



Graduate Handbook

2012/2013

ORFE Graduate Handbook

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This handbook describes the basic academic requirements and contains many tips and suggestions for new graduate students in the ORFE department.

Message from the Chair, Professor Jianqing Fan



Welcome to the Department of Operations Research and Financial Engineering. It is my hope that you will strive to make your graduate study successful and explore the richness of the research programs of Princeton University. Your success is our success. Enjoy the stimulating academic environment at Princeton.

Message from the Director of Graduate Studies (DGS), Professor Patrick Cheridito



Princeton is a small school where close interaction with advisors is encouraged. It is important that you establish a close working relationship with your advisor. If you feel that this is not happening, or you are having problems with your advisor, please feel free to come and see me.

Satisfactory Academic Progress

To establish the foundation for satisfactory academic progress, the Graduate School and academic departments expect the following from enrolled students, as evidence of their successful engagement with graduate work and for them to continue to receive their stipends and other benefits of enrollment:

- Full-time Commitment. Graduate study at Princeton, at both the doctoral and master's levels, requires full-time commitment to study and research on the part of students. The Graduate School's financial aid structure is one, but only one, indication of that requirement: full-time, 12-month support for full-time academic effort. Our commitment to clearly stated degree program lengths (e.g., a five-year Ph.D. program in most departments) and timely completion of graduate degrees is another.
- Presence: Students must be visibly present in the department and on campus, unless *In Absentia* or on an approved Leave of Absence. As importantly, students must be intellectually "present," that is, noticeably engaged in the normal work of their degree program—course-taking, paper-writing, research, teaching, attending colloquia.
- Production: Students must be producing work of good quality, at the appropriate and expected stages of their degree program, and showing the products of their study and research to the faculty for evaluation.
- Communication: Students must regularly communicate with and respond in a timely manner to communications from their department graduate program administrator, director of graduate studies, advisor(s), committee members, and other faculty members as appropriate. This is a reciprocal responsibility and graduate students should therefore expect regular and timely communication in order to maintain satisfactory academic progress.

Failure to perform according to these guidelines may result in, for example, deferred reenrollment or denial of reenrollment during the spring term review or termination at mid-year.

In the first year, students select at least four of six core courses in optimization, probability and statistics in consultation with the Department's Director of Graduate Studies, to be followed by a qualifying exam at the end of the summer. In addition, at least two advanced courses and two semesters of directed research are completed under the direction of a faculty advisor in the student's area of interest by the end of the second year in preparation for the general examination. The general examination is normally taken in the spring of the second year of study. Usually, beyond the general examination, two to three years are needed for the completion of a suitable dissertation. Upon completion of thesis studies and acceptance of the dissertation by the department, the candidate is admitted to the final public oral examination.

1. PhD Program Requirement Summary

- In the first year of graduate study, students must take at least four of the six core courses.

Core courses:

ORF 522	Linear & Convex Optimization
ORF 523	Advanced Optimization
ORF 524	Statistical Theory and Methods
ORF 525	Statistical Learning and Nonparametric Estimation
ORF 526	Probability Theory
ORF 527	Stochastic Calculus

- Qualifying exams: Qualifying exams are held in September of the second year. Students can place out of the qualifying exams by receiving at least an A- in four of the core classes.
- All Ph.D. and M.S.E. candidates are required to take EGR501 in the fall term of their second year. This is a half-semester course that will educate graduate students in engineering in the responsible conduct of research. The lectures provide theoretical background information as well as case studies about ethics in day-to-day research situations, publishing and peer-reviewing, student-advisor relationships, collaborative research, as well as in the big picture and considerations of long-term impact. Students are provided resources to consult when faced with ethical questions. The theoretical concepts are made relevant via small-group discussions in departmental and research field-specific precepts. The course is graded on a pass/fail basis.
- ORF 509 & 510: Before taking the general exams, Ph.D. students must complete two research projects under the supervision of a faculty belonging to ORFE or associated to ORFE. Students are required to submit a written report on the findings in both projects. In addition, the results of ORF 509 are presented at a poster session. The results of ORF 510 are presented in the oral part of the general exam.
- General exam (at the end of the second year)
- Research dissertation and Final Public Oral Exam (FPO)

In addition, students take a number of additional classes. At least two of these classes (not including Seminars) passed with at least a B+ are required to pass the general exam. Some relevant classes are:

ORF 504 Financial Econometrics
ORF 505 Modern Regression and Time Series
ORF 518 Applied Stochastic Analysis and Methods (see APC 518)
ORF 531 Computational Finance in C++
ORF 533 Convex Analysis for Mathematical Finance
ORF 534 Investment Science
ORF 535 Financial Risk Management
ORF 538 PDE Method in Financial Mathematics
ORF 542 Stochastic Control and Stochastic Differential Games
ORF 547 Dynamic Programming
ORF 548 Large-Scale Optimization
ORF 549 Stochastic Programming
ORF 551 Random Measures and Levy Processes
ORF 554 Markov Processes
ORF 565 Empirical Process and Asymptotic Statistics
ORF 557, 558 Stochastic Analysis, Seminar
ORF 575 Financial Engineering, Seminar

Pertinent courses in other departments:

COS 511 Theoretical Machine Learning
COS 528 Data Structures and Graph Algorithms
COS 557 Analysis & Visualization of Large Scale Genomic Data Sets
ECO 517 Econometric Theory I
ECO 518 Econometric Theory II
ECO 525 Financial Economics I
ECO 526 Financial Economics II
ELE 525 Random Processes in Information Systems
ELE 531 Communication Network
MAE 546 Optimal Control and Estimation
APC 550 Introduction to Differential Equations
APC 503 Analytical Techniques in Differential Equations
MAT 314 Introduction to Real Analysis
WWS 509 Generalized Linear Statistical Models

1.1 Research & Thesis Advisor

The core classes are there to establish a solid foundation with tools required for research in the disciplines covered by the department. The funding provided by the university for the first year provides freedom and time for students to acclimate to the new environment of graduate school and to make a wise choice of research direction and advisor. Some may know early on the direction they wish to pursue, but for many, it is worth exploring a number of classes taught by a variety of professors before deciding.

The directed classes ORF 509 and 510 should be taken with a faculty advisor with a grade received for 509 by the time of the general exams. The grade for 510 counts as the oral general exam grade. Some take these classes in the spring of the first year and fall of the second year. Others take it in the fall and spring of the second year.

The department is small and there is plenty of opportunity to meet and talk with faculty about research interests. Please be pro-active in doing so as you discover your areas of interest. At various times, some faculty might simply be too busy to take on new students: do not take it personal if a faculty member is unable to take you on as an advisee, there are plenty of excellent research opportunities available to you.

1.2 Ph.D. Qualifying and General Examinations

The requirements for the PhD degree include passing the qualifying exam requirements, the general examination, a presentation of an acceptable thesis, and passing the final oral examination (thesis defense).

Qualifying Examination Procedure

Each student must satisfy qualifying requirements in the areas of 4 of the 6 core classes.

Qualifying exams in these areas will be offered in September of the student's second year. If a student's grade in a core course taken in the first year is A- or better, the student is exempt from taking the qualifying exam in that area. Before the exam, the student must have acquired demonstrated competence in real analysis at the level of MATH 314.

The optimization exams are based on ORF 522 and ORF 523. The probability exams are based on ORF 526 and ORF 527. The statistics exams are based on ORF 524 and ORF 525.

The results of the qualifying exam are determined by a vote of the faculty. For each student, there are two possible outcomes:

- A. Student passes the exam,
- B. Student fails the exam and must transfer out of the PhD program. There is no option to retake the exam.

In case B, we anticipate that the student will be able to continue onto the masters program, provided that the faculty votes to accept such a continuation of the student's education. If the student is deemed unprepared for continuing graduate education in ORFE, he or she will be required to withdraw immediately.

General Examination Procedure

ORFE students take the general exam in April or May of their second year. By that time, the students have met the qualifying examination requirements, have taken and passed ORF 509, have taken or are currently enrolled in ORF 510 and have passed with a B+ or higher two advanced courses. The student must have shown adequate progress on research and an acceptable level of understanding of his or her area of specialization.

The general exam consists of two parts, a written and an oral part, both covering the students primary area of specialization. The written part requires taking and passing with a B+ or higher two approved advanced courses at the graduate (500) level beyond the 4 core classes counted for the Qualifying Exam. These two courses must be approved by the student's advisor and the DGS.

For each student, an examining committee is selected by the student and advisor. It has to be approved by the Director of Graduate Studies. The committee consist of the student's advisor and two other faculty belonging to or affiliated with ORFE. The committee will administer the oral exam, evaluate the student's performance in research and overall knowledge of his/her field, and make a recommendation to the department faculty. A departmental faculty vote determines the final outcome. The oral exam may be up to 3 hours in length.

Information on the oral exam: Before the exam, the student is required to submit a comprehensive written report on the research conducted in ORF 509-510. It is due one week before the exam takes place. The report serves as the basis for the student's presentation. The purpose of the presentation is to explain the research the student has done so far and plans to do in the future. So that the committee can give feedback and make a decision whether the student has the necessary background to complete a Ph.D. thesis. Examining faculty may ask questions on the presentation and on any other material deemed appropriate for a comprehensive examination.

The possible outcomes of the general exam are as follows:

- A. Student passes the exam and is admitted to Ph.D. candidacy,
- B. Student fails the exam but is given the option to retake the exam at a future date,
- C. Student fails the exam and must withdraw from the Ph.D. program.

As mentioned earlier, the ORFE faculty will determine the outcome based on the recommendation of the examining committee. In case C, the student is usually given the MA degree and must terminate unless the faculty recommends otherwise.

1.3 Annual Reenrollment

Second Year Reenrollment

Upon passing the general examination, the recommendation for readmission for the next academic year is made by the student's thesis advisor and approved by the department faculty.

Research Advising Committee for Ph.D. Candidates

If the thesis advisor plans to recommend against the readmission of the student, an examination committee *must* be formed to determine the progress of the student's work and the recommendation must be made by the committee and approved by the department faculty.

Third and Fourth Year Advisory Committee

Optional-If requested by either the student's thesis advisor, or the student, or the Director of Graduate Studies, an examination committee shall be appointed by the department chair to examine the progress of the student. The committee would be composed of the student's advisor plus two other advisory faculty members. The student will present a seminar to this committee describing the proposed area of research, the background work completed in preparing for the research effort, the intended avenues of investigation, specific problems with the work the student feels are likely to cause the most difficulty, and the aspects of the work that will require the most guidance. The purpose of this interchange is to provide the student and the advisor some assistance in assuring that the research proceeds in a fruitful direction..

1.4 Dissertation and Post-Generals Courses

Usually completion of a suitable dissertation takes two to three years beyond the general examination. During those years the student is encouraged to select an area outside his/her specialty and to broaden his/her base of knowledge by enrolling in courses in that area. It is also expected that additional courses will be taken related to the student's specialty area. Upon completion and acceptance of the dissertation by the department, the candidate will be admitted to the final public oral (FPO) examination.

2. MSE Degree Requirements

The program requires, as a minimum, 10 courses in two years plus a master's thesis. In particular, ORF 509 and 510 must be taken (and can be included in the required 10 courses). The following is a recommended study plan. Alterations can be made, subject to the approval of the advisor and depending on the background and interests of the student.

Sample Study Plan for MSE:

First year

Fall	Spring
ORF 505	ORF509
ORF522	ORF523
ORF526	ORF527
Elective	ORF534

Second year

Fall	Spring
ORF 510	ORF547
Elective	Elective

ORF 509/510 Requirements:

ORF 509 and ORF 510 are directed research projects. Under the direction of a faculty member, students carry out research and write a report. In addition, the results of 509 are presented at a poster session and the results of 510 in an oral exam.

3. Other Regulations

3.1 Academic Regulations/Fraud

The Graduate School has become increasingly concerned about academic fraud. Please take time to read information on “General Requirements for the Acknowledgment of Sources in Academic Work” and “Definitions of Academic Violations under the Jurisdiction of the Faculty-Student Committee on Discipline” contained in “Rights, Rules and Responsibilities”. Upon entering Princeton you also received information concerning this important subject. This information is furnished to make you aware of your responsibilities regarding University requirements on acknowledgment of sources and academic fraud. The department joins with the Graduate School in taking a strict stance in this area.

3.2 Changes in Course Status

Any changes (grading options, dropping or adding courses etc.) that you may need to make to your registered courses, should be discussed with your advisor or DGS prior to making changes. You may change your status in a course no later than two weeks prior to the last day of the regularly scheduled class of the semester.

3.3 Auditing Courses

1. Courses selected by pre-Generals and Masters Students must be taken for a letter grade and cannot be audited.
2. Post-generals students may sign up for courses as audit.
3. Post-generals students may take courses on a pass/fail (P/F) basis with the approval of their advisor and the course instructor.

Generally, courses taken on a P/F basis should be outside of the student's primary area of interest.

3.4 Assistants in Instruction (AIs)

Normally, PhD candidates receive appointments as assistant in instruction (AI) beginning their second year. All students are required to attend AI training prior to term. Before an international student can be appointed as an AI, they need:

- i. to pass the English Language Program (ELP) test administered by the Graduate School, and to complete any required ELP courses.

3.5 Part-time employment

The following employment policy is quoted from the Princeton University Graduate School:

The Graduate School considers employment beyond a maximum full-time assistantship of 20 hours per week incompatible with full-time graduate study.

The Graduate School reviews students' on-campus employment records. Accordingly, the Graduate School can and will disallow part-time employment, excluding all service awards, if that employment does not comply with federal immigration and employment regulations, and/or fellowship policies. The following policies will be applicable:

Under no circumstance can a U. S. student or permanent resident work more than 20 hours per week from all sources (AI, AR and/or hourly employment). Any work beyond a full AI and/or AR appointment may jeopardize the full-time student status of this and other graduate students (with serious tax implications), and will therefore be closely scrutinized.

Under no circumstances can an international student on a visa, with a full AI and/or AR appointment, work even one hour more through hourly employment or otherwise. This not

only jeopardizes the full-time student status of this and other graduate students as noted above, but it also violates the terms of the visa status.

International students may not accept off-campus employment without authorization from either the Immigration and Naturalization Service or the J-1 program sponsor. International students should contact the International Graduate Student Advisor (Office of General Counsel), for further information on employment eligibility.

Historically, in addition to being employed as ARs and AIs by the Department, graduate students have intermittently been involved in employment elsewhere. It is the concern of the Department that, at times, this latter type of employment is neither manageable nor necessary and, in fact, is incompatible with full-time graduate study. Therefore, the Department feels it is important to ensure the awareness of the above employment policy. Included in this policy is consulting projects. All employment other than an AR or AI is subject to review by the Director of Graduate Studies.

Students must seek approval of part-time employment opportunities by filing a Request for approval from their advisor and the Departmental Director of Graduate Studies.

3.6 Leave of Absence

Written approval of advisor and DGS are required. Leave of Absence forms are available on the department website under the About Tab, Internal, & Forms.

3.7 Holiday, Vacation, and Travel

All time away from campus (*except weekends*) must be approved in writing by your advisor and if an Assistant in Instruction, approval from the DGS and course instructor. An email requesting time away from campus with your leave and return date including reason for absence is appropriate. In the case of first year students that may not yet have an advisor, you must submit your request via email through Kim Lupinacci in the Graduate Office who will obtain approvals from the Director of Graduate Studies.

Graduate study is understood to be a full-time commitment on the part of students. During an academic year, defined as September 1 to August 31, graduate student degree candidates may take up to (but no more than) four weeks of vacation, including any days taken during regular University holidays and scheduled recesses (e.g., the Fall- and Spring-term breaks and inter-term break). Graduate students holding University financial support during the summer, and assuming that they have taken no vacation during regular term time, are expected to put in a two-month, full time work effort between June 1 and September 15 each year. The specific periods taken as vacation must not conflict with the student's academic responsibilities, coursework, research, or teaching, and should be discussed in advance with one's director of graduate studies, adviser, or dissertation committee. Reading and exam periods are considered term time not recess.

If a student receives financial support for graduate study for only part of the year (e.g., regular term time, September 1 to June 30), then the amount of vacation should be pro-rated accordingly. If a student receives summer support and has taken the allowed vacation during regular term time, September 1 to June 30, then he or she should not take additional vacation time during the summer months of July and August.

***PLEASE NOTE**

All ORFE Graduate Students are required to be on campus during term time. Any time away from campus exceeding 3 business days **MUST BE APPROVED** in writing by your advisor or DGS for 1st year students without an adviser. You are responsible for submitting a signed request to Kim Lupinacci in the student affairs office. The form may be found on the department website.

Please visit the registrar's website for the Princeton University Academic Calendar:
<http://registrar.princeton.edu>

3. Miscellaneous Information

- Watch your emails and mark your calendars for the following departmental events. Your presence at these events will be appreciated.
 - Graduate Welcome Reception (September)
 - Faculty Presentations to 1st year incoming Graduate students (October)
 - Holiday Party (last week of classes in December)
- Student Affairs Office is room 120, ext 8-4018.
- E-mail is how department correspondence is transmitted. PLEASE check it regularly.
- Stipend checks are put in your mailbox on the last working day of the month. Go Green! Sign up for direct deposit via SCORE.
- Mailboxes are located on the second floor, Room 221. PLEASE CHECK YOUR MAILBOX DAILY. The door to the mailroom is to be kept locked at all times.
- The address for package delivery is: your name, Princeton University, 1 Charlton Street, Sherrerd Hall, Princeton, NJ 08544
- A Fax Machine is located in the mailroom. To receive a fax use 609-258-3791. To send International 9-011+number, In US-9+number, Campus 8+4 digit number.

- Telephones are located in every room. Local calls are free. In case of an emergency and you want to make a long distance call, please contact the Department Manager, Connie Brown.
- Graduate Student Kitchen. Located in room 223. It is available to both graduate students and faculty in the ORFE department. Remember to clean up after your use. Vending machines are located in the basement. Please refrain from using the 3rd floor kitchen facilities which is reserved for CITP faculty, staff and students.
- Graduate Lounge. The open area located on the second floor provides a meeting space for graduate students and faculty. This is a common area shared by all. Please clean the area after using.
- Bulletin boards. The graduate information board is located in the faculty and graduate open work space area on the second floor. There are also two seminar notice boards at the end of each hallway on the first and second floors. Information on current fellowships, scholarships, grants, call for papers, etc. to which students may apply are posted on the boards.
- Other sources of useful information can be found at the Graduate School website.

4. Important Contacts

Chair, Professor Jianqing Fan, Ext. 7924

Director of Graduate Studies, Professor Patrick Cheridito, Ext. 8281

Department Manager, Connie Brown, Ext. 5422

Graduate Program Administrator, Kimberly Lupinacci, Ext. 4018

McCosh Health Center Emergency, Ext. 3139

Public Safety Emergency 9-1-1

-- Welcome to the department, and

We wish you success as you pursue your graduate degree --