



**Review of the
Graduate Certificate in Statistical Genetics**

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1. Procedures

We reviewed the self-study of the program, the original application for the certificate submitted in 2000, the charge letter from the deans, interviewed all members of the current faculty, and interviewed two groups of students — one group actively pursuing the certificate and a second that chose not to complete the certificate requirements.

2. Findings

2.1. Faculty

The faculty for the program is superb. The program is directed by Elizabeth Thompson, as it has been from the start. The other key faculty members include Ellen Wijsman, Bruce Weir, Phil Green, and Joe Felsenstein. John Storey has contributed in the past by directing the 552 course and continues to teach. The program lost two key faculty members, Matthew Stephens and Stephanie Monks, but new members include Bruce Weir and John Storey in Biostatistics, Vladimir Minin in Statistics, Lon Cardon at FHCRC and in Biostatistics, and several new faculty in Genome Sciences who have the potential to contribute.

2.2. Certificate course content

The course requirements are the Statistical Genetics core courses: Stat/Biostat 550, Statistical Genetics I (Mendelian Traits), taught by Elizabeth Thompson; Stat/Biostat 551, Statistical Genetics II (Quantitative Traits), taught by several faculty; Stat/Biostat 552, Statistical Genetics III (Design and Analysis), taught by Ellen Wijsman; Genome 562, Population Genetics, taught by Joe Felsenstein; Genome 540, Introduction to Computational Molecular Biology (Genome and Protein Sequence Analysis), taught by Phil Green; and Biostat 580b, the Statistical Genetics Seminar. The project required in Stat/Biostat 552 is considered the “capstone” for the certificate.

A strength of the program is the systematic organization of the Statistics and Biostatistics core courses and the in-depth and sequential coverage of course topics and material. Similar devotion to the definition, organization, and achievement of learning objectives occurs in the Genome Sciences courses and in the required seminar. The dedication of the faculty was noted by all students and was considered outstanding. The quality of instruction was viewed as universally superb and course content was very well thought out. Several students and faculty suggested new course options to better include array analysis, proteomics, functional genomics, and genome-wide and large-population association studies. The idea of additional course options was considered.

2.3. Students

Since the program's inception, 10 students have completed the requirements for the certificate. In addition, at least 4 students are currently enrolled in the program. Most students come from the Statistics and Biostatistics programs. Based on our discussions with these students, they appear to be an exceptionally qualified group. Certificate students do not complete the Statistical Genetics PhD pathways in Statistics or Biostatistics. One Genome Sciences student and one graduate non-matriculated student employed by Genome Sciences are currently enrolled in the program; one student from Computer Sciences completed the certificate.

The average time to completion of the certificate appears to be 2 years, in part because some course material is offered only every other year and also because the majority of students are taking the certificate path in addition to regular PhD coursework.

The current enrollment is smaller than the 8 students per year anticipated in the initial application. At the outset of the program, graduate non-matriculated students were considered ineligible. This situation changed with the revised guidelines for certificate programs issued in 2006.

2.4. Admission and governance

The program is directed by Professor Thompson, without significant administrative help from the participating departments. Admission occurs after consultation with Elizabeth and progress is noted by completion of the required courses. The Advisory Board has not met; the Curriculum Committee has met rarely and has not involved faculty from Genome Sciences. The Departments of Biostatistics (Bruce Weir, John Storey), Statistics (Vladimir Minin), and Genome Sciences (Bill Noble, Joshua Akey, among others) have all had active recruiting programs and have brought in faculty that could enhance the teaching of and join leadership positions in the certificate program.

2.5. Visibility of the program

The program is advertised through its website, but external visibility seems limited. Many populations of potential students exist. These include graduate non-matriculated students; fellows in the medical training programs; graduate students in many other disciplines, not limited to health sciences and traditional biology programs; and could include industry, fisheries, and government labs and commissions in the region. Distance learning programs could be considered and might allow the program to become self-sustaining, if the current format could be readily transmitted.

3. Recommendations

3.1. Continuation

We enthusiastically recommend that the Graduate Certificate in Statistical Genetics be continued.

3.2. Steering committee

The certificate program needs an active steering committee that assumes the functions previously assigned to the Advisory Board and the Curriculum Committee and that meets regularly. For the first year, it should meet, at a minimum, quarterly. The steering committee needs to have members from all major constituencies, including Biostatistics, Statistics, and Genome Sciences. The committee should include young faculty. The committee is charged with:

- (a) Admissions
 - (i) The admissions procedures should be brought into compliance with established Graduate School policy.
 - (ii) Certificate students should be admitted before undertaking the capstone experience.
- (b) Tracking of students
- (c) Evolution of the program, including faculty
 - (i) This field is rapidly evolving, and the emergence of new and different types of large-scale data presents new challenges and opportunities. The committee needs to take this into consideration as they consider the intelligent design and evolution of the curriculum.
 - (ii) Program size and visibility
 - (1) We recommend that the Graduate Certificate in Statistical Genetics be more aggressively advertised as a stand-alone program, to reach a wider audience of possible students.
 - (2) We recommend increased enrollment of graduate non-matriculated students.
- (d) Identifying and enhancing the capstone experience.
- (e) Identifying and establishing the learning objectives for the program.

3.3. Programmatic support

- (a) We recommend support for 25% of a staff member to provide for the administrative needs for this program.
- (b) We recommend additional resources for curricula, advertising, web-site development and support, computer lab support, and other programmatic expenses

- (c) Consideration should be given to instructional support where needed.
- (d) If the size of this program increases, the amount of support provided should be reconsidered so as to be commensurate with needs.

3.4. Review

We recommend that the Graduate Certificate in Statistical Genetics be reviewed, together with the Statistical Genetics PhD pathways in Statistics and Biostatistics, prior to the usual 10-year performance review.

APPENDIX A

A. Comparison with Similar Programs

A.1. University of Iowa

Prior to Veronica Vieland's recent departure from the University of Iowa, she led a Certificate in Statistical Genetics program within the Program in Public Health Genetics. This certificate was designed to complement an MS degree in Biostatistics or a related field, such as Statistics. The certificate could be completed either in conjunction with an MS degree program or following receipt of the MS degree; it could not be awarded prior to completion of an MS degree. The certificate required 16 semester hours of course work with at least a 3.0 grade-point average and involved a preceptorship, a supervised research project involving statistical genetics, which had to be approved by the director of the Program in Public Health Genetics. The required courses were:

Number	Course Title	Hours
170:110	Medical Genetics	2
185:285	Clinical Genetics Practicum	1
185:102	Introduction to Genetic Data Analysis	3
185:270	Genetics and Epidemiology	4
185:276	Statistical Genetics Laboratory	3
185:280	Preceptorship in Statistical Genetics	

Comments:

- (a) The fact that the Iowa certificate program closed after Veronica's departure underscores the importance of involving the next generation of junior faculty to ensure the survival and success of the Graduate Certificate in Statistical Genetics after the key senior faculty retire.
- (b) The preceptorship, described as "individual work experience in using statistical genetics knowledge and skill acquired in classroom" seems to be more clearly a capstone experience, as it is more than just regular class work.

A.2. Washington University, St. Louis

A Certificate in Genetic Epidemiology is offered by the Division of Biostatistics at Washington University. The certificate requires completion of the following four core courses with an average of B or higher:

Number	Course Title
M21-503	Statistical Computing with SAS
M21-505	Biostatistics for Research Workers
M21-515	Fundamentals of Genetic Epidemiology
M21-550	Introduction to Bioinformatics

These four courses are summer courses. Also, certificate candidates must participate in an orientation and two workshops (statistics and computing/Unix) prior to taking the first course in the certificate program.

Comments:

- (a) This program has a very formal application process, complete with a downloadable application form.
- (b) This program seems a bit more self-contained than the UW program, in that it is aimed at a much wider audience beyond those already enrolled in Biostatistics or Statistics programs, as evidenced by the required "Biostatistics" and "Statistical Computing" courses.
- (c) This program seems a bit broader than the UW program, as it covers bioinformatics. At the same time, it does not have the in-depth exposure to molecular genetics methods and the evolutionary background provided in the Genome Sciences courses.
- (d) A student could complete this certificate in just one summer, as evidenced by the 2007 course schedule:

Dates	Course Title
July 13–20	Statistical Computing with SAS
July 23–August 3	Biostatistics for Research Workers
August 6–17	Fundamentals of Genetic Epidemiology
August 20–31	Introduction to Bioinformatics

A.3. University of Alabama at Birmingham (UAB)

The Department of Biostatistics at UAB offers a Certificate in Statistical Genetics (CSG), which consists of the courses:

Number	Course Title
BST 675	Introduction to Statistical Genetics
EPI 730	Introduction to Human Population Genetics Theory
BST 676	Statistical Bioinformatics
BST 775	Stat Methods for Genetic Analysis I
BST 776	Stat Methods for Genetic Analysis II

The purpose of the CSG is to recognize that certain graduate students have completed specific requirements beyond those ordinarily completed by graduate students and that completion of those requirements offers those students particular expertise in statistical genetics. It is aimed at Biostatistics PhD students or those who already have a doctoral degree in statistics or biostatistics (or the equivalent). Furthermore, CSG recipients must either successfully complete all requirements for the PhD in Biostatistics at UAB or be judged capable of performing as a statistician at the level of a doctoral level academic statistical geneticist.

Comments:

- (a) This program has a very formal application process, complete with a downloadable application form.
- (b) This program seems a bit broader than the UW program, as it covers bioinformatics.
- (c) This program seems to be narrowly aimed at statisticians, rather than at a broader audience.

A.4. Cardiff University, Wales

An MSc in Genetic Epidemiology & Bioinformatics is offered by Cardiff University. While this isn't a certificate program per se, it is useful as a comparison, as it consists of a limited number of courses and a research project.

In the first term, students study three compulsory modules:

An Introduction to Statistical Approaches in Life Sciences
Postgenomic Biosciences
Computing for Bioinformatics

In the second term, there are three more compulsory modules:

Informatics for 'omic' Biosciences
Statistical Applications in Bioinformatics, Genetics, and Epidemiology
Case Studies in Bioinformatics and Biostatistics

In the third term, students take three specialist modules from a choice of five:

Genetic Epidemiology (Association Analysis)
Genetic Epidemiology (Model-based and Model-free Linkage Analysis)
Protein Bioinformatics
Machine Learning and Data Mining
Information Systems in Bioinformatics

In the fourth term, the students undertake a research project and write a thesis.

Comments:

- (a) This program seems to have a more “modern” than “classical” emphasis.
- (b) With the bioinformatics emphasis, it is aimed at a wider audience. It aims to introduce the commonly exploited computational, statistical and analytical approaches to post-genomic biology and genetics.
- (c) Outlines of the course modules are provided in one freely accessible web page. In contrast, several of the syllabi for the UW program are not accessible to those outside of UW, as they sit on secure servers that require a UW ID for access. For marketing purposes, the UW program should try to make all syllabi up-to-date, externally accessible, and easy to find.
- (d) The question and answer information sheet, http://bbu.cardiff.ac.uk/html/training/What_is_Bioinformatics.pdf, is very good, and the UW program should think about augmenting their already quite good web pages with an information sheet in this style.

**APPENDIX B
REVIEW TIMETABLE**

Monday, March 12	Graduate School Conference Room 032 Communications Building
4:00–5:00 pm	Melissa Austin, Associate Dean Office of Academic Programs Graduate School
	Frederick A. Connell, Associate Dean School of Public Health and Community Medicine
	Augustine McCaffery, Senior Academic Specialist Office of Academic Programs Graduate School
	Werner Stuetzle, Divisional Dean College of Arts and Sciences

Monday, March 19	D-518 Health Sciences Center
2:00–3:00 pm	Review Committee Meeting

Friday, March 23	F-665 Health Sciences Center
10:00–11:00 am	Bruce Weir, Professor and Chair Department of Biostatistics

Thursday, March 29	Graduate School Conference Room 032 Communications Building
12:30–1:30 pm	Elizabeth Thompson, Professor Program Director
1:30–2:00 pm	John Storey, Associate Professor Departments of Biostatistics and Genome Sciences

Sunday, April 1	Nishino Restaurant 3130 E Madison St
6:30–8:30 pm	Review Committee Working Dinner

**SITE VISIT
Day One**

Monday, April 2	322 South Campus Center
9:00–9:30 am	Elizabeth Thompson, Professor Program Director
9:30–10:00 am	Ellen Wijsman, Research Professor Departments of Medicine and Biostatistics
10:00–10:30 am	Mary Kuhner, Research Associate Professor Department of Genome Sciences
10:30–11:00 am	Break
11:00–11:30 am	Peter Guttorp, Professor and Chair Department of Statistics
11:30–12:00 pm	Kathleen Kerr, Assistant Professor Department of Biostatistics
12:00–1:00 pm	Lunch with Graduate Students (Catered to conference room)
1:00–1:30 pm	John Storey Graduate Students
1:30–2:15 pm	Joseph Felsenstein, Professor Departments of Genome Sciences and Biology
	Philip Green, Professor Department of Genome Sciences
2:45–3:00 pm	Break
3:00–4:30 pm	Review Committee Executive Session

**SITE VISIT
Day Two**

Tuesday, April 3	346 South Campus Center
9:00–9:30 am	Review Committee Executive Session
9:30–10:30 am	Exit Interview
	Melissa Austin, Associate Dean Office of Academic Programs Graduate School
	Frederick A. Connell, Associate Dean School of Public Health and Community Medicine
	Peter Guttorp, Professor and Chair Department of Statistics
	Augustine McCaffery, Senior Academic Specialist Office of Academic Programs Graduate School
	Werner Stuetzle, Divisional Dean of Natural Sciences College of Arts and Sciences
	Elizabeth Thompson, Professor Program Director, Statistical Genetics
10:30–11:30 am	Exit Interview (Continued)
	Melissa Austin, Associate Dean Office of Academic Programs Graduate School
	Frederick A. Connell, Associate Dean School of Public Health and Community Medicine
	Augustine McCaffery, Senior Academic Specialist Office of Academic Programs Graduate School
	Werner Stuetzle, Divisional Dean of Natural Sciences College of Arts and Sciences