the criteria in Section 7.1, and be in a position to

ensure satisfactory supervision of the student's program to its completion. In this situation, a student is guided officially by two co-supervisors.

- 7.3 To ensure that the criteria in Sections 7.1 and 7.2 are upheld, all choices of supervisors must be approved by the Graduate Committee in consultation with the Department Chair before submission to FGSR for approval.

## Summary of Time Lines for Master's (course-based) Program

### Supervisor

No later than the end of the first year. Supervisor and/or student confirm with Department Graduate Secretary.

### Project Completion

Normally within two years, but no later than six years. Supervisor and Reader approve submitted project and sign acceptance form.

Immediately after approval Department advised FGSR of decision on Report of Completion form.

Student must submit one copy of the project to the Department Graduate Secretary.

## Summary of Time Lines for Master's (thesis-based) Program

### Supervisor

No later than the end of the first year. Supervisor and/or student confirm with Department Graduate Secretary.

### Supervisory Committee

No later than the end of first year Department nominates supervisory committee on an Approval of Supervisor/Supervisory Committee form to FGSR.

Annually Supervisory committee meets with student to review program and progress.

### Final Oral Examination

Normally within two years, but no later than four years. Department sets date for final oral examination and recommends an examining committee to the FGSR.

At least three weeks prior to examination Department submits a Notice and Approval of Oral Examination Committee form to FGSR, notifies examiners of the date, and supplies a copy of the thesis to them.

Immediately after examination Department advises FGSR of examining committee's decision on Report of Completion of Final Oral Examination form.

Within six months of examination Student must submit three unbound copies of the thesis to FGSR in order to graduate.

## Summary of Time Lines for Doctoral Program

### Supervisor

No later than the end of first year                      Department nominates supervisor on an Approval of Supervisor/Supervisory Committee form to FGSR.

### Supervisory Committee

No later than the end of first year                      Department nominates supervisory committee on an Approval of Supervisor/Supervisory Committee form to FGSR.

Annually    Supervisory committee meets with student to review program and progress.

### Candidacy Examination

Normally within two years and not less than six months prior to final examination                      Department sets date for candidacy examination and recommends a candidacy examining committee to the FGSR.

At least three weeks prior to examination                      Department submits a Notice and Approval of Oral Examination Committee form to FGSR.

At least one week before examination                      Student gives 8-10 page presentation to candidacy examining committee to review before examination.

After successful examination                                      Department submits a Recommendation for Change of Category form to FGSR.

After unsuccessful examination                                      Department recommends course of action to FGSR.

### Final Oral Examination

Prior to setting examination date and before the thesis is sent to the external                      All supervisory committee members declare in writing to the supervisor that the thesis is adequate to proceed to the final oral examination. Request form from Grad Secretary.

Approximately three months prior to examination                      Supervisor nominates an external examiner and proposes a date for the examination and the composition of the rest of the examining committee.

Normally at least two months prior to examination                      Department nominates external examiner to FGSR and completes a Request to Invite External Examiner form. FGSR invites external examiner.

At least four weeks prior to examination                      Department must ensure that the external examiner receives the thesis.

At least three weeks prior to examination                      Department recommends examining committee members to FGSR using a Notice and Approval of Oral Examination Committee form, notifies examiners of the date, and supplies a copy of the thesis to them.

Immediately after examination                                      Department advises FGSR of examining committee's decision on Report of Completion of Final Oral Examination form.

Within six months of examination                                      Student must submit three unbound copies of the thesis to FGSR in order to graduate.