ORFE Graduate Handbook

September 1, 2010

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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 Chair

Welcome to the Department of Operations Research and Financial Engineering. It is my hope that you will strive to make your graduate study successful. Your success is our success. In addition to your academic work, I hope you will take some time to explore the historical riches of Princeton University as well as the Princeton community at large.

Message from the Director of Graduate Studies (DGS)

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 (e.g., graduate program administrator), director of graduate studies, advisor(s), committee members, and other faculty members as appropriate. This is a reciprocal responsibility with the faculty. Graduate students should therefore expect regular and timely communication from the faculty (DGS, seminar leaders, advisor(s), dissertation committee members) 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.

1. **PhD Requirements**

The PhD degree has the following main requirements:

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

  Core courses:

  ORF 522   Linear Optimization
  ORF 524   Statistical Theory and Methods
ORF 526 Probability Theory
ORF 523 Nonlinear Optimization
ORF 525 Generalized Regression Models (currently offered in alternate years)
ORF 527 Stochastic Calculus

- Qualifying exams: September of second year in the chosen 4 core classes (a grade of A- or better in the class exempts a student from that qualifying exam);

- Initial directed research: ORF 509, 510 (to be taken by the time of Generals);

- General exam (typically April of 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 grade B+ or higher 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 534 Investment Science
- ORF 535 Financial Risk Management
- ORF 538 PDE Method in Financial Mathematics
- ORF 542 Controlled Markov Processes
- 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 Foundation of Machine Learning
- COS 524 Combinatorial Optimization and Algorithms
- COS 527 Probabilistic Algorithms
- 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 Networks  
MAE 569 Optimal Control and Estimation I  
MAE 570 Optimal Control and Estimation II  
APC 550 Introduction to Differential Equations  
APC 503 Analytical Techniques in Differential Equations  
APC 505 Numerical Methods in Computational Science  
APC 583 Wavelets: Applications of Wavelets in Mathematics and Other Fields  
MAT 314 Introduction to Real Analysis  
WWS 509 Generalized Linear Models

1.1 Research & Thesis Advisor

The core classes are there to establish a solid foundation in the foundational tools required for research in the disciplines covered by the department. The funding provided by the university in your first year provides freedom and time for students to acclimate to the new environment of graduate school (and possibly also a new country), 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.

During the summer at the end of the first year, support from the department may be available for students to begin exploratory research with a professor.

The directed classes ORF 509 and 510 should be taken with a faculty advisor with a grade received by the time of the General exams (usually in April of the second year). For some, these classes may be taken Spring of the first year and Fall of the second year respectively. For others, it will be in Fall & Spring of the second year, after completion of the Qualifying Exam requirements.

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. There is no advantage in rushing to select an advisor, but it is enormously beneficial in the long-run to take the time to wait till both you and the faculty member are ready and convinced to make the long-term commitment to working together. At various times, some faculty might simply be too busy to take on new students: do not take it personally 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 written exams for each class are 4 hours in length offered on 3 days: one on both optimization classes, one day on stochastics, and one day on statistics. The exams will be given on three separate days in September of the second year. The dates will be announced in advance.

The Optimization exams will be based on ORF 522 and ORF 523. The Stochastics exams will be based on ORF 526 and ORF 527. The statistics exams will be based on ORF 524 and ORF 525. Each exam will be prepared by a committee of faculty members appointed by the Department Chair. In addition to testing the students’ mastery of the subject matter, each exam will endeavor to test the students ability to combine disparate topics in novel ways in order to solve complex problems.

Information on the qualifying exam: These exams are of the open-book, open-notes variety. 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 in one of the masters programs, 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

Typically, ORFE students take the general exam at the end of their second year. By that time, the students have met the qualifying examination requirements, have taken and passed ORF 509 and ORF 510, and 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, one written and one oral, both covering the students primary area of specialization. The written part requires taking and passing with a B+ or higher, two approved advanced courses beyond the 4 core classes counted for the Qualifying Exam. These two courses must be pre-approved by the student’s advisor and/or the DGS.
For each student, an examining committee is appointed by the Department Chair. The committee is to consist of the student’s advisor plus at least two ORFE faculty. 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 done in ORF 509-510, due one week before the exam is scheduled. This report serves as the basis for a research presentation by the student at the first hour of the oral examination. Examining faculty may ask questions on this material, and on any 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 PhD candidacy,

B. Student fails the exam, but he or she is given the option to retake the exam at a future date,

or

C. Student fails the exam and must withdraw from the PhD program.

As mentioned earlier, the ORFE faculty 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 Research Advising Committee for Ph.D. Candidates**

Upon passing the General examination, the recommendation for readmission for the next academic year shall be made by the student’s thesis advisor and approved by the department faculty.

*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.
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.

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. Make alterations as you deem appropriate, subject to the approval of your advisor and depending on your background and interests. With the permission of the Director of Graduate Studies, students may do a masters thesis under the direction of an adviser outside of the department.

Sample Study Plan for MSE:

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<tr>
<th>First year</th>
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<tbody>
<tr>
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<td>Fall</td>
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<tr>
<td>ORF 505</td>
<td>ORF509</td>
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<tr>
<td>ORF522</td>
<td>ORF523</td>
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<td>ORF526</td>
<td>ORF527</td>
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<tr>
<td>Elective</td>
<td>ORF534</td>
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<table>
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<th>Second year</th>
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<td></td>
<td>Fall</td>
</tr>
<tr>
<td>ORF 510</td>
<td>ORF547</td>
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<tr>
<td>Elective</td>
<td>Elective</td>
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</tbody>
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ORF 509/510 Requirements:

ORF 509 and ORF 510 are directed research. Under the direction of a faculty member, MSE students carry out research and write a report, with the results presented in an final oral exam.

3. Other Regulations

3.1 Academic Regulations/Fraud
The Graduate School is becoming 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, must be filled out on a Course Change Form. 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)
Before an international student can be appointed as an AI, they need:

i. to pass the test of English as a Second Language (ESL) administered by the Graduate School, and

ii. to complete any required ESL courses. (All students are required to attend AI Training offered prior to term).
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 Part-time Employment Form for review by the Departmental Director of Graduate Studies.

3.6 Leave of Absence
Written approval of advisor and DGS are required.

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 to me via email through Kim Lupinacci in the Graduate Office.

Graduate study is understood to be a full-time commitment on the part of students. An academic year, is 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). Reading and exam periods are considered term time not recess. The specific periods taken as vacation must not conflict with the student’s academic responsibilities, coursework, research progress, or teaching.

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

4. 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)
  - 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.

- Mailboxes are located on the second floor, Room 221. PLEASE CHECK YOUR MAILBOX DAILY.

- 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 at the bottom of the stairs in the Atrium.

• 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.

5. Important Contacts

Chair, Professor Robert Vanderbei, Ext. 2345

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 --