

2017/2018

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Regulations and Guidelines of Graduate Programs

Department of Mathematical and Statistical Sciences
University of Alberta

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Graduate Programs

Research Area	D	Ph	MSc Thesis Based	MSc Course Based
Mathematics (Algebra, Analysis, Geometry, Number Theory, Probability, Topology)	Yes		Yes	Yes
Applied Math (Differential Equations, Dynamical, Systems, Fluid Dynamics, Mathematical Biology, Scientific Computing)	Yes		Yes	Yes
Math Finance	Yes		Yes	Yes
Math Physics	Yes		Yes	Yes
Statistics	Yes		Yes	Yes, one-year program
Biostatistics	No		Yes	Yes
Statistical Machine Learning	Yes		Yes	No
Interdisciplinary programs	Yes		Yes	No

Definitions

Department: The Department of Mathematical and Statistical Sciences at the University of Alberta

Associate Chair: The Associate Chair (Graduate Studies) at the Department

Student: A Student enrolled in a graduate program at the Department

Guidelines: Regulations and Guidelines for Graduate Programs in the Department (that is, this document)

Calendar: University of Alberta Calendar: <http://www.registrar.ualberta.ca/calendar/>

FGSR: The Faculty of Graduate Studies and Research

Graduate Office: The Associate Chair (Graduate Studies) and/or the Graduate Student Services Advisor (currently Jochen Kuttler and Tara Schuetz)

GPA: Grade Point Average; a measure of performance ranging from 0 to 4.

BSc: Bachelor of Science degree at the University of Alberta

MSc: Master of Science degree at the Department

PhD: Doctor of Philosophy degree at the Department

* : course credits, for example *18 means 18 course credits. A typical course has *3 credits.

GTA: Graduate Teaching Assistantship at the Department

Program credit: If a course may be used to satisfy degree requirements, its associated course credit is referred to as program credit, For example undergraduate courses don't have program credit (but still count towards registration requirements).

RA: Research Assistantship at the Department, typically funded by the supervisor's grant(s).

Regular term: the Fall or Winter term.

Graduate Committee: The executive entity, which oversees the graduate program of all Students, is the Graduate Committee. It is represented by the Associate Chair and can be contacted via the Associate Chair, Graduate Office. The following regulations allow for some flexibility. However, exceptions from these regulations need written approval by the Graduate Committee or the Associate Chair.

Important Webpages for information regarding your program

Department of Mathematical and Statistical Sciences

<http://www.mathstats.ualberta.ca/>

Graduate Program, Department of Mathematical and Statistical Sciences

<http://www.mathstats.ualberta.ca/en/Graduate%20Studies.aspx>

Faculty of Graduate Studies and Research (FGSR)

<http://www.gradstudies.ualberta.ca/>

Statistics Centre

http://www.stat.ualberta.ca/stat_centre/

0.0 PREAMBLE

All Graduate Students are strongly encouraged to make themselves familiar with these guidelines. It is a priority for the Department to help Students achieve success. Nevertheless Students are responsible for their own academic progress. The Department will help where it can, but ultimately it is the Student who determines the outcome. In that spirit all Students are urged to address any problems early on. If problems arise, Students should proactively address the issue, either by talking to their Advisor/Supervisor or by contacting the Graduate Office. Most of the time, help is available and effective.

1.0 REGULATIONS COMMON TO ALL PROGRAMS

1.1 General FGSR Program Requirements

The general FGSR program requirements apply. For details see the appropriate sections of the [University Calendar](#) and the FGSR Graduate Manual (at <https://www.ualberta.ca/graduate-studies/about/graduate-program-manual>), which are an integral component of any Student's program. The Departmental requirements and regulations, as described here, are above and beyond the FGSR regulations.

1.2 Maintenance of Registration

To maintain full-time registration status for academic purposes¹ in a particular (regular) term, Students must be registered in one of the following formats:

- i) At least three *3 courses (*9 total).
- ii) Students in MSc course-based programs must register in Math 900 A/B (plus at least two courses), or Stat 900 A/B (plus at least two courses), or Stat 901/902 (plus at least 3 courses)
- iii) Thesis based Students must register in Thes 903 (plus at least two courses) or Thes 906 (plus at least one course), or Thes 909.

Notes:

- a) PhD Students will not be allowed to register in Thes 906 or higher (Thes 9XX where XX is at least 06) during regular terms until the second year of registration as a Graduate Student at the Department
- b) A minimum of *3 must be obtained in any of Math 900, Stat 900, or Stat 901/902 or Thes 9XX to finish a graduate program.
- c) Students in a course based program must register for at least *3 in any September to August period to keep their program active.

¹ Full-time registration status may mean different things in different contexts. For example full-time status as defined by Immigration Authorities, or as defined by Financial Institutions, may differ from the definition here.

The maintenance of full-time status is especially important for international Students with respect to their status with Immigration Authorities, and for Students holding scholarships or GTAs, i.e. for most Students. International Students should discuss registration requirements with the International Centre. The Department is not authorized or competent in offering advice regarding immigration and/or visa issues.

To maintain an active program in a thesis based program the Student must register in both regular terms in course work and/or thesis research. Students in thesis-based programs also must register in Spring and Summer terms (usually Thes 909).

1.2.2 Part Time Status

Students who commence any thesis-based program as a part time Student can switch to full time during their program (however, any TA funding is subject to the rules outlined in Section 1.9 and is not guaranteed). The details of a part time program will be arranged on a case-by-case basis. Part time Students are not normally eligible for Department funding.

Students who commence any thesis-based degree program as a full-time Student must register full-time for the remainder of their program.

1.3 English Language Requirements

All applicants for graduate programs who do not hold a BSc or MSc 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 before they can be admitted. A list of foreign institutions recognized as having English as the language of instruction is available from the FGSR.

The following examinations are acceptable for demonstrating English Language Proficiency:

- TOEFL minimum score of 100 (Internet Based) with a score of at least 22 in each individual skill area.
- IELTS minimum score of 7.0 overall with a minimum of 6.0 on each band.
- MELAB minimum score of 88.
- PEARSON minimum score of PTE 68 with a minimum of 59 in each of the categories listening, reading, speaking, writing.

The Department will only accept scores that reflect a test date that has taken place within the last 2 years.

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 a grade of C+/2.3. All Students in degree programs (including time spent as a qualifying Graduate Student) must maintain a minimum cumulative GPA of B/3.0 throughout the course of the program. In cases where the cumulative GPA falls below 3.0, the Department may recommend to the FGSR the Student be put on Academic Probation or be required to withdraw. In any case, convocation shall not take place with a cumulative GPA of less than B-/2.7, and

usually requires a GPA of at least 3.0. In cases where the cumulative GPA is below 2.3, or below 2.7 for two consecutive terms, the Department will recommend to the FGSR that the Student withdraw from the program.

The overall GPA is calculated based on courses required for the degree. (That is, extra to degree courses will be excluded.)

Unless for medical reasons or other reasons accepted by the Graduate Committee, a Graduate Student with a cumulative GPA below 3.0 will be considered unsatisfactory, and any GTA at the Department may be terminated,

Graduate Students on Academic Probation will not receive a GTA appointment (see also 1.9). They may be assigned research duties only.

Each Student's progress is reviewed continually by the Graduate Committee. Financial support will be suspended or discontinued when progress is deemed unsatisfactory. A Student whose academic work or research progress is unsatisfactory may at any time be recommended to the FGSR to be put on Academic Probation or required to withdraw. Students on Academic Probation will have to satisfy specific conditions (as determined by the FGSR) to lift Academic Probation. Students on Academic Probation are not considered to be in good academic standing, and may for instance not convocate.

1.5 Time limits

Expected completion times: The Department expects Students to complete the MSc program in two years and the PhD program during their fifth year. An exception is the course based MSc program in Statistics, which will normally be completed within 8-12 months.

Maximum time limits: Students in a thesis-based MSc program have a maximum of 4 years to complete their program. Students in a course-based MSc program have 6 years. PhD Students must complete their program within 6 years (including any time spent in an MSc program for Students that transferred to the PhD program) after they first registered as a PhD Student in the FGSR. Individual degree components may have an earlier completion requirement.

1.6 Appointment of Advisor

Each Student, on admission to a graduate program, will be assigned an Advisor by the Associate Chair/Graduate Committee. During the first two regular terms, the Advisor will guide the Student's program until a thesis or project Supervisor has been approved. - See also Sections 2.4 and 3.8.

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 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.

1.8 Course Requirements

Both the MSc and PhD graduate programs have minimum course requirements. These minimum course requirements are not to be viewed as sufficient for a graduate education.

Graduate courses are courses on the 500 level or above. Students can take undergraduate courses (300-400 level courses; and in the case of Honours Calculus and Honours Linear Algebra also the 200 level) to solidify their education upon approval by their Advisor/Supervisor and the Associate Chair². However, undergraduate courses will not be counted against the necessary course requirements for the various graduate programs (and hence carry no program credit). However, performance in a 300/400-level course will be used to evaluate the overall academic standing of the Student. Students should also note that 300/400 level courses are not ranked as highly as 500/600 level courses in most scholarship competitions.

Unless specifically specified otherwise in the program requirements only courses offered by the Department may be used to satisfy minimum degree requirements. However, the Associate Chair/Graduate Committee may approve exceptions upon request.

Reading courses may be used to satisfy degree requirements with the approval of the Associate Chair.

Seminar courses³, Graduate Colloquium courses, audited courses, project courses (Stat/Math 900, Stat 901/902), or Thes 9XX courses cannot be used to satisfy minimum course requirements.

It is recommended that Students register before July 31 for Fall-term courses and before November 30 for Winter-term courses. Changes to course registration can still be made up to the Calendar deadline.

1.8.1 Transfer Credit

Transfer credit may be allowed by the 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. Students must apply for transfer credit and barring exceptional circumstances at most two courses (*6) may be transferred.

² Students are strongly discouraged to take undergraduate courses for the sole reason to improve their overall GPA. Such requests will not be approved.

³ Students in the PhD program who must satisfy the 10-course requirement may count 3 instances of a seminar course as one course **once** against their course requirement upon approval by the Associate Chair. See Section 3 for details.

1.9 Funding

The Department is committed to provide adequate financial support to Graduate Students for the duration of their program within specific time limits set out below. Departmental funding for Students is provided in several ways. The financial commitment of the Department is subject to the availability of funds and applies only to Students in good academic standing. In addition, the Department, the Faculty of Science, and the University also offer several scholarships. It is the Students' responsibility to inform themselves regarding deadlines and eligibility.

1.9.1 Graduate Teaching Assistantships

The Department offers Graduate Teaching Assistantship (GTA) positions to Students in a full-time thesis-based program (MSc or PhD).

Unless specifically mentioned otherwise in the Departmental Offer of Admission⁴, Students in a thesis-based MSc program are offered GTA funding for their first two years in the program. Students in a PhD program are offered GTA funding for their first four years into the program with an option to apply for a fifth year of funding. Incoming Students in a thesis-based program are automatically appointed to a GTA position for their first two regular terms, unless they are funded by a major scholarship.

The following conditions, exceptions, and details apply:

- A. Incoming Students in a thesis-based program are automatically appointed to a GTA position for their first two regular terms unless they are funded by a major scholarship, including sponsorships by their home government.
- B. Continuing Students must timely submit a GTA questionnaire for each term where they want to be considered for GTA funding.
- C. All Graduate Students in a thesis-based program are offered at most 4 regular terms of GTA funding in the MSc program and at most 8 regular terms of GTA funding in the PhD program (during the first two and four years in the program, respectively). PhD Students may apply for a fifth year of funding (see M.).
- D. Students must be in good academic standing (Qualifying Students and Students on Academic Probation are not eligible); the performance during past GTA duties must have been satisfactory. The Graduate Committee makes the final decision. See also 1.4 Academic Standing: a Student whose cumulative GPA drops below 3.0 may be ineligible for GTA funding upon decision by the Associate Chair/Graduate Committee.
- E. To be eligible for GTA funding, Students must attend the GTA Orientation Sessions offered by the Department at the beginning of their program. Exceptions for valid reasons may be granted.
- F. Students who transferred from an MSc program into the PhD program are offered GTA funding for their first five years of combined studies at the Department (at most 10 terms of GTA funding).

⁴ The Offer Letter sent to the Student at the time of admission, signed by the Associate Chair. Not to be confused with the Admission Letter sent by the FGSR.

- G. Students who transferred from a PhD program to a thesis-based MSc program are offered GTA funding during their first two years of combined studies at the Department.
- H. Students who transferred from a course-based to a thesis-based program may be eligible on a case-by-case basis (as approved by the Associate Chair/Graduate Committee); the time spent in the course-based program counts against the funding time limits.
- I. Holders of a major scholarship (defined as providing support of \$20,000⁵ per year or \$10,000 per term⁵ plus tuition and fees) are eligible for at most a quarter⁶ TA while holding the scholarship, subject to the same time limitations. Also, recipients of the Excellence Award or similar awards will not receive GTA funding during the tenure of the award. The scholarship sponsor may impose additional rules and limitations.
- J. Students who have been admitted based on a Departmental Offer Letter that explicitly excludes any funding commitment (e.g. Students sponsored by their home governments, or self-funded students) are not guaranteed GTA funding, even partially.
- K. Students switching from a part-time to a thesis-based full-time program are eligible for TA funding upon approval by the Associate Chair/Graduate Committee.
- L. Employment other than a GTA or RA appointment at the Department should be discussed first with the Advisor/Supervisor while holding a full-time GTA.
- M. PhD Students may apply for one or two additional terms of GTA funding for their fifth year in the program. Applications consist of a written statement explaining the reasons for the delay/need for extra time, including a proposed timeline to completion, and a letter of support from the Supervisor, and must be submitted⁷ to the Graduate Committee no later than February 1 of the fourth year in the program⁷. The Graduate Committee will base its decision on the merit of the application (academic and research performance of the Student, proposed timeline), financial needs of the Student, and availability of funds.
- N. Students in course-based programs are not eligible for GTA funding. If a Student in a thesis-based program switches to a course-based program while holding a GTA, that GTA may be terminated effective the date of program switch.
- O. A term spent on paid leave (maternity/medical/compassionate) counts against the maximum term limits established in C. A term spent on deferred leave does not.
- P. A Student holding a GTA must be registered full time. Loss or reduction of registration for whatever reason (e.g. suspension) may result in the immediate termination of the GTA appointment for cause as per the GSA agreement.
- Q. Students are advised to consult the GSA agreement ([Graduate Student Assistantship Collective Agreement](#)) governing assistantships regarding their rights and responsibilities.

These limitations apply to the length of the entire program, inclusive of any period spent as a qualifying Student or on Academic Probation.

Periods where a Student holds a major scholarship or is employed outside the Department and consequently does hold no or only a partial GTA do not extend the time limits.

⁵ These amounts may vary from year to year as determined by the Department. For the purposes of this regulation all related scholarships (e.g. top-up funds) are deemed to be part of the scholarship.

⁶ This means a quarter GTA averaged over two regular terms in the academic year. For example, a Student could hold one half of a GTA position in one term and no GTA in the second term.

⁷ Students admitted prior to September 1, 2015, do not need to apply and receive a fifth year of funding if needed.

Incoming Students receive a GTA contract upon arrival. Students renewing their GTA appointments typically receive a GTA contract by July 1 for the following Fall term. GTA contracts are typically issued by November 1 for the Winter term.

Exceptions to these rules are possible subject to the rules set out by the Faculty of Science and subject to approval by the Associate Chair/Graduate Committee.

Limitations, conditions, and terms set out in the Departmental Offer Letter are in addition to the regulations mentioned above.

1.9.2 Research Assistantships

Another source of funding are Research Assistantships (RA). There are two types of such appointments: Graduate Research Assistantships (GRA) and Graduate Research Assistantship Fellowships (GRAF).

The differences between these two types are as follows:

- GRAs should be viewed as akin to a GTA. The work required for a GRA is not directly related to the Student's thesis research. The combined workload of all GRA/GTA appointments a Student holds at the University cannot exceed 12h per week (averaged over a term).
- GRAFs are intended to support Students in their thesis research. There is no specific number of weekly work hours associated to GRAFs, and Students are not considered employees of the Assistantship Supervisor (usually, the funding faculty member).

During May to August Supervisors typically provide RA funding ("Summer Support") from their research grants to thesis-based MSc and PhD Students. This funding may be contingent on the Student's performing of research related duties at the Department, and is at the discretion of the Supervisor (and subject to availability of funds). It is provided in the form of a GRAF if the work is directly related to the student's thesis research.

Supervisors should discuss their funding commitment with the Student early on in the program (for example it should be clear to both Supervisor and Student, for how many summers the Supervisor will be providing summer support). Students must be aware that Supervisors cannot guarantee funding beyond the lifetime of their research grants.

Students appointed to an RA for May to August will receive a GRA or GRAF contract by April 1 or upon choosing a Supervisor whichever is later⁸.

The recommended Summer Support is \$7,000⁹ (in total) for Students who are Canadian Citizens or Permanent Residents, and \$8,000¹⁰ for International Students (due to their higher tuition requirements). For International Students, Supervisors are also encouraged to provide some GRAF support during regular terms.

⁸ Students are advised that due to the nature of how research grants are assigned, sometimes Supervisors cannot commit to Summer Support by the April 1 deadline.

⁹ These amounts may vary from year to year as determined by the Graduate Committee.

1.9.3 Funding Guarantee

Most thesis-based Students¹⁰ admitted in Fall 2016 and beyond are guaranteed a minimum level of funding in their Departmental Offer Letter. To be applicable, this guarantee requires the Student to be in good academic standing, and research progress as well as past performance as a GTA to be satisfactory. If any one of these conditions are not met, the entire guarantee is null and void¹¹. The details are outlined in the document accompanying the Departmental Offer Letter, and are individual to each Student. The Student should contact the Graduate Office immediately, if he/she feels that the Department is not satisfying the Funding Guarantee.

2.0 MSc PROGRAMS

2.1 Programs and Specializations

The Department offers both thesis-based and course-based programs leading to the degree of Master of Science (MSc) 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, Mathematical Physics, and Statistical Machine Learning.

Course-based programs are intended as a terminal degree. Thesis-based programs may be terminal, but may also offer the possibility to pursue a PhD degree afterwards.

2.1.1 Program switch

Students are admitted to either a course- or thesis-based program.

Switches from a thesis- to a course-based program need the approval of the Associate Chair/Graduate Committee and the FGSR. Students switching to a course-based program are no longer eligible for GTA funding, and any GTA may be terminated upon approval of the switch.

Switches from a course- to a thesis-based program will typically be permitted only with the strong backing of a prospective supervisor and are subject to approval by the Associate Chair/Graduate Committee, and the FGSR. Also, if the switch is approved, there is no entitlement of the Student to additional funding beyond what was offered for the course-based program (but the Department may at its discretion offer the usual GTA funding for thesis-based Students).

For transfers to or from the PhD program see 3.3.1.

¹⁰ This means most Students admitted after September 1, 2016.

¹¹ For example, if a Student is ineligible for GTA funding due to poor past performance or poor academic standing, the Funding Guarantee ceases; the Department will not substitute the GTA portion of the Student's funding by other means.

2.2 Entrance Requirements

Candidates for the MSc degree will normally have a BSc (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. A minimum GPA of 3.3 in the most recent two years of study is required (study programs not relevant to the program applied to are usually not considered).

2.3 Courses

Programs of courses must be approved by the Advisor/Supervisor and the Associate Chair/Graduate Committee. See Sections 2.6 and 2.7 below for minimum course requirements in the course-based and thesis-based programs. The Associate Chair/Graduate Committee may, on the recommendation of the Advisor/Supervisor, require more than the minimum number of courses.

Reading courses will count towards satisfying degree requirements upon approval by the Associate Chair. Normally not more than one ungraded reading course per *18 credits will be approved.

2.4 Supervisors

See FGSR guidelines in [Section 8.1.2 Appointment of the Supervisor\(s\)](#). In addition, the Department will assign an Advisor to the Student for the first two regular terms (see Section 1.6). During the first two regular terms, Students need to find a Supervisor within the Department. For the one year course-based program in Statistics, a Supervisor within the Department must be found by the end of the first term. It is possible for a Student to have several Supervisors. The Dean of Science appoints the Supervisor.

2.4.1 Supervisory Committee

Students in a thesis-based MSc program must have a Supervisory Committee¹². The Committee monitors the Student's academic progress and offers guidance and advice to the Student throughout his/her program. The Committee consists of at least three members and includes the Supervisor(s). To be a member of a Supervisory Committee it is necessary to be eligible as an Examiner (for the Final Oral Examination) as specified by the FGSR. The Committee meets at least once a year with the Student.

¹² The Supervisor will determine the Supervisory Committee, subject to approval by the Associate Chair.

2.5 Residency Requirement

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

2.6 Thesis-based MSc programs

Unless mentioned explicitly otherwise in the program specific sections, the minimum requirements for a thesis-based MSc are met by completing an approved program of graduate courses with a total course weight of *18, the writing of a thesis, and the passing of the Final Oral Examination (there are some additional requirements like Ethics Courses and the Graduate Colloquium, described in Section 5). The total number of credits (including Thes 9XX credits) must be at least *24. Some Students will be required to take such additional course work as is deemed appropriate by the Advisor/Supervisor and Associate Chair/Graduate Committee. Some specializations will also require a greater total course weight.

The requirements for a written MSc thesis are outlined in Section 8.4 Thesis Requirements.

2.6.1 Final Oral Examination

Each Student must, upon submission of the thesis, pass a Final Oral Examination.

The structure of the MSc Examining Committee is described in Section 8.2 The Structure of Examining Committees.

Any Department member may be present at the exam portion with the approval of the Chair of the Examination Committee. However, no one (other than e.g. an Associate Dean of the FGSR) not on the Examination Committee can be present during the discussion of the outcome of the Exam. See the FGSR regulations for details.

The MSc Examining Committee is required to include:

- A minimum of four Examiners.
- The Supervisory Committee is automatically (ex-officio) part of the Examining Committee.
- At least two Examiners from the Department.
- At least one Arm's Length Examiner. Members of the Supervisory Committee cannot be Arm's Length Examiners.
- A Committee Chair. The Chair is not an Examiner, and must be without conflicts of interests with the remainder of the Committee¹³.

The conduct of the MSc examination is outlined in [Section 8.3.2 Thesis-based Master's Program Examination](#) (FGSR Graduate Program Manual). In addition, the Department encourages the Student to give a 50 minutes public talk instead of a short (20 minutes) presentation to the committee. The public talk must be requested at the time the examination forms are submitted to the Department. If a public presentation is chosen the general audience has the opportunity to

¹³ This rule will be enforced for exams taking place in or after the Winter 2018 term.

ask questions. Immediately after the oral presentation, the Examination Committee will continue the exam with the exclusion of the public.

2.7 Course-based MSc programs

Unless stated explicitly otherwise in the sections regarding specific programs, the minimum requirements for a course-based MSc are met by completing an approved program of graduate courses with a total course weight of *24, and a project (*6), normally embodied by Math 900/Stat 900 (there are additional requirements like Ethics Courses described in Section 5). Some Students will be required to take such additional course work as is deemed appropriate by the Supervisor/Advisor and Associate Chair/Graduate Committee. Some specializations may have additional requirements.

The Student's Supervisor and one other faculty member will evaluate the project. There is no oral exam.

See also Section 8.5 Course-based Program Requirements.

2.7.1 Project courses

Students in a course based program must complete a capstone project. While working on the project the Student must enrol in Stat 900 A/B (for the MSc in Biostatistics), Math 900 A/B (MSc in Mathematical Finance, Mathematics, Applied Mathematics, Mathematical Physics), or Stat 901/902 (MSc in Statistics). Math/Stat 900 A/B can be taken in consecutive terms or concurrently. Students cannot enrol in Stat 902 unless the work on their project has started.

2.8 MSc in Mathematics

The courses taken for satisfying the degree requirements for an MSc in Mathematics (course- or thesis-based) must be courses in Mathematics offered by the Department.

The coursework must include courses from at least two different areas (see the tables in 4.4).

2.9 MSc in Applied Mathematics

The courses taken for satisfying the degree requirements for an MSc in Applied Mathematics (course- or thesis-based) must be courses in Mathematics or Statistics offered by the Department, or graduate courses offered by other departments as deemed appropriate.

2.10 MSc in Mathematical Finance

2.10.1 Entrance Requirements

Candidates for the Mathematical Finance program will normally have a bachelor's degree in Mathematics, Statistics, Physics, Engineering, or Finance, subject to the usual minimum GPA requirements (see 2.2).

2.10.2 Degree Requirements

The thesis-based MSc program consists of a minimum of 18* credits of graduate courses plus a thesis. The course-based MSc program consists of a minimum of 24* credits of graduate courses plus a project. If available, Math Finance MSc Graduate Students are required to take

- MATH 505 Stochastic Analysis I
- MATH 508 Computational Finance
- MATH 510 Stochastic Analysis II
- MATH 515 Mathematical Finance I
- MATH 520 Mathematical Finance II
- FIN 501 Managerial Finance or, both, FIN 502 and FIN 503

It is recommended that Students take also

- FIN 654 Risk Management

Further courses of interest include

- MATH 625 Advanced Mathematical Finance
- STAT 580 Stochastic Processes
- STAT 571 Probability and Measure
- STAT 671 Probability Theory I
- STAT 672 Probability Theory II
- MATH 527 Intermediate Partial Differential Equations
- MATH 536 Numerical Solutions of Partial Differential Equations
- BUEC 503 Economic Foundations

Courses at the School of Business may incur additional tuition and fee charges.

2.11 MSc in Statistics

2.11.1 Thesis based program

For the thesis-based MSc 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 512, Stat 532, Stat 561, 568, 575, 578, 679.

It is strongly recommended that Students who have not previously completed the equivalent of Stat 479 include Stat 503 in their program.

It is strongly recommended that Students who have not previously completed the equivalents of Stat 471 and 472 include Stat 580 in their program. This should be discussed with the Advisor/Supervisor immediately at the beginning of the program.

Stat 503 cannot be taken for program credit if credit has previously been obtained for Stat 479. Stat 505 cannot be taken for graduate credit in thesis-based Statistics programs.

Students who are planning to pursue a PhD in Statistics are encouraged to include Stat 664 in their program.

At the request of the Advisor/Supervisor and at the discretion of the Associate Chair/Graduate Committee, certain Math courses or courses offered by other Departments may be accepted, or required, for graduate credit.

2.11.2 Course based program

The course-based MSc in Statistics is a one year program, and requires a minimum of *21 of coursework (7 courses) and a project (*3).

The program will consist of:

- Stat 566 and Stat 590
- Five electives chosen from Stat 503, Stat 505, Stat 512, Stat 532, Stat 553, Stat 561, Stat 562, Stat 568, Stat 575, Stat 578, Stat 580.
- a project (Stat 901 and Stat 902); see section 2.12.3 for a detailed description

Notes:

- Students are advised to consult the requirements for accreditation, by the Statistical Society of Canada (SSC), as Associate Statistician, when choosing their courses. Information on this is available from the Department, and from the SSC web site.
- Stat 503 cannot be taken if credit has previously been obtained in Stat 479.
- Stat 505 cannot be taken if credit has previously been obtained in Stat 441.
- Stat 512 is strongly recommended for Students without training in mathematics at the level of Stat 312 or higher.

2.11.3 Project Description for the Course-based MSc

Students will serve for two terms as consultants. Alternatively, the equivalent of this component can be performed in the summer months of a 12-month program. Each term will consist of at least 39 hours attendance at the Training Consulting Centre. With the permission of the Supervisor this service can instead be carried out at another approved consulting centre on campus. During the first of the two terms the Student will have “observer” status and register in Stat 901. During the second of these two terms he/she will be registered in Stat 902, and will undertake a project of sufficient depth to serve as the capping project required by the FGSR.

This work will be described in a written report, which will be read by the Supervisor and one additional faculty member.

2.12 MSc in Biostatistics

All Students must complete a Practicum, which is described below.

Students in both the thesis- and course-based MSc 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:

- SPH 597 Fundamentals of Epidemiology for Public Health (see below)
- or SPH 596 Epidemiology Methods I (see the note below)
- SPH 696 Epidemiology Methods II (prereq is SPH 596)

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

Note: SPH 596 is a *2 credit course only. Students must take another *1 credit course in Epidemiology at the School of Public Health (there is usually a *1 credit option SPH 561 that fits in the schedule). Access to SPH 696 is not guaranteed if only SPH 597 has been taken. Students wishing to take SPH 597 should discuss this early on with their Advisor.

Students must fulfill remaining 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

Alternatively, possible elective courses include: SPH 531, SPH 570, SOC 558, SOC 616, INTD 570, Stat 503, 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 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.

2.13 MSc in Mathematical Physics

2.13.1 Entrance Requirements

Candidates will normally have a four-year degree in Physics, or Mathematics, or Statistics.

2.13.2 Degree Requirements

The courses taken for satisfying the degree requirements for an MSc in Mathematical Physics (course- or thesis-based) must be courses in Mathematics or Statistics offered by the Department, or courses offered by the Department of Physics, approved by the

Advisor/Supervisor. Exceptions to that rule must be approved by the Associate Chair/Graduate Committee.

2.14 MSc in Statistical Machine Learning

The MSc in Statistical Machine Learning is a joint program with the Department of Computing Science. This degree can be obtained through either department.

2.14.1 Entrance Requirements

The entrance requirement for the Master of Science degree in Statistical Machine Learning is the equivalent of a BSc in Computing Science, Mathematics, or Statistics with the usual minimum GPA requirements.

2.14.2 Degree Requirements

The MSc degree can be obtained only in a thesis-based program. Students must select two of the following courses:

- Stat 571 Probability and Measure
- Stat 566 Methods of Statistical Inference (or Stat 664, Advanced Statistical Inference)
- Stat 665 Asymptotic Methods in Statistical Inference

Students must select two graduate courses from the Department of Computing Science, relevant to machine learning, chosen by the Student and Advisor/Supervisor.

Students who applied to the Department of Computing Science must also take Cmput 603 (Teaching and Research Methods). Students who applied to the Department of Mathematical and Statistical Sciences may take Cmput 603.

For completing their course requirements, in addition to the courses listed above, Students can select courses from the following options:

- Stat 512 Techniques of Mathematics for Statistics
- Stat 575 Multivariate Analysis
- Stat 580 Stochastic Processes
- Stat 671 Probability Theory I
- Stat 672 Probability Theory II
- Stat 503 Directed Study III
- Stat 679 Time Series Analysis
- Stat 578 Regression Analysis
- Cmput 615 Applications of Machine Learning in Image Analysis
- Cmput 654 Online learning
- Cmput 607 Reinforcement Learning
- Cmput 651 Decision Making in AI: From Foundations to the State of the Art
- Cmput 650 Topics in Artificial Intelligence: Learning To Make Decisions
- Cmput 607 Reinforcement Learning in Practice
- Cmput 605 Statistical Natural Language Processing

2.15 Interdisciplinary MSc programs

Interdisciplinary programs can be set up on a case-by-case basis. The guidelines of the FGSR will be followed, see: <https://www.ualberta.ca/graduate-studies/programs/interdisciplinary-studies>.

3.0 GENERAL REGULATIONS FOR PhD PROGRAMS

3.1 Primary Requirements

In order to obtain a PhD degree, a Student must, among other requirements, and in order, pass the Entrance Year and the Candidacy Examination, write a PhD Thesis, and successfully defend the thesis in a Final Oral Examination (Defence). Details of these requirements are spelled out below. There are additional requirements (eg. Ethics Courses and the Graduate Colloquium) described in Section 5. As per FGSR regulations, all degree requirements except for the thesis and the defence must be met within 3 years into the program; for Students transferring from the MSc program this means within 4 years after their entering the MSc program.

Students are also expected to participate actively in Departmental research related activities (e.g. colloquia and appropriate seminars).

3.2 Programs and Specialization

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

The field of specialization in each particular case shall be largely determined by the Student's and Associate Chair/Graduate Committee's choice at the time of admission. Changes are possible anytime upon approval by the Associate Chair/Graduate Committee and the FGSR.

3.3 Entrance Requirements

To be admitted for the PhD program a Student normally must hold the equivalent of a thesis-based MSc degree in Mathematics or Statistics from the University of Alberta. A minimum GPA of 3.3 (or equivalent) in the most recent two years of relevant study is required to be considered for admission.

The program specific sections may specify additional or alternate entrance requirements.

3.3.1 Transfer to or from the MSc Program

Exceptionally strong Students in a thesis-based MSc program at the Department may upon request transfer to the PhD program bypassing the MSc degree, subject to the following conditions:

- the request must be approved by the Associate Chair/Graduate Committee and the FGSR.
- the request must be made during the first year of study as an MSc Student (typically after the first two regular terms). Exceptions are possible, but, in particular past four regular terms as an MSc Student¹⁴, will rarely be granted.
- Students making the request after two regular terms of study in the MSc program should have completed the equivalent of the PhD Entrance Year (see below) in their desired PhD program, or comparable course work.
- Two faculty members at the University (at least one at the Department) must support the request by submitting a letter of support (each). At least one faculty member at the Department must express an interest in supervising the Student during the PhD program.

Transfers from course-based programs are not permitted unless in exceptional circumstances. If the transfer is approved the Student is not automatically entitled to additional funding above what was guaranteed in the original Departmental Offer Letter into the MSc program. However, the Department will make an effort to offer the regular PhD funding as outlined in Section 1.9. and will issue an amended Offer Letter detailing the funding commitment.

Students in a PhD program may upon request and approval by the Associate Chair/Graduate Committee and the FGSR transfer to an MSc program (course- or thesis-based). Such requests will only be approved with the backing of a prospective supervisor. As for GTA funding eligibility Section 1.9 applies; that is, Students transferring to a course-based program are ineligible for TA funding effective immediately; Students transferring to a thesis-based program are only eligible as long as the combined program time is less than two years.

3.4 Course Requirements

At least *36 credits (in coursework and research, that is, including Thes 9XX credits) are required to obtain the degree of PhD.

For Students without relevant MSc degree, or with a relevant MSc degree from the Department, normally 10 single-term graduate courses (*30) after the relevant BSc degree are required.

Students with a relevant MSc degree from *outside* the Department will be required to take at least *18 units of graduate level courses offered by the Department (or other departments as specified in the program specific sections).

The program specific sections will provide detailed requirements for a particular program

¹⁴ It is generally expected that Students obtain their MSc degree within two years.

All course requirements must have been met at the time of the Candidacy Exam (see 3.10), or after three years into the program (four years combined for Students transferred from an MSc program), whichever is sooner.

3.5 Graduate Courses

Programs of courses must be approved by the Advisor/Supervisor and the Associate Chair/Graduate Committee. The Associate Chair/Graduate Committee may, on the recommendation of the Advisor or Supervisory Committee, require more than the minimum number of courses. Courses on the 400 level or lower will not be counted towards the degree requirements.

In all programs, graduate courses offered by other departments will be counted towards the minimum requirements upon approval by the Supervisor/Advisor and the Associate Chair.

Reading courses will be counted towards the minimum requirements upon approval by the Associate Chair. Normally not more than one (ungraded) reading course per *18 of coursework will be approved. Students are advised to consider that reading courses typically will not carry as much weight as regular classes as far as evaluations for scholarships or awards are concerned.

Seminar courses are not counted against course requirements unless the Student must satisfy the *30 credit rule: then three instances of one seminar course (having a weight of *1 each) may be counted once as one *3 course upon approval of the Associate Chair, provided the Student demonstrates active participation in each instance.

3.6 Residency Requirement

The residency requirement for a PhD Student is full-time registration for 2 academic years.

3.7 PhD Thesis

The most important requirement for the PhD degree is an original and substantial contribution to knowledge, embodied in a thesis. Details are outlined in Section 8.4 Thesis Requirements.

3.8 Supervisor

See FGSR guidelines in Section 8.1.2 Appointment of the Supervisor(s). In addition, the Department will assign an Advisor to the Student for the first two regular terms (see section 1.6). During the first two regular terms, Students need to find a Supervisor within the Department. It is possible for a Student to have several Supervisors. The Dean of Science appoints the Supervisor.

3.8.1 Supervisory Committee

Students in a PhD program must have a Supervisory Committee¹⁵. The Committee monitors the Student's academic progress and offers guidance and advice to the Student throughout his/her program. The Committee consists of at least three members and includes the Supervisor(s). To be a member of a Supervisory Committee it is necessary to be eligible as an Examiner (for the Final Oral Examination) as specified by the FGSR. The Committee meets at least once a year with the Student.

3.9 Entrance Year in the PhD Program

3.9.1 Entrance Year

All incoming PhD Students are automatically enrolled in the Entrance Year. The Entrance Year comprises of four Core Courses¹⁶ within the first two regular terms for which an average GPA of 3.6 or better must be attained to stay in the PhD program¹⁷. At the beginning of the first term the Student's Advisor/Supervisor 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 or transferred from an MSc program at the Department and have completed core courses in their program while an MSc Student, these courses may be counted towards the Entrance Year by the Graduate Committee. The same applies for core courses taken while an Undergraduate Student at the Department.¹⁸

3.9.2 Continuation after Entrance Year

When a Student has completed two full regular terms (Fall and Winter) in the PhD program, the Department Council, upon recommendation of the Graduate Committee, decides whether the Student has passed the Entrance Year and may continue in the program, or else whether Academic Probation or withdrawal is recommended to the FGSR.

The decision of Department Council is final and not appealable.

The Graduate Committee bases its recommendation on the Student's performance in the Entrance Year. 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.

¹⁵ The Supervisor will help with composing the supervisory committee.

¹⁶ A Core Course is a course designated as such by these Regulations and Guidelines for a specific program. A course may be a Core Course for one but not another program at the Department.

¹⁷ For Students who take more than four eligible core courses within their first year, the best four are counted towards this GPA requirement.

¹⁸ When taken as an Undergraduate or during the MSc program, the core courses do not count towards program requirements (i.e. carry no program credit). For cross-listed core courses, only the graduate version counts towards the Entrance Year.

3.9.3 Midterm evaluation

Notwithstanding the regulations of Section 1.4, the Graduate Committee may, at its discretion, recommend Academic Probation or withdrawal to the FGSR after one regular term, if the Student's performance is judged unsatisfactory.

3.9.4 Course work during the Entrance Year

During the Entrance Year, Students must be registered in *18 of courses, at least *12 of which are core courses for the Student's program (if as per 3.9.1 past courses are counted towards the core course requirement, this may be lower as appropriate). Students that already have a thesis project may register in Thes 903 for up to *3 credits with the approval of the Associate Chair. Students who completed their MSc degree at the Department may register in up to *6 in Thes 9XX during their first year as a PhD Student, provided an appropriate thesis project has been established.

Upon recommendation of the Advisor/Supervisor and at the discretion of the Associate Chair/Graduate Committee, additional courses must be taken aimed at remedying deficiencies in the background of the Student. In such cases one core course can be moved to the third term upon approval of the Associate Chair; however, the Student still needs to obtain a GPA of at least 3.6 in the first three core courses and in all four core courses. In this case, the Entrance Year evaluation (see 3.9.2) will take place after three regular terms.

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 Associate Chair on a case-by-case basis (see Interdisciplinary Degrees in Section 4.6).

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.

3.10 Candidacy Examination

The purpose of the Candidacy Examination is to establish the Student's expertise in the general area of research that the Student's thesis will focus on. It determines whether the Student is prepared to write a PhD thesis (i.e. among other things, whether the Student is well versed in the relevant literature, and is capable of performing research). The Student should also present a research proposal. The Candidacy Examination Committee will offer advice to the Student regarding the proposed research, and determines whether additional coursework is necessary.

It is strongly recommended that Students take their Candidacy Exam before the end of their second year in the PhD program. For Students who transferred from the MSc program this means the second year of combined studies. The FGSR requires Students to pass their Candidacy Exam within three years of their entering the program (four years combined for Students transferring from an MSc program). Extensions for one year need a formal written application to the Associate Chair and will be approved only in exceptional circumstances.

All course requirements should have been met for a Student to take the Candidacy Exam. As an outcome of the Exam, the Examination Committee may, at its discretion, require additional coursework as is deemed appropriate.

See Sections 8.3 Conduct of Examinations and 8.3.3 Doctoral Program Candidacy Examination Procedure in the FGSR Graduate Program Manual.

The PhD Candidacy Examination Committee is required to include:

- A minimum of five Examiners.
- The Supervisory Committee is automatically (ex-officio) part of the Examination Committee.
- At least three Examiners from the Department.
- At least two Arm's Length Examiners. Members of the Supervisory Committee cannot be Arm's Length Examiners.
- A Committee Chair. The Chair is not an Examiner, and must be without conflicts of interest with the remainder of the Committee¹⁹.

The Department requires Students to submit a Candidacy Report no later than two weeks (14 calendar days) before the exam date to the Graduate Office (electronically). The report must describe the Student's research area and plans. Students must contact the Graduate Office for detailed requirements regarding formatting and length of the report (typically not more than ten pages).

At the exam the Student will give a presentation of about 20 minutes after which the Committee will ask questions.

Failure to pass the Candidacy Examination may result in the termination of the program. See the FGSR regulations for details.

3.11 Final Oral Examination

In addition to Sections 8.3 Conduct of Examinations and 8.3.4, Final Doctoral Examination, the Department requires that the Student shall make a public presentation (50 minutes) outlining the thesis and stressing its major points. Following this presentation, the general audience has the opportunity to ask questions. Immediately after the oral presentation, the Examining Committee will continue the exam with the exclusion of the public.

Any Department member may be present at the exam portion with the approval of the Chair of the Examination Committee. However, no one (other than e.g. an Associate Dean of the FGSR) not on the Examination Committee can be present during the discussion of the outcome of the Exam. See the FGSR regulations for details.

The Examination Committee for the Final Oral Examination is required to include:

- a minimum of five Examiners.
- the Supervisory Committee is automatically (ex-officio) part of the Examining Committee.
- at least three Examiners from the Department.

¹⁹ This rule will be enforced for exams taking place in or after the Winter 2018 term.

- at least two Arm's Length Examiners. Members of the Supervisory Committee cannot be Arm's Length Examiners.
- an External Examiner or External Reader²⁰, who is an external arm's length expert in the area of the thesis and must be approved beforehand by the Associate Chair, the Faculty of Science, and the FGSR. The external expert, whether Reader or Examiner, is considered to be attending the exam and therefore counts as one Committee Member and one of the two Arm's Length Examiners.
- A Committee Chair. The Chair is not an Examiner, and must be without conflicts of interest with the remainder of the Committee²¹.

4.0 REGULATIONS SPECIFIC TO INDIVIDUAL PhD PROGRAMS

4.1 PhD in Applied Mathematics

The core courses must include

1. Math 536 Numerical Analysis
2. Math 538 Techniques in Applied Mathematics, or
Math 539 Applied Functional Analysis

plus any two courses selected from

- Math 524 Ordinary Differential Equations
- Math 527 Partial Differential Equations
- core courses from the Statistics PhD program
- core courses from the Mathematics PhD program.
- core courses from the Mathematical Finance PhD program.

To satisfy degree requirements, graduate courses offered by other departments may be used as deemed appropriate.

4.2 PhD in Mathematical Finance

The four core courses taken in the Entrance Year must include

- Math 515 Mathematical Finance I
- Math 520 Mathematical Finance II
- Math 510 Stochastic Analysis II

²⁰ The external expert is either an Examiner or a Reader; in the first case the external is physically present or attending the exam by teleconferencing, in the second case the external is only submitting a written report (and is typically asked to provide written questions to the candidate). In both cases the external is considered as attending the exam.

²¹ This rule will be enforced for exams taking place in or after the Winter 2018 term.

plus one core course from

- Stat 571 Probability and Measure
- Stat 580 Stochastic Processes
- Math 505 Stochastic Analysis I
- Math 508 Computational Finance

It is required that PhD Math Finance Students include the following courses in their program, if available:

- Math 625 Advanced Mathematical Finance
- Fin 654 Risk Management

Further recommended courses include:

- Stat 671 Probability Theory I
- Stat 672 Probability Theory II

Course requirements can also be satisfied with courses offered by the School of Business. Courses at the School of Business may incur additional tuition and fee charges.

4.3 PhD in Mathematical Physics

The core courses are:

- Math 521 Differential manifolds

and any three of the following, with at least one being a Math course:

- Math 506 Complex Variables
- Math 516 Linear Analysis
- Math 527 Partial differential equations
- Math 524 Ordinary differential equations
- Math 535 Numerical Methods I
- Math 581 Group Theory
- Phys 511 Advanced Quantum Mechanics
- Phys 530 Statistical Mechanics
- Phys 610 Quantum Field Theory I

To satisfy the degree requirements, Mathematics courses offered by the Department and courses offered by the Department of Physics may be used.

4.4 PhD in Mathematics (Pure Mathematics)

At least one core course must be in Algebra/Number Theory and at least one core course must be in Analysis/Probability from the tables below.

The core courses are:

<i>Algebra/Number Theory</i>	<i>Analysis/Probability</i>	<i>Topology/Geometry</i>	<i>Differential Equations</i>
Math 581 Group Theory	Math 516 Linear Analysis	Math 506 Complex Variables	Math 524 ODEs
Math 582 Rings and Modules	Math 542 Fourier Analysis	Math 521 Differential Manifolds	Math 527 PDEs
		Math 530 Algebraic Topology	

Non-Core Courses

<i>Algebra/Number Theory</i>	<i>Analysis/Probability</i>	<i>Topology/Geometry</i>	<i>Differential Equations</i>
Math 512 Algebraic Number Theory	Math 518 Functional Analysis	Math 523 Applications of Differential Geometry to Mechanics	Math 536 Numerical Solutions of PDEs
Math 681 Topics in Algebra	Math 519 Operator Algebras	Math 630 Topics in Algebraic Topology	Math 525 ODE II
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		

<i>Algebra/Number Theory</i>	<i>Analysis/Probability</i>	<i>Topology/Geometry</i>	<i>Differential Equations</i>
	Math 641 Banach Space Theory		
	Math 642 Abstract Harmonic Analysis		
	Math 643 Topics in Analysis		
	Stat 671 Probability Theory		

4.4 PhD in Statistics

The core courses in Statistics 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 Advanced Statistical Inference
- Stat 665 Asymptotic Methods in Statistical Inference
- Stat 571 Probability and Measure
- Stat 575 Multivariate Analysis
- Stat 578 Regression Analysis

Stat 512 is strongly recommended.

At least six of these courses are to be taken by every PhD (Statistics) Student with at least four of them taken in the Entrance Year. These six courses must include STAT 664, 665, 571.

Stat 505 cannot be taken for credit.

4.4.1 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 PhD in Statistics are:

STAT I: The Stat I exam is based on our more theoretical senior undergraduate courses Stat 466 and Stat 472. Material includes 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 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 Stirzaker, *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: The Stat II exam is based on our more applied courses: Stat 479, Stat 361, Stat 368, and Stat 378. Material includes 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.

The exams are administered by the Statistics Centre. They cannot be failed. The results are used to advise Students of gaps in their background and determine appropriate course work to remedy these.

Students who obtained an MSc degree in Statistics at the Department are exempt from this exam requirement. Students who transfer from an MSc (Statistics) to the PhD (Statistics) program are exempt, if they prima facie pass the Entrance Year in Statistics (i.e. took four core courses with a minimum average GPA of 3.6).

4.5 PhD in Statistical Machine Learning

4.5.1 Entrance Requirement

The entrance requirement for the PhD program in Statistical Machine Learning is an MSc degree in Computing Science or in the Mathematical and Statistical Sciences, or equivalent.

4.5.2 Entrance Year and Course Requirements

Students must select two of the following core courses:

- Stat 571 Probability and Measure
- Stat 566 Methods of Statistical Inference
or Stat 664 Advanced Statistical Inference
- Stat 665 Asymptotic Methods in Statistical Inference

Students must select another two of the following core courses:

- Cmput 551 Machine Learning
- Cmput 670 Numerical Optimization: Theory and Algorithms
- Cmput 651 Probabilistic Graphical Models
- Cmput 609 Reinforcement Learning in Artificial Intelligence

Students who applied to the Department of Computing Science must also take Cmput 603 (Teaching and Research Methods). Students who applied to the Department of Mathematical and Statistical Sciences may take Cmput 603.

For completing their course requirements, in addition to the core courses listed above, Students can select courses from the following options:

- Stat 512 Techniques of Mathematics for Statistics
- Stat 575 Multivariate Analysis
- Stat 580 Stochastic Processes
- Stat 671 Probability Theory I
- Stat 672 Probability Theory II
- Stat 503 Directed Study III
- Stat 679 Time Series Analysis
- Stat 578 Regression Analysis
- Cmput 615 Applications of Machine Learning in Image Analysis
- Cmput 654 Online learning
- Cmput 607 Reinforcement Learning
- Cmput 651 Decision Making in AI: From Foundations to the State of the Art
- Cmput 650 Topics in Artificial Intelligence: Learning To Make Decisions
- Cmput 607 Reinforcement Learning in Practice
- Cmput 605 Statistical Natural Language Processing

4.6 Interdisciplinary PhD programs

Interdisciplinary programs can be set up on a case-by-case basis. The guidelines of the FGSR will be followed, see: <https://www.ualberta.ca/graduate-studies/programs/interdisciplinary-studies>. For example, successful interdisciplinary PhD degrees have been obtained with the Departments of Biological Sciences, Computing Science, Physics, and the School of Public Health.

5.0 PROFESSIONAL DEVELOPMENT

In addition to being an expert in a given area, it is important that Graduate Students develop professional skills that enable them to obtain and function in challenging occupations. These skills include the abilities to give scientific presentations, to write scientific papers, to teach on a high scientific level, and to understand scientific and professional ethical principles.

5.1 Professional Development Requirement

Every Graduate Student must satisfy a Professional Development Requirement as follows: during the first year of graduate studies the Student must complete an Individualized Development Plan (IDP) and submit it to their Supervisor²² and the Associate Chair for approval. To graduate, Students must complete at least 8 hours of approved Professional Development *towards

²² Students in a thesis based program only

implementation of their IDP*. Students are responsible for providing proof of fulfillment of this requirement before graduation.

5.2 Graduate Colloquium

Each Graduate Student in a thesis based program is required to register in two credits (*2) of Math 601 Graduate Colloquium. At least one of these credits must be obtained in a Fall term (unless approved otherwise by the Associate Chair).

Each Student must give at least one presentation in the Graduate Colloquium. Presentations at conferences or in seminars count towards this requirement upon approval by the Associate Chair. Credits in Math 601 earned while an MSc Student will be counted towards this requirement in the PhD program.

5.3 Ethics

It is mandatory that each Graduate Student in a thesis based program completes 8 hours (h) of ethics education. These hours can be obtained through a menu of events such as the FGSR online ethics course (5h), or ethics seminars across campus. Most of these are organized through FGSR, but there are also Department specific events. Our Department offers a 2h ethics seminar for Mathematics and Statistics, normally around April 1st of a given year.

Students must keep track of their ethics training and submit proof of fulfillment of the 8 hour requirement before graduation.

5.4 Graduate Teaching and Learning Program²³

The University offers to our Graduate Students a Graduate Teaching and Learning Program (GTL), which is intended to prepare Students for teaching jobs. Details are given at: <http://www.gradstudies.ualberta.ca/gtl/>. The GTL program is split into three Levels:

Level One (no costs)

Level One is intended to provide an overview of skills and concepts required for teaching at a post-secondary level. All Students enrolled in 15 or more hours of FGSR Teaching Development sessions will receive a letter indicating they have met Level One pedagogical requirements.

Level Two (no costs)

In addition to Level One, Students will be required to complete 4 program components: additional pedagogy sessions, practical teaching experience, feedback from peers and teaching mentor, and completion of a teaching dossier. Completion of Level Two will be recognized by an official entry in the transcript.

²³ This program is currently being redesigned by the FGSR. Students should check the FGSR website for the most up to date information on the program.

Level Three (extra tuition fee might apply)

Students may enroll in the new post-baccalaureate Certificate Program in Teaching and Learning to be available through the Faculty of Extension. Completion of Level One or Two is not required to participate in this program. The Certificate will provide Students an opportunity to explore the deeper relationships of pedagogy with Student learning.

5.5 Embedded Certificate in Data Science

The growing availability of large data sets in industry and government increases the demand for qualified data analysts. The certificate in DS allows PhD and MSc Students in theory based mathematics programs to upgrade their qualifications towards data analysis.

The DS certificate is open to registered Students in MSc and PhD programs in Mathematics, Applied Mathematics, and Mathematical Physics.

For the DS certificate Students are required to complete the Graduate Teaching and Learning Certificate Level 1 (GTL Level 1) plus *9 credits chosen from the following list:

- Stat 501 Directed Study I (Experimental Design)
- Stat 502 Directed Study II (Regression)
- Stat 503 Directed Study III (Time Series)
- Stat 504 Directed Study IV (Sampling)
- Stat 505 Directed Study V (Data Mining)
- Stat 568 Design and Analysis of Experiment
- Stat 578 Regression Analysis
- Stat 575 Multivariate Analysis
- Math 508 Computational Finance
- BIOL 501 (Applied Bioinformatics)
- Cmput 551 Topics in Artificial Intelligence (Machine Learning) (This course requires solid programming skills. It is highly recommended to first take Cmput 174 and Cmput 175).
- Cmput 659

Other courses may be approved in consultation with the Associate Chair (Graduate Studies) at the Department of Mathematical and Statistical Sciences: for example, MIN E 612 (Geostatistics).

Upon successful completion of the graduate program, inclusive of the designated DS certificate courses, and the GTL Level 1, the Student will be awarded the Embedded Certificate in Data Science in addition to their graduate degree.

Courses used for satisfying the requirements of the DS certificate will be counted towards degree requirements if appropriate, as determined by the Associate Chair/Graduate Committee²⁴. The Supervisors/Advisors will provide guidance in selecting the appropriate courses.

²⁴ Some courses are closed for registration to Graduate Students at the Department. These courses will count towards the DS certificate, but not the degree program.