

MISSOURI DEPARTMENT OF HIGHER EDUCATION

FORM NP: NEW PROGRAM PROPOSAL FORM

Sponsoring Institution(s): Washington University

Program Title: Master of Science in Biostatistics (MSB)

Degree/Certificate: degree

Options:

Delivery Site(s): Washington University, Medical School Campus

CIP Classification: 26.1102

Implementation Date: July 1, 2011

Cooperative Partners:

Expected Date of First Graduation: December 2012

AUTHORIZATION

Name/Title of Institutional Officer:

Edward S. Macias, Provost

Signature _____ Date _____

Person to Contact for More Information:

Susan E. Hosack, Director, Office of Student Records/Registrar

Telephone: (314) 935-5567

MISSOURI DEPARTMENT OF HIGHER EDUCATION

Form SE: STUDENT ENROLLMENT PROJECTIONS (see attached page 33)

Year	1	2	3	4	5
Full Time					
Part Time					
Total					

Form PS: PROGRAM STRUCTURE (see attached pages 14-30)

A. Total credits required for graduation: _____

B. Residency requirements, if any: _____

C. General education: Total credits: _____

Courses (specific courses OR distribution area and credits):

_____ cr. _____ cr. _____ cr.

_____ cr. _____ cr. _____ cr.

D. Major requirements: Total credits: _____

_____ cr. _____ cr. _____ cr.

_____ cr. _____ cr. _____ cr.

E. Free elective credits: _____ (Sum of C, D, and E should equal A.)

F. Requirements for thesis, internship or other capstone experience:

G. Any unique features such as interdepartmental cooperation:

MISSOURI DEPARTMENT OF HIGHER EDUCATION

Form PG: PROGRAM CHARACTERISTICS AND PERFORMANCE GOALS (see attached pages 4-5)

Institution Name: Washington University

Program Name: **Master of Science in Biostatistics**

Date: July 1, 2011

(Although all of the following guidelines may not be applicable to the proposed program, please carefully consider the elements in each area and respond as completely as possible in the format below. Quantification of performance goals should be included wherever possible.)

Student Preparation

- Any special admissions procedures or student qualifications required for this program which exceed regular university admissions, standards, e.g., ACT score, completion of core curriculum, portfolio, personal interview, etc. Please note if no special preparation will be required.
- Characteristics of a specific population to be served, if applicable.

Faculty Characteristics

- Any special requirements (degree status, training, etc.) for assignment of teaching for this degree/certificate.
- Estimated percentage of credit hours that will be assigned to full time faculty. Please use the term "full time faculty" (and not FTE) in your descriptions here.
- Expectations for professional activities, special student contact, teaching/learning innovation.

Enrollment Projections

- Student FTE majoring in program by the end of five years.
- Percent of full time and part time enrollment by the end of five years.

Student and Program Outcomes

- Number of graduates per annum at three and five years after implementation.
- Special skills specific to the program.
- Proportion of students who will achieve licensing, certification, or registration.
- Performance on national and/or local assessments, e.g., percent of students scoring above the 50th percentile on normed tests; percent of students achieving minimal cut-scores on criterion-referenced tests. Include expected results on assessments of general education and on exit assessments in a particular discipline as well as the name of any nationally recognized assessments used.
- Placement rates in related fields, in other fields, unemployed.
- Transfer rates, continuous study.

Program Accreditation

- Institutional plans for accreditation, if applicable, including accrediting agency and timeline. If there are no plans to seek specialized accreditation, please provide reasons.

Alumni and Employer Survey

- Expected satisfaction rates for alumni, including timing and method of surveys
- Expected satisfaction rates for employers, including timing and method of surveys

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

PROPOSAL for NEW DEGREE GRANTING PROGRAMS

Proposed name of program	<i>Biostatistics Graduate Training Program</i>
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Check One	Level of Degree	Proposed Name of Degree
	Bachelor	
X	Master	<u>Master of Science In BioStatistics (MSIBS)</u>
	Master of Arts	
	Doctor of Philosophy	

Director of Program	D. C. Rao Professor & Director, Division of Biostatistics
Mailing Address	660 South Euclid, Box 8067 St. Louis, MO 63110
Office Location	School of Medicine Campus 706 S. Euclid, Room 1100 St. Louis, MO 63110
Building	Old Shriners Building
Room number	1100
Telephone number	(314) 362-3608
Facsimile number	(314) 362-2693
e-mail address	<u>rao@wubios.wustl.edu</u>

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

Checklist For Review of Program

- Initial Review and Approval by Program Committee
- Initial Review and Approval by Department Head or Program (i.e., OT, PT, HA) Director
- Initial Review and Approval by Dean to proceed with development of formal proposal
- Submit proposal for review by Administration of School of Medicine
Includes review by Registrar, Budget Office and Office of Medical Education
- Administrative review forwarded to Dean of School of Medicine
- Approval by Dean to present proposal to Academic Affairs Committee
- Review and Approval by Academic Affairs Committee
- Presentation of Proposal to Executive Faculty of School of Medicine for review and approval

For degree granting programs where recommendation for degree will be directly from the School of Medicine

- Proposal forwarded to Chancellor for review and approval
- Presentation of Proposal to Board of Trustees for review and approval

For degrees awarded upon recommendation of other Schools including Graduate School of Arts and Sciences

NA Approval from School of Medicine forwarded to other relevant School

Review and Approval by School from which recommendation for degree will emanate

NA Proposal forwarded to Chancellor by School which will recommend establishing the new degree granting program

NA Review and Approval by Chancellor

NA Presentation of Proposal to Board of Trustees for review and approval

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Program Overview

It is common knowledge that the supply of well trained biostatisticians, at both masters and doctoral levels, has always been lagging behind the demand. What is even more striking is that the gap between demand and supply has also been increasing. As if this were not enough, the launching of CTSA's and other NIH Roadmap initiatives along with the increased emphasis on translational research have all contributed to the demand side of the equation whereas very little has been done about the supply side. Washington University School of Medicine has been at the forefront of these initiatives, thus generating an increased demand for biostatisticians on campus. As part of the Dean's goal in his **Plan for Excellence**, all Departments and Programs have been charged with training experts and academic leaders in all disciplines of research. To help achieve this goal, and to help address the growing demand for well trained biostatisticians at all levels on our campus and throughout the country, we seek to establish a **Graduate Training Program in Biostatistics**. We propose to launch such a program initially with an 18-month **Master of Science in Biostatistics** (MSIBS) that will help meet the needs of this growing field and put Washington University on the supply side of the equation. In particular, it will provide a steady stream of well trained Biostatisticians to its own scientists at WU. Once this program is established, we would like to start plans for a University-wide effort at launching a PhD program through the Graduate School of Arts and Sciences.

Overlap with other programs at WUSM? Our proposal is compatible with other, and does not compete with any, existing programs including the MSCI (Dr. Evanoff) and the latest MPHS program (Dr. Colditz). The proposed MSIBS program differs from these and other campus programs in 2 major aspects: First, MSIBS emphasizes deeper training in quantitative and computational methods including statistical genetics. Second, the target prospective student populations are entirely different. Our ideal target is undergraduates majoring in mathematics or statistics or a similar quantitative field whereas the ideal students in MSCI and MPHS are clinicians and physician scientists interested in clinical and population science research. Therefore there is not even perceived conflict with any of the programs. More importantly, especially these 3 programs (MSCI, MPHS, and now the proposed MSIBS) work closely and all of them benefit from each other's curricula. The Program Directors of both MSCI (Dr. Evanoff) and MPHS (Dr. Colditz) support the proposed MSIBS program. They have also agreed to serve on the Advisory Committee for MSIBS. Recently we learnt that the successful MPH program launched by the IPH at Brown School has plans to introduce a Biostatistics concentration within the MPH program. We believe that such a prospect would actually bring added value by enhancing training in biostatistics. We wish to note that there should not even be any perceived conflict between our plans and those of the MPH since the typical applicant to MSIBS (a major in mathematics and/or statistics) is unlikely to seek biostatistics training as part of an MPH. Likewise, a typical applicant to MPH (who seeks training primarily in public health) is unlikely to be interested in MSIBS. Therefore, as best as we are able to anticipate, there is no scope for any real conflicts between MSIBS and any of the existing masters level programs.

Uniqueness of our program: We believe that our proposed MSIBS program will rival the best masters programs in the country in key ways. First, Washington University has excellent international reputation in the area of genetic epidemiology, statistical genetics and genomics which is well integrated into MSIBS which most of our competition programs cannot match. Second, in addition to some required coursework in statistical genetics, it offers a pathway in statistical genetics. Third, while most of our competition programs are 2 years long, we are able to fast track our program by using 2 summers so that the students can obtain the degree in 18 months. This feature will be attractive to prospective students since they will be able to enter the job market a semester early. Finally, by virtue of graduating in December, they will face least competition in the job market.

SIBS programs and potential pipeline: Our proposal builds upon an NIH level effort to increase the supply of biostatisticians (*"Minding the Gap" for Biostatistics* by Drs. DeMets, Davidian, and Boos, 2008). As a result of 2 workshops organized by NIH in 2001 and 2003, the NHLBI created a limited program to support an undergraduate summer program in biostatistics referred to as the **Summer Institute for Training in**

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Biostatistics (SIBS). Three institutions (Boston University, North Carolina State, and the University of Wisconsin) were initially funded beginning in 2004, which was renewed in 2006. Finally, in addition to continuing those 3 summer programs, 5 more were funded in 2010 (Emory University, University of Iowa, University of Pittsburgh, University of South Florida, and Washington University in St. Louis). The SIBS grants provide funding for students which covers tuition for approximately 6 credits, room and board, social and networking activities during the program and travel to and from the institution. Perhaps the most important aspect of SIBS is the exposure of students to the many career opportunities in biostatistics. Most of these undergraduates are in the middle of their programs and are searching for a direction to apply their quantitative skills and interest in public health and biomedical research. The program has been a tremendous success to date, with the vast majority of SIBS graduates entering graduate school or taking jobs in the field of biostatistics.

We are delighted to note that the SIBS program at WUSM, headed by Drs. C. Charles Gu and Jay Piccirillo, was very successful this past summer. Some students were enquiring about opportunities for graduate training in biostatistics at WU. We feel that the 7 SIBS programs will serve an important pipeline for the proposed MSIBS program.

Status of the current GEMS program: We considered rolling the GEMS into MSIBS completely and retiring the GEMS program as we know it. However, we were encouraged by the Leadership to retain GEMS also since it has some name recognition over the years (to accommodate those who seek the GEMS type of education and training). Therefore we are retaining the GEMS MS degree as well as the Certificate in Genetic Epidemiology. However, we are taking this opportunity to streamline both of them.

Conclusion: If approved, the **Graduate Training Program in Biostatistics**, hosted by the Division of Biostatistics and made possible by a large number of outstanding faculty across the institution, will contain the MSIBS, the streamlined GEMS MS degree, and the Certificate.

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Proposal for New Degree Granting Programs

Academic

- List all faculty of the proposed program (duplicate this page as necessary).**

NOTE: All faculty listed below will serve as mentors for Internships and Thesis projects for both graduate programs (MSIBS & GEMS). Some have additional roles also which are identified in the Table below. Both programs will have one combined Program Committee, one combined Admissions Committee, one combined Curriculum Committee, and one combined Advisory Committee. The program code “M21” will cover both MSIBS and GEMS.

Program Faculty			
Name	Rank	Primary Department	Role in the Program
D. C. Rao, PhD	Professor	Biostatistics (Director)	Program Director
Arpana Agrawal, PhD	Assistant Professor	Psychiatry	Curriculum Comm.
Laura Bierut, MD	Professor	Psychiatry	Mentor
Ingrid Borecki, PhD	Associate Professor	DSG (Co-Director) - Genetics	Instructor
Anne Bowcock, PhD	Professor	Human Genetics (Co-Director)-Genetics	Mentor
Ross Brownson, PhD	Professor	Public Health-Social Work	Mentor
Kathleen Bucholz, PhD, MPH	Professor	Psychiatry	Mentor
Li-Wei Chang, PHS	Research Instructor	Pathology and Immunology	Mentor
Ling Chen, PhD	Research Instructor	Biostatistics	Instructor
James Cheverud, PhD	Professor	Anatomy	Mentor
C. Robert Cloninger, MD	Professor	Psychiatry	Mentor
Graham Colditz, MBBS	Professor	Surgery	Advisory Comm.
F. Sessions Cole, MD	Professor	New Born Medicine (Director)-Pediatrics	Mentor
Linda Cottler, PhD	Professor	Psychiatry	Mentor
Robert Culverhouse, PhD	Assistant Professor	Internal Medicine	Mentor
Gina D'Angelo, PhD	Assistant Professor	Biostatistics	Course master, Admissions Comm., Curriculum Comm., Program Comm.

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Victor Davila-Roman, MD	Professor	Internal Medicine	Advisory Comm.
Warwick Daw, PhD	Research Associate Professor	Genetics	Mentor
Lisa de las Fuentes, MD	Assistant Professor	Internal Medicine	Mentor
Jimin Ding, PhD	Assistant Professor	Mathematics	Mentor
Timothy Eberlein, MD	Professor	Surgery (Head) SCC (Director)	Advisory Comm.
Bradley Evanoff, MD	Professor	GMS (Director)- Internal Medicine ICTS (Director)	Advisory Comm.
Victoria Fraser, MD	Professor	Internal Medicine (Head)	Advisory Comm.
Brian Gage, MD	Associate Professor	Internal Medicine	Mentor
Feng Gao, PhD	Research Assistant Professor	Biostatistics	Admissions Comm.
Jefferson Gill, PhD	Professor	Political Science CAS (Director)	Advisory Comm.
Alison Goate, PhD	Professor	Genetics in Psychiatry	Mentor
Paul Goodfellow, PhD	Professor	Surgery	Mentor
Jeffrey Gordon, MD	Professor	CGS (Director) – Pathology & Immunology	Mentor
Mae Gordon, PhD	Professor	Ophthalmology and Visual Sciences	Mentor
C. Charles Gu, PhD	Associate Professor	Biostatistics	Course Master, Curriculum Comm., Program Comm.
Aaron Hamvas, MD	Professor	Pediatrics	Mentor
Andrew Heath, DPhil	Professor	Psychiatry	Mentor
Patrick Jay, MD, PhD	Assistant Professor	Pediatrics	Mentor
Aldi Kraja, PhD	Research Associate Professor	Genetics	Instructor
Steven Kymes, PhD	Research Assistant Professor	Ophthalmology and Visual Sciences	Mentor
Nan Lin, PhD	Professor	Mathematics	Course master
Jinqxie (Esther) Liu, PhD	Research Instructor	Biostatistics	Instructor
Michael Lovett, PhD	Professor	Human Genetics (Co- Director)-Genetics	Mentor
Jingqin (Rosy) Luo, PhD	Instructor	Biostatistics	Course Master, Curriculum Comm.

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George Macones, MD	Professor	Obstetrics and Gynecology (Head)	Mentor
Pam Madden, PhD	Associate Professor	Psychiatry	Mentor
Timothy McBride, PhD	Professor	Public Health-Social Work	Advisory Comm.
J. Phillip Miller, A.B.	Professor	Biostatistics	Course master, Curriculum Comm., Program Comm.
Rakesh Nagarajan, MD, PhD	Associate Professor	Pathology and Immunology	Mentor
Jeffrey Peipert, MD, PhD	Professor	Obstetrics and Gynecology	Mentor
Jay Piccirillo, MD	Professor	Otolaryngology	Mentor
Michael A. Province, PhD	Professor	DSG (Director) - Genetics	Course Master, Curriculum Comm., Advisory Comm.
John Rice, PhD	Professor	Psychiatry	Course Master, Curriculum Comm., Program Comm.
Treva Rice, PhD	Research Associate Professor	Biostatistics	Course master, Curriculum Comm., Admissions comm., Program Comm.
Nancy Saccone, PhD	Assistant Professor	Psychiatry	Instructor
Stanley Sawyer, PhD	Professor	Mathematics	Mentor
Kenneth Schechtman, PhD	Associate Professor	Biostatistics	Course Master, Curriculum Comm., Program Comm.
Mario Schootman, PhD	Associate Professor	Health Behavior Research (Director) - Internal Medicine	Mentor
William Shannon, PhD	Associate Professor	Internal Medicine	Course master, Curriculum Comm., Program Comm.
Gang Shi, D Sc	Research Instructor	Biostatistics	Instructor
Ed Spitznagel, Ed, PhD	Professor	Mathematics	Curriculum Comm., Program Comm.
Gary Stormo, PhD	Professor	Genetics	Mentor
Brian Suarez, PhD	Professor	Psychiatry	Mentor
Yun Ju Sung, PhD	Assistant Professor	Biostatistics	Course Master, Curriculum Comm., Admissions Comm.
Alan Templeton, PhD	Professor	Biology	Mentor
Alexandre Todorov, PhD	Research Professor	Psychiatry	Mentor
Herbert (Skip) Virgin, MD, PhD	Professor	Pathology and Immunology (Head)	Advisory Comm.

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Mark Watson, MD, PhD	Professor	Pathology and Immunology	Mentor
Chengjie Xiong, PhD	Associate Professor	Biostatistics	Course Master, Curriculum Comm., Admissions Comm., Program Comm.
Yan Yan, MD, PhD	Research Associate Professor	Surgery	Mentor
Charles Zorumski, MD	Professor	Psychiatry (Head)	Advisory Comm.

2. List members of the Program Committee. (This committee is charged with the responsibility for overall oversight of the program including review of policies and procedures, curriculum, admissions, etc. At least half of the members must be full-time faculty members.)

Program Committee			
Name	Rank	Primary Department	Role in the Program
D. C. Rao, Ph.D.	Professor	Biostatistics	Program Director, Program Comm. (Chair), Curriculum Comm. (Co-Chair)
C. Charles Gu, PhD	Associate Professor	Biostatistics	Course Master, Curriculum Comm. (Co-Chair), Program Comm.
John Rice, PhD	Professor	Psychiatry	Course Master, Program Comm.
Kenneth Schechtman, PhD	Associate Professor	Biostatistics	Course Master, Program Comm.
Chengjie Xiong, PhD	Associate Professor	Biostatistics	Course Master, Curriculum Comm. (Co-Chair), Program Comm.
Gina D'Angelo, PhD	Assistant Professor	Biostatistics	Course master, Admissions Comm. (Co-Chair), Program Comm.
J. Philip Miller, A.B.	Professor	Biostatistics	Course master, Program Comm.
Treva Rice, PhD	Research Associate Professor	Biostatistics	Course master, Admissions Comm. (Co-Chair), Program Comm.
Jay Piccirillo, MD	Professor	Otolaryngology	Program Comm.

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Ed Spitznagel, Ed, PhD; moved him to the Advisory comm. and replaced him here with Nan Lin, also from math dept with approval from Co- Chairs of the Adv comm; the move was suggested by Math dept. after AAC and EF mtngs	Professor	Mathematics	Program Comm.
Student representative			Student Member

NOTE: All Program Committee members are full-time faculty members.

3. Operating principles of the Program Committee and all other Committees (include description of meeting frequency, quorum status, voting rules). (See **Appendix A** for full details including a list of all committees, faculty and staff roles, along with their duties).

(A) The Program Committee: It is charged with the overall oversight of the program including review and approval of policies and procedures, curriculum, as well as requirements and competencies at the program and course levels.

The Program Committee, assisted by three sub-committees (Executive, Admissions and Curriculum), will establish policy and direction for the program, will review and approve courses, will review and approve admissions, and will oversee the entire program. In addition to the Program Director, the Program Committee is composed of faculty members who represent elements of the Washington University School of Medicine community with direct interests in the training of biostatistics, genetic epidemiology, and statistical genetics. The Committee includes the Co-Chairs of the Admissions Committee, Co-Chairs of the Curriculum Committee, and several course masters. The committee also includes key external members with a record of accomplishment in implementing and administering training programs, including Dr. Shannon from General Medical Sciences, Dr. Rice from Psychiatry who is a Co-Director of the DBBS PhD program in Human and Statistical Genetics, and Dr. Spitznagel from the Department of Mathematics. In addition, one student representative will be included to directly voice the needs and suggestions of students. The student representative may be rotated between the 2 masters degree programs (MSIBS & GEMS). If each program has a class size of at least 5, we will add one student representative from each of the two programs.

The Program Committee will routinely meet on a quarterly basis, and additional meetings may be scheduled as necessary (especially during the early months). Official business will be conducted only when a majority of the members are present. Voting will be based on one vote per person of those present with simple majority necessary for all decisions. Six will be considered the quorum.

Program Committee members will be invited and retained on a 3-year renewable term basis. Only those playing active roles in the overall direction will be renewed. At least half of the Program Committee members will be full-time faculty.

(a) The Program Committee will be assisted by an Executive sub-committee with day to day operations. It will include the Program Director (Dr. Rao), one Co-Chair of the Curriculum (Dr. Gu) and one Co-Chair of the Admissions (Dr. D'Angelo) committees, and one senior and highly experienced biostatistician (Professor Miller). The Executive committee will meet on a bi-weekly or

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monthly basis as needed. Its primary role is assisting the Program Committee in terms of the daily operations.

(b) The Program Committee will be assisted by a Curriculum Committee. The committee includes all (primary) course masters (one per course), as well as three other faculty (chosen on a 3-year rotation basis from a short list; the inaugural members will be Drs. Spitznagel, Shannon, and Agarwal). The committee will meet 3 times a year to handle student evaluations and to plan any changes to the curriculum. Minimum quorum is a majority of the membership and a simple majority will rule. The Curriculum Committee will be Co-Chaired by Drs. Rao, Xiong, and Gu

The Curriculum Committee will be responsible for the initial design of new core courses and for integration and coordination of existing courses. A major goal for this committee is to coordinate course content and course scheduling to provide an integrated and comprehensive curriculum that best suits the needs of our students. The committee will establish uniform grading and attendance policies, will review the courses and course materials, and will review student evaluations and recommendations for changes in these courses. Any outstanding issues will be referred to the Program Committee for resolution.

(c) The Program Committee will be assisted by an Admissions Committee. The committee will be Co-Chaired by Drs. Rice and D'Angelo, and also includes Drs. Gao, Sung, and Xiong. Dr. Rice has been serving as the Chair of the GEMS Admissions Committee for several years (who introduced a standardized approach to assessing all applications). Dr. Xiong has also been serving on the GEMS Admissions Committee for a number of years. Drs. Gao and Sung are amply qualified to serve on the committee.

- The Chairs of the committee assign a Primary Reviewer for each applicant. All members score each application on a 5-point scale, 1 being the highest score. Usually a score above 3 is considered ineligible for admission.
- The committee meets and discusses all applications scored, resolving any concerns members may have about a particular application.
- All applications will be ranked using the aggregate score for each application. The Co-Chairs will present the results and make recommendations to the Program Director.
- The Program Director presents the results to the Program Committee along with recommendations for admission. The Program Committee will make all final decisions concerning admission.

See section 4(b) below for additional details.

(B) Advisory Committee: The Advisory Committee is an external committee that will advise and guide the Program Committee on programmatic challenges or major changes and how they affect the overall education provided at Washington University School of Medicine. The advisory committee membership includes Program Directors of the MPHS (Dr. Colditz) and MSCI (Dr. Evanoff) who are familiar with the current GEMS program and the proposed MSIBS program. The committee includes several Department Heads (Drs. Eberlein, Fraser, Virgin, and Zorumski), Director of the Center for Applied Statistics (Dr. Gill), Program Director of the MPH program from IPH (Dr. McBride), and senior faculty leaders with outstanding reputation in training and mentoring (Drs. Davila-Roman and Province). The Program Director (Dr. Rao) will serve as a non-voting member who will be responsible for scheduling meetings, setting up agenda, and for the minutes. Drs. Colditz and Fraser will Co-Chair the committee. It is expected that this committee will meet annually. When issues arise between meetings, the committee will be consulted by e-mail. Simple majority will rule.

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Advisory Committee

Name	Rank	Primary Department	Role in Program
Graham Colditz, MBBS	Professor	Surgery	Co-Chair
Victor Davila-Roman, MD	Professor	Internal Medicine	Member
Timothy Eberlein, MD	Professor	Surgery (Head)	Member
Bradley Evanoff, MD	Professor	GMS (Director) - Internal Medicine	Member
Victoria Fraser, MD	Professor	Internal Medicine (Head)	Co-Chair
Jefferson Gill, PhD	Professor	CAS (Director), Political Science	Member
Timothy McBride, PhD	Professor	Public Health - Social Work	Member
Michael Province, PhD	Professor	DSG (Director) - Genetics	Member
Herbert (Skip) Virgin	Professor	Pathology & Immunology (Head)	Member
Charles Zorumski	Professor	Psychiatry (Head)	Member

4. a) Describe selection criteria. (Notation of prior academic qualifications, review of degrees/transcripts, etc. should be included. Other items might include scores achieved on preparatory examinations as well as recommendations from suitably qualified individuals.)

General Admissions Requirements for the MSIBS (M.S. Degree)

Admission to MSIBS generally requires undergraduate majors in a quantitative field (ideally mathematics, statistics, computer science, or biomedical engineering). Students at possibly different points in their careers may apply to the MSIBS degree program (which may include those with some graduate school experience in a related field with sufficient math/stat background). The following individuals may be interested in applying to the MSIBS degree:

- Recent recipients of at least an undergraduate degree or higher degree in mathematics, statistics, computer science, or biomedical engineering from an accredited institution, and
- Individuals with terminal degrees in other (related) disciplines who seek to gain expertise in biostatistics.

Other Prerequisites: Students entering the program with background only in quantitative sciences will benefit from a basic human biology and/or a basic genetics course. Prospective students should also have basic skills in working with computers. Some knowledge of computer programming will be helpful.

In most cases MSIBS degree students should be able to devote full time to the Program (entering the program around July 1 and graduating the following December). However, part-time accommodations will be made for students who need it. Such arrangements should be discussed with the Program Manager and must be declared in the application form.

Selection Criteria are based on the Admission's Committee's non-biased review of academic and professional accomplishments. Specifically, the following materials are required:

All Applicants are required to submit:

1. A completed MSIBS application form
2. Documentation of degrees and official transcripts

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3. Current GRE test results are required in most cases (GRE generally within three years of applying); exceptions may be made only when all available materials make an exceptionally strong case for offering admission to the applicant (e.g., top cumulative GPA from an accredited US institution)
4. For international students, GRE and TOEFL test results are both required (within three years of applying)
5. Two academic letters of recommendation
6. A Personal Statement (addressing the motivation for training in biostatistics and why MSIBS is a good fit)

b) If School of Medicine is to offer degree, include description of Admissions Committee membership.

The Admissions Committee will consist of:

Treva Rice, PhD (Co-Chair)
Gina D'Angelo, PhD (Co-Chair)
Feng Gao, PhD
Yun Ju Sung, PhD
Chengjie Xiong, PhD

This committee will review all applications and make recommendations to the Program Committee concerning acceptable applicants. Our admissions process will strive for adequate representation of women and underrepresented minorities. The committee will meet once during early fall to approve recruitment and application materials and procedures. Starting early spring, the committee will meet as often as necessary to discuss and evaluate applicants so that rolling admissions could be offered. Both U.S. citizens and non-U.S. citizens will be considered for admission. Visa applications for matriculating students from other countries will be handled by the Program Manager.

c) Describe specifically how transfer of credits from other programs and institutions will be evaluated and handled.

We will accept transferable credits from other accredited institutions of higher education and from other programs at Washington University provided that the didactic courses are considered to be equivalent to the courses offered in our program. The curriculum committee will make such determinations. However, in order to graduate from the MSIBS program, at least 75% of the credits must be completed through the MSIBS program (residency requirement). Similar requirement also applies to the GEMS program. Therefore, MSIBS will accept a maximum of 11 transfer credits and GEMS MS degree will accept a maximum of 9 transfer credits. The GEMS Certificate will not accept any transfer credits.

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5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
THE FOLLOWING ARE ALL REQUIRED					
Introduction to SAS (R) (2 credits) M21-502 Summer (Offered in July and again in August)	No	Intensive hands-on summer training in SAS® over 7 full weekdays. Starting with a brief introduction to computing environment and Unix, students will learn how to use the SAS® System for handling, managing, and analyzing data. Instruction is provided in the use of the SAS® programming language and procedures. The course will teach students how to become effective, self-reliant SAS® users, and will instruct the students in data management and basic exploratory data analysis using SAS®. Topics include, but are not limited to: Reading External Files into SAS; Examining and Manipulating the Contents of SAS Datasets; and SAS Macro Variables and Programs. Students will learn how to output results, and create high quality tables and graphs in SAS. A brief introduction to statistics in SAS will also be included. Instruction manual and computer lab will be provided. This course meets the prerequisite for M21-560 Biostatistics I. The registration/grade option of "Audit" is not available. <i>Offered:</i> 7 full weekdays in July and repeated in August	Karen Schwander, Rosy Luo, and others	Karen Schwander, Rosy Luo, and others	5 - 20 per session
Fundamentals of Genetic Epidemiology (R) (3 credits) M21-515 Summer	Yes Math/Stat Workshop	Intensive two-week summer course. Lectures cover causes of phenotypic variation, familial resemblance and heritability, Hardy-Weinberg Equilibrium, ascertainment, study designs and basic concepts in genetic segregation, linkage and association. The computer laboratory portion is designed as hands-on practice of fundamental concepts. Students will gain practical experience with various genetics computer programs (e.g. SOLAR, MERLIN, QTDT, and PLINK). Auditors will not have access to the computer lab sessions.	Treva Rice, Yun Ju Sung		

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
Intro to Bioinformatics (R) (3 credits) M21-550	Yes Math/ Stat & Comput/UNIX Workshop	Intensive two-week summer course designed to provide a broad exposure to the basic concepts, methodology and application of bioinformatics to solve biomedical problems. Specifically, students will learn the basics of online genomic databases and database mining tools, and acquire understanding of mathematical algorithms in genome sequence analysis (alignment analysis, gene finding/predicting), gene expression microarray (genechip) analysis, and of the impact of recent developments such as protein microarrays or whole-genome DNA chips for genome-wide association studies. They will also take computer labs and learn basics of bioinformatics tools and databases (BLAST/WUBLAST, Prospector, etc.), practice basics of R/Bioconductor programming, and apply specialized R packages to solve bioinformatics problems pertinent to real medical research of human diseases. Auditors will not have access to the computer lab sessions.	C. Chalres Gu, Gary Stormo	Various	
Biostatistics I (R) (3 credits) M21-560 Fall 1	Yes M21-502	This course is designed for students who want to develop a working knowledge of basic methods in biostatistics. The course is focused on biostatistical and epidemiological concepts and on practical hints and hands-on approaches to data analysis rather than on details of the theoretical methods. We will cover basic concepts in hypothesis testing, will introduce students to several of the most widely used probability distributions, and will discuss classical statistical methods that include t-tests, chi-square tests, regression analysis, and analysis of variance. Both in-class examples and homework assignments will involve extensive use of SAS®. Auditors will not have access to the computer lab sessions. Prerequisite: M21-502 Statistical Computing with SAS® or student must have practical experience with SAS®. <i>Offered:</i> Fall 1, Monday & Wednesday 9-12 pm	Ken Schect- mann & Kim Trinkaus	Gang Shi, Ling Chen	Variable

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number (R = required course E = elective)	Prerequisites	Brief Description	Course Master	Participating Faculty	Max & Min Enrollment
Biostatistics II (R) (3 credits) M21-570 Fall 2	Yes M21-560	This course is designed for students who have taken Biostatistics I or the equivalent and who want to extend their knowledge of biostatistical applications to more modern and more advanced methods. Biostatistical methods to be discussed include logistic and Poisson regression, survival analysis, Cox regression analysis, and several methods for analyzing longitudinal data. Students will be introduced to modern topics that include statistical genetics and bioinformatics. The course will also discuss clinical trial design, the practicalities of sample size and power computation and meta analysis, and will ask students to read journal articles with a view towards encouraging a critical reading of the medical literature. Both in-class examples and homework assignments will involve extensive use of SAS®. Auditors will not have access to the computer lab sessions. Prerequisite: M21-560 Biostatistics I or its equivalent as judged by the course masters. <i>Offered:</i> Fall 2, Monday & Wednesday 9-12 pm	Ken Schectmann & Kim Trinkaus	Gang Shi, Ling Chen	Variable
Study Design and Clinical Trials (R) (3 credits) M21-617 Spring	No	streamlined: The course will focus on statistical and epidemiological concepts of study design and clinical trials. Topics include: different phases of clinical trials, various types of medical studies (observational studies, retrospective studies, adaptive designs, and comparative effectiveness research), genetic studies (linkage studies and association studies), and power analysis, along with statistical methods for the various types of studies. Study management and ethical issues are also addressed. Students will be expected to write up a proposed design for a study of their choice, to practice power analysis/sample size estimation during lab sessions, and to critique published medical literature. Permission of the Course Master required. Prerequisites: M21-560 Biostatistics I and M21-570 Biostatistics II or the equivalent as determined by the course masters.	Gina D'Angelo & J. Philip Miller	Various	Variable
Ethical and Legal issues in Clinical Research (R) (2 credits) M17-510 Spring	No	Exploration of ethical issues which research scientists encounter in their professional activities. Topics will include but are not limited to: student-mentor relationships, allegations of fraud, collaborators' rights and responsibilities, conflicts of interest, confidentiality, publications. Case study and scenario presentations will provide focus for discussions. Prerequisite. Open to graduate students engaged in research.	DuBois	Various	

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
Internship (R) (6 credits) M21-XXX Summer 2	Yes M21-560 & M21-570 & Permission of Course Master	The primary goal of the Internship program is for all students to acquire critical professional experience so that they will be well prepared to enter the job market upon graduation. This provides an opportunity for students to test-drive the job market, develop contacts, build marketable skills, and figure out likes and dislikes in the chosen field. While this is listed as a project to be pursued during the 2 nd summer, students may elect to stretch the project over Spring and summer semesters. Students are required to spend a total of 500 hours in the laboratories of their chosen Mentors. One of two types of projects may be pursued as part of the Internship experience. A student may elect to pursue a <u>"Data Analysis Project"</u> involving data management and extensive analyses of data which may lead to a publication quality manuscript (possibly earning co-authorship for the student). Alternatively, a student may choose a highly focused research oriented project and carry out <u>"Mentored Research"</u> by working closely with the mentor. In this case, the student will assist the mentor by preparing a publication quality manuscript as part of the Internship. In either case, as part of the Internship requirements, each student will submit a one page Abstract of the work performed as part of the Internship, and make a 5-minute presentation of the internship experience. Internship presentations will be scheduled in late summer. Grade for each student will be determined in consultation with the mentor. Internships will be facilitated and coordinated by an Internship Committee consisting of Drs. D.C. Rao & J. Philip Miller (Co-Chairs), Ken Schechtman, and Chengjie Xiong.	J. Philip Miller & D.C. Rao	Various	

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number (R = required course E = elective)	Prerequisites	Brief Description	Course Master	Participating Faculty	Max & Min Enrollment
Biostatistics Consulting Lab (R) (1 credits) M21-XXX Fall (2 nd year)	Yes M21-560 & M21-570	All MSIBS students are required to take this supervised course whose primary goal is to train the students to develop competency for collaborating with and providing biostatistics consultation services to clinical and applied scientists. Students will be trained to develop the art and skill necessary to be good collaborators. Students will work on real time consultation projects and will have opportunities to interact with the Principal Investigators of the projects under close supervision from experienced faculty and staff. This is another invaluable opportunity for students to develop contacts with potential employers upon graduation.	Karen Steger-May & Ken Schechtman	Various	Variable
Thesis or 2 Electives (R) (6 credits) M21-XXX Fall (2 nd year)	All required courses	All MSIBS students are required to complete a Master's thesis, which may involve conducting and reporting a comprehensive data analysis or conducting research and reporting on a focused methodological problem; the latter may include a computer simulation approach to solve a problem, an in depth review of available methods in a certain topical area, or developing new methods. The Biostatistics Consulting Laboratory experience may provide leads for the MS thesis. Each student will work closely with a Mentor who has expertise in biostatistics or a related quantitative field. Three bound copies and an electronic copy of the Thesis must be submitted to the Program Manager by the dead line determined by the University for December graduation. A Thesis Committee consisting of Drs. Gina D'Angelo & Chengjie Xiong (Co-Chairs), Feng Gao, Rosy Luo, and Gang Shi will examine all theses submitted and determine the grade in consultation with the mentors.	Gina D'Angelo & Chengjie Xiong	Drs. Feng Gao, Rosy Luo, and Gang Shi & various	

THE FOLLOWING ARE ELECTIVES FROM WHICH TO CHOOSE 12 CREDITS

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number (R = required course E = elective)	Prerequisites	Brief Description	Course Master	Participating Faculty	Max & Min Enrollment
Human Linkage and Association Analysis (E) (3 credits) M21 – 5483 (Cross-listed as L41-5483) Fall	Yes M21-502	Basic Genetic concepts: meiosis, inheritance, Hardy-Weinberg Equilibrium, Linkage, segregation analysis; Linkage analysis: definition, crossing over, map functions, phase, LOD scores, penetrance, phenocopies, liability classes, multi-point analysis, non-parametric analysis (sibpairs and pedigrees), quantitative trait analysis, determination of power for mendelian and complex trait analysis; Linkage Disequilibrium analyses: allelic association (case control designs and family bases studies), QQ and Manhattan plots, whole genome association analysis; population stratification; Quantitative Trait Analysis; measured genotypes and variance components. Hands-on computer lab experience doing parametric linkage analysis with the program LINKAGE, model free linkage analyses with Genehunter and Merlin, power computations with SLINK, quantitative trait analyses with SOLAR, LD computations with Haploview and WGAViewer, and family-based and case-control association analyses with PLINK and SAS. The methods and exercises are coordinated with the lectures, and students are expected to understand underlying assumptions and limitations, and the basic calculations performed by these computer programs. Auditors will not have access to the computer lab sessions.	John Rice	Arpana Agarwal, Ingrid Borecki, Nancy Saccone	
Population Genetics (E) (3 credits) M21 535 (same as L41-4181) Fall	Yes Bio 2970	An introduction to the basic principles of population and ecological genetics. Mechanisms of microevolutionary processes; integrated ecological and genetic approach to study the adaptive nature of the evolutionary process. Prerequisite: Bio 2970.	Alan Templeton		Variable
Introduction to Epidemiology (E) (3 credits) M19-501 Fall 1	Yes M21-502	This course introduces the basic principles and methods of epidemiology, with an emphasis on critical thinking, analytic skills, and application to clinical practice. Topics include outcome measures, methods of adjustment, surveillance, quantitative study designs, and sources of data. Designed for those with a clinical background, the course will provide tools for critically evaluating the literature and skills to practice evidence-based medicine. <i>Offered:</i> Fall 1, Tuesday & Thursday 9-12pm	L. Arnold		

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
Intermediate Epidemiology (E) (3 credits) M19-502 Fall 2	Yes M19-501	The second course in the Epidemiology series, this course builds upon the basic principles and methods of epidemiology and introduces additional tools and concepts that are critical to a comprehensive study design. Topics include risk and association, sampling strategies, interaction, confounding, adjustment, lifetables, applied causal inference, validity and reliability, social epidemiology, and approaches to data analysis. Upon exiting this course, students will be prepared to approach the study design portion of a protocol, as required by the final course in the Epidemiology series. <i>Offered:</i> Fall 2, Tuesday & Thursday 9-12pm	M. Shootman		
Survival Analysis (E) (3 credits) Math 434 Fall (Odd years)	Yes Math 320 and 309 or equivalents	Life-table analysis and testing, mortality and failure rates, Kaplan-Meier or product-limit estimators, hypothesis testing and estimation in the presence of random arrivals and departures, and the Cox proportional hazards model. Used in medical research, industrial planning, and the insurance industry. Some topics covered on the actuarial examination	Jimin Ding		
Multilevel Models in Quantitative Research (E) (3 credits) L55-430 Fall	Yes ASTAT 364 or equiv	Multilevel models (also called hierarchical, random-effects, and mixed-effects models) are an increasingly important statistical tool in many social sciences. Examples include education (data on students within schools), economics (panel data), political science (data characterized by states and years), law (police stops categorized by date, location, and ethnic group), medicine (meta-analysis), public health (small-area estimation), social work (studies of individuals within housing areas), and many other areas. This course covers setup, inference, and checking the fit of multilevel models. Computation using the software packages R and Bugs and applications in social science and elsewhere. By the end of the course, you should be able to understand multilevel models and apply them creatively to your data-analysis problems.			

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
Probability (E) (3 credits) L24-493 Fall	Yes Math 318 or 308	Mathematical theory and application of probability at the advanced undergraduate level; a calculus based introduction to probability theory. Topics include the computational basics of probability theory, combinatorial methods, conditional probability including Bayes' theorem, random variables and distributions, expectations and moments, the classical distributions, and the central limit theorem	Russ Woodroffe		
Randomized Controlled Trials (3 credits) M19-550 Fall 1 & 2	Yes M21-560	This course provides a comprehensive introduction to randomized controlled clinical trials. Topics include types of clinical trials research (efficacy and effectiveness trials), study design, treatment allocation, randomization and stratification, quality control, analysis, sample size requirements, patient consent, data safety and monitoring plans, reporting standards, and interpretation of results. Course activities include lectures, manuscript critiques, class project, paper.	G. Colditz, E. Liu		
Computational Statistical Genetics (E) (3 credits) M21-621 Spring	Yes M21-5483, M21-560 and Permission of Course Master	This course is designed to give the students computational experience with the latest statistical genetics methods and concepts, so that they will be able to computationally implement the method(s)/model(s) developed as part of their thesis. Concentrating on the applications of genomics and SAS® computing, it deals with creating efficient new bioinformatic tools to interface with some of the latest, most important genetic epidemiological analysis software, as well as how to derive, design and implement new statistical genetics models. The course also includes didactic instruction on haplotype estimation and modeling of relationship to phenotype, LD mapping, DNA pooling analysis methods, analysis approaches in pharmacogenomics (with an emphasis on possible genomic role in drug response heterogeneity), and epistasis (GxG) and GxE interactions; data mining methods, including clustering, recursive partitioning, boosting, and random forests; and fundamentals of meta-analysis, importance sampling, permutation tests and empirical p-values, as well as the design of monte-carlo simulation experiments. Course not available to auditors.	Michael Province, Aldi Kraja	Various	

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
Biostatistics III (E) (3 credits) M21-580 Spring	Yes M21-570, a course in matrix algebra & multivariate calculus or equiv	The primary objective of this course is to provide students with a solid foundation of most used statistical methods in biology and medicine, including maximum likelihood methods, general linear models, random effect models, general and generalized linear mixed models, longitudinal data analysis, meta-analysis, categorical data analyses and ROC curve analysis, multivariate analysis, Bayesian methods, survival analysis and competing risk analysis, and bootstrapping methods. The emphasis will be on statistical models, including both the methodology (the interpretation of the models and parameters, point and confidence interval estimation, hypothesis tests) and their biomedical applications as well as the computer implementation. SAS® will be extensively used for computation, both in homework assignments and term projects. Auditors will not have access to the computer lab sessions.	Chengjie Xiong	Rosy Luo, Esther Liu	Variable
Research Methods (E) (3 credits) M21-XXX Spring		NEW COURSE TO BE DEVELOPED FOR SPRING 2012	Charles Gu	Various	
Advanced Genetics (E) (3 credits) L41-5491 Spring	Yes Permission of instructor	Fundamental aspects of organismal genetics with emphasis on experimental studies that have contributed to the molecular analysis of complex biological problems. Examples drawn from bacteria, yeast, nematodes, fruit flies and mammalian systems. Prerequisite, graduate standing or permission of instructor.	Tim Schedl		

DEVELOPMENT OF NEW DEGREE GRANTING PROGRAMS

5. Provide a list of courses for the Program (duplicate as required).

Course Name & Number <small>(R = required course E = elective)</small>	Prerequisites	Brief Description	Course Master	Partici- pating Faculty	Max & Min Enroll- ment
Mathematical Statistics (E) (3 credits) L24-494 Spring	Yes Math 493 or Permission	Parametric and non parametric significance and hypothesis testing; order statistics; theory of estimation; theory of runs, sampling schemes, analysis of variance, sequential analysis.	Stanley Sawyer		
Bayesian Statistics (E) (3 credits) L24-459 Spring every two years	Yes Math 493 or Instr. Permission	Introduces the Bayesian approach to statistical inference for data analysis in a variety of applications. The topics include: comparison of Bayesian and frequentist methods. Bayesian model specification, choice of priors, computational methods, empirical Bayes method, hands-on Bayesian data analysis using appropriate software.	Nan Lin		

6. Thesis Requirement

A thesis is required for completion of this degree:

Yes (Student has an **option** to do a Thesis or take 2 advanced electives)

No

The MSIBS program requires a Thesis or 2 additional advanced electives, both totaling 6 credits. An overall Thesis Committee consisting of Drs. Gina D'Angelo & Chengjie Xiong (Co-Chairs), Feng Gao, Rosy Luo, and Gang Shi will advise all students about the expectations and they will examine all theses submitted and determine the grade in consultation with the mentors. Individual students will not have separate Thesis Committees. They will work directly with their mentors. The following describes the process:

- By March 1 each year, each student will notify the Program manager in writing whether (s)he is exercising the Thesis option or take 2 advanced electives.
- The Thesis Committee will meet with all students pursuing thesis by April 1 and discuss the expectations and timelines for making progress toward thesis.
- Each student and Thesis Committee will work together to pick a thesis mentor who will work with the student. The mentor will begin working with the student and help the student choose the research question, providing data and guidance. While some progress may be made during summer, most of the thesis work will be done in the Fall semester.
- The thesis research may involve conducting and reporting a comprehensive data analysis or conducting research and reporting on a focused methodological problem; the latter may include a computer simulation approach to solve a problem, an in depth review of available methods in a certain topical area (review paper), or developing new methods.
- Each student will work closely with a Mentor who has expertise in biostatistics or a related quantitative field.
- Three bound copies and an electronic copy of the Thesis must be submitted to the Program Manager by the dead line for December graduation. The deadline for thesis submission is December 1 unless announced otherwise. There will be no defense.
- All theses will be examined by a Thesis Committee consisting of Drs. Gina D'Angelo & Chengjie Xiong (Co-Chairs), Feng Gao, Rosy Luo, and Gang Shi. The committee will determine the grade (Pass/Fail) in consultation with the mentor(s).
- Primary criteria for evaluating and grading the thesis will include: regularity and amount of effort put into the thesis work as well as the overall quality of the thesis experience (as judged and reported to the thesis committee by the mentor), novelty of the work reported (paying attention to possible plagiarism), and the quality of organization and presentation within the written thesis.

7. Calendar of the Program

a) *Provide proposed dates for matriculation, start and end of classes, semester/trimester/quarter dates, and examination periods.*

While there is an option for completing the program on a part-time basis, students will be strongly encouraged to follow the recommended sequence of full-time coursework in order to complete the program in 18 months. Students will matriculate by July 1, and full time students will graduate the following December. Classes would begin immediately (with 3 required summer courses). The start date for fall semester Session I would coincide with the University schedule. Session I (8 weeks in duration) would be immediately followed by Session II (also 8 weeks) to allow for consistency between the program and the University semester end dates. Currently, only Biostatistics I and II (both required) and Introduction to Epidemiology and Intermediate Epidemiology (both electives) follow the quarter system in the Fall semester. Spring semester would follow the corresponding University calendar.

During summer 2, and possibly starting in spring, all students will be required to do 500 hours of Internship with a pre-chosen PI/Lab. The internship may entail a limited scope research project (possibly leading to a publication) or test driving a future job (which will entail carrying out a lot of data management and statistical analysis of data). Both MSIBS and GEMS students will be required to do Internship. This replaces the current “Mentored Research” in GEMS (both are 6 credits each).

In the second fall semester, all MSIBS students will be required to participate in a 1-credit Biostatistics Consulting Lab (providing statistical consultation to clinical scientists on campus under the supervision of experienced faculty and staff). In addition, they will work either on a Thesis (6 credits) or take two advanced electives (6 credits).

Students who can not pursue the degree on a full time basis will be given an opportunity to complete it on a part-time basis. Ordinarily, a part-time student will have up to 3 years to complete the degree. Student needing exceptions will be considered on a case-by-case basis in consultation with the Advisory Committee.

b) Describe how a typical student would progress through the program: **Typical curriculum** for a student seeking training in **traditional biostatistics** for 18-month Full Time (FT) or 30-month Part Time (PT): F1 = 1st year Fall; F2 = 2nd year Fall; F3 = 3rd year Fall; same for Spring (S1 and S2); summers are denoted by s1, s2, and s3.

SEMESTER/COURSE	MSIBS - FT Biostatistics	MSIBS - PT Biostatistics
SUMMER 1		
Bootcamp	x	<u>s1</u>
Fundamentals of Genetic Epidemiology (3)	x	<u>s1</u>
Introduction to Bioinformatics (3)	x	<u>s1</u>
SAS (2)	x	<u>s1</u>
FALL 1		
Biostatistics I (3)	x	F1
Biostatistics II (3)	x	F1
Intro to Epidemiology (3) (MPHS)	x	F2
Survival Analysis (3)	x	F2
SPRING 1		
Study Design (3)	x	S1
Biostatistics III (3)	x	S1
Internship (0): Initiate in spring	x	S2
Ethics (2; MSCI)	x	S2
Clinical Trials (3; MPHS)	x	S2
SUMMER 2		
Internship (6): Complete in summer	x	<u>s3</u>
FALL 2		
Consulting (1)	x	F3
Thesis OR 2 Electives (6)	x	F3
TOTAL CREDITS	44	

Typical curriculum for a student seeking the statistical genetics pathway:

SEMESTER/COURSE	MSIBS – FT Statistical Genetics	MSIBS – PT Statistical Genetics
SUMMER 1		
Bootcamp	x	<u>s1</u>
Fundamentals of Genetic Epidemiology (3)	x	<u>s1</u>
Introduction to Bioinformatics (3)	x	<u>s1</u>
SAS (2)	x	<u>s1</u>
FALL 1		
Biostatistics I (3)	x	F1
Biostatistics II (3)	x	F1
Human Linkage & Association (3)	x	F2
Population Genetics (3)	x	F2
SPRING 1		
Computational Statistical Genetics (3)	x	S1
Study Design (3)	x	S1
Biostatistics III OR Research Methods (3)	x	S2
Internship (0): Initiate in spring	x	S2
Ethics (2 credits; MSCI)	x	S2
SUMMER 2		
Internship (6): Complete in summer	x	<u>s3</u>
FALL 2		
Consulting (1)	x	F3
Thesis OR 2 Electives (6)	x	F3
TOTAL CREDITS	44	

The following Table lists all courses, required and electives, for each of the MSIBS degree, GEMS degree, and the GEMS Certificate.

SEMESTER/COURSE (GEMS; MPHS; MSCI; NEW; Others)	MS in Biostatistics 18 months	GEMS 14 months	GEMS Certificate (REVISED)
SUMMER 1			
Bootcamp	x	x	x
Fundamentals of Genetic Epidemiology M21-515 (3)	x	x	x
Introduction to Bioinformatics M21-550 (3)	x	x	x
SAS M21-502 (2)	x	x	x
FALL 1			
Biostatistics I M21-560 (3)	x	x	x
Biostatistics II M21-570 (3)	x	x	x
Intro to Epidemiology M19-501 (3)	•	E1	
Intermediate Epidemiology M19-502 (3)	Δ		
Human Linkage & Association M21-5483 (3)	■	x	x
Probability L24-493 (3)	Δ		
Population Genetics M21-535 (3)	■	E2	
Multi-Level Models in Quantitative Research L55-430 (3)	Δ		
Survival Analysis L24-434 (3)	•		
SPRING 1			
Computational Statistical Genetics M21-621 (3)	■	x	
Study Design & Clinical Trials M21-617 (3)	x	x	
Biostatistics III M21-580 (3)	•		
Research Methods M21-xxx (3)	■		
Bayesian Statistics L24-459 (3)	Δ		
Mathematical Statistics L24-494 (3)	Δ		
Advanced Genetics L41-5491 (3)	Δ		
Internship M21-xxx (0): Initiate in spring	x	x	
Ethics M17-510 (2 credits)	x	x	
Randomized controlled Trials M19-550 (3)	•		
SUMMER 2			
Internship M21-xxx (6): Complete in summer	x	x	
FALL 2			
Biostatistics Consulting Lab M21-xxx (1)	x		
Thesis M21-xxx OR 2 Electives (6)	x		
TOTAL CREDITS (Target)	44	34	17

x = required; All students must take 4 electives (other symbols); • = suggested electives; ■ = suggested electives for pathway in Stat-Gen; Δ = other electives

GEMS will target those with some level of post graduate studies or research experience, or, fresh undergraduates using this as a stepping stone for higher studies (e.g., PhD). Must take one elective (**E1** or **E2**).

MSIBS will target fresh undergraduates with quantitative majors.

NOTE: Students on training grants will be acceptable subject to the general guidelines for PT students (see the preceding 2 Tables on pages 25 and 26).

8. Distribution Requirements and Course Prerequisites

a) What are the prerequisites for entry into this degree?

(Equivalents to Washington University courses listed below as examples)

Students applying must have strong quantitative skills with an undergraduate degree from an accredited institution in mathematics, statistics, computer sciences, biomedical engineering, or other highly related areas. We expect that all candidates will also have taken basic coursework in human biology and/or genetics. All prospective students must provide evidence of basic skills in computer programming (see suggestions below) through coursework, documented experience, or by passing a proficiency exam. Promising candidates can arrange to take the appropriate courses to rectify deficiencies with the approval of the Program Director. Typically, we expect all applicants to have taken the following courses or their equivalents (among others):

Department: Mathematics

Course Name/Subject: Probability

Course Number: Math L24-493

Description: Mathematical theory and application of probability at the advanced undergraduate level; a calculus based introduction to probability theory. Topics include the computational basics of probability theory, combinatorial methods, conditional probability including Bayes' theorem, random variables and distributions, expectations and moments, the classical distributions, and the central limit theorem **Prerequisite:** Math 318 or 308.

Department: Mathematics

Course Name/Subject: Mathematical Statistics

Course Number: Math 494

Description: Parametric and non parametric significance and hypothesis testing; order statistics; theory of estimation; theory of runs, sampling schemes, analysis of variance, sequential analysis. **Prerequisite:** 493 Probability.

Useful courses to take before matriculation in MSIBS

Department: Biology

Course Name/Subject: Principles of Biology I

Course Number: L41 Biol 2960

Description: An introduction to biological molecules and biochemical strategies employed by the three domains of life. The flow of genetic information within cells is discussed in the context of cellular structure, organization, and function. Investigation and manipulation of genetic information by molecular genetic technologies, such as recombinant DNA, forms the final phase of the course. Weekly labs reinforce concepts from lecture, and explore common laboratory techniques and computer-based resources. **Prerequisite:** Chem 111 and Chem 112 (concurrently). Three hours of lecture and 2 hours of lab per week.

Department: Biology

Course Name/Subject: Human Genetics

Course Number: L41-324

Description: Broad coverage of the role of genetics in medicine, with a focus on the application of genomic technologies to the understanding of human disease. Areas covered include the identification of human disease genes, modern cytogenetics, risk assessment in pedigrees, biochemical genetics, imprinting, mitochondrial genetics, gene therapy, complex inheritance, assisted reproduction, prenatal diagnosis, immunity, cancer, and pharmacogenetics. The profound ethical and legal considerations raised by modern genetic technologies are also discussed. **Prerequisite:** Bio 2960, 2970.

- b) Describe the distribution requirements for this degree. (Include any specific details about requirements within and between sections of the program.)

Required credits will be distributed as follows:

Research Ethics	2 credits
Genetic Epidemiology/Bioinformatics	6 credits
SAS & Biostatistics	11 credits
Biostatistics Consulting & Internship	7 credits
Thesis/ 2 Electives	6 credits
Electives/concentrations	12 credits
TOTAL	44 credits

Elective/concentration credits (12):

Biostatistics pathway:

- Intro to Epidemiology (M19 - 501)
- Survival Analysis (Math 434)
- Biostatistics III (M21- 580)
- Randomized Controlled Trials (M19 – 550)

Statistical Genetics pathway:

- Human Linkage and Association Analysis
- Population Genetics
- Computational Statistical Genetics
- Research Methods (or Biostatistics III)

Eligible WUSM & WUSTL courses available through cross registration to meet elective/concentration specifications include the following:

- Ethics (M17-510)
- Introduction to Epidemiology (M19-501)
- Intermediate Epidemiology (M19-502)
- Randomized Controlled Trials (M19 – 550)
- Population Genetics (L41-4181; M21-535)
- Survival Analysis (Math 434)
- Multilevel Modeling (L55-430)
- Probability (Math 493)
- Mathematical Statistics (Math 494)
- Advanced Genetics (L41-5491)
- Bayesian Statistics (L24-459)

c) *Specify the requirements for graduation. (Include information such as number of credit hours, certain grade point average, submitted thesis, defended thesis, etc.)*

- Students are required to complete a total of 44 credit hours
- A cumulative grade point average of 3.0/4.0 or higher.
- If a Thesis option is chosen, students must submit a written thesis
- Upon completion of the required Internship, all students must submit a one page Summary/Abstract of the internship experience and make a brief (5 minute) presentation. An Internship Committee will determine the grades for all students in consultation with the mentors.

9. Describe how proposals to change the curriculum or course distribution will be evaluated and acted upon.

Modifications to curriculum and course distribution, which may be initiated by aggregate class evaluations and post-graduation feedback, require review and approval by the Curriculum Committee and ratified by the Program Committee. Other methods of changing the curriculum can be initiated by teaching faculty and the Advisory Committee.

10. Append a copy of the procedure which will be used to evaluate student performance. This document *must* contain the text as it will be distributed to participating students. Specific information about each course's grading (Pass/Fail, A/B/C, etc.) should be provided as well as the method of examination. Details of any requirement to maintain a certain grade point average for continuation in the program should be included.

Evaluation and Grading System:

Grading System: A grade is used to report the final standing in each course. Each course master determines grade criteria for the course and describes the class grading system in the course syllabus. Final grades are assigned to represent the level of competence that is achieved by the student.

All students must maintain a minimum of a "B" (or "Pass" when letter grade is not offered) in all required courses, a minimum grade of "C" (or "Pass") in all other courses, and an overall grade point average of 3.0 on a 4.0 scale (or an average grade of B). Twenty nine or more of the 44 credit hours are taken for a letter grade (the others are offered as pass/fail).

All grades are based on satisfactory completion of the course materials and a final examination, term paper, or project. At the instructor's discretion, an incomplete grade may be assigned when a student has not completed all the requirements of the course. This course must be completed with a passing grade prior to progressing in the academic program. A definitive mark for the term is recorded on the official transcript when the work is completed and the incomplete grade is removed. In case the work is not completed within six months (12 months if it involves re-taking the course since each course is offered only once a year), the recorded grade will be changed to Fail. "Incomplete" grades are not acceptable for graduation and students need to complete their assignments in a timely manner.

If a student receives a letter grade below "B" or "Fail" in any required courses or a "Fail" in elective courses, he/she will be required to repeat the course with a passing grade in order to receive credit. Failing a course for the second time may result in termination from the program.

If a student has failed to make satisfactory academic progress (minimum of "B" in required courses, minimum of "C" in electives, "Pass" in pass/fail courses) after the first semester, the Program Committee

will notify the student and his/her advisor. Failure of the student to correct the causative deficiency within a reasonable time (no more than six months) after such notification may lead to a review and recommendation from the Program Committee.

Prior to graduation, each student is required to:

- a) Complete and pass all academic coursework in the program.
- b) Achieve an overall cumulative grade point average of 3.0 or better.
- c) Complete and submit an approved thesis, if (s)he chose to do a thesis (no defense).

It is the responsibility of the student who believes personal concerns, health problems, or any other factors that may adversely affect his or her academic performance to bring such matters to the attention of the student's advisor who will promptly confer with the Program Director.

Program Committee decisions will be communicated to the student in writing. Potential actions include development of a remediation plan that specifies requirements, timelines, and measurements of improvement (this could include warning, probation, penalty, suspension) or a recommendation that the student be dismissed from the program. See **Appendix B** for full description of Actions for Academic Review.

If the program requires a thesis, provide information about any qualifying examinations as well as the method of review of the thesis.

When a student opts to do a Thesis (instead of two advanced electives), he/she will submit a written thesis which will be examined by a Thesis Committee consisting of Drs. Gina D'Angelo & Chengjie Xiong (Co-Chairs), Feng Gao, Rosy Luo, and Gang Shi. The committee will determine the grade (Pass/Fail) in consultation with the mentor(s).

Each student and Thesis Committee will work together to pick a thesis mentor who will work with the student. The mentor will begin working with the student and help the student choose the research question, providing data and guidance. While some progress may be made during summer, most of the thesis work will be done in the Fall semester. See **section 6** above for details of the process and timeline.

A detailed description of how academic encumbrances will be handled should be provided.

Review and resolution of academic encumbrances will be handled consistent with the deliberation process for unsatisfactory academic performance (described in **Item #10** above and **Appendix B** in greater detail).

11. Describe how the program will evaluate whether the objectives are being achieved.

Evaluation of programmatic objectives will be achieved through re-contact of graduating students at 12, 36 and 60 months post-graduation to solicit feedback related to relevance of MSIBS coursework and applicability in current position and/or future career plans. Program success will be assessed in terms of the percent of graduates who are gainfully employed in scholarly and leadership positions in business, academia, and health care or pursuing higher graduate studies such as MD and/or PhD programs. The Program Committee will review outcomes, progress, and determine if any changes to the program are necessary. The proposed changes will be discussed with the Advisory Committee which must approve before any major changes are implemented.

12. Describe academic resources.

- a) ***Teaching Facility:*** The Division of Biostatistics will host the MSIBS program (and continue to host the GEMS program). The program will share the classroom and computer facility with the current GEMS

program. The MSIBS/GEMS training facility includes a dedicated classroom and a fully equipped computer lab with 37 desktop PCs and two dedicated laser printers. Both rooms are equipped with a ceiling-mounted data projection A/V system and the classroom has an audio system. The adjoining space provides a lounge and kitchen area for students to meet. The entire area is 2,393 square feet.

b) Library:

- 1) MSIBS/GEMS Library: A GEMS library exists with limited copies of most frequently used books and other materials. The library will be upgraded to serve both programs by adding additional books and journals relating to both programs that the students may use as resource material and may check out certain books and journals for use. This is included in the budget.
- 2) The Bernard Becker Medical School Library is the primary library resource for both programs. However, students have access to all University libraries with a valid Washington University ID.

c) Computing facilities:

The MSIBS Program computer lab is located on the 3rd floor of the Shriner's Building. This computer lab is shared with the GEMS Program.

In support of our MSIBS and GEMS training programs a dedicated Linux server and a computer lab with 37 XP workstations is located on an additional DMZ within the Division. All meeting and classroom space within the Division is equipped with digital projectors and wireless and hardwired network connections. The Bernard Becker Medical School Library has computer facilities available to students, including Wi-fi.

All students will be assigned an email address and will have internet access to all University libraries with a valid Washington University ID.

d) Academic support from faculty:

All students admitted into the MSIBS program will be assigned an advisor who will be responsible for guiding the student in terms of meeting program requirements and aligning coursework and projects with his/her research interest. Advisor selection will be driven by the student's area of interest as expressed in the one-page description accompanying the application.

Faculty willing to act as Advisors and Mentors are listed in Item #1 of the Academic Proposal (starting on page 6).

e) **Administration**

1. Describe the matriculation procedures. (Append a copy of the offer letter and acceptance form.)

Awareness of the MSIBS program will be accomplished through distribution of informational materials in paper form, electronically, through the WUSM website, as well as through campus visits to schools in the Midwest. Interaction with a potential applicant is initiated when a candidate expresses interest in the program.

Inquiries will be handled initially by the Program Manager who will provide any additional information sought, answer general questions regarding the program, and guide them through the application process. More intensive questions will be handled by the program Director and/or course masters.

Potential candidates will submit a complete formal application (components described below) for review by the Admissions Committee. All components, including all official records and recommendations, must be received before the Admissions committee will review any application.

The Admissions Committee reserves the right to request an in-person interview and/or request additional information after reviewing the application (when necessary). Admissions Committee acts on all applications on a rolling basis and makes initial decisions regarding admission. At each meeting of the committee, it prepares and submits to the program Director a short list of applicants who should be offered admission. The Program Director acts on the recommendations, by consulting with the Program Committee as necessary.

The Program Manager will notify applicants, in writing, within one week (7 days) after final decisions are made. The applicant is expected to respond, in writing, within 2 weeks (7 days) using the attached acceptance letter as a template. Students are officially enrolled in the program once the Program Manager has received written documentation of acceptance (along with a non-refundable matriculation fee of \$100 which will be applied towards tuition once classes commence).

Students will work with the Program Manager to register for courses, obtain an email address, and any other logistics associated with matriculation.

Relevant attachments: Application forms (2)
 Notification letters (2)
 Acceptance letter template

2. Anticipated Enrollment:

- a) Projected date of first matriculating students: **July 1, 2011**
- b) Expected enrollment

	Total	F-T MSIBS	F-T GEMS	Single Courses/ Other Program Electives*
1 st year	12-15	8	3	20
2 nd year	15-20	10	3	20
3 rd year	17-20	12	3	20
4 th year	20-25	15	3	20
5 th year	20-25	20	3	20

* Only tuition paying students are included (with up to 50% remission).

- 3. Describe the application procedures for students interested in the Program, including a detailed list of all the documents which will be required for each applicant as part of the application package (e.g., copies of degrees, transcripts, letters of recommendation, application forms, etc.). Also include copies of any materials, brochures, etc. which will be used for recruitment.

Program description, eligibility requirements, and application materials will be available on a publicly accessible WU website

All Applicants are required to submit:

- A completed MSIBS application form
- Documentation of degrees and official transcripts
- Current GRE test results where required (GRE within three years of applying)
- For international students, TOEFL test results within three years
- Two academic letters of recommendation

- A one-page “Personal Statement”, describing the applicant’s specific area of interest within the field and why MSIBS is a good fit. This document will be used to (1) identify an appropriate advisor/preceptor and (2) to guide course selection and concentration decisions.

Students admitted to other programs on campus that offer MSIBS courses as electives (e.g., Biostatistics I and Biostatistics II) will be accepted into classes only if any prerequisites (e.g., SAS) are fulfilled.

4. Finances:

- a) *Provide the name, address, and telephone number of the contact individual in the Program Director’s office.*

June Mueller (Program Manager)
Campus Box 8067
(314) 362-1052
june@wubios.wustl.edu

Nancy Grafton (Business Manager)
Campus Box 8067
(314) 362-3607
nancy@wubios.wustl.edu

- b) *Provide a detailed budget proposal for operating the program. The budget section should also provide information about the arrangements which have been made concerning allocation of overhead costs and tuition allocation between participating schools.*

See Appendix H for itemized budget.

- c) *In the event that a student withdraws from the program, indicate how reimbursement of tuition will be handled.*

Tuition reimbursement is dependent upon the time point at which the student withdraws. In all cases, notice of withdrawal must be submitted in writing. Similarly, fees are charged when students fail to meet registration and payment deadlines.

Specific fees and reimbursements are as follows if students:

<u>Time point</u>	<u>Fee/Refund</u>
Regular Semester	
Have not registered and paid by the deadline	\$50.00 late fee
Withdraw prior to the first class . . .	Tuition refunded in full
Withdraw within the first week of the semester	80% refund
Withdraw within the first 2 weeks of the semester	60% refund
Withdraw within the first 4 weeks of the semester . . .	50% refund
Withdraw after 4 weeks or after 50% of semester, whichever comes later	None
Intensive Courses and Summer Semester	
Withdraw after the first day of intensive courses	60%
Withdraw before the mid-point of intensive courses	30%
Withdraw after the mid-point of intensive courses	None

d) Indicate how tuition will be collected. Which office will collect tuition?

Tuition will be charged and processed through the office of the Registrar, School of Medicine., using the on-line payment system offered by the University. The Program Manager will be responsible for monitoring and collecting any unpaid amounts.

- *What are the proposed consequences for a student of failure to submit tuition in a timely manner?*

Tuition not paid by the due date set by the Registrar accrues interest at the rate of one percent per month for each month in which that payment is due. Any amounts not paid when due plus accrued interest thereon must be paid in full within three months of the original due date.

The School of Medicine will not release the student's academic record or progress reports pending settlement of any unpaid account. A student who has not satisfied all past due financial obligations to the University one month before the end of the academic year will not be allowed to progress to the next academic year or be issued a degree if it is the final semester. Diploma will be withheld until the account is settled.

5. Financial Aid and Tuition

Will financial aid be offered?

- X Yes (If yes, indicate in detail below how this will be managed.)

We expect to offer an average of 25% of the tuition costs in scholarship or tuition remission to Full Time Masters Students. The amount of aid will be based to a larger degree on academic excellence and to a lesser degree on financial need. The students must apply for aid through the application process which is then reviewed by the Admissions Committee and the Program Manager (PM) who will make recommendations to the Program Director. The Program Director is responsible for all final decisions regarding the awarding of scholarships/ remission, in consultation with the Executive Committee as necessary.

US citizens or permanent residents may apply for work/study through the University Financial Aid Office. The PM will assist them, if needed, with the process.

In addition, the program offers Research Assistance-ships (RA-ships) for students who need/want to work during their tenure in the program. The RA's are paid approximately \$16,000 per year, which is based on an average of 20 hours of work per week. Funds for RAs are dependent on PI grant support and will vary from year to year.

What is the proposed tuition rate? \$1,100 per credit hour ***includes*** health and disability insurance costs and prorations. *There will be no discount for part-time students. We believe that part-time students should not receive a benefit of reduced tuition based only on their part time status.*

Will the tuition rate be frozen at matriculation? X Yes No

The tuition rate will be frozen at matriculation **only for full time continuously enrolled students.** Appeals for an extension may be made to the Program Director.

Describe how the tuition rate was established.

The basic tuition rate follows what is in place for the GEMS program and compares well with the rates in other sister programs on campus (which do not always include health and disability insurance costs and prorations). Our tuition rate includes the other costs and is competitive as compared to external programs also. The current rate of \$1,000 per credit hour charged by some of the sister programs on campus (esp those of MSCI and MPHS) excludes health and disability insurance costs.

Tuition rates will not increase above the amount set at the time of enrollment, assuming continuous full-time enrollment.

Additional charges include one-time matriculation fee at \$100.00

6. Operational Support Staff:

Currently the GEMS program has a full time Program Manager and a part-time recruitment assistant. Once MSIBS is established (which may take a couple of years), we project that 2 full-time individuals, a full-time Program Manager for both MSIBS and GEMS and a full-time Recruitment Specialist, should be able to run both programs. These costs are included in the budget projections (see **Appendix H**). During the first year or two, more staff time will be needed (which is being addressed with the Dean as a part of our Strategic Plan). All administrative functions related to the MSIBS program (as well as the GEMS program) will be handled by:

June Mueller, Program Manager for MSIBS and GEMS
Campus Box 8067
(314) 362-1052

7. Describe policies of the program listed under Student Affairs, including written materials which will be given to students concerning these matters.

a) Student advising

The Program Director and the individual student's Faculty Advisor, who will monitor the academic progress of each student throughout his/her graduate education, provide formal advising for all students. Course grades and progress reports provided by each student's advisor/mentor are all considered in the review of student performance.

During the Spring semester, and as often as a student wishes, each matriculating student will meet with the Program Director to discuss his/her academic progress and address any concerns. The Program Manager will meet with each matriculating student periodically to review and bring to the Program Director's attention any concerns a student may have (academic and otherwise).

b) Supervision of students for Internships and Thesis (if applicable)

The program director and the program manager will facilitate the choice of Internship labs for each student. For this purpose, all program faculty listed on pages 6-9 serve as potential Internship Labs. Once the Internship Lab is established for each student, supervision of the student's Internship will be provided by the student's Internship PI/Mentor and other personnel in the PI's lab. Upon completion of the Internship, each student will prepare and submit a one-page summary of the Internship experience and make a 5-minute presentation. During the last week of Internship, the Internship Mentor will inform the Internship Committee (Chaired by Professors J. Philip Miller and D. C. Rao) as to whether or not the Internship services provided by the student were satisfactory. This advisory will be taken into account by the Internship Committee when determining the grades. We expect that, in some cases, the Internship PI may also serve as the

Thesis mentor if the student chooses to pursue a thesis (this will be entirely up to the student and the Internship PI).

Similarly, students opting to pursue a Thesis (instead of 2 advanced electives) will be supervised and mentored by the Thesis Mentor each student selects for the purpose. Again, all program faculty are eligible to mentor one or more students on a thesis. During the last weeks of the semester when the thesis is pursued, the thesis Mentor will inform the Thesis Committee (Chaired by Drs. D'Angelo and Xiong) about his/her own opinion of the quality of the thesis and whether or not the student's efforts were satisfactory. This advisory will be taken into account by the Thesis Committee when determining the grades.

See **section 6 on page 24** for guidelines, timelines, and criteria for evaluating the thesis.

c) Health and Disability Insurance

Health and Disability Insurance are provided to full time MS students in MSIBS and GEMS by the graduate program as part of tuition.

NOTE: Please see the University webpage that describes qualification, accommodations, and resources for students with disabilities.

d) Leave policies (family leave, vacation, leave of absence, etc.)

Students may request a (voluntary) leave of absence for academic or personal reasons by submitting a statement in writing to the Program Director. Such a statement should include indication of the beginning and anticipated ending dates of the leave, and a brief statement of the reason (academic or personal). Requests for leaves of absence must be approved by the Program Director.

Leaves of absence shall be granted for no more than one academic year by the Program Director. In unusual cases leave may be renewed for up to 2 additional years provided that it is approved by the Program Committee. Students requiring a personal leave of absence for medical reasons must, in addition, submit a letter from the attending physician(s); in such cases, a physician's letter would also be needed when the student wants to re-join the program.

e) Disciplinary actions for non-academic transgressions

Matters involving possible breaches of professional integrity shall be brought to the attention of the Program Committee for appropriate action. Behavior inappropriate to the program shall mean breaches of personal confidence and trust including cheating or unauthorized use of materials during examinations; abuse, misrepresentations or other seriously improper conduct in relation to faculty, staff, or colleagues; and other misconduct, misrepresentation or failure in personal actions or in meeting obligations. See **Appendix B** for full details of the procedure for involuntary leave. Voluntary leave policy is addressed in item (d) above.

f) Privileges for library access, identification cards, housing, parking, etc.

Students will receive Washington University identification cards to allow access to resources and privileges such as WU libraries, computer labs, and campus parking. Housing accommodations will not be provided through the MSIBS program.

PROPOSAL for NEW DEGREE GRANTING PROGRAMS

Proposed name of program *Biostatistics Graduate Training Program*

Check One	Level of Degree	Proposed Name of Degree
	Bachelor	
X	Master	<u>Master of Science In BioStatistics (MSIBS)</u>
	Master of Arts	
	Doctor of Philosophy	

APPENDIX MATERIALS ONLY: V7; 12/28/10

Director of Program	D. C. Rao Professor & Director, Division of Biostatistics
Mailing Address	660 South Euclid, Box 8067 St. Louis, MO 63110
Office Location	School of Medicine Campus 706 S. Euclid, Room 1100 St. Louis, MO 63110
Building	Old Shriners Building
Room number	1100
Telephone number	(314) 362-3608
Facsimile number	(314) 362-2693
e-mail address	<u>rao@wubios.wustl.edu</u>

Appendix A

Committees and Staff for MSIBS and GEMS

REVIEW

Committees and Staff

MSIBS and GEMS

The responsibilities of each committee and staff listed in the organizational charts are as follows:

Program Director

- Overall supervision and academic administration for the Program
- Immediate supervision of Program employees
- Present annual budget and tuition proposal to Dean
- Identify Course Masters for the Program
- Chair of the Program Committee
- Co-Chair of the Curriculum Committee
- Ensure the quality of the Program
- Ensure course masters and mentors meet their obligations to the Program
- Review mentor evaluations of student progress
- Review student evaluations of course masters and the Program
- Perform academic progress review with each student at least once per year
- Meet with the entire class at least once a semester

Program Committee (PC)

- Overall oversight of the program
- Review, finalize, and maintain policies and procedures
- Finalize recommendations by various sub- committees (especially those of Admissions Committee and the Curriculum Committee).

Admissions Committee (AC)

- Co-Chaired by Drs. Gina D'Angelo and Treva Rice, and includes Drs. Feng Gao, Yun Ju Sung, and Chengjie Xiong
- Reviews all application materials and recommends the most qualified ones for admission.
- Applications will be processed in batches so that rolling admissions could be offered.

Curriculum Committee (CC)

- Initial design of courses and course materials
- Annual review of all courses and course materials
- Review recommendations/suggestions from individual course masters for making changes to courses and course materials
- Review all student evaluations (group evaluations using averages)
- Responsible for making all changes (as necessary) to courses and course materials
- Make recommendations to the PC concerning the students' suitability for advancement in the program
- Membership includes the Program Director, all primary course masters of all required courses, and three other faculty (chosen on a rotation basis from a short list; the current members are Drs. Arpana Agarwal, William Shannon, and Ed Spitznagel).

Faculty Advisor

- A Faculty Advisor will be assigned to each student from the list of participating faculty (A Faculty Advisor can be changed by the Program Director at the initiative of the student, and in consultation with the current Faculty Advisor and the new Faculty Advisor)
- Tracks the student's overall performance and acts as the student's advocate

Internship Committee

- The Internship Committee is Co-Chaired by Professors J. Philip Miller and D. C. Rao, and includes Drs. Ken Schechtman and Chengjie Xiong. Supervision of a student's Internship will be provided by the student's Internship PI/Mentor and other personnel in the PI's lab. Upon completion of the Internship, each student will prepare and submit a one-page summary of the Internship experience to the Internship Committee and make a 5-minute presentation.
- During the last week of Internship, the Internship Mentor will inform the Internship Committee as to whether or not the Internship services provided by the student were satisfactory.
- The Internship Committee will take all feedback from the Internship PIs/Mentors into account by when determining the grades.

Thesis Mentor

- Each MSIBS student must choose to do a thesis or 2 advanced elective courses. When a student opts to do a thesis (during the 2nd fall semester), he/she selects a Thesis Mentor in consultation with members of the Thesis Committee (Drs. D'Angelo, Xiong, Gao, Luo, and Shi) and/or the Program Director.
- Supervise student in the thesis work and thesis preparation
- Provide scientific advising of the student

Thesis Committee

- Thesis Committee is Co-Chaired by Drs. Gina D'Angelo and Chengjie Xiong, and includes Drs. Feng Gao, Rosy Luo, and Gang Shi
- Evaluate the completed Thesis and assign a grade in consultation with the mentors' feedback.

Program Manager

- Daily administration of the program
- Create student records in **SIS**
- Assist students in registration and daily activities of the program
- Prepare and maintain financial records and budget under the supervision of the Business Manager
- Communicate tuition and course requirements to the Medical School Registrar
- Assist course-masters and faculty in preparation of course materials
- Schedule, attend and record all Committee meetings

- Attend Registrar's meetings
- Provide student support services (counseling and advice on non-academic matters)
- Communicate changes of program and student status to Registrar
- Maintain all program files (including the, student records, admissions files, grade reports, student financial aid, etc)

Recruiter

- Assist in the development of a recruiting plan. Implement and maintain the recruiting plan.
- Assess the recruiting strategies and make recommendations for changes.
- Promote the Graduate Programs through communication with faculty and staff at various Colleges and Universities in town and across the nation.
- Visit select institutions whose students would be more likely to apply to our program and benefit from the graduate programs.
- Work with all potential applicants until they have initiated their applications (at which stage the program manager will take over).

Appendix B

Student Affairs MSIBS and GEMS Policies and Benefits

REVIEW

Student Affairs

MSIBS and GEMS Policies and Benefits

Administrative support for the academic programs of the Division of Biostatistics, including admissions and recruiting activities, is provided by the Program Manager located in the Old Shriner's building at 706 South Euclid (room 3301). Files for current students, as well as for the current admissions season, are maintained in these offices. The Program Director implements academic policy and serves as the ombudsman for all students. The Program Manager handles the day-to-day operations of the program and serves as the primary administrative resource for the faculty and students in the program. One of the principal responsibilities of the Administrator is responding to student concerns, and students should always call on the [Program Manager](#) for assistance and information. Students are responsible for informing the Administrator of address changes, papers authored, and presentations made at meetings.

Student advising: The Program Director and the individual student's Faculty Advisor, who will monitor the academic progress of each student throughout his/her graduate education, provide formal advising for all students. Course grades and progress reports provided by each student's advisor/mentor are all considered in the review of student performance.

During the Spring semester, and as often as a student wishes, each matriculating student will meet with the Program Director to discuss his/her academic progress and address any concerns. The Program Manager will meet with each matriculating student periodically to review and bring to the Program Director's attention any concerns a student may have (academic and otherwise).

Evaluation and Grading System:

Grading System: A grade is used to report the final standing in each course. Each course master determines grade criteria for the course and describes the class grading system in the course syllabus. Final grades are assigned to represent the level of competence that is achieved by the student.

All students must maintain a minimum of a "B" (or "Pass" when letter grade is not offered) in all required courses, a minimum grade of "C" (or "Pass") in all other courses, and an overall grade point average of 3.0 on a 4.0 scale (or an average grade of B). Twenty nine or more of the 44 credit hours are taken for a letter grade (the others are offered as pass/fail).

All grades are based on satisfactory completion of the course materials and a final examination, term paper, or project. At the instructor's discretion, an incomplete grade may be assigned. This course must be completed with a passing grade prior to progressing in the academic program. A definitive mark for the term is recorded on the official transcript when the work is completed and the incomplete grade is removed. In case the work is not completed within six months, the recorded grade will be changed to

Fail. "Incomplete" grades are not acceptable for graduation and students need to complete their assignments in a timely manner.

If a student receives a letter grade below "B" or "Fail" in any required courses or a "Fail" in elective courses, he/she will be required to repeat the course with a passing grade in order to receive credit. Failing a course for the second time may result in termination from the program.

If a student has failed to make satisfactory academic progress (minimum of "B" in required courses, minimum of "C" in electives, "Pass" in pass/fail courses) after the first semester, the Program Committee will notify the student and his/her advisor. Failure of the student to correct the causative deficiency within a reasonable time (no more than six months) after such notification may lead to a review and recommendation from the Program Committee.

Prior to graduation, each student is required to:

- a) Complete and pass all academic coursework in the program.
- b) Achieve a overall cumulative grade point average of 3.0 or better.
- b) Complete and defend their thesis, if they chose to do a thesis.

It is the responsibility of the student who believes that personal concerns, health problems, or any other factors that may adversely affect his or her academic performance to bring such matters to the attention of the student's advisor who will promptly confer with the Program Director.

Actions for Academic Review:

General: Throughout a student's enrollment, it is within the jurisdiction of Program Committee to recommend termination of enrollment of a student who has demonstrated academic failure or a breach or compromise of academic or professional behavior. Circumstances in which the Program Committee will become involved include, but are not limited to:

- a. When a student is not achieving a passing grade prior to submission of a course grade, these corrective actions will be taken:
 - i. The student will meet with the course master to address the difficulties. The student will also meet with his or her academic advisor to develop a plan. Possible actions may include, but are not limited to: tutoring and/or formal review sessions; structured meetings with instructors, advisors or administration; additional academic requirements or experiences; referral to appropriate university or community resources; or re-examination. The plan will be filed with Program Committee.
- b. When a student does not achieve a passing grade after submission of a final course grade, these corrective actions will be taken:
 - i. If this is the first occasion that the student has not passed a course, the student will meet with the advisor in order to develop an academic plan which will facilitate the student's satisfaction of the Program's requirements. This plan will include retaking the course that has not been passed, and entering an extended program. The plan will be developed by the student in consultation with the student's academic advisor, and will be forwarded to the Program Committee for review and consideration. If approved by the Program

- Committee, the plan will be implemented. If the student achieves the goals of the plan, including receiving a passing grade in the course, the student will be allowed to continue in the Program. If the student does not achieve the goals of the plan, the student will be referred to the Program Committee for consideration of academic dismissal.
- ii. The maximum number of attempts to pass any individual course during enrollment in the Program is two (2). If the student has not passed a course after two attempts, the student will be referred to the Program Committee for consideration of academic dismissal.
- c. When a student is not maintaining the required minimum grade point average of 3.0, these corrective actions will be taken:
 - i. The student will confer with the student's academic advisor in order to develop a plan, which will facilitate the student's satisfaction of the Program's requirements.
 - ii. The plan will be developed by the student, advisor, and will be forwarded to the Program Committee for review and consideration.
 - iii. If the plan is approved, the plan will be implemented. If the student achieves the goals of the plan, the issue will be considered resolved. If the student does not achieve the goals of the plan, the case will be referred to the Program Committee for consideration of academic dismissal.
 - d. A student may request that he or she be allowed to withdraw from enrollment. Such requests are directed to the Program Director. Unless a student has been granted an extended program or leave of absence by the Program Committee, a student may not voluntarily withdraw from a course in the Program without withdrawing from the Program at large.
 - e. When a student demonstrates a breach or compromise of professional behavior standards, including difficulties with sound judgment or responsibility, these corrective actions will be taken:
 - i. The student will be referred to the Program Committee in order to determine whether or not it is reasonable to develop a plan, which will facilitate the student's achievement of the Program's requirements. If it is determined by the Program Committee that it is not reasonable to develop such a plan, the student will receive an academic dismissal.
 - ii. If the Program Committee determines that dismissal is not necessary, a plan that will facilitate the student's achievement of the Program's requirements will be developed by the student, and his or her advisor.
 - iii. The plan will be forwarded to the Program Committee for review and approval. If approved by the Program Committee, the plan will be implemented. If the student achieves the goals of the plan, the issue will be considered resolved. If the student does not achieve the goals of the plan, the student will be referred to the Program Committee for consideration of a recommendation to the Program Director for dismissal from the Program.
 - f. If other difficulties or unsatisfactory performance, which limits the ability of the student or other students to benefit from the Program, are identified, the matter will be brought before the Program Committee. In such cases, the guidelines and rules and policies described in this document will be considered pertinent and guiding to subsequent deliberations.

Program Committee decisions will be communicated to the student in writing. Appeals of such action will be heard first by the Program Committee which will notify the Advisory Committee and the student of its final decision. If the student still feels that the action has been unfair, a written petition may be submitted to the Program Director within 14 days of receipt of notice of dismissal. The Program Director will take up such matters with the Advisory Committee where a final resolution will be sought.

Student grievances in academic matters should first be addressed with the instructor and then with the course master(s). If this does not lead to a satisfactory resolution, the student may appeal to the Program Director in writing within 30 days after receiving the grade. The Program Director will notify the Curriculum Committee and will appoint a subcommittee (typically consisting of two members who are not involved in that course) who will meet with the student and instructor/course master separately, review all materials provided by both parties and make a final decision within 30 days after receiving the appeal. This recommendation will be reviewed by the full Curriculum Committee for a final decision. Any conflicts will be referred to the Program Committee for resolution. If disagreements persist, the matter will be taken to the Advisory Committee.

Academic Integrity: Upon matriculation, every student receives the Academic Integrity Policy for Graduate Students, which was adopted by the Graduate Council of the Faculty of Arts and Sciences in 1991 and revised in 1995. It is of the utmost importance that you read and understand the principles of academic conduct that are described in that document. Failure to abide by those principles can have serious consequences. In particular, students should be aware that some rules governing academic integrity tend to be enforced more strictly at the graduate level than they are accustomed to as undergraduates.

The policy describes in detail the offenses, which constitute violations of academic integrity and the procedure that will be followed in all cases where active misconduct appears to be an issue. University policy does not allow individual faculty members, departments, divisions, or students to adjudicate charges of integrity violations at the course or departmental level. Instead, in the interest of providing consistent, prompt consideration and resolution of allegations of academic integrity infractions, all such cases must be filed in writing with the Associate Dean of the Graduate School of Arts and Sciences.

The Washington University Judicial Code is also given to every student entering the program and describes the University's judicial system, the procedures to be followed in filing complaints, and those employed in adjudicating violations of the code.

Responsible Conduct of Research: Because of the importance of student awareness of the issues surrounding research integrity, all entering students will receive a copy of the Research Integrity Policy for Washington University that deals specifically with the University's policies for reporting and investigating violations of the responsible conduct of research.

In addition, each student is provided with a copy of On Being a Scientist published by the National Academy of Sciences. During the orientation period, these

policies are discussed. Attendance at orientation sessions during which ethics are discussed is mandatory.

Procedures Concerning Breaches of Integrity Matters involving possible breaches of professional integrity shall be brought to the attention of the Program Committee. Behavior inappropriate to the medical profession shall mean breaches of personal confidence and trust including cheating or unauthorized use of materials during examinations; abuse, misrepresentations or other seriously improper conduct in relation to colleagues including breaches of confidentiality; and other misconduct, misrepresentation or failure in personal actions or in meeting obligations, so as to raise serious unresolved doubts about the integrity of the student.

In such matters, the following rules apply:

- a. The individual(s) raising the question(s) of possible misconduct shall present them in writing to the Program Director, and shall be reminded of their confidentiality.
- b. The Program Director shall convene a meeting with the Associate Dean for Student Affairs of the Medical School to review the complaint, and decide whether further action is necessary.
- c. If further inquiry is deemed necessary, the Program Director, and the Associate Dean for Student Affairs will discuss the complaint with the student.
- d. If the Program Director, and the Associate Dean for Student Affairs consider the matter sufficiently serious, the Program Director shall convene a Program Academic or Disciplinary Committee.
- e. Unless it is determined by the Program Director and the Associate Dean for Student Affairs that extraordinary circumstances exist (e.g. physical threat to others), the student will be permitted to continue in the usual academic activities during the Disciplinary proceedings.
- f. Appointment to a Disciplinary Committee will be made by the Program Director, and will include five faculty members. Appointees will decline if assurances of their impartiality in the matter are not evident. Members of the committee will elect a chairperson who will be responsible for conducting any hearing in accordance with this procedure.
- g. The Associate Director of Academic Systems will attend the meeting to record minutes. A simple majority will prevail (3 out of 5 votes), except when the motion is for suspension or dismissal from enrollment in the school, where 4 out of 5 votes will be required.
- h. If the Disciplinary Committee is convened, the Associate Director of Academic Systems will forward all information concerning the matter to the Committee.
- i. The Disciplinary Committee shall, whenever possible, convene within one-two weeks after the initial meeting between the student, the Associate Dean for Student Affairs, and the Program Director.
- j. At least 72 hours prior to the meeting of the Disciplinary Committee, the Associate Director of Academic Systems will inform the student in writing regarding the time, date, and place of the meeting, that the proceedings are completely confidential, and that the student may bring a faculty member, or fellow student of the Program in Occupational Therapy for guidance and support. A copy of the complaint will be provided to the student at that time as well.
- k. The following guidelines will be applied to the conduct of a Disciplinary Committee, and these will be made available to members of the committee at the opening of

the meeting. The aim of the Committee is to provide fair, and prompt review of the inquiry. The Committee is not positioned in an adversarial role against the student, but simply to review the evidence as presented, and determine its decision regarding disciplinary action. The Committee has neither the advantages nor limitations inherent in a court of law. Innocence of the student being questioned will be presumed. No facts or conclusions will be assumed. The decision as to the whether the student perpetrated the alleged act will be made solely on the basis of evidence, and testimony presented at the meeting. During the hearing the student will have access to all the evidence presented. The record of such proceedings will be held confidentially with access restricted to Committee members, the student involved, and members of the Administration involved in the proceedings. The hearing will be taped. The student may request a copy of the tape of the proceedings.

- l. All who appear before the Committee are assured that their appearance occurs without fear of repercussions from their testimony.
- m. After the meeting, and decision of the Disciplinary Committee, a recommendation by the Committee shall be made to the Program Director.
- n. The Program Director will review, and may implement the recommendation of the Disciplinary Committee. The decision of the Program Director will be communicated in writing to the Associate Dean for Student Affairs.
- o. The Associate Dean for Student Affairs will inform the student in writing of the Director's decision within three (3) working days of its receipt.
- p. In the event that the student wishes to appeal the decision of the Program Director suspending or dismissing the student from enrollment in the School, such an appeal should be directed to the Executive Vice Chancellor of the University or his designate, according to the University Judicial Code V11.B.1.

Research Integrity Policy:

1. Allegations of breach of research integrity policy are the primary responsibility of the Research Integrity Committee of the School of Medicine. The Program Chair will direct complaints regarding students promptly to that committee.
2. The Research Integrity Committee will promptly investigate the charges, and report its conclusion, and recommendations to the Dean who will convene a Disciplinary Committee (as detailed in the Washington University Policy).

Disciplinary actions for non-academic transgressions: Matters involving possible breaches of professional integrity shall be brought to the attention of the Program Committee. Behavior inappropriate to the program shall mean breaches of personal confidence and trust including cheating or unauthorized use of materials during examinations; abuse, misrepresentations or other seriously improper conduct in relation to faculty, staff, or colleagues; and other misconduct, misrepresentation or failure in personal actions or in meeting obligations.

If an involuntary leave of absence is imposed, the suspending authority shall prepare a written notice of the imposition and shall have the notice mailed certified or personally presented to the student. The written notice shall include a brief statement of the reasons therefore, and a brief statement of the procedures provided for resolving cases of involuntary leave of absence under these rules.

The student shall be given an opportunity to appear personally before the suspending authority within five (5) business days from the date of service of the notice of imposition of the involuntary leave of absence. If the student asks to appear personally before the suspending authority, only the following issues shall be considered:

- Whether the suspending authority's information concerning the student's conduct is reliable; and
- Whether under all the circumstances, there is a reasonable basis for believing that the continued presence of the student on campus poses a substantial threat to the student, or to the rights, of others to engage in their normal University functions and activities.

Within one week of the date of imposition of the involuntary leave of absence, the suspending authority shall either file a statement of charges against the student with the University Judicial Board and shall have the statement or charges served by mail or personal service upon the student and the Dean of the school or college or Director of the program in which the student is enrolled, or initiate proceedings under these rules to convene a Disciplinary Committee.

A temporary suspension shall end when (i) rescinded by the suspending authority, or (ii) there is a failure of the suspending authority to promptly file a statement of charges with the University Judicial Board or a Disciplinary Committee, or (iii) the case is heard and decided by the University Judicial Board or the Disciplinary Committee. Return of students from involuntary leave of absence requires clearance of both the Director of the Student Health Service and the Associate Dean for Student Affairs.

Supervision of students for Internships: Supervision of a student's Internship will be provided by the student's Internship PI/Mentor and other personnel in the PI's lab. Upon completion of the Internship, each student will prepare and submit a one-page summary of the Internship experience and make a 5-minute presentation. During the last week of Internship, the Internship Mentor will inform the Internship Committee (Chaired by Professors J. Philip Miller and D. C. Rao) as to whether or not the Internship services provided by the student were satisfactory. This advisory will be taken into account by the Internship Committee when determining the grades.

Supervision of students for Thesis (if applicable): The MSIBS program requires a Thesis or 2 additional advanced electives, both totaling 6 credits. A Thesis Committee consisting of Drs. Gina D'Angelo & Chengjie Xiong (Co-Chairs), Feng Gao, Rosy Luo, and Gang Shi will advise all students about the expectations and they will examine all theses submitted and determine the grade in consultation with the mentors.

Students opting to pursue a Thesis (instead of 2 advanced electives) will be supervised and mentored by the Thesis Mentor each student selects for the purpose. During the last weeks of the semester when the thesis is pursued, the thesis Mentor will inform the Thesis Committee (Chaired by Drs. D'Angelo and Xiong) about his/her own opinion of the quality of the thesis and whether or not the student's efforts were satisfactory. This

advisory will be taken into account by the Thesis Committee when determining the grades. The following describes the process:

- By March 1 each year, each student will notify the Program manager in writing whether (s)he is exercising the Thesis option or take 2 advanced electives.
- The Thesis Committee will meet with all students pursuing thesis by April 1 and discuss the expectations and timelines for making progress toward thesis.
- Each student and Thesis Committee will work together to pick a thesis mentor who will work with the student. The mentor will begin working with the student and help the student choose the research question, providing data and guidance. While some progress may be made during summer, most of the thesis work will be done in the Fall semester.
- The thesis research may involve conducting and reporting a comprehensive data analysis or conducting research and reporting on a focused methodological problem; the latter may include a computer simulation approach to solve a problem, an in depth review of available methods in a certain topical area (review paper), or developing new methods.
- Each student will work closely with a Mentor who has expertise in biostatistics or a related quantitative field.
- Three bound copies and an electronic copy of the Thesis must be submitted to the Program Manager by the dead line for December graduation. The deadline for thesis submission is December 1 unless announced otherwise. There will be no thesis defense.
- All theses will be examined by a Thesis Committee consisting of Drs. Gina D'Angelo & Chengjie Xiong (Co-Chairs), Feng Gao, Rosy Luo, and Gang Shi. The committee will determine the grade (Pass/Fail) in consultation with the mentor(s).
- Primary criteria for evaluating and grading the thesis will include: regularity and amount of effort put into the thesis work as well as the overall quality of the thesis experience (as judged and reported to the thesis committee by the mentor), novelty of the work reported (paying attention to possible plagiarism), and the quality of organization and presentation within the written thesis.

Internship: During the 2nd summer, and possibly starting in spring, all students will be required to do 500 hours of Internship with a pre-chosen PI/Lab. The internship may entail a limited scope research project (possibly leading to a publication) or test driving a future job (which will entail carrying out a lot of data management and statistical analysis of data).

The program director and the program manager will facilitate the choice of Internship labs for each student. For this purpose, all program faculty listed will serve as potential Internship Labs. Once the Internship Lab is established for each student, supervision of the student's Internship will be provided by the student's Internship PI/Mentor and other personnel in the PI's lab. Upon completion of the Internship, each student will prepare and submit a one-page summary of the Internship experience and make a 5-minute presentation. During the last week of Internship, the Internship Mentor will inform the Internship Committee as to whether or not the Internship services provided by the

student were satisfactory. This advisory will be taken into account by the Internship Committee when determining the grades.

Biostatistics Consulting Lab: In the second fall semester, all MSIBS students will be required to participate in a 1-credit Biostatistics Consulting Lab (providing statistical consultation to clinical scientists on campus under the supervision of experienced faculty and staff).

Full Time versus Part Time: Students are expected to pursue the MS degree on a full time basis so that they can complete it in 18 months. We recognize that some people will need flexibility, such as junior faculty and other employees at WU, and accordingly part time is permitted. However, to prevent undesirable dilution, students will normally be allowed twice the standard duration (i.e., approximately 3 years). Exceptions may be considered on a case by case basis.

Health and Disability Insurance: The University Student Insurance plan is required for all full time students in the program (9 credits hours or more). This plan provides the student with health insurance, disability insurance, and \$10,000 life insurance. The cost is covered in the tuition charged. The payment over two semesters for the insurance covers the student from the start of the school year until the start of the next school year. Dental Insurance is available for the individual to purchase.

Student Health is located on campus and functions similar to an HMO. On staff doctors and nurses treat the students and, if warranted, refer them to specialists. The number for Student Health Services (appointments) is 362-3523.

Leave policies (family leave, vacation, leave of absence, etc.): Normal scheduled breaks set by the University for all students will be adhered to in this program.

Students may request a leave of absence for academic or personal reasons by submitting a statement in writing to the Program Director. Such a statement should include indication of the beginning and anticipated ending dates of the leave, and a brief statement of the reason (academic or personal). Requests for leaves of absence must be approved by the Program Director.

Leaves of absence shall be granted for no more than one academic year, but in unusual cases may be renewed by the Program Director for a second year. Students requiring a personal leave of absence for medical reasons must, in addition, submit a letter from the attending physician(s); in such cases, a physician's letter would also be needed when the student wants to re-join the program.

Students receiving financial aid should be advised that at the end of six (6) or more months of leave of absence, the grace period for loan repayment during a leave of absence will have been exhausted. In such cases there may be an obligation for the student to start payments. According to the Federal rules under which loans are made, the use of a grace period during a leave of absence will generally mean that the schedule for loan repayment may be changed. Students who are receiving financial assistance should consult with the Financial Aid Office to determine the implications of a Leave of Absence for their financial aid.

Privileges for library access, identification cards, housing, parking, etc.:

Students will receive Washington University identification cards to allow access to resources and privileges such as WU libraries, computer labs, and campus parking. Housing accommodations will not be provided through the MSIBS program.

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REVIEW

Campus Resources

Washington University offers many resources for its students. We have listed a few below and will provide more details on these and other resources during student orientation.

Housing may be available through Olin Resident Hall on a first come, first served basis. Cost is determined in late March of each year for the following academic year. The charges for meals are separate from the room charge. There is also an Apartment Referral Service that students can use to find suitable housing in the area. Much information can be found on the university web pages. The Program Administrator will guide each student with housing needs upon request.

Parking and Transportation: All matriculating students will be provided complete information on parking. Garage parking will be available for all students who require it. The cost will be billed to the student on a semester basis and payable with tuition. The prevailing parking fees will apply. Washington University provides a free shuttle service with generous schedules between all four campuses—Medical School, Hilltop, North Campus, and West Campus—and also to shopping areas. Many students use the shuttle service or bicycles instead of their cars. Metrolink, St. Louis' rapid transit system, services the Medical School and Hilltop campuses, and provides convenient transportation to Lambert Airport, downtown St. Louis, and to Illinois. All full time students are offered a free Metro Pass during their course of study. We encourage all of our students to leave their automobiles at home!

Libraries: The Wette Library of the Division of Biostatistics contains over 600 books on epidemiology, genetic epidemiology, statistics, and applications, as well as subscriptions to over 20 scientific journals. The GEMS program has a small student library with copies of many basic texts required for coursework. Students will have access to the considerable resources of the Becker Medical Library in an adjacent building and also from the computers within the Division. Students are eligible to use all Washington University libraries after identification cards are issued. Access to buildings will be identical to privileges provided to the Medical School's other graduate students.

Computing Facilities: Computing facilities are provided by the Division of Biostatistics. A computer core lab is available for student' use at all hours, with access to word processing programs, as well as specific databases and programs needed to complete the coursework. The Media Center in Becker Medical Library also has a computer lab, which is available to all students.

Bookstores: The Medical School has a convenient bookstore on campus. Required course textbooks and sundries will be available through the Medical School Bookstore, located on the corner of Euclid and Children's Place.

Tuition and Financial Matters

Tuition

1. Tuition effective summer of 2011 will be \$1,100 per credit, or a total of \$48,400 for the 18-month MSIBS degree, or \$37,400 for the 14-month GEMS degree.
2. Matriculating students may receive partial tuition remission. Tuition remission will be based both on merit and need. Average remission per student is expected to be about 25%.

Financial Resources: See the website below.

[Office of Student Financial Planning](#)

Appendix C

MSIBS Application Forms

APPLICATION TO MASTER OF SCIENCE IN BIOSTATISTICS GRADUATE STUDIES

MASTER OF SCIENCE IN BIOSTATISTICS (MSIBS)

Please read the instructions carefully before completing the application. Type or print clearly. Applications should be postmarked by the due date announced on the MSIBS home page, and must be received with a non-refundable processing fee of \$100.00. Admissions decisions are announced via letter and e-mail.

My application is for entry 2011

BIOGRAPHICAL INFORMATION

FULL LEGAL NAME		LAST, FAMILY, OR SURNAME		FIRST		MIDDLE			
<input type="checkbox"/> Mr. <input type="checkbox"/> Ms.									
CURRENT MAILING ADDRESS		Number & Street		City		State or Foreign Country		Zip Code	
PERMANENT MAILING ADDRESS (If different from above)		Number & Street		City		State or Foreign Country		Zip Code	
ELECTRONIC MAIL ADDRESS					CURRENT DAY PHONE (area code)				
CURRENT EVENING PHONE (area code)			PERMANENT PHONE (area code)		SOCIAL SECURITY NO. (if available)				
DATE OF BIRTH		Month	Day	Year	PLACE OF BIRTH		City	State or Foreign Country	CITIZENSHIP
Please indicate your race and ethnicity using the following categories. You may check one or more items as appropriate. The categories do not denote scientific definitions of anthropological origins. The designations are used to categorize U.S. citizens, resident aliens, and other non-citizens.				<input type="checkbox"/> American Indian/Alaskan Native		<input type="checkbox"/> Black or African American		<input type="checkbox"/> Asian	
				<input type="checkbox"/> Native Hawaiian or Other Pacific Islander		<input type="checkbox"/> Hispanic or Latino		<input type="checkbox"/> White	
				<input type="checkbox"/> Not Reported					
If you are a non-U.S. citizen currently in the United States, what is your immigration status?				<input type="checkbox"/> Student (F1)		<input type="checkbox"/> Exchange Visitor (J1)		<input type="checkbox"/> Permanent resident Number _____	
				<input type="checkbox"/> Student Spouse (F2)		<input type="checkbox"/> Other (specify type) _____			

ACADEMIC HISTORY

Please list all colleges and universities attended (beginning with current or most recent institution)

NAME OF INSTITUTION	DATES		MAJOR FIELD OF STUDY	GRADE POINT	AVERAGE	NAME OF DEGREE	DATE AWARDED OR EXPECTED
				COURSES IN SCIENCE	COURSES In Math		
	FROM	TO					
	FROM	TO					
	FROM	TO					
	FROM	TO					
	FROM	TO					

Please submit official transcripts from all institutions attended.

If you have previously applied to Washington University for graduate admission, list year your application was submitted: _____

Other names, if appropriate, on academic records or previous applications: _____

Please submit an official copy of your GRE score for an exam taken within the past 3 years.

Do you wish to be considered for financial aid? ____ yes ____ no. If yes, please submit a separate letter or statement of explanation.

Briefly indicate how you learned about our program, and list the source of information you consulted before you submitted this application.

LETTERS OF RECOMMENDATION. Please submit these sealed letters with your application or have the recommenders mail them directly to the MSIBS Program Manager, Division of Biostatistics, Washington University in St. Louis Medical School, 660 South Euclid, Campus Box 8067, St. Louis, MO 63110.

Applicants are asked to submit at least two letters of recommendation from current or past professional teachers, academic advisors, mentors, or professional colleagues. Additional personal or other letters of recommendation are optional.

NAME / TITLE	DEPARTMENT / INSTITUTION	CITY / STATE	TELEPHONE

ATTACH YOUR CURRICULUM VITA OR RESUME

ATTACH A SUMMARY of your academic and/or work and research experience in these three areas on a separate sheet of paper.

- 1) mathematics/statistics,
- 2) biological sciences and genetics,
- 3) computer programming and general computer facility.

PERSONAL STATEMENT

Describe on **one** separate page (with your full name at the top) why you are interested in undertaking a graduate program in BIostatistics. Outline your professional goals, and, if known, suggest the topics or issues you may want to explore as part of the research phase of the program.

FOR INTERNATIONAL STUDENTS ONLY:

Have your TOEFL or TSE Score (not more than 3 years old) sent directly to us at the address given. If you already have notification of your score, please enclose a copy with your application. Note that you may be asked to participate in a telephone interview before a final admissions decision is made.

Name of Exam: _____ Test Date: _____

Where Taken: _____ Your Score (if known): _____

You may not be required to take an English exam, if you have completed a higher education degree in the United States. If you are not including TOEFL or TSE information, please explain here.

I submit that the information given above is complete and truthful.

Signature _____

Date _____

Recommender's Name: _____

RECOMMENDATION

To be completed by Applicant:

_____	_____	_____	_____
Last	First	Middle Initial	Social Security No.

The Family Education Rights and Privacy Act of 1974 and its amendments guarantee students access to educational records concerning them. Applicants are also permitted to waive their right of access to recommendations. This form is used to help reach decisions on admission. It is not retained as part of the academic record of a student who enrolls at Washington University. Please indicate below whether or not you waive your right of access to this recommendation.

<input type="checkbox"/> I DO WAIVE my right to inspect the contents of the following recommendation. <input type="checkbox"/> I DO NOT WAIVE my right to inspect the contents of the following recommendation.	SIGNATURE
--	-----------

Advisor/Teacher/Mentor/Colleague

The applicant named above wishes you to provide a recommendation on behalf of her/his application for admission to the Master of Science in Biostatistics at Washington University School of Medicine. We would greatly appreciate your objective evaluation of the applicant's qualifications. **Please complete the front side of this form and, in an accompanying letter, answer the questions on the reverse side.** Thank you for your help.

Please rank the applicant with respect to each category below.

	Excellent (Upper 5%)	Good (6-20%)	Average (21-60%)	Below Average (<60%)	No Basis For Judgement
Communication skills					
Overall intellectual ability					
Understanding of the fundamentals of clinical medicine					
Ability to organize facts and ideas					
Motivation and industry					
Reliability and integrity					
Ability to handle stressful situations					
Ability to interact well with others					
Ability to function independently					
Potential as a clinical research scientist					

What is your overall recommendation regarding this applicant:

- accept for Masters
- accept for Masters with some reservation
- not accept

Name	Signature	
Title and Department	Date	
College/University/Institution		
Street Address		
City	State	Zip Code
Telephone Number	E-mail Address	

**PLEASE RETURN THIS FORM TO THE APPLICANT USING THE ENVELOPE PROVIDED.
PLEASE SEAL AND SIGN THE FLAP TO ENSURE CONFIDENTIALITY.**

**Address all questions to the Program Manager of the Master of Science in Biostatistics (MSIBS) Program
Via Telephone: 314-362-1052; Fax: 314-362-2693; or e-mail: june@wubios.wustl.edu**

Name of Applicant: _____

Last

First

In your accompanying letter of recommendation, please address the following points:

- Please evaluate the applicant's potential to be a successful in this program.
- How long and in what capacity have you known the applicant?
- If the applicant has worked for you, please describe his or her accomplishments.
- What is your opinion regarding the overall potential of this applicant to succeed in a graduate program?
- Are there any special circumstances that our admissions committee members should take into account when assessing the applicant's suitability for this graduate program?

Appendix D

Acceptance Materials

REVIEW

(Example of acceptance letter)

Month/day/year

Name
Address
City, ST ZIP

Dear (Student Name),

On behalf of the Program Executive and Admissions Committee of Master of Science in Biostatistics (MSIBS) training program, I am pleased to inform you that you have been accepted into our Masters Degree Program. Please accept my sincere congratulations on behalf of Dr. Larry J. Shapiro, the Dean of the Medical School. Your admission expresses both our respect for your previous academic achievements, and our confidence that you will become a successful and valued member of the Washington University in St. Louis community, maintaining the high standards characteristic of this institution.

Our orientation program will begin on (Day), (Date) at 8:00 a.m. The Math and Computing/Unix Workshops are scheduled to begin on. The summer courses will follow immediately after the workshops. See the enclosed 2011-2012 academic calendar for details.

Should you accept our offer of admission, please complete and return the enclosed Statement of Intent to Matriculate along with the registration fee of \$100. Once you matriculate, the \$100 fee will be credited toward your tuition. **We must receive your final decision in writing within 2 weeks of the date of this letter.** Please call our Program Manager, June Mueller, at 314-362-1052 or contact her by e-mail (June@wubios.wustl.edu) if you need any additional information about your admission.

Congratulations again. We hope you will decide to join the students and faculty in the MSIBS Training Program. If this program does not fit with your current career plans, please notify us as soon as possible, so that we may release the seat to other qualifying applicants. I look forward to hearing from you soon.

Sincerely,

D.C. Rao
Program Director, GEMS
Director, Division of Biostatistics

Enclosures

(Example of acceptance letter to International Students)

Month/Day/Year

Name
Address
City, ST Zip

Dear (Student Name),

On behalf of the Program Executive and Admissions Committee of the Master of Science in Biostatistics that you have been accepted into our Masters Degree Program. Please accept my sincere congratulations on behalf of Dr. Larry J. Shapiro, the Dean of the Medical School. Your admission expresses both our respect for your previous academic achievements, and our confidence that you will become a successful and valued member of the Washington University in St. Louis community, maintaining the high standards characteristic of this institution.

Our orientation program will begin on (Day), (Date) at 8:00 a.m. The Math and Computing/Unix Workshops are scheduled to begin immediately. The summer courses will follow. See the enclosed 2011-2012 academic calendar for details.

Upon your arrival in St. Louis, you should report promptly to the International Office for Students and Scholars (OISS) with your documents. Washington University in St. Louis requires that all international students must take the English Language Testing Program administered by the OISS after arrival. We will make the testing arrangements for you. If, after testing, the International Office makes any recommendations, including taking additional English language courses, we will expect you to follow those recommendations faithfully and at your own expense. Failure to comply may jeopardize your continuation in the program.

All international students should go to the OISS web site for helpful information on making a successful visa application, submitting a declaration and certification of finances, planning for a successful interview at the Consulate, and anything else related to study for international students here at Washington University in St. Louis (<http://oisshome.wustl.edu/students/new/>).

This section to be included only for current F-1 students at another U.S. University or WU.

As you are a student in the United States at this time on F-1 status, you will need to complete a process to transfer your F-1 status to Washington University. This must be coordinated through your current school and the Office for International Students and Scholars at Washington University. The attached sheet gives you the necessary information about the process. Note that you will not be able to obtain your I-20 form until the "release date" determined by the international student office at your current institution.

Should you accept our offer of admission, please complete and return the enclosed Statement of Intent to Matriculate along with the registration fee of \$100. Once you matriculate, the \$100 fee will be credited toward your tuition. **We must receive your final decision in writing within 2 weeks of the date of this letter.**

Please call our Program Manager, June Mueller, at 314-362-1052 or contact her by e-mail (June@wubios.wustl.edu) if you need any additional information about your admission.

If this program does not fit with your current career plans, please notify us as soon as possible, so that we may release the seat to other qualifying applicants.

Congratulations again. We hope you will decide to join the students and faculty in the MSIBS Training Program. I look forward to hearing from you soon.

Sincerely,

D.C. Rao
Program Director, MSIBS
Director, Division of Biostatistics

Enclosures

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**STATEMENT OF INTENT TO MATRICULATE
Master of Science in Biostatistics**

Student Name: **In Bold**

Due Date: **give 2-wk date in bold**

This form must be completed by you and received by the Master of Science in Biostatistics (MSIBS) Program Manager within two weeks of the admissions letter date. If you accept admittance into this program, a \$100.00 check or money order made out to "Washington University" must be sent with this form to hold your place in the class. This deposit will be applied to your tuition costs in the fall semester.

Please check the one statement that applies:

ACCEPTANCE STATEMENT

I accept the offer of admission to the 2011/2012 Class of the Washington University School Medicine Master of Science in Biostatistics (MSIBS) Program. This statement and a \$100.00 check or money order will serve to reserve my position in this class.

Signature of Accepted Applicant Attesting to
Acceptance of the Offer of Admission

Date

OR

DECLINATION STATEMENT

I decline the offer of admission to the 2011/2012 Class of the Washington University School of Medicine's Master of Science in Biostatistics (MSIBS) Program.

Signature of Accepted Applicant Attesting to
Declination of the Offer of Admission

Date

For full-time MSIBS Degree students

Tuition Charges for Academic Year 2011-2012

\$1,100 per credit hour or \$48,400 for the entire program
of 44 credit hours

Tuition is payable incrementally at the start of each semester, due no later than one week before the first day of class each semester. These payments are currently projected as follows:

- Summer 2011 (8 credits, total \$8,800)
- Fall 2011 (12 credits, total \$13,200)
- Spring 2012 (11 credits, total \$12,100)
- Summer 2012 (6 credits, total \$6,600)
- Fall 2012 (7 credits, total \$7,700)

Insurance Requirements

A mandatory Student Health, Disability and Life Insurance policy is included at no extra cost to you. Upon acceptance of our offer of admission an insurance packet will be sent to you. The Health History form should be returned to the Student Health Service by June 1 or as soon as possible thereafter. No registration is complete until this requirement is met.

All new students must present a report of a physical examination done within twelve months prior to admission. If you need to schedule a physical examination locally and don't have your own physician, a physical can be obtained at Barnes Care Corporate Health Service. The cost for a physical only will be approximately \$45, and you must call early for an appointment, (314)747-5800.

Until all insurance requirements are met, you will not be allowed to attend classes. These requirements include the Health History, submitting the physician's exam report, and attending the Health Services orientation on campus where you receive verification of insurance coverage from that day forth.

Appendix E

MSIBS Course Selection Form

REVIEW

Appendix F

Market Demand for Biostatistics

REVIEW

Need for Careers in Biostatistics

Biostatisticians play essential roles in designing studies and analyzing data from research problems. They help formulate the scientific questions to be answered, determine the appropriate sampling techniques, coordinate data collection procedures, and carry out statistical analyses to answer those scientific questions. Projected employment growth for biostatisticians is simply excellent as it has been the last few decades. The field will expand as disciplines such as biology, chemistry, and electronics continue to converge and become more interdisciplinary, creating demand in rapidly emerging fields such as bioinformatics and nanotechnology. Research demands have steadily increased the need for Biostatisticians, especially on NIH grants that require a Biostatistician be named on all grants to oversee the study, the data collection and the analysis of the data.

Career and Economic Outlook for Biostatistics: The continued growth of the pharmaceutical field will generate a large share of the demand for Biostatisticians, according to the U.S. Department of Labor (www.bls.gov). Government and academic positions will continue to provide a large number of jobs, especially for Biostatisticians with advanced degrees.

As the table below indicates, the earnings for Biostatisticians are competitive and job growth is expected to continue throughout the next decade and beyond.

Wages & Employment Trends for Biostatisticians at Master's Level

State and National Wages		2008				
Location	Pay Period	10%	25%	Median	75%	90%
United States	Hourly	\$19.11	\$25.35	\$34.91	\$45.76	\$56.34
	Yearly	\$39,700	\$52,700	\$72,600	\$95,200	\$117,200
Missouri	Hourly	\$16.79	\$21.16	\$28.48	\$39.70	\$49.48
	Yearly	\$34,900	\$44,000	\$59,200	\$82,600	\$102,900
Median wages (2008)		\$34.91 hourly, \$72,610 annual				
Employment (2008)		23,000 employees				
Projected growth (2008-2018)		Average (7% to 13%) For the period 2008-2018				
Top industries (2008)		Government, Professional, Scientific, and Technical Services				

Roles and the opportunities for Biostatisticians (AMSTAT News)

1. Biostatistics involves the development and application of statistical techniques to scientific research in health-related fields, including medicine, epidemiology, and public health. From the beginning of this century, biostatistics has become an indispensable tool in improving health and reducing illness. Active areas of research include Bayesian

methods, high-speed computing and simulation, survival analysis, analysis of geographical patterns of disease, longitudinal data analysis, and methods for analyzing data from epidemiologic studies and clinical trials. They provide crucial guidance in determining what information is reliable and which predictions can be trusted. They often help search for clues to the solution of a scientific mystery and sometimes keep investigators from being misled by false impressions.

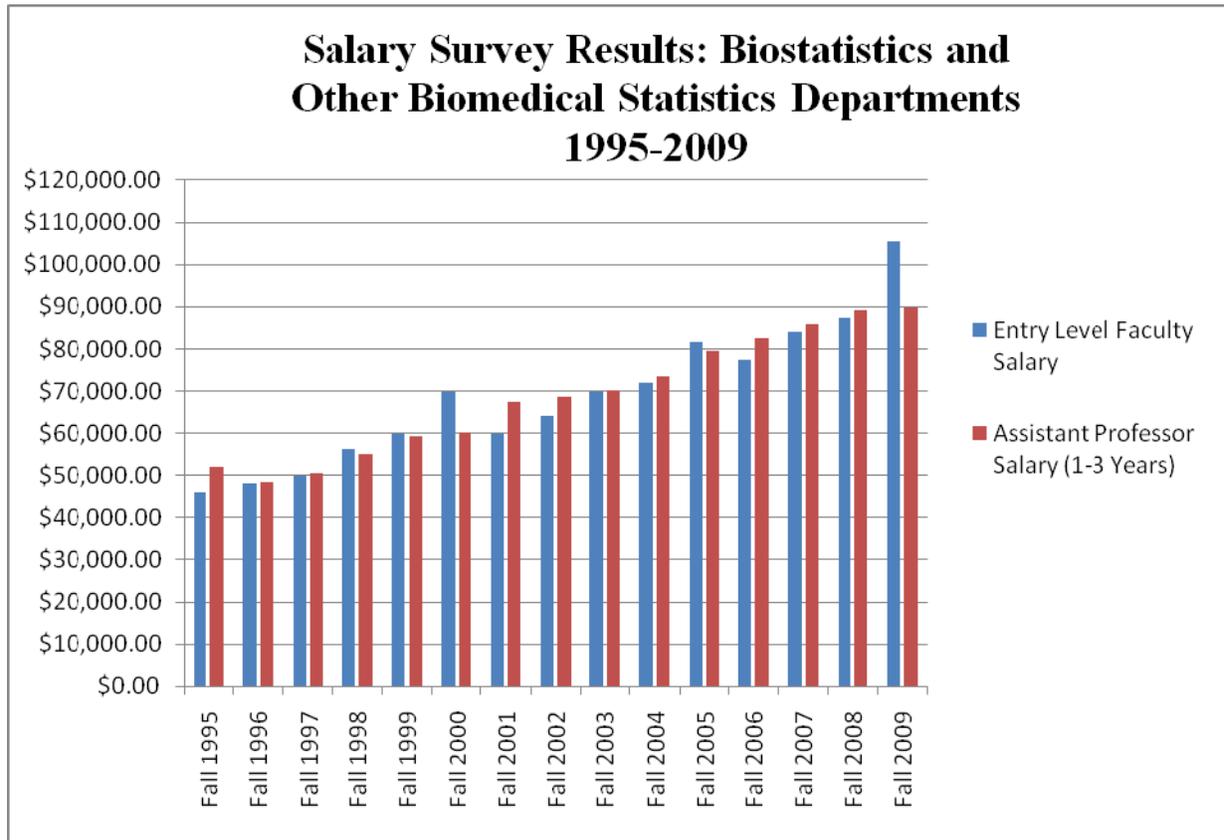
2. Biostatisticians with advanced degrees can look forward to excellent career opportunities in government, industry, and academia. Recent graduates have found positions with employers as diverse as pharmaceutical companies, university research groups, hospitals, and health-related industries. Job prospects for new graduates with master's and PhD degrees are excellent.
3. Typical starting salaries range from \$35,000 to \$65,000 for master's-level graduates and \$55,000 to \$85,000 for PhD-level graduates. (Salary ranges will be different regarding the type of position acquired)
4. **A statistician is rated as having one of the nation's 10 best jobs in the new "2009 Jobs Rated Report". ...Secure, well-paying office jobs, such as mathematician and statistician, landed high. ...it appears statisticians are on steady ground. (Amstat news, February 2009)**
5. A master's degree or PhD is very helpful and often recommended or required for higher-level positions. Scholastic statistics programs range from theoretical to applied and can be found in departments such as mathematics, biostatistics, public health, psychology, engineering, education, business, and economics in addition to traditional statistics departments.

Source: <http://magazine.amstat.org/2009/12/fundingoppdec09/>

Article: "Biostatistics Funding: Opportunities from NIH" **by Keith Crank, 12/1/09**

...Two issues have surfaced as being of primary importance (in terms of the community's interaction with the [National Institutes of Health \(NIH\)](#)): the need for more funding to train the next generation of biostatisticians and the need for more funding for methodological research in biostatistics. The increasing demand for biostatisticians and the need for the development of new methods to understand biomedical data make these requests fairly obvious and worth supporting. But, according to the NIH, there are opportunities available and the biostatistics community is not applying for them....

Source for chart: Amstat.org



Source: <http://www.indeed.com/salary/Biostatistician.html>

Average Salary of Jobs Matching Your Search



Average Biostatistician salaries for job postings nationwide are 48% higher than average salaries for all job postings nationwide.

Average Salary of Jobs with Related Titles

- [Biostatistician Clinical Research](#) \$106,000
- [Senior Biostatistician](#) \$112,000
- [Biostatistician](#) \$71,000
- [Senior SAS Programmer](#) \$92,000

Other sources support the claim that the field of Biostatistics is growing and we need to take this opportunity to train the best Biostatistician in the country.

Biostatisticians are more essential than ever to medical innovation... What's the difference between a biostatistician and a physician? A physician makes an analysis of a complex illness whereas a biostatistician makes you ill with a complex analysis. ... Biostatisticians don't just analyze results. They also help shape the design of studies and even prepare grant proposals.... Two things are powering the growth in demand for biostatisticians—the ballooning volume of complex data that must be managed and analyzed and the mandates attached to new NIH money. ... The National Institutes of Health is granting Clinical and Translational Science Awards (CTSAs)—\$4 million to \$6 million per year—to big medical centers for personnel and lab facilities that enhance a center's overall research capability. ... Fifty to 60 CTSAs will be given nationwide. Twenty have been awarded so far. Mayo has one. The University of Minnesota hopes to get one in 2008. "CTSAs will increase demand for biostatisticians and job opportunities nationwide," Connett says: Article: "Number Crunchers" by Howard Bell. See the full article at:

<http://www.minnesotamedicine.com/PastIssues/November2007/FeatureNovember2007/tabid/2344/Default.aspx>

REVIEW

Appendix G

Other Leading Programs in Biostatistics

REVIEW

TOP BIOSTATISTICS PROGRAMS IN THE COUNTRY

UNC School of Public Health

The primary research goal of the Department of Biostatistics is to develop new statistical methodology to address issues in public health and the biomedical sciences. All faculty members in the department have research interests both in the development of statistical methodology and in the application of statistics in applied research. Applied research projects generally involve other faculty in the School of Public Health, investigators at the Medical School, or even scientists at outside institutes such as the Research Triangle Institute, the National Institute of Statistical Sciences or the National Institute of Environmental Health Sciences.

- **Doctors Program**
 - The Doctor of Public Health (DrPH) program is designed to prepare students for positions of leadership in applied research settings related to human health.
 - 75 credit hours
 - The basic written examination, preliminary doctoral examination and final oral examination
 - The Doctor of Philosophy program (Ph.D) is designed to provide advanced, research-oriented training in theory and methodology to prepare individuals for academic careers and for research positions in government and private industry.
 - At least 70 credit hours
 - The basic written examination, preliminary doctoral examination and final oral examination
- **Masters Program**
 - The Master of Public Health (MPH) program in Biostatistics is designed to prepare individuals for positions that require broad knowledge of public health as well as specialized knowledge of biostatistics.
 - 2 years
 - At least 42 semester hours of course work, typically 46 credit hours
 - The basic written examination
 - The Master of Science (MS) program in Biostatistics is designed to provide research-oriented training in the theory and methodology of biostatistics and its application to the solution of problems in the health sciences.
 - 2 years
 - At least 36 semester hours of course work, typically 44 credit hours
 - The basic written examination
- **Financial aid and funding for students**

Graduate students in the Department of Biostatistics are funded through a variety of sources, including Graduate Research Assistantships, Training Grants, BIOS Departmental Scholarships, and University-Wide Scholarships. More than 90 percent of their graduate students are funded by the department, typically by Graduate Research Assistantships or Training Grants. The remaining students not funded by the department are generally funded from other departments or outside sources.

Johns Hopkins Bloomberg School of Public Health

The faculties in Biostatistics create and apply methods for quantitative research in the health sciences, conduct research across the spectrum of statistical science from foundations of inference to the discovery of new methodology to health applications. The graduates from this department have leadership careers as researchers and educators in academic departments of statistical science and in government and industry.

- **Ph.D Program**
 - Four- to five-year program
 - Two years of core coursework
 - written and oral exams and research thesis
- **Masters Program**
 - Master of Science (ScM) in Biostatistics is an applied degree designed to prepare students for a career as a professional statistician.
 - One and one-half years of core coursework and six months of work on research thesis
 - written examination
 - The Master of Health Science (MHS) in Biostatistics is an applied degree designed to provide an intensive course of study in biostatistical theory and methods for doctoral-level researchers working primarily in other fields of public health.
 - One-year program of core coursework and final research project
 - written examination
- **Financial aid and funding for students**
 - All applicants to the PhD program, regardless of citizenship or nationality, are automatically considered for the small number (i.e., between 4-6) of fully-funded slots available each year. Up to five years of funding for Ph.D including tuition, research assistantship and health insurance.
 - The Department also offers funded training programs in [Biostatistics for Genetics/Genomics](#), [Statistical Methods in Environmental Epidemiology](#), [Biostatistics Mental Health/Psychiatry](#) and [Epidemiology and Biostatistics of Aging](#) for US citizens and permanent residents.

The University of Washington School of Public Health

The Department of Biostatistics is a recognized leader in the statistical sciences. Its 78 faculty include a Member of the United States National Academy of Sciences, two Members of the Institute of Medicine and 20 Fellows of the American Statistical Association. The postdoctoral and graduate students are among the most talented in the country, and 488 alumni hold leadership roles in academia, government and industry worldwide. The Department is a center of excellence for development and application of statistical methodology across the health sciences, and has collaborative partnerships with Fred Hutchinson Cancer Research Center, Children's Hospital Research Institute, Group Health Cooperative, and the Veteran's Administration.

- **Doctors Program**
 - The Doctor of Philosophy program (Ph.D) is designed to develop statistical theory and applications particular to the health
 - At least 4 years
 - Requires 105 credits
 - Encouraged to identify an individual research project early in their academic program which may or may not be the same as their dissertation topic, typically through a research assistantship
 - Meet computing proficiency requirement, students strongly encouraged to learn C and /or Fortran
 - M.S. level statistical theory exam, qualifying examinations, biology project, general examination and final examination
- **Masters Program**
 - The Master of Public Health (MPH) program in Biostatistics is viewed to provide quantitative research training to candidates who hold a doctoral level degree in another field (e.g., M.D., Ph.D., J.D.) or be currently working on such a doctoral degree.
 - 2 years (four quarters / year)
 - Requires 63 credits
 - Complete a practicum experience within an organization or agency that provides planning or services relevant to public health
 - Master of Science (MS) program in Biostatistics
 - 2 years (four quarters / year)
 - Requires 62 credits
 - M.S. statistical theory examination
 - Take a consulting class, write a thesis
- **Financial aid and funding for students**

TA, RA and Trainee (support for Ph.D candidates is guaranteed for 5 years)

Harvard University School of Public Health

The faculty includes leaders in the development of statistical methods for clinical trials and observational studies, studies on the environment, and genomics/genetics. The department's research involves the theory and application of statistical science to analyze public health problems and to further biomedical research. The statistical methods and interdisciplinary collaborations provide many opportunities for student participation.

- **Doctor of Philosophy (Ph.D) program**
 - Trains students in statistical theory, the use of statistical methods in formulating problems, planning studies, conducting analyses, writing reports, the interpretation of numeric data for scientific inference, and the ability to collaborate and communicate effectively with scientists in related disciplines. The Ph.D. program has the additional objectives of training statisticians capable of conducting independent methodological research and providing scientific leadership.
 - Course requirement:
 - 5 core curriculum courses, 30 credits of advanced doctoral core, at least 10 credits in the cognate field (a non-quantitative field outside of biostatistics or statistics),
 - consulting seminar, research ethics
 - Written examination and oral examination, doctoral dissertation
- **Masters Program**
 - Master of Arts (AM) program in Biostatistics is the requirement for Ph.D degree (one is admitted as a candidate only for the Master of Arts)
 - Expected to be completed by the end of the fourth semester
 - The department may confer a terminal Am degree on students who will not be completing the requirements for Ph.D
 - At least 60 ordinal credits
 - Must complete the requirements for the Master of Science degree
 - Master of Science (SM) program in Biostatistics
 - 42.5 credits program (complete in one year) and 80 credits program (complete in two years)
 - 42.5 / 80 credits in total, a minimum of 30 / 60 ordinal credits , respectively
 - Successfully complete all courses required by the particular concentration
 - Research ethics
- **Financial aid and funding for students**

A variety of sources including [Student Financial Services Scholarships](#), [University-Wide Scholarships](#), [Academic Department Funding](#) and [University-Wide Fellowships](#)

The University of Michigan School of Public Health

The Department of Biostatistics at the University of Michigan is bringing biostatistical expertise to a wide spectrum of health-related problems, advancing knowledge in biostatistics and health through educational programs for students and applied researchers, as well as providing leadership and outstanding scholarship in research, teaching, and service. Faculty, students, and staff work in important areas of current biostatistical research. They are engaged in collaborative research with researchers in the UM Institute of Social Research and the Schools of Public Health, Medicine, Nursing, Dentistry, and elsewhere.

- **Doctors Program**
 - The Doctor of Philosophy program (Ph.D)
 - Required core coursework:
 - at least 46 credits for students with a relevant Master's degree and at least 61 credits for students without a relevant Master's degree
 - include core courses, electives in Biostatistics and Statistics, Epidemiology and electives in a cognate area
 - Qualifying Examinations in Theory and Applications
 - Dissertation
 - Presentation of proposal for research including an extensive literature review
 - Research
 - Writing of the dissertation
 - Oral defense
- **Masters Program**
 - The Master of Public Health (MPH) program in Biostatistics
 - 2 years (4 terms)
 - 49 credits
 - At least 3 Public Health related courses (one in Epidemiology and the other two from two other departments)
 - Master of Science (MS) program in Biostatistics
 - 2 years (4 terms)
 - 46 credits
 - Must take at least 9 hours of course work in a cognate area
 - Master of Science (MS) in Clinical Research Design and Statistical Analysis (CRDSA) offered by the Department of Biostatistics and Epidemiology
 - Developed to provide a means for physicians, dentists, pharmacists, pharmacologists and others who are involved in clinical research to develop expertise in research design and statistical analysis appropriate to such research while remaining in their existing employment
 - Participants meet in Ann Arbor at the School of Public Health for a four-day weekend (Thursday, Friday, Saturday, and Sunday) once every four to five weeks for thirty hours of class time.
 - Lasts eighteen weekends spread over eighteen to twenty months.
- **Financial aid and funding for students**
 - All students admitted to Ph.D, MS or MPH in Biostatistics programs are considered for financial support.
 - Four types of financial support offered to students: Graduate Student Instructor (GSI), Graduate Student Research Assistant (GSRA), Training Grants and Fellowships.

The University of Wisconsin School of Medicine and Public Health

At the University of Wisconsin School of Medicine and Public Health the Department of Biostatistics and Medical Informatics serves as a resource for clinical, population and basic sciences investigators. A major goal of the Department faculty and staff is to collaborate in the design, conduct, and analyses of laboratory, clinical, and epidemiologic studies in a variety of biomedical disciplines and departments. In addition, faculty conduct research in statistical methodology and computational methods and participate in several [graduate and postdoctoral training programs](#).

- **Doctor of Philosophy (Ph.D) program in Statistics with an Emphasis in Biostatistics**
 - Combines the strong program in theoretical and applied statistics at the Department of Statistics with course work in biostatistics and health science, and with consulting experience with medical researchers.
 - Course requirement: at least 48 credits in Statistics and Biostatistics, one course in biological sciences
 - Students must engage in faculty-mentored biostatistics consulting or collaborative research training achieved through the Lab Rotation System.
 - A written PhD qualifying exam (usually taken in the second or third year)
 - complete a minor requirement, either by course work in another department with Biological topics
 - Qualifying examination, preliminary examination and a final oral Ph.D examination based on the written dissertation

- **Master of Science (MS) Degree in Statistics with an Emphasis in Biostatistics**
 - 33 required credits
 - Approximately 2 years
 - electives must include statistical methods in clinical trials and statistical methods in epidemiology
 - Pass a competency test of the candidate's potential as a practicing statistician

- **Financial aid and funding for students**

Assistantships, fellowships and traineeships