Graduate Student Handbook

Department of Statistics
Columbia University

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Contents

Preamble

This Handbook is intended to provide a roadmap to the graduate program in Statistics at Columbia University. It is written primarily for the benefit of three constituencies: students who are considering Columbia to pursue a PhD in Statistics, students who have been admitted to the Statistics program but have not yet arrived on campus, and students already enrolled in the program. We have attempted to accurately reflect the policies and procedures of the Graduate School of Arts and Sciences (GSAS) and the Department of Statistics, but undoubtedly some blunders in interpretation were made along the way. For the last word on policies at Columbia, please consult the GSAS and the Statistics Department's websites (www.columbia.edu/cu/gsas/ and www.stat.columbia.edu) often for details and updates. Finally, you should feel free to contact the Chair of the Department, the Department Administrator, and the Director of Graduate Studies (DGS) for additional information and assistance. In creating this handbook, we borrowed quite liberally from many sources including various webpages at Columbia, T.W. Anderson's article on the early years of Columbia's Statistics Department, and, of course, Wikipedia. We are indebted to the authors, many of whom are anonymous, for the insight and information contained in their articles.

1. Introduction

1.1 Overview of the Statistics Department and the University

Columbia University was founded in 1754 as the King's College by the Church of England. It was the first institution of higher learning in the State of New York and the fifth established in the Thirteen Colonies.

Through the years, eighty-seven Nobel Prize winners have been affiliated with Columbia, a record unmatched by any other academic institution. Numerous scientific discoveries and technological breakthroughs originated at Columbia. It was the birthplace of FM radio, the laser and modern genetics. The scientific research of the atom bomb at the Morningside Heights campus of Columbia grew into the Manhattan project. Columbia has also had a long tradition in liberal arts. It is home to the Pulitzer Prize and was the first American university to offer historic preservation, anthropology and political science as academic disciplines. Columbians have also been active in the health sciences. The first M.D. degree was granted at Columbia and more than 30 pharmaceutical products were discovered and invented at the University. Each year, more than 100 new inventions are created at Columbia. Like New York City, the Columbia academic population of faculty, students and scholars is ethnically diverse with broad international representation.

Statistics, as a general methodology, as compared to statistics in particular fields, started with the appointment of Harold Hotelling in the Columbia Economics Department in 1931. Seven years later, Abraham Wald was added to the faculty and together they attracted students such as Abe Girshick, Bill Madow and Kenneth Arrow to study statistics at Columbia, although at that time the idea of a statistics department had not yet been envisioned. After the United States entered World War II in 1942, the Columbia Statistical Research Group (SRG) was formed, mainly to deal with problems of the military including topics such as sampling inspection and quality control. Under the direction of Allen Wallis, the group included Jacob Wolfowitz, Lenoard Savage, Abe Girshick, Milton Friedman and George Stigler as staff members. In one of the SRG projects, a Navy captain asked Wallis the question of why test all the items in randomly selected samples after already meeting the number to reject the lot. Wallis sought the assistance of Wald to address this curious question. Wald

was very impressed by the idea and came back a few days later with the notion of a sequential probability ratio test (SPRT), an important class of statistical procedures.

In 1946, the department of mathematical statistics was finally formed at Columbia, simultaneously with the statistics department at Chapel Hill and Raleigh, North Carolina, where Hotelling had moved. It was one of the first such departments in the United States. The original faculty included Wald as chair of the department, Jacob Wolfowitz as an associate professor and Theodore Anderson as an instructor. Back in the 1940s, statistics referred mainly to statistical inference, so education in theoretical statistics was highlighted in the department. It became a tradition at Columbia that a well-known researcher in theoretical statistics would teach this course. Thus Columbia had such illustrious statisticians as Neyman, Doob, Bose, Loeve and Pittman as visiting professors all teaching the inference course in the first two years of the department's existence. By 1948, Howard Levene, Henry Scheffé and Kai Lai Chung were added to the faculty of the department, completing the roster.

In the fall of 1950, the department suffered a major blow due to a plane crash that took the lives of Wald and his wife. Nevertheless, the department continued with its success, thanks to the efforts of both permanent faculty members (Ted Anderson, Henry Scheffe, Howard Levene, Howard Raiffa, Herbert Solomon, Herbert Robbins and Lajos Takas) and visitors (S.N. Roy, R.C. Bose, Donald Darling, Salem Khamis, Michele Loeve, Erich Lehman, etc.)

A number of basic books in statistics in some sense originated from the teaching activities of the department, such as "Stochastic Processes" by Doob, "Testing Hypothesis" by Lehman, "An introduction to Multivariate Statistical Analysis" by Anderson and "Markov Chains" by Chung.

Although the department's original name was "Mathematical Statistics Department," pioneers of the department also had interests in statistical applications. Wald had considerable interest in Economics, Anderson worked on Statistical Problems in Economics, Psychology and Sociology, Scheffé had been interested in problems in Industry and Consumer Research, and Levene provided a bridge between Statistics and the Biological Sciences. To address the increasing interests in applications of statistical methodologies, the department changed its name to Statistics Department in 1983. The location of the department has also changed over the course of this evolvement, from Fayerweather Hall under political science, to the Mathematics Building and then to the present location in the School of Social Work Building.

Today, the department has evolved into a healthy size with 20 regular faculty members, approximately 10 adjunct faculty, 45 PhD students and over 350 MA students. The department offers an MA in Actuarial Science as well as two other interdisciplinary specialties: Mathematics of Finance (with the Mathematics Department) and Quantitative Methods in the Social Sciences (with six academic departments in social sciences).

1.2   The PhD Program

The PhD program prepares students for research careers in probability and statistics in both academia and industry. The first year of the program is devoted to training in theoretical statistics, applied statistics, and probability. Upon completion of the first year, the qualifying exams for the above three subjects are to test students' ability to take on research. In the following years, students take advanced topics courses and seminars. Summer courses, instructed by invited scholars are also available each year. Dissertation work typically begins in the second year, after students choose advisors to guide their research. The length of the program may vary, ranging from 3 to 7 years. Students have opportunities for gaining teaching experience and for taking part in a wide variety of projects involving applied probability or applications of statistics, in which collaborations with researchers from other disciplines are to be expected. Students also participate in the Department's consulting service.

2. Getting Started (After Admission)

2.1 Getting a UNI

Your UNI (University Network ID), consisting of your initials plus an arbitrary number, is the key to accessing computer services and electronic resources at Columbia. You will use it to gain access, for example, to restricted Library information on the WorldWide Web, Human Resources and benefits information, student grades, billing and registration information. Your UNI is also the first part of your official Columbia email address.

After completion of your UNI application, you shall receive email containing information about your UNI.

To activate your UNI, visit `http://uni.columbia.edu` and select *Activate a New UNI Account*. Then follow the on-screen instructions. Once you have successfully activated your UNI, you will be able to access Columbia's secure online applications, including Student Services Online (SSOL), Courseworks, online library resources and much more.

2.2 Getting a Student Visa (Foreign Students Only)

If you are a foreign student, then you have to obtain an F-1 visa for a valid stay in the United States. For details about applying for visas, please visit the International Students and Scholars Office (ISSO) website (`http://www.columbia.edu/cu/isso/`) and select the International Admissions link. The F-1 entry visa must be obtained prior to coming to the United States. Application for a visa stamp generally must be made at your country of residence. About three weeks after the completion of the application for sponsorship by Columbia, accessible at the above website, you can expect to receive the visa certificate, i.e., Form I-20. Then make an appointment at a U.S. Consulate. Make sure that all information on your I-20 is correct and complete and that your passport is valid for more than 6 months. (Students from some countries are exempted from the 6 months requirement, please check the International Students and Scholars Office website for the list of countries.)

Once you have made an interview appointment at a U.S. Consulate, go to `http://www.fmjfee.com` and pay the SEVIS fee. Remember to print copies of the receipt, which you will need in the visa interview. If you have been a student in the U.S and are transferring schools or beginning a program at a new level of study, it is possible that you may not have to pay the fee. Refer to information posted at `http://www.ice.gov/sevis/i901/faq.htm`.

For the interview, you will need some other documents and materials, such as the DS-156, DS-157, DS-158 Department of State application forms, a passport-size photo less than six months old, school admission letter, receipt for visa application fee, financial evidence that shows you have sufficient funds to cover your tuition and living expense during your course of study, and any supporting materials that demonstrate your intention to return to your home country after completion of the program. Requirements for different countries may be also be different, so refer to your U.S. Consulate for a complete list. It is imperative that you have completed all of the requirements before your interview with a consular officer, The visa is usually approved, or checked or rejected at the day of the interview. After the visa is approved and processed, a stamp will be posted in your passport. Check your passport to be sure you obtained an F-1 visa and your dependents, if any, obtained an F-2 visa. Also, be certain that the I-20 was returned to you, as you must have the original with you when you arrive in the United States.

2.3 Arranging for Housing

To obtain information for Columbia-owned buildings in the immediate vicinity of the Morningside Heights campus, please go to University Apartment Housing (UAH) `http://www.columbia.edu/cu/ire/`.

To view types of university accommodations, please visit `http://www.columbia.edu/cu/ire/studaccomod.html`.

To view transfer information, please visit `http://www.columbia.edu/cu/ire/transfers.html`.

As a new student, you always have high priority in specifying your preferences in the first housing application. Do NOT wait for the transfers to open up. If you have some desired roommates in mind, this might be the only chance for you to move in together. It's almost impossible to do a group transfer later on due to limited housing resources. In addition, the UAH policy requires that there must be more than one resident who will be living in the apartment you will transfer to for more than one year.

To obtain information for Non-Columbia-owned buildings located in the metropolitan area, please go to Off-campus housing assistance (OCHA) `http://www.columbia.edu/cu/ire/ocha/`.

To obtain information for all kinds of housing in NYC, you can consult `http://newyork.craigslist.org/`.

2.4 Reporting to the International Students and Scholars Office (ISSO)

Within a week of your arrival in New York, you must report to the ISSO with your documents online at `https://www1.columbia.edu/sec/cu/isso/new_arrival_check_in.html` The ISSO must update your SEVIS record with a NY-area address (even if it's temporary) and change your status from "initial" to "active". This is EXTREMELY IMPORTANT and must take place within 30 days of your program start date, or your SEVIS record will automatically be "terminated" and you will be out of status.

Before your first trip outside the U.S. make sure that your I-20 has been signed by an ISSO advisor on page 3. This is known as a travel or recertification signature and the immigration inspector will look at this signature each time you return from a trip abroad. Each signature is valid for one year from the date it is signed or the end date on your I-20, whichever is earlier.

2.5 Getting a Social Security Number (Foreign Students Only)

The Social Security Number (SSN) is used by employers and employees for tax purposes. The only way for a student in F-1 status to be eligible to apply for an SSN is to be employed or have an offer of employment. Since PhD students in the department generally have to TA, all PhD students in the department are eligible for the application. Please contact the Department Administrator to obtain a form or letter printed on the department's letterhead. Then bring your passport, I-94 card, I-20 and form to the ISSO. The form must be signed by an ISSO officer. Then you may go to the Social Security Administration office with the above materials. The office location is 123 William Street, 3rd Floor, New York, NY 10038.

In order to be paid by Columbia University, you must apply for or have a Social Security number. When applying for an SSN, be sure to ask for a receipt. The receipt may be needed in order to be added to the Columbia University payroll before the actual Social Security card and number are received.

It will take approximately three weeks before your Social Security card arrives in the mail from the Social Security Administration. When you receive your number, you should take the following steps to ensure uninterrupted access to facilities and services for which you have been granted temporary authorization. After you have completed these steps, you are advised not to carry the Social Security card with you, but memorize the number or make a note of it elsewhere.

1. Take your current Columbia ID card and your Social Security card to the Student Services Center in 205 Kent Hall to change your University Student Information System record.

2. Students in University Apartment Housing or on a wait list for housing through the Institutional Real Estate Office must visit the Office at 400 West 119th Street to notify the Office of the Social Security number.

3. Notify your Department Administrator of your Social Security number.

4. Notify your bank or financial institution of your Social Security number. Your bank will probably require completion of a form to make the change on your account.

2.6   Getting a Photo ID

The Columbia Card is the official university identification card, which offers visual identification, access to administrative buildings and residential halls, library borrowing privileges and dining dollars. You will need this card to enter the School of Social Work (SSW) building which houses the Statistics Department! Students may receive the University ID only upon proof of registration. The registration verification could be done online at ssol.columbia.edu. The card could be picked up in person at the ID center in 204 Kent Hall. A passport size photo is needed for print on the card. The photo can either be mailed to the ID center in advance or be taken on site.

The ID card is useful outside of Columbia as well. It entitles you to free or reduced admission to many of New York's museums (e.g., The Metropolitan Museum of Art, MOMA, Whitney Museum of American Art) and discounted tickets for theater, music, and other cultural events around the city.

2.7   Registering for Classes

2.7.1   Obtaining Registration Information

To obtain registration information, including your personal identification number and registration appointment times, follow these steps:

- go to `https://ssol.columbia.edu`

- type in your UNI and password

- on the menu along the left-hand side, click on the item "REGISTRATION APPOINTMENTS AND PIN"

- record or print this information

2.7.2   Registration

Once you have your PIN and your appointment times, you can register following the steps described below. You will register for the majority of your courses online using your four-digit PIN (see above) and your UNI.

- Click on registration

- Select courses from those offered in the Schedule of Classes, which is available at `http://www.columbia.edu/cu/bulletin/uwb`. You will need the CALL NUMBER for these courses (each section also has a unique 5-digit identifier or CALL NUMBER). In deciding which courses to take, you should follow the guidelines of your department or program; be sure to discuss your choices with your mentor, advisor, or Director of Graduate Studies (DGS). For classes outside of statistics, you may need written permission from the instructor before you are allowed to register.

- All PhD students in Graduate School of Arts & Sciences must register in a billing category and must register for a RESIDENCE UNIT to accumulate six RESIDENCE UNITS, one for each of the first six semesters in residence. Most (but not all) new PhD students are pre-registered for a Residence Unit (RU). International students may not register or pre-register until they arrive on campus and have checked in with the International Students and Scholars Office (ISSO).

- All GSAS students must be registered by the end of the day on Thursday, August 30th, 2018. You do not need to register for all (or even any) of your classes before that date, but you do need to register for at least one class. Registration for your full or partial residence unit is also sufficient. Any student unregistered by the end of the day on September 1 will be subject to a late fee. You may add courses without penalty through September 14. Please remember to drop courses for which you register but for which you are subsequently denied a seat by the instructor or department, as well as those which you decide to drop.

2.7.3   Important Dates for Registration

Regular registration is August 28- August 30 (first day of classes is Tuesday September 5). Late registration (with late fee) and ADD/DROP period is September 5-15.

- A $50 late fee is charged for those who register for the first time during the first two weeks of the semester

- A $150 late fee is charged for those who register for the first time after the first two weeks of the semester

- To avoid late fees, enroll in your registration category or at least in one course before the end of the day on August 30, then adjust your schedule between September 1-14.

- There is no full refund for courses dropped after September 14.

PLEASE PAY ATTENTION TO THESE DATES—THERE ARE NO EXCEPTIONS TO THIS POLICY EVEN FOR PHD STUDENTS!

2.8 Health Insurance

All new full-time new students must enroll in the health insurance plan or be covered by comparable insurance. There are two levels of insurance: Basic and Comprehensive. Basic coverage is paid for by the department while comprehensive coverage requires additional payment from the student. There is also an option to purchase medical insurance for your spouse, same-sex partner, or dependent child. Health insurance may be waived (only for non-international students) by filing an insurance waiver at the Student Health services office. Please consult the Health Services booklet, available in the Health Services office, for current fees.

IMPORTANT INFORMATION FOR ALL INCOMING STUDENTS:

- Note concerning Measles, Mumps, and Rubella (MMR): Under New York State law, as of September 1991, any student born after January 1, 1957, and enrolled for 6 or more points in one semester must be vaccinated against measles twice. If you cannot prove that you have been vaccinated or that you have had the measles and are immune to them, your registration will be cancelled; you may not attend classes, participate in University-sponsored events, or come onto campus.

- For information concerning measles, go the health services website (`http://www.health.columbia.edu`) as it contains important and useful information about Columbia's Health Services.

- New York State Public Health Law 2167, enacted in 2003, requires all colleges and universities to:

    - Distribute information to students about meningococcal meningitis and the vaccine that protects against the disease, and

    - Collect and maintain a record of each student's decision regarding meningitis vaccination

HEALTH SERVICES

- John Jay Hall, 2nd floor `http://www.health.columbia.edu`

- Medical Services (212) 854 2284

- Health Insurance & Immunization (212) 854 7210

- Counseling & Psychological Services (212) 854 2878

2.9 Getting Paid

U.S. citizens or Permanent Residents who are recipients of fellowship awards, which include teaching or research responsibilities, are required to complete the financial aid forms for the federal aid programs. Students must submit

the Columbia University Application for Loans and Work-Study and must have completed the Free Application for Federal Student Aid (FAFSA). Copies of the federal tax return may also be required for some students. The financial information contained in these documents will NOT alter the amount of the fellowship award from GSAS.

STIPENDS are processed as follows for GSAS students:

Stipend Checks: Stipend checks may be picked up at the Student Financial Services Cashier's Window at 210 Kent Hall two times during the academic year: at the beginning of each term in September and January. Since your fellowship includes a teaching or research appointment, 2/3 of the total award is disbursed in two stipend checks as described above to be picked up from 210 Kent Hall. Students may choose to have stipends deposited directly into their bank accounts. To obtain the stipend, students must be registered and are required to show a valid CUID card. International students must have a Social Security Number (SSN) or need to show a receipt of application of SSN in order to receive their stipend checks. To arrange for direct deposit, please contact Student Financial Services at 212-854-4206 or `http://www.columbia.edu/cu/sfs/`.

Biweekly Checks: Biweekly checks are issued at the middle and end of each month during the academic year for students who hold teaching or research appointments, and they can be picked up from the student's departmental administrator. The total of the 18 checks (Sept-May) is approximately 1/3 of the award. The entire GRA stipend is issued as monthly checks. Biweekly checks may also be deposited directly; please see the departmental administrator.

2.10 Computing

2.10.1 Purchasing A Laptop

All new PhD students in the Statistics Department are given funds (up to $2000 reimbursement) to purchase a laptop or desktop computer, and additional computing resources are supplied for research projects as necessary. These purchases must be made after your arrival at Columbia in the fall. Please contact the Department Administrator for details about purchasing a computer with these funds.

2.10.2 Statistics Department Username and Account

After arriving in the department, you will be given a departmental username and password that can be used to access email and the department workstations. Your email address will be username@stat.columbia.edu and will be added to the student alias for broadcasting departmental announcements. Virtually all

department announcements are disseminated via email only—please read your email regularly, both during and outside of the semester.

2.10.3   Computing FAQ

Please see the computing FAQ for details about department email and printing in the department. `http://www.stat.columbia.edu/`.

2.10.4   CUIT Software and Matlab

Microsoft office and other software can be downloaded from CUIT website with a Columbia UNI. Students can buy the software Matlab from the Mathworks website for $99 with Simulink or $49 for Matlab only. The department will reimburse this. Any other software will have to be bought by the student and/or with some potential support from his/her advisor.

3. Navigating the First Year and Beyond

3.1 Program Timeline

Below is a typical schedule of the program. Details can be found in subsequent sections.

Year	Semester	Classes	Notes
One	Fall	GR6101 GR6201 GR6301	- Attend seminars (see 3.3) and explore potential research areas. - Meet with mentor
	Spring	GR6102 GR6202 GR6302	- Attend seminars (see 3.3) and explore potential research areas. - Plan to attend conference/workshop (see 3.11)?
	Summer		- Attend 1 or 2 special summer courses. - Study for qualifying exams - Qualifying exams in August (see 3.7) - Explore potential dissertation research areas

Year	Semester	Classes	Notes
Two	Fall	GR6xxx(core) GR6105 GR8xxx Electives	• Begin work on a consulting project • Begin narrowing down a choice of advisor • Continue exploring research options. • Teach your own class?
	Spring	GR6xxx(core) GR6105 GR8xxx Electives	• Continue fall activities. • Try to have research area and advisor selected (see 3.10) • Seek summer internship
	Summer		• Attend 1 or 2 special summer courses. • Summer internship • Attend conference • Begin exploring dissertation research
Three	Fall	GR8xxx Electives	• Continue research program
	Spring	GR8xxx Electives	• Plan and complete oral exam (choose committee and prepare, see 3.12)
	Summer		• Attend 1 or 2 special summer courses. • Attend conference • Continue research program
Four	F,SP,SM	GR8xxx Electives	• Continue previous years activities • Prepare for defense if ready (select PhD committee, schedule exams, et. see 3.13)
Five	F,SP,SM	GR8xxx Electives	• Continue previous years activities • Prepare for defense if ready (select PhD committee, schedule exams, et. see 3.13)

3.2 Curriculum Requirements

Students are required to take 7 courses (as specified below) from the core curriculum:

1. STAT GR6101-GR6103 (Applied Statistics I-III)

2. STAT GR6201-GR6203 (Theoretical Statistics I-III)

3. STAT GR6301-GR6303 (Probability Theory I-III)

4. STAT GR6104 (Statistical Computing)

In the first semester, students typically take GR6101, GR6201, and GR6301. In the second semester students take any three of GR6102, GR6202, GR6302, and GR6104. In the third semester, students must take at least one of GR6103, GR6203, and GR6303. Students wishing additional preparation before embarking on the Probability sequence (STAT GR6301-GR6302) may take MATH GU4061-GU4062 (Introduction to Modern Analysis) first.

International students (with some exceptions; e.g for native English speakers) are required to take English placement tests in the beginning of the first semester. Depending on the test scores, the students may be asked to take English courses for teaching fellows from American Language Program (ALP) http://www.ce.columbia.edu/alp/ in Columbia. These courses are designed for the international teaching fellows, i.e., teaching assistants and lecturers, and are useful for improvements of teaching skills and techniques.

Each semester, students are required to attend at least one of the departmental seminar series (see Section 3.3 for more details). Students who have passed the qualifying exams must take two classes per academic year from any of the following:

- GR6103, GR6203, GR6303, and any of the "topics" courses offered by the department (see Section 3.4 for more details)

- the consulting class GR6105 (see Section 3.2.1 for more information)

- an approved substitute (e.g math, engineering, and science courses outside of the department).

Taken together, these courses require plenty of time and effort. It is perhaps safest to focus only on the core curriculum and (if required) the English courses during your first year of studies. For advice on time management, students are encouraged to consult with senior students for tips. Do not be afraid to ask questions! Make the most of your TA's office hours for the three core courses.

Students who passed the qualifying exams upon entering the program may have their course requirements substituted with other classes or reduced upon consultation with the DGS. See more information in the section on qualifying exams (Section 3.9).

Students will be awarded the MA degree after they fulfilled their course requirements.

3.2.1 Consulting Requirements

Students are required to enroll in the consulting course GR6105 for two semesters. In this course, you will receive hands-on consulting experience with scientists around Columbia. One semester of GR6105 can be waived either by

- completing a summer internship (if approved by the DGS), or

- by taking the class GR8307 ("Statistical Communication & Graphics") for credit.

Note that *only one semester of consulting can be waived in this fashion; you must complete at least one semester of GR6105.*

3.3 Departmental Seminars

As mentioned earlier, you must attend (and register for) one of the following seminar series offered by the department:

- Seminar in Theoretical Statistics (GR9201) (*Note: Despite the name, this seminar also covers computational and applied statistics.*)

- Seminar in Probability Theory (GR9301) (`http://www.math.columbia.edu/department/probability/seminar/hp.html`)

- Seminar in Applied Probability and Risk (GR9302)

- Seminar in Mathematical Finance (GR9303)

Details for locations/speakers/times/etc are available on the departmental calendar (`http://stat.columbia.edu/calendar/`). There are also several other seminars on quantitative research at Columbia which may be of possible interest, which are listed online at `http://stat.columbia.edu/seminars/`.

3.4 Topics courses

A variety of topics courses (usually 8000 level courses, although sometimes the Applied/Theoretical/Probability III courses function as these) are available each semester. The content varies according to the interests of the instructor and the students. The focus may range from exploring mathematical techniques useful to researchers in probability and statistics, to surveys of statistical methods used in particular application areas, to developing advanced data analytic skills. Frequently these courses are given by invited professors from other universities, focusing on their area of expertise. In recent semesters, topics have included:

- Extreme Value Theory (Anthony C. Davison, EPFL)

- Selective Inference (Yoav Benjamini, Tel Aviv)

- Statistical Analysis of Neural Data (Liam Paninski, Columbia)

- Foundations of Graphical Models (David Blei, Columbia)

- Long-Range Dependence And Self-Similarity (Murad Taqqu, Boston University)

3.5   Student Seminar

The student seminar provides an opportunity for students to meet and discuss their own research ideas and developments. Traditionally, it is held during lunch hour (lunch provided!). The free exchange of ideas often generates other new ideas and suggestions to the presenting students. Sometimes, professors and visitors are invited to talk about their research interests and challenges students with open problems. Such exchanges can be helpful in deciding on a research topic and advisor. The schedule of speakers, which is organized solely by the students, is circulated to the PhD students via email.

To help build and sharpen presentation skills, all students in their third year and above will be required to present a talk, either in the Minghui conference or in the student seminar, at least once per year.

3.6   Mentors

Shortly after arrival on campus in your first year, you will be assigned a statistics faculty member as your mentor. Mentors essentially serve the role as a temporary advisor until you have chosen a dissertation advisor (see below). They are responsible for monitoring your academic progress and provide assistance in navigating the vicissitudes of graduate student life more generally. Mentors and students are jointly responsible for meeting regularly, at least once a semester the students should reach out to their mentors. The site `http://www.columbia. edu/cu/gsas/pages/cstudents/std-ser/mentor/index.html` provides more information about the role of mentors at GSAS. Of course, all students should feel free to consult with the Chair and DGS as well as any other faculty member.

3.7   Obligations and Responsibilities as TA

In both the fall and spring semesters, every student is (usually) required to TA one class (or one section of a class). TA's provide faculty with support as needed for their respective course. They are expected to take responsibility for their assigned course and the related tasks. This includes responding promptly to faculty and student emails and requests (within 24 hours), meeting with the professor on a regular basis and keeping the professor informed of any student issues or concerns.

TA's provide operational support for the course; in general they: (i) have oversight of HW assignments and exam questions; (ii) are responsible for providing oversight of the graders, and (iii) are responsible for hosting weekly office hours. TA's can anticipate up to an average of 10 hours a week commitment. Note that the time commitment, along with the exact responsibilities of the TA, may vary depending upon the semester, course and instructor.

Occasionally, graduate students are requested to TA classes for which the course material is new to them, and in such cases, it is important to keep abreast of material covered both in the class and in the textbook in order to speak confidently about the subject matter to their students. If the class has an assigned textbook, a copy will be provided to the TA by the Department Administrator and should be returned as soon as the TA duties are over.

The TA position provides a great opportunity to learn various topics in statistics. Even the most introductory classes - for example the class UN1001 Introduction to Statistical Reasoning - present challenges in describing basic concepts and ideas of statistics to the layperson. Such classes often reinforce your own understanding of statistics. For professional career development, teaching is an important skill that will serve you well in both the academic and non-academic sectors.

3.8 Fellowship Support

All of the students admitted into our PhD program are supported on a GSAS Fellowship, which covers a nine-month period from September to May. There are TA obligations associated with this fellowship as described in the previous section. *Students on the fellowship should not be performing any other work beyond their TA responsibilities during this period.* The fellowship is renewable for up to five years, provided satisfactory progress is being made. There is no guarantee that the fellowship will be extended beyond a fifth year.

3.9 Qualifying Exams

In order to continue on the PhD program students must pass two qualifying exams:

- the core competency exam, which is to be passed by the *end of the first year*, and

- one of the three subject exams (in Applied Statistics, Statistical Inference or Probability), which must be passed by the *end of the second year.*

A description of each exam is provided below. The core competency exam is offered twice a year (early September and mid/late May), while the subject exams are offered once per year at the end of the summer (mid/late August).

While each exam is written and graded by a committee of faculty, pass/fail decisions are decided by the entire faculty. If a student should fail one or more

of the exams, they are eligible to repeat the failed exam(s) in order to attempt to pass it by the relevant deadline listed above. In some cases of a borderline fail, faculty might assign additional requirements, such as taking extra courses, or doing additional problems in advance of the next exam.

You should take a positive approach in studying for qualifying exams and view it as an opportunity to digest and assimilate the topics that you have learned during your first year. The material covered in your first year classes will likely be the building blocks for your research endeavors.

To prepare for the exams, it is advisable to go through old exams which are available from the Department Administrator. At the beginning of summer, faculty will announce the exact format of the exams (open or closed book, in-class or project). Efforts are also made to formalize a study group that is coached by a senior graduate student and/or faculty member.

The qualifying exams may also be passed before the start of the program by students who covered the required topics during their previous academic training. In this case the corresponding course requirements can be waived in consultation with the DGS.

3.9.1 Core Competency

The core competency exam tests core skills in probability and statistics (including linear algebra) deemed as necessary skills for *all* PhD students in the department, regardless of their area of research. The syllabus of this exam is the content of the book "Statistical Inference" by George Casella and Roger Berger. Further, the following books (or one of a similar level) are recommended to help preparation:

- (Probability) Ross' "First Course in Probability"

- (Linear Algebra) Strang's "Introduction to Linear Algebra"

- (Real analysis) Rudin's "Principles of Mathematical Analysis"

- (Regression) Weisberg's "Applied Linear Regression"

All incoming students take the core exam upon arrival.

3.9.2 Statistical Inference Sequence

To pass the inference sequence, students must demonstrate an understanding of the theoretical aspects of classical statistical theory (such as asymptotic theory of the MLE, M-estimators, decision theory, hypothesis testing, etc.) at the level of the following textbooks:

- Lehmann and Casella's "Theory of Point Estimation"

- Lehmann and Romano's "Testing Statistical Hypotheses"

- Keener's "Theoretical Statistics"

- van der Vaart's "Asymptotic Statistics"

3.9.3 Probability Sequence

To pass the probability sequence, students must demonstrate an understanding of probability and measure theory (including discrete and continuous time stochastic processes, martingales and basic stochastic integration) at the level of e.g the following textbooks:

- Billingsley's "Probability and Measure"

- Durrett's "Probability: Theory and Examples"

- William's "Probability with Martingales"

- Jacod and Protter's "Probability Essentials"

3.9.4 Applied Statistics Sequence

To pass the applied sequence, students must demonstrate the following minimal skills (must-haves):

- understanding and facility with core linear regression, categorical, GLM tools, in at least one standard language (e.g., R, Matlab, Python, or similar)

- "ability to think with data"

- ability to deal with data subtleties, to construct statistical models and valid inferential procedures for non-standard data: non-iid data, hierarchical structure, outliers, missing data, etc.

- communication skills – ability to write a clear, logical project report

The best applied students will also be able to demonstrate:

- familiarity with and ability to extend computational methods critical for modern statistical analyses (these skills are not emphasized in the applied sequence per se, but are developed more in 6104, which applied students are strongly encouraged to take)

- familiarity with Bayesian and modern statistical machine learning methods, especially graphical/multilevel models, including (for example) time-series or spatial models

- exposure to a variety of models/data types (some selected mix of the following depending on the instructor): mixed models, survival models, survey data, point process models, time series models, spatial models. Also exposure to recurring ideas and "tricks of the trade": nonparametric methods, bootstrap, causality/confounding, permutation tests, likelihood/estimating equations, etc.

All applied students are strongly encouraged to also take GR6104 Statistical Computing.

3.10 Summer Responsibilities (Teaching, Attending Classes, Stipend)

The academic year begins in early September and runs to the middle of May. There are no formal responsibilities for graduate students in the summer. While it is a good time to take a brief break, it is an excellent time to work on some research ideas, study for the qualifying exams (for first year students), and to do an internship (not advised for the first summer, but strongly encouraged in later years; as earlier mentioned this can also count towards one semester of credit for GR6105). At the beginning of the summer (usually in June), the department invites two renowned researchers in statistics and probability to deliver intensive summer courses (lasting for approximately a week) for the graduate students.

In total, there is up to $6500 available in summer funding, $3000 of which is provided unconditionally by GSAS and a further $3500 provided by the department if you attend at least one of the two summer courses. There are also TA and teaching opportunities available for the summer classes offered by the department to the undergraduate and masters students, which is a good way of earning some extra money in the summer.

3.10.1 Internship Policy

Since the departmental summer funding is intended to encourage students to stay and do research over the summer: students that do a summer internship will typically forgo the summer funding from the department - though exceptions can be discussed with the DGS.

3.11 Annual Progress Reports

It is important to meet periodically with your mentor (assigned during the first year) or your advisor (after he/she has been selected) to discuss curriculum issues, progress in the program, potential areas of research, etc. The Graduate School of Arts and Sciences (GSAS) has instituted an electronic annual progress report system to monitor the progress of PhD students in their programs. This progress report consists of two parts: a student component and a mentor/advisor component. The intent of this report is to ensure that both student and advisor are clear on the student's progress to date and their study plan for the duration of their graduate studies. This is also an opportunity to identify problems in the student's progress and/or interaction with their advisor. The progress of every statistics PhD student is also discussed in an annual faculty meeting held during the spring semester.

3.12　Choosing an Advisor

Choosing an advisor is perhaps the most important decision that a student must make during his/her graduate studies. Many students already have a firm idea about the subject area of their intended dissertation research before arriving at graduate school. In this case, the choice of advisor would likely be narrowed down to those faculty who are experts in this particular chosen area. Other students get a good sense about their subject area during the first year of graduate school. It is advisable to select an advisor by the end of your second year of studies—earlier in your program is preferable. Certainly, your desired research area should be consistent with the advisor's research expertise.

It is strongly recommended to talk with many (at least three!) faculty, as well as your fellow students, to get a sense about research topics and the style in which an individual professor advises students. Ultimately, you will develop a close working relationship with your dissertation advisor, so it is important to choose someone that is compatible with your research and professional aspirations. Once have you have decided on an advisor (with his/her permission!), please inform the DGS and the Department Administrator of this development. You will also need to update your student profile to reflect this change of advisor. The DGS is listed as your default advisor until a permanent advisor has been selected.

After the first year, if the student has not chosen an advisor, he/she must find two prospective faculty members to start research with and signal so to the DGS.

3.13　Obtaining Department Support to Attend Conferences

Attending professional workshops and conferences constitutes an important part of your professional development. The Statistics Department will provide support for students to attend professional meetings, up to twice per academic year. The *maximum* level of financial support available depends on the location of the conference; for a conference which is (approximately) a week long, you should expect no more than

- $1500 for a domestic conference,

- $2000 for a conference in Europe, and

- $2500 for a conference in Asia.

In *exceptional circumstances* the level of support may be extended, but only with prior approval from the DGS and Department Administrator.

The reimbursement can be used to cover the conference registration fee, train tickets, economy round-trip airfare, fare, mid-level accommodation and basic food costs (no more than $40 per day). In particular, the following ARE NOT

REIMBURSABLE: alcoholic drinks, fees charged by airlines for bulk-head seats, excess baggage, economy comfort/plus, priority boarding, etc. If you are unsure as to whether something is reimbursable, you should contact the Department Administrator.

In order to secure funding from the department, you MUST do the following ONE MONTH PRIOR to the conference visit:

- Submit a short proposal of approximately one page to the DGS. This proposal should provide details about the nature of the conference, how it helps you in your research activities, and a budget.

- Display evidence of seeking complementary funding from other sources, which should include

    - the GSAS (available after you have passed your oral exams)
    - the conference host themselves, which usually has money available to support student participation.

Your advisor may also be a source of funding, although they should be used only to "top-up" the support provided by the department. *No support will be awarded if this proposal is not submitted and approved by the DGS before the conference visit.*

Proposals are reviewed by a small committee of faculty headed by the DGS. Preference will be given to those students who will present a paper or poster at the meeting. For more information on conferences/workshops happening around the globe, please visit the websites imstat.org, amstat.org, etc.

3.14 International Travel

It is highly likely that at some point during your time at Columbia you will travel internationally as part of your studies (such as for a conference). The University has an agreement with International SOS to provide assistance (e.g emergency healthcare) in the case of any problems during international travel. In order to be able to gain access to this service quickly in the case of an emergency, it is important that you register your itinerary with the University before travel. More information on ISOS and how to register can be found at http://globaltravel.columbia.edu/.

3.15 Oral Exam

Every PhD student must pass their oral exam by the end of their 3rd year (in the PhD program), and preferably by the end of their 5th semester. Students who fail to meet this 3rd year deadline may lose good academic standing and be placed on academic probation. If you have any questions/concerns, please feel free to discuss this with the DGS.

The exam will include a written component (about 30 pages) turned in before the oral portion of exam. The point of the exam will be to test the student's mastery of the literature in the chosen topic area; the student will also be required to demonstrate evidence of some real research output, but the oral topic need not be the eventual thesis topic. Be sure to abide by the GSAS rules for scheduling and executing this exam (see the GSAS website and consult the Department administrator for further information).

For the oral portion of the exam, you will need to form a committee consisting of your advisor and two faculty members from the statistics department. Some things to consider when choosing committee members are as follows: Who has an understanding in or around the area of your research? Will they know how your research fits into the open questions in your chosen area of focus? Do you think they will be able to provide you with useful feedback, both in terms of your presentation and the content of it?

3.16 Dissertation Defense

The rules governing the makeup of your dissertation committee can be found on the GSAS website at `https://gsas.columbia.edu/student-guide/dissertation/nomination-and-appointment-defense-committee`. The presentation of the thesis is open to faculty and students, but the formal examination and deliberations are in closed session with your dissertation committee. The defense, including the presentation lasts approximately 2 hours. Be sure to allow ample time for questions by your committee. Your dissertation must be delivered to your committee four weeks in advance of your scheduled defense date. Be sure to check with the Department Administrator who will help guide you through the GSAS rules for graduation.

3.17 Departmental Placement Officer

The DGS also functions as the "Departmental Placement Officer" (DPO) for the department, whose responsibility is to provide doctoral students with the knowledge, expertise, and materials that they will need in preparation for the academic job market. They can assist you by, for example, providing you with feedback on your CV, teaching/research statements etc and arranging for mock job talks to take place during e.g the student seminar. If you are in your final year and are applying for academic jobs, you should contact the DPO and discuss what assistance you feel would be beneficial.

3.18 Graduate Student Representation

Every year, the graduate students convene in May to select a representative that serves as a critical communication conduit between faculty and graduate students. The primary responsibilities of the representative is to convey graduate

student concerns and issues to the chair and DGS, to keep students informed about departmental issues and policies, to transmit student preferences on a range of issues from faculty hiring to program and curriculum matters, and to organize social functions.

3.19   Websites

Students in their fourth or fifth year are strongly encouraged to put up a website, with some information about research interests, a CV, current projects etc.

3.20   Other Resources (Counseling, Ombuds Office, Gym and Athletic Facilities, Sexual Harassment, etc.)

Columbia offers an extensive range of resources for addressing a range of personal and other problems. A listing of services can be found at e.g `https://gsas.columbia.edu/graduate-life/student-life-well-being` and `https://universitylife.columbia.edu/student-resources`.

4. FAQ for Admissions

1. *[International students only] I have earned a master degree in xxx at University of xxx in the US. I am wondering whether I can obtain a waiver for the TOEFL.*

   The TOEFL exam is required by the graduate school for anyone who has had undergraduate education in a non-English speaking country. Our department does not issue waivers.

2. *[International students only] I took the TOEFL more than two years ago. I am wondering whether your department will accept my score.*

   As long as ETS can still send an official transcript of your score, we will accept it.

3. *Is the GRE subject exam required? If I haven't taken it, will I still be qualified for admission or financial aid?*

   The GRE subject exam is recommended since it provides more information about the applicant. However it is not required and not taking it will not disqualify you.

4. *How many students are you going to admit next year? How many of them will receive financial aid? How many of them will be from country xxx?*

   We don't decide how many students we are going to admit until late December or even early January. And we don't discuss this matter with applicants (especially over email). ALL students admitted will receive financial support for their graduate study. Admission is based on merit, not nationality.

5. *Below are my grades and standard tests [...]. Can I apply to your program? What are my chances of being admitted?*

   We receive more than 250 applications a year and there are many students in our applicant pool who are qualified for our program. However, we can only admit a few top students. Before seeing the entire applicant pool, we cannot comment on admission probabilities.

6. *What is the deadline for application? What is the deadline for financial aid?*

We only have one deadline for application (Ph.D. program), that is January 15.

7. *What is the minimum requirement for TOEFL, GRE and GPA for admission?*

   For the standard tests, please read `http://www.columbia.edu/cu/gsas/pages/pstudents/admissions/faq/tests.html`. We don't have a threshold for GPA and will read applicants' transcript for grades on individual courses.

8. *How many years does it take to pursue a Ph.D. degree in your program?*

   Our students usually graduate in 4-6 years. Some students take less time to graduate, others slightly more.

9. *My transcript is not in English. What should I do?*

   You would have to submit a notarized translated copy along with the original transcript.

10. *What is the distribution of students currently enrolled in your program (their background, GPA, standard tests, etc)?*

    We don't post such information.

11. *Can I send a photocopy of my GRE score in with my application?*

    Yes, but make sure you arrange for ETS to send the official score to the graduate school.

12. *What is the mailing address for your Ph.D. admission office?*

    All students must apply online (`http://www.columbia.edu/cu/gsas/pages/pstudents/admissions/apply/index.html`) for admission into the PhD program.

13. *What are the required application materials?*

    Specific admission requirement for our programs can be found at `http://www.columbia.edu/cu/gsas/departments/statistics/department.html`. The general required materials for admission by the graduate school can be found at `http://www.columbia.edu/cu/gsas/pages/pstudents/admissions/apply/index.html`.