AN APPLICATION FOR A PROFESSIONAL MASTER'S DEGREE PROGRAM IN BIOSTATISTICS

The Graduate School
The University of Connecticut

Submitted by the Department of Statistics

Summary

There is a high demand in industry, government, and medical center settings for people trained at the master's level who can contribute to the statistical design and analysis of biomedical studies. To meet this demand, we propose to start a Professional Master's Program (henceforth "the Program") in Biostatistics in Fall 2014, emphasizing practical skills needed in the work force. Students completing this program will have statistical expertise in inference, linear regression, analysis of variance, design and analysis of clinical trials and epidemiological studies, programming in SAS and R, and consulting experience in working on the statistical aspects of biomedical problems. The Program will require 31 credits and passing a written qualifying exam on both theoretical and applied aspects of biostatistics. The Program will take three semesters to complete.

The Program builds on the strengths of the Department of Statistics at the University. Founded in 1962, the Department of Statistics has awarded a total of 132 Ph.D. and 310 M.S. degrees, including 57 Ph.D. and 122 M.S. degrees awarded in the past ten years. A majority of the Ph.D. graduates are employed in biostatistics departments at research universities and pharmaceutical companies. Most of the M.S. graduates are employed as biostatisticians in the health industry. Ten years ago we initiated a Biostatistics concentration within the M.S. program in Statistics. At that time, we added three biostatistics courses (Introduction to Biostatistics, Clinical Trials, and Survival Analysis) as electives to our M.S. curriculum. Based on our success since then, we will build an innovative, comprehensive, and practical biostatistics program by adding more biostatistics courses and restructuring the requirements. We are in an especially advantageous position to do so given the close ties we have cultivated with UConn Health Center, the new Center for Genomics of Jackson Laboratories, the Connecticut Institute for Clinical and Translational Science (CICATS), Center for Health, Intervention, and Prevention (CHIP), Center for Public Health and Health Policy (CPHHP), Center for Environmental Sciences and Engineering (CESE), College of Agricultural and Natural Resources, the School of Engineering, the Neag School of Education, the School of Nursing, the School of Pharmacy, and many pharmaceutical companies such as Pfizer, Boehringer-Ingelhem, and Bristol Meyers Squibb. Consequently, we will be successful in offering modern courses and consulting services and providing valuable learning and internship opportunities to our students. In view of the heavy demand for workers with training in biostatistics from pharmaceutical companies, hospitals, and government, and the near future employment in the field of genomics, there is strong impetus for us to offer the proposed Professional Master's Program in Biostatistics.

INTRODUCTION

Many universities have developed Professional Master's Programs since 1997 in response to calls for more realistic programs to serve the nation's science and engineering needs

from policy leaders in employment and education, including the National Research Council, the Alfred P. Sloan Foundation, and the National Science Foundation. These programs have been designed to prepare people to work primarily in nonacademic sectors as laboratory administrators or project directors. There are now more than 125 such programs in more than 60 institutions in 25 states and the District of Columbia in disciplines such as mathematics, physics, biological sciences, computational science, forensics, chemistry, and geographical information systems. Most Professional Master's Programs are interdisciplinary in nature. About 2,500 students are enrolled annually, and the number is increasing. Although the early Professional Master's Programs were initiated with startup funds from the Sloan Foundation and the Council of Graduate Schools, they have demonstrated they can become self-supporting as their value to industry and their students' professional aspirations become apparent. Moreover, a growing number of such programs are going abroad, as other nations see the value of preparing Science-and-Engineering trained managerial workforce.
(http://www.nsf.gov/statistics/seind10/c2/c2s.htm#s64).

Our University currently has three Professional Master's Programs: Applied Financial Mathematics, Applied Genomics, and Microbial Systems Analysis. Their graduates have demonstrated how they have been contributing to technological developments in our state. We would like to add more contributions to our state's technology and health welfare by training biostatisticians who are extremely well trained and marketable upon graduation.

1. OBJECTIVES

State the objectives of this program in relation to the goals and objectives of the institution. In so doing, public institutions shall relate the proposed program to their approved mission, role, and scope. Identify target clientele and likely post-graduation activities.

The objectives of the Program are to provide rigorous training in modern biostatistics knowledge and skills that are sought after in all health related fields, including genomics. While statistical science is the general study of the collection, organization, analysis, and interpretation of data, biostatistics specifically involves the theory and application of statistical science to solve problems in public health, health services, policy, and biomedical research.

This is also directly related to our institution's strategic plan: through teaching and learning, to help our students grow intellectually and become contributing members of the state, national and world communities.

The target clientele for the Program are baccalaureate students with degrees in science, engineering, business or other related fields who wish to pursue careers in the health industry as biostatisticians. Such students may be recent graduates, or non-traditional students who wish to update training for new career opportunities or for advancements with current employers. We

expect that our master's graduates will find employment in pharmaceutical companies, clinical research labs, biotechnology companies, hospitals, and healthcare services.

2. EDUCATIONAL PLANNING STATEMENT

a. Indicate the relationship of the proposed program to other programs and resources of the institution, and to any institutional plan.

The University's Board of Trustees has adopted a Strategic Plan to provide direction for growth and development. The newly proposed Professional Master's Degree in Biostatistics is consistent with the objectives of the Strategic Plan, including economic development, collaboration with health industry and governmental agencies, training a skilled work force, and assuming national leadership roles in integrative research and education. The Biostatistics program will forge partnerships between the academic and private sectors to conduct research and education in biostatistics and its applications. A new academic plan is being developed with emphases and investment in STEM (science, technology, engineering and math), Bioscience CT program and Jackson Lab partnership, and UConn Technology Park. Biostatistics programs belong naturally in STEM, and have been making important contributions to bioscience, medicine, and technology.

b. Indicate what consideration has been given to similar programs in the geographic area to be served by the proposed program. Identify any similar existing academic programs in Connecticut in public, independent and proprietary institutions and explain the relationship of the proposed program to existing offerings.

Harvard, Yale, Brown, and Boston University offer an MS degree in Biostatistics, and Yale also offers an MS degree in Epidemiology and Public Health with a concentration in Biostatistics. None of these is structured as a Professional Master's Program. As far as Professional Master's degrees in Statistics or Biostatistics are concerned, there are only a few including Applied Statistics awarded by Cornell University and Penn State University, and Master of Business and Science with Statistics & Biostatistics concentration offered by Rutgers University. We have also carefully studied the curricula of a dozen biostatistics MS programs to develop our curriculum. Although there are overlaps between the above mentioned programs and ours, there are no programs like ours. The unique features include: (1) most of our courses contain a major computing component that is integrated seamlessly to the problem solving part of the course, so active and hands-on learning is emphasized; (2) in the required 11 courses, one of them can be selected from three courses: clinical trials, epidemiology, and survival analysis, and another one can be selected from a list of 16 modern biostat/stat courses, and so students have the freedom to develop individual interests and follow career aspirations; and (3) the required student seminar course (STAT5099) is

primarily for students to report and share their internship experiences. Moreover, it includes lessons on research ethics, management, and research paper discussions.

In Connecticut, we will be the only program that offers a Professional Master's degree in Biostatistics. Although Yale offers a regular MS degree in Biostatistics and an MPH degree with Biostatistics concentration, our excellent curriculum, central geographical location, and more affordable tuition will make our program more attractive than that of Yale for a majority of students.

c. Explain and provide supporting data regarding the relationship of the proposed program to further educational opportunities and current employment trends. Indicate evidence of student demand.

According to Occupational Outlook Handbook, 2010-11 ed. (http://www.bls.gov/oco), "employment of statisticians is projected to grow 13 percent from 2008 to 2018, about as fast as the average for all occupations. The use of statistics is widespread and growing. Statistical models aid in decision making in both private industry and government. There will always be a demand for the skills statisticians provide. Technological advances are expected to spur demand for statisticians. Ever-faster computer processing allows statisticians to analyze greater amounts of data much more quickly and to gather and sort through large amounts of data that would not have been analyzed in the past. As data processing continues to become more efficient and less expensive, an increasing number of employers will want to employ statisticians to take advantage of the new information available. Biostatisticians should experience employment growth, primarily because of the growing pharmaceuticals business. As pharmaceutical companies develop new treatments and medical technologies, biostatisticians will be needed to do research and clinical trials."

The most important change is that statisticians are now seen as integral members of the team from day one of any project, rather than as an afterthought as in the past. They now are at the table when new problems are discussed, whether it is in drug discovery, manufacturing, new medical treatments, or health policy.

The American Statistical Association has been actively advocating for statistical literacy, not only to increase the pipeline for future statisticians, but also to help develop critical thinkers for the future. We agree on that communication, computational, quantitative and analytical/critical thinking skills are essential to be a good statistician. Future biostatisticians need to build their knowledge and skills in mathematics, computation, communication, and biological and health sciences. Our Program will provide rigorous yet practical training for these needs.

Our department has graduated 132 Ph.D.'s since its founding. More than half of them are employed in the field of biostatistics. The others are mostly employed in the insurance and financial industries. Appendix 1 contains a list of these biostatisticians. This list confirms the job prospects of biostatisticians. We have not kept an employment record for our MS students. Appendix 2 contains some information we have on our MS graduates.

The projected demand for the proposed Professional Master's Program in Biostatistics is strongly supported by the continually increasing number of applicants for admissions to our graduate programs. The numbers were 167, 214, 196, 214, 318, 433, and 435 respectively for the years of 2007 to 2013. Majority of them have indicated their preference for biostatistics.

d. Board policy requires that all public institutions consider transferability of credit in the development of new undergraduate programs. Describe program articulation agreements planned or under development for this program. If possible, indicate the amount of credit which will transfer.

Not applicable.

e. Board of Trusties policy requires that the proposed new program proposal will be submitted for approval.

The development of our Professional Master's Program in Biostatics is supported by the Dean's office of CLAS and the Provost's Office. Once the proposed program is approved by the Course and Curriculum of CLAS, the Graduate School, and the Dean's Council, it will be submitted for approval to the UCONN Board of Trusties.

3. ADMINISTRATION

a. Indicate the dates by which students will enroll in and complete the program.

The first cohort of students will enroll in the program for fall 2014. The program takes 3 semesters (full time) for completion**.**

b. Describe the position and qualifications of the person directly responsible for administration of the program.

For the initial period of establishment of the Biostatistics Professional Degree, the Director will be Professor Joseph Glaz, Head of the Department of Statistics. He has extensive experience in advising and mentoring graduate students. He is a member of the Connecticut Academy of Arts and Sciences, Fellow of the Institute of Mathematical

Statistics, and Fellow of the American Statistical Association. He initiated the plan for a professional degree in Biostatistics and will be devoted to the development of the Program. He will be assisted by the Associate Head and Director of Graduate Programs, Professor Zhiyi Chi and the Director of Graduate Admissions, Professor Vladimir Pozdnyakov. He will be also assisted by all faculty members of the department of Statistics in teaching, and by the Professional Master's Program in Biostatistics Development Committee (Lynn Kuo, chair, Ming-Hui Chen, Ofer Harel, Elizabeth Schifano, and Jun Yan) in curriculum planning and student advising.

The Program will be part of the Graduate School of the University. It will receive oversight and administrative support from the Graduate School. It will formally report to the Dean of the Graduate School. The academic policies and procedures that govern the Graduate school will apply to the master's program in Biostatistics, as well, including admission requirements, general academic requirements, graduation requirements, and program review policies.

The Graduate Faculty Council is the legislative body of the Graduate School. It establishes academic policy for graduate education, except for those areas reserved to the Board of Trustees, to the University Senate, or to the faculties of other colleges and schools. The 60 members, representing specific content areas derived from constituent Fields of Study, are elected to serve three-year terms. The membership includes two voting student members chosen by the Graduate Student Senate. The President, the Provost, the Vice Provost and Dean of the Graduate School, and certain other administrative officers of the Graduate School are nonvoting ex officio members. The Council, representing the Graduate Faculty at large, exercises legislative authority in such areas as admissions criteria, curricular and degree requirements, new course approval, academic program review, and the like. (Ref: http://grad.uconn.edu/faculty/gfc.html).

c. List any specialized accrediting agency to which the institution plans to apply for program accreditation.

[None]

d. Describe procedures for internal evaluation of the program, including criteria that will be used.

Three years after initiation of the program, an internal review will be conducted. Recommendations from this review will be used to make improvements to the program. In addition the Graduate School will conduct an annual review. Every six to seven years the program will be reviewed as part of a University–wide assessment plan.

4. FINANCE

a. Summarize how resources described in questions 5, 7, and 9 will be provided- existing resources, reallocation and /or new resources. In case of existing or reallocated resources, indicate how the institution will prevent a negative impact on other programs. New costs and sources of funding are to be indicated in the attached resource summary.

The department has all the resources, including faculty members, established courses and facilities to start a Professional Master's Program in Biostatistics. No negative impact on other existing programs will occur. It is planned to admit in the first year 15 additional MS students to the new Professional Master's Program in Biostatistics.

Additional Faculty/staff resources:

We will start with the current faculty in the Statistics Department. When the Program matures, we anticipate the need for a full time Program Assistant, and two additional faculty members. This will be fully funded by the tuition generated by the Professional Master's Program in Biostatistics.

Additional student support resources:

We will need an additional administrative assistant for this program. As mentioned in the previous section, a full time Program Assistant will be needed, funded by the tuition generated from this new program.

Additional Library resources: None

Office Space:

All required office space is currently available in individual faculty, departmental, or shared spaces. More office space is will be needed in the future for new faculty and Ph. D. graduate students that are appointed as Teaching Assistants or Graduate Assistants. The administration of the Professional Master's Program itself does not require additional space.

Impact on other programs (both positive and negative):

The new Program will add another dimension to the University's expanding presence in Health Sciences and Genomics, which have a great need in expertise in the field of biostatistics. It will raise our reputation statewide and nationally. It will help to train workforce for the Jackson Lab of Genomic Medicine Institute.

We expect some of the graduates of the Professional Master's Program in Biostatistics, after completion of their degree, to enroll in our Ph. D. program in Statistics. We envision no negative impact on other programs within the university.

b. Complete the resource summary.

The Department of Statistics has a teaching computer lab and a research computer lab. The research lab has three Intel-based Linux workstations dedicated to large scale numerical computing and statistical simulation. The Department received a SCREMS grant from the National Science Foundation with the matching support from the College and the University. With this funding, the Department replaced all PCs in the research lab with 15 new Dell OptiPlex double dual-core PCs with Window XP operating systems and purchased a Linux based computer cluster with 32 computing nodes, each with double quad-core. With these changes, the computing facilities of the Department are now accessible to graduate students, visiting scholars, and faculty members.

A large software base is now available in either the PCs or the Linux workstations in both labs, which includes SAS, S-Plus, SPSS, GLIM, MINITAB, Mathematica, Maple, IMSL (Fortran and C), R, WinBUGS, as well as other packages and languages. IMSL (FORTRAN and C) and R are also available in the Department Linux cluster.

The Department's computers are managed and maintained by four lab managers, a Linux quarter time operations manager and a PC quarter time operations manager from the office of the Dean of the College of Liberal Arts and Sciences, and a student Linux cluster manager and a student Webmaster. The computer management team maintains, installs, and upgrades the operating systems and software, and they also provide the service of weekly tape back-up, as well as daily trouble-shooting of system problems.

Ref: http://www.stat.uconn.edu/www/?cate=resource&info=lab

5. FACULTY

a. List the name, title and qualifications for each person who will teach specialized courses in the program. Include for each person, degrees with areas of specialization, institutions at which the degrees were earned, pertinent experience, professional publication, and proposed course assignments.

Key Faculty, Ph.D. Degree Institution & Areas of Specialization

Haim Y. Bar Assistant Professor	Ph.D. Statistics Cornell University	High-Throughput Analysis in Biostatistics Variable and Model Selection Machine Learning High-Dimensional/Correlated Data Analysis
Joseph Cappelleri Adjunct Professor Senior Director	Ph.D. Psychometrics Cornell University Pfizer Inc.	Patient-Reported Outcomes Meta-Analysis Clinical Trials Epidemiologic Studies
Kun Chen Assistant Professor	Ph.D. Statistics University of Iowa	Dimension Reduction & Variable Selection Multivariate Analysis High-Dimensional Statistics Statistical Computing
Ming-Hui Chen Professor	Ph.D. Statistics Purdue University	Bayesian Data Analysis Design of Clinical Trials Meta-Analysis Missing Data Analysis Prostate Cancer Research Repeated Measures & Longitudinal Analysis Survival Analysis
Zhiyi Chi Professor	Ph.D. Applied Math Brown University	Applied Probability Stochastic Processes Multiple Hypothesis Testing Large Deviations Statistical Analysis of Neural Data
Dipak Dey Professor	Ph.D. Statistics Purdue University	Bayesian Modeling Multivariate Analysis Reliability and Survival Analysis Statistical Genetics
Joseph Glaz Professor	Ph.D. Statistics Rutgers University	Applied Probability Parametric Bootstrap

		Scan Statistics Simultaneous Inference
Ofer Harel Associate Professor	Ph.D. Statistics The Pennsylvania State University	Methods for Incomplete Data Causal Inference Verification Bias Statistical Consulting
Sangwook Kang Assistant Professor	Ph.D. Biostatistics Univ. of North Carolina at Chapel Hill	Survival Analysis Design of Epidemiological Studies Analysis of Epidemiological Studies Statistics in Sports
Lynn Kuo Professor	Ph.D. Math (Statistics) University of California at Los Angeles	Bioinformatics Biostatistics Survey Sampling Survival Analysis
Nitis Mukhopadhyay Professor	Ph.D. Statistics Indian Statistical Institute	Survey Sampling Environmental Sampling Clinical Trials Multivariate Data Analysis
Nalini Ravishanker Professor	Ph.D. Statistics New York University	Time Series Modeling Time-To-Events Analysis Marketing Environmental and Transportation Eng.
Naitee Ting Adjunct Professor Sr. Principal Biostatistician Boehringer-Ingelheim Pharmaceuticals	Ph.D. Statistics Colorado State University	Clinical Trial Dose Finding in Drug Development Therapeutic Equivalencies Variance Component Models
Elizabeth D. Schifano Assistant Professor	Ph.D. Statistics Cornell University	Biostatistics Variable and Model Selection Statistical Genomics High-Dimensional/Correlated Data Analysis
Alexander Tartakovsky Professor	Ph.D. Statistics/Information Moscow Institute of Physics	Statistics Decision Theory

	and Technology	Sequential Analysis
Richard Vitale Professor	Ph.D. Applied Mathematics Brown University	Convex-Geometric Methods Stochastic Geometry Inequalities
Xiaojing Wang Assistant Professor	Ph.D. Statistics Duke University	Bayesian Modeling Time Series Data Analysis Gaussian Processes and Spatial Statistics Subgroup Analysis and Multiplicity
Jun Yan Associate Professor	Ph.D. Statistics University of Wisconsin	Dynamic Survival Models Longitudinal Data Analysis Spatial Statistics Statistical Computing

Key Program Faculty & Proposed Course Assignments

Haim Bar	Stat. 5505 Applied Statistics, I Stat 5515 Design of Experiments
Joseph Cappelleri	Stat. 6494. Epidemiology Stat. 6494. Longitudinal Data Analysis
Kun Chen	Stat. 5665. Applied Multivariate Analysis Stat. 5361. Statistical Computing Stat. 5725. Linear Models I
Ming-Hui Chen	Stat. 5505, 5605. Applied Statistics I, II Stat. 5645. Survival Analysis Stat. 6494. Applied Bayesian Data Analysis Stat. 6494. Categorical Data Analysis Stat. 6494. Statistical Consulting
Zhiyi Chi	Stat. 4875. Nonparametric Methods Stat. 5361. Statistical Computing Stat 5665. Applied Multivariate Analysis
Dipak Dey	Stat. 5099. Investigation of Special Topics
Joseph Glaz	Stat. 5099. Investigation of Special Topics Stat. 5515. Design of Experiment Stat. 6494. Bioinformatics I
Ofer Harel	Stat. 5625. Introduction to Biostatistics Stat. 6494. Epidemiology Stat. 6494. Statistical Consulting

Sangwook Kang	Stat. 5625. Introduction to Biostatistics
	Stat. 5645. Survival Analysis
	Stat. 6494. Epidemiology
	Stat. xxxx. Data Management and Programming in SAS and R
Lynn Kuo	Stat. 5099. Investigation of Special Topics
	Stat. 5625. Introduction to Biostatistics
	Stat. 5645. Survival Analysis
	Stat. 6494. Bioinformatics II
	Stat. 6494. Statistical Consulting
Nitis Mulkhopadhyay	Stat. 5585. Mathematical Statistics I
	Stat. 5685. Mathematical Statistics II
	Stat. 5525. Sampling Theory
Nalini Ravishanker	Stat. 5505, 5605. Applied Statistics I, II
	Stat. 5665. Applied Multivariate Analysis
	Stat. 5825. Applied Time Series
	Stat. 6494. Longitudinal Data Analysis
Elizabeth Schifano	Stat. 5505, 5606. Applied Statistics, I, II
Naitee Ting	Stat. 5635. Clinical Trial
Alexander Tartakovsky	Stat. 5585. Mathematical Statistics I
	Stat. 5685. Mathematical Statistics II
Richard Vitale	Stat. 3965. Elementary Stochastic Processes
Xiaojing Wang	Stat. 5725. Linear Models I
Jun Yan	Stat. xxxx. Data Management and Programming in SAS and R
	Stat. 5645. Survival Analysis
	Stat. 6494. Longitudinal Data Analysis
	Stat. 6494. Environmental Statistics
	Stat. 5585. Mathematical Statistics I
	Stat. 5685. Mathematical Statistics II

Professional Publications:

Haim Bar (with J. Booth and M. Wells) 2012. A mixture-model approach for parallel testing for unequal variances. *Statistical Applications in Genetics and Molecular Biology* Vol. 11, Iss. 1, Article 8.

(with D. Lillard) 2012. Accounting for heaping in retrospectively reported event data - A mixture model approach. *Statistics in Medicine*, DOI: 10.1002/sim.5419

(with J.G. Booth, E. Schifano and M.T. Wells) 2010. Laplace approximated EM microarray analysis: An empirical Bayes approach for comparative microarray experiments. *Statistical*

Science, 25(3), 388-407.

(with E. Schifano) 2011. Empirical and fully Bayesian approaches for random effects models in microarray data analysis. *Statistical Modelling*, 11(1), 71-88.

Joseph C. Cappelleri (with K.H. Zou, A.G. Bushmakin, J.M.J. Alvir, D. Alemayehu, T. Symonds). 2013. *Patient-Reported Outcomes: Measurement, Implementation and Interpretation.* Chapman & Hall/CRC. In press.

(with A.G. Bushmakin). 2013. Interpretation of patient-reported outcomes. *Statistical Methods in Medical Research*. In press. E-pub ahead of print.

(with D.M. Sobieraj, W.L. Baker, O.J. Phung, C.M. White, C.I. Coleman). 2013. Methods used to conduct and report closed loop Bayesian mixed treatment comparisons published in the medical literature: A systematic review. *BMJ Open* (British Medical Journal Open). In press.

(with K.H. Zou, A.G. Bushmakin, M.O. Carlsson, T. Symonds). 2013. Cumulative response curves to enhance interpretation of treatment differences on the Self-Esteem And Relationship questionnaire for men with erectile dysfunction. British Journal of Urology *International*. 2013; 11:E115-E120.

Kun Chen (with Dong, H. and Chan, K.-S.) 2013. Reduced rank regression via adaptive nuclear norm penalization. *Biometrika.* In press.

(with Stenseth, N. C. and Chan, K.-S.) 2012. Reduced rank stochastic regression with a sparse singular value decomposition. *Journal of the Royal Statistical Society: Series B*. 74(2), 203-221.

(with Chan, K.-S.) 2011. Subset ARMA model selection via the adaptive lasso. *Statistics and Its Interface*. 4, 197-205.

(with Jiang, W. and Tanner, M.) 2010. A note on some algorithms for the Gibbs posterior. *Statistics and Probability Letters*. 80 (15-16), 1234-1241.

Ming-Hui Chen (with Q. Chen, D. Ohlssen and J.G. Ibrahim) 2013. Bayesian modeling and inference for clinical trials with partial retrieved data following dropout. *Statistics in Medicine*, 32, 4180-4195.

(with J.G. Ibrahim, A.K. Shah, J. Lin and H. Yao (2012). Meta-analysis methods and models with applications in evaluation of cholesterol lowering drugs. *Statistics in Medicine*, 31, 3597-3616.

(with A.V. D'Amico, M. de Castro, M. Loffredo, D.S. Lamb, A. Steigler, P.W. Kantoff and J. W. Denham) (2012). Surrogate endpoints for prostate cancer-specific mortality after radiation

and androgen suppression therapy in men with localised or locally advanced prostate cancer: an analysis of two randomised trials. *The Lancet Oncology*, 13(2), 189-195.

(with J.G. Ibrahim, P. Lam, A. Yu and Y. Zhang) 2011. Bayesian design of non-inferiority trials for medical devices using historical data. *Biometrics,* 67, 1163-1170.

Zhiyi Chi (with C. Guan, P.B. Luh, and L.D. Michel) 2013. Hybrid Kalman filters for very short-term load forecasting and prediction interval estimation. *IEEE Trans. Power Systems*. In press.

2012. On exact sampling of nonnegative infinitely divisible random variables. *Advances in Applied Probability,* 44(3), 842-873.

2011. Effects of statistical dependence on multiple testing under a hidden Markov model. *Annals of Statistics,* 39(1), 439-473.

2010. Multiple hypothesis testing on composite nulls using constrained p-values. *Electronic J. Statistics,* 4, 271-299.

Dipak K. Dey (with M.O. Prates, R. H. Aseltine, Jr., J. Yan) 2013. Assessing intervention efficacy on high-risk drinkers using generalized linear mixed models with a new class of link functions. *Biometrical Journal*. In press.

(with R.Fu and K. Holsinger) 2011. A beta mixture model for assessing genetic population structure. *Biometrics*, 67(3), 1073-82.

(with V. Lachos and D. Bandopadhyay) 2011. Linear and non-linear mixed-effects models for censored HIV viral loads using normal/independent distributions. *Biometrics*, 67(4), 1594-604.

(with R. Liu, D. Boss, P. Marquet and B. Javidi) 2011. Recognition and classification of red blood cells using digital holographic microscopy and data clustering with discriminant analysis. *Journal of the Optical Society of America*, A, 28 (6), 1204-1210.

Joseph Glaz (with Wu, Tu.-L. and Fu, J. C.) 2013. Discrete, continuous and conditional variable window scan statistics. *Journal of Applied Probability*, in press.

(with Wang, X.) 2013. Variable window scan statistics for normal data. *Communications in Statistics-Theory and Methods Ser. A.,* in press.

(with Chen, J.) 2013. Scan statistics for monitoring data modeled by a negative binomial distribution. Proceeding of the XV International Symposium on Applied Stochastic Models and Data Analysis, June 25-28, 2013, Barcelona, Spain, in press.

(with Naus, J. and Wang, X.) 2012. Approximations and bounds for distribution of moving sums of normal random variables. *Methodology and Computing in Applied Probability* 14, 597-616.

Ofer Harel (with Chung, H. and Miglioretti, D.) 2013. Latent class regression: inference and estimation with two-stage multiple imputation. *Biometrical Journal*, 55(4), 541–553.

(with Boyko, J.) 2013. Missing data: Should we care? *The American Journal of Public Health*, 103(2), 200-201.

(with Siddique, J. and Crespi, C.M.) 2012. Addressing missing data mechanism uncertainty using multiple-model multiple imputation: application to a longitudinal clinical trial. *Annals of Applied Statistics*, 6(4), 1814-1837.

(with J.L. Schafer) 2009. Partial and latent ignorability in missing-data problems. *Biometrika*, 96, 37-50.

Sangwook Kang (with S. Chiou, and J. Yan) 2013. Fast accelerated failure time modeling for case-cohort data. *Statistics and Computing*, *DOI 10.1007/s11222-013-9388-2*.

(with J. Cai, L. Chambless) 2013. Marginal additive hazards model for case-cohort studies with multiple disease outcomes: an application to the Atherosclerosis risk in communities (ARIC) study. *Biostatistics*, 14(1), 28-41.

(with Y. Yoon, C. Park, and C. Hofmeister) 2012. Group variable selection in cardiopulmonary cerebral resuscitation data for veterinary patients. *Journal of Applied Statistics*, 39(7), 1605-1621.

Lynn Kuo (with C. Song) Dynamic frailty and change point models for recurrent events data. *Journal of the Iranian Statistical Society*, 2013. 12 (1) 127-151.

(with Y. Zhao, MH Chen, B. Pei, D. Rowe, D-G Shin, W. Xie, and F. Yu) 2012. A Bayesian approach to pathway analysis by integrating gene-gene functional directions and microarray data, *Statistics in Biosciences*, 4(1), 105-131**;** DOI 10.1007/s12561-011-9046-1

(with F. Yu, M.H. Chen, P. Huang and W. Wang) 2011. Bayesian hierarchical modeling and selection of differentially expressed genes for the EST data. *Biometrics*, 67, 142-150.

(with C. Song, C. A. Derby, R. B. Lipton, and C. B. Hall) 2011. Multi-stage transitional models with random effects and its application to the Einstein Aging Study, *Biometrical Journal*, 53(6) 938-955.

Nitis Mukhopadhyay (with Bhargab Chattopadhyay) 2013. Asymptotic expansion of percentiles for a sample mean standardized by GMD: An application in the normal case. *Journal of Japan Statistical Society*, 42, 165-184.

(with Sankha Muthu Poruthotage) 2013. Sequential fixed-width confidence interval procedures for the mean under multiple boundary crossings. *Sequential Analysis*, 32, 83-109.

(with Mun S. Son) 2013. Ratios X/Z, Y/Z built from independent random variables (X,Y) and Z may not always be dependent. *Statistical Methodology*, 14, 62-66.

(with Swarnali Banerjee) 2013. Sufficiency, Fisher information, and ancillarity: Some clarifications. *Metron*, 71, 33-38.

Nalini Ravishanker (with A. Thavaneswaran, and Y. Liang, Y) 2013. Inference for linear and non linear stable error processes via estimating functions. *Journal of Statistical Planning and Inference,* 143(4): 827-841.

(with J. R. M. Hosking and J. Mukhopadhyay) 2010. Spectrum-based comparison of stationary multivariate time series. *Methodology and Computing in Applied Probability,* 12(4), 749-762.

(with Jeffrey S. Pai) 2009. A multivariate preconditioned conjugate gradient approach for maximum likelihood estimation in vector long memory processes. *Statistics and Probability Letters,* 79(9), 1282-1289.

(with J. P. Nolan) 2009. Simultaneous prediction intervals for ARMA processes with stable innovations. *Journal of Forecasting*, 28, 235-246.

Elizabeth Schifano (with T. Sofer, J.A. Hopping, L. Hou, and A.A. Baccarelli) 2013. A-clustering: a novel method for detection of co-regulated methylation regions, and regions associated with exposure. *Bioinformatics*, (advance access) doi:10.1093/bioinformatics/btt498

(with L. Li, D.C. Christiani, and X. Lin) 2013. Genome-wide association analysis for multiple continuous secondary phenotypes. *American Journal of Human Genetics*, 92(5), 744−759.

(with R.L. Strawderman and M.T. Wells) 2013. Hierarchical Bayes, maximum a posteriori estimators, and minimax concave penalized likelihood estimation. *Electronic Journal of Statistics*, 7, 973−990.

(with M.P. Epstein, L.F. Bielak, M.A. Jhun, S.L.R. Kardia, P.A. Peyser, and X. Lin) 2012. SNP set association analysis for familial data. *Genetic Epidemiology*, 36, 797−810.

Alexander Tartakovsky (with I. Nikoforov and M. Basseville) 2013. *Sequential Analysis:*

Hypothesis Testing and Change-Point Detection, Chapman & Hall/CRC, in press.

2013. *Rapid Detection of Attacks in Computer Networks by Quickest Changepoint Detection Methods, in Data Analysis for Network Cyber-Security*, Imperial College Press, 2013, in press

(with G. Fellouris) 2013. Almost minimax sequential tests of composite hypotheses. *Statistica Sinica*, 23-4 (Invited paper for special issue in honor of the 70th birthday of Professor David Siegmund).

(with A.S. Polunchenko) 2012. State-of-the-Art in sequential change-point detection. *Methodology and Computing in Applied Probability*, vol. 14, no. 3, pp. 649–684, 2012.

Naitee Ting (with X. Wang) 2012. A proof-of-concept clinical trial design combined with dose-ranging exploration. *Biopharmaceutical Statistics*, wileyonlinelibrary.com DOI: 10.1002/pst.1525

2011. Phase 2 clinical development in treating chronic diseases, *Drug Information Journal* 45-4, 431-442

2010. *Classical Dose-Finding Trial* in *Handbook of Adaptive Designs in Pharmaceutical and Clinical Development*, CRC Press, 9-1-9-19.

2009. Practical and statistical considerations in designing an early phase II osteoarthritis clinical trial: a case study, *Communications in Statistics – Theory and Methods*, 38, 3282-3296

Rick Vitale 2010. Convex bodies and Gaussian processes. *Image Analysis and Stereology*, 29, 13–19.

2008. On the Gaussian representation of intrinsic volumes. *Statistics and Probability Letters*, 78, 1246–1249.

(with Y. Wang) 2008. The Wills functional for Gaussian processes. *Statistics and Probability Letters*, 78, 2181–2187.

2007. Multivariate medians and measure-symmetrization. In: Proceedings, Vardi Memorial Conference (R. Liu, W. Strawderman and C-H Zhang, eds.). *Institute of Mathematical Statistics Lecture Notes -- Monograph Series*, 54, 260–267.

Xiaojing Wang (with J. O. Berger and L. Shen) 2013. A Bayesian approach to subgroup identification. *Journal of Biopharmaceutical Statistics*. In press.

(with J. O. Berger and D. S. Burdick) 2013. Bayesian analysis of dynamic item response models. *Annals of Applied Statistics*, 7(1):126-153.

(with Y. Zhou, A. T. K. Wan and S. Xie) 2010. Wavelet analysis of change-points in a nonparametric regression with heteroscedastic variance. *Journal of Econometrics*, 159 (1): 183-201.

(with Y. Zhou, A. T. K. Wan) 2008. Estimating equations inference with missing data. *Journal of the American Statistical Association*, 103 (483): 1187-1199.

Jun Yan (with Wang, X. and Ma S.) 2013. Augmented estimating equations for semiparametric panel count regression with informative observation times and censoring time. *Statistica Sinica* 23(1): 359-381.

(with Aseltine, R. and Harel, O.) 2013. Comparing regression coefficients between nested models for clustered data with generalized estimating equations. *Journal of Educational and Behavioral Statistics* 38(2): 172-189.

(with Kojadinovic, I.) 2012. Goodness-of-fit testing based on a weighted bootstrap: A fast large-sample alternative to the parametric bootstrap. *Canadian Journal of Statistics* 40(3): 480-500.

(with Huang, J.) 2012. Model selection for time-varying coefficient Cox models. *Biometrics* 68(2): 419-428.

b. For each vacant or proposed faculty position, provide title, position qualifications, areas of teaching specialization, and proposed date of appointment.

One assistant professor in Genomics to be filled by August 2014.

6. CURRICULA AND INSTRUCTION

a. Identify and describe each major component of the program (major or specialization, general education, thesis, etc.); specify credit requirements for each component. Indicate the required sequence of courses and established prerequisites. Attach appropriate excerpts from the catalog.

Degree Requirements: Minimum of 31 credits.

Required Courses: (Each course has 3 credits except Stat. 5099 Student Seminar).

Stat. 5099. Investigation of Special Topics, Student Seminar (PS, ELS) (1 credit)
Stat. 5505. Applied Statistics I (PS, CL)
Stat. 5605. Applied Statistics II (PS, CL)
Stat. 5515. Design of Experiment (PS, CL)

Stat. 5585. Mathematical Statistics I (PS)
Stat. 5685. Mathematical Statistics II (PS)
Stat. 5625. Introduction to Biostatistics (PS, CL)
Stat. xxxx. Data Management and Programming in SAS and R (CL, PS)
Stat. xxxx (6494). Statistical Consulting (PS, CL, ELS)
Elective I: one course from the following three courses:
Stat. 5635. Clinical Trial (PS, CL)
Stat. 5645. Survival Analysis (PS, CL)
Stat.xxxx(6494). Epidemiology (PS, CL)
Elective II: one course from the following list, except the course chosen in Elective I:
Stat. 5635. Clinical Trial (PS, CL)
Stat. 5645. Survival Analysis (PS, CL)
Stat. 6494. Epidemiology (PS, CL)
Stat. 3965. Elementary Stochastic Processes (PS)
Stat. 4875. Nonparametric Methods (PS, CL)
Stat. 5361. Statistical Computing (CL, PS)
Stat. 5525. Sampling Theory (PS, CL)
Stat. 5665. Applied Multivariate Analysis (PS, CL)
Stat. 5725. Linear Models I (PS)
Stat. 5825. Applied Time Series (PS, CL)
Stat. 6494. Applied Bayesian Data Analysis (PS, CL)
Stat. 6494. Bioinformatics I (PS, CL)
Stat. 6494. Bioinformatics II (PS, CL)
Stat. 6494. Categorical Data Analysis (PS, CL)
Stat. 6494. Longitudinal Data Analysis (PS, CL)
Stat. 6494. Environmental Statistics (PS, CL)
Stat. 5099. Independent Study (PS, CL, ELS)
Or one course involving the application of biostatistics offered by any other departments on campus approved by the student's advisory committee.

Content Key
PS (problem solving), CL (computer literacy), ELS (ethical, legal, social aspects)

The recommended sequences of courses are:
First Semester: Stat. 5505. Applied Statistics I
Stat. 5585. Mathematical Statistics I
Stat. 5625. Introduction to Biostatistics
Stat. xxxx. Data Management and Statistical Programming in SAS and R

There are two recommended sequences for the second and third semesters. Each student needs to consult with his/her major advisor to choose the most suitable sequence:

(1) Choice I:

Second Semester:	Stat. 5605. Applied Statistics II
	Stat. 5685. Mathematical Statistics II
	Stat. 5515. Design of Experiments
	Elective I (Elective II)
Third Semester:	Stat. xxxx (6494). Statistical Consulting
	Elective II (Elective I)
	Stat. 5099. (1 credit). Investigation of Special Topics, Student Seminar

(2) Choice II:

Second Semester:	Stat. 5605. Applied Statistics II
	Stat. 5685. Mathematical Statistics II
	Stat. 5515. Design of Experiments
	Stat. 5099. (1 credit) Investigation of Special Topics, Student Seminar
Third Semester:	Stat. xxxx (6494). Statistical Consulting
	Elective I
	Elective II

Advisory Committee

Three members of the Graduate faculty in the Biostatistics Program Development Committee will be selected to serve as the advisory committee for each candidate for the Professional Master's of Science in Biostatistics. The Advisory Committee will assist students in the selection of courses best suited to meet her/his career aspirations.

Plan of Study

The student will prepare a Plan of Study containing the courses he or she takes to fulfill her/his MS degree requirements, before taking the Exit Exam. The Advisory Committee and the Executive Committee of the Graduate School has to approve it.

Exit Examination

The final requirement for the Professional Master Degree is a passing grade on a comprehensive written exam covering the basic material from six courses taken in the first year. The exam has two parts with theory and application tested separately. The theory exam is based on the courses: Mathematical Statistics I and II (Stat. 5585 and 5685). The applications exam is

based on the following courses: Applied Statistics I and II (Stat. 5505 and 5605), Design of Experiment (Stat. 5515), and Introduction to Biostatistics (Stat. 5625).

b. Give the number, title, and a narrative course description for each course in the major area of specialization in the proposed program, noting which courses are new. Attach appropriate excerpts from the catalog.

Stat. xxxx. Data Management and Programming in SAS and R (New Course)

Introduction to concepts and techniques in the computerized management of research data in public health and biomedicine using computer software such as SAS and R. Students get hands on experiences on creating and managing biomedical, clinical trials, and epidemiology data sets and using SAS, R, and Epi-Info procedures to conduct basic statistical analyses. Topics include: research data management, computers and operating systems, R and SAS programming, graphics, public health databases, working with human subjects data (data security and Hippa requirements, Institutional Review Boards, data and Safety Monitoring Boards in Clinical Trials), data quality monitoring and assurance, archiving, working with Structured Query Language (SQL), basic statistics analysis with R and SAS, and report writing.

Stat. xxxx (6494). Statistical Consulting (Was offered occasionally on experimental basis)

Prerequisites: Stat 5505/5605 and Stat 5515 or equivalent.

Introduction to basic concepts of a statistical consulting process. Human side (non-statistical aspect) of statistical consulting including the role of the consultant; conducting meetings with clients; interpersonal and communication skills (written and verbal), interaction with clients; principles of good consulting practice - learning to critique consulting sessions; and ethics, professional conducts, and authorships. Solving statistical consulting problems including design an experiment that fits the need of the clients; power and interval-width based sample size determination; data handling, data validation and summary data descriptions; quality graphical display; statistical modeling with clear statements of assumptions made; and goodness of fit and model validation. During the semester, students will interact with clients and make class presentations.

Statistics 3965. Elementary Stochastic Processes

Prerequisite: Statistics 3025Q or 3375Q or 5585 or consent of instructor.

Conditional probability and expectation, moments and distribution of random sums,

transition probabilities of Markov chains, first step analysis of Markov chains, long run behavior of Markov chains, classification of states, homogeneous and nonhomogeneous Poisson processes, interarrival time and waiting time distributions, spatial Poisson process, compound Poisson process, birth and death processes, branching processes, queuing processes with exponential interarrival times and service times.

Statistics 3515Q/5515. Design of Experiments

Prerequisite: A previous statistical methods course and consent of instructor.

Completely randomized, randomized block, Latin squares, nested and repeated measures designs, multiple comparisons, factorial experiments, random and mixed models, confounding and fractional factorials, analysis using SAS computer package.

Statistics 4875. Nonparametric Methods

Prerequisite: Statistics 3375Q or 5585 or consent of instructor.

Intuitive approach and basic concepts, one and two-sample problems, estimation, testing and confidence procedures, small sample and asymptotic distribution theory, Pitman efficiency, K sample problems, rank correlation.

Statistics 5099. Student Seminar/Internship

Each student is required to make a one hour presentation. The topics can be his/her internship experience, a high-impact article in his/her research area, or his/her original research.

Stat. 5099. Independent Study (PS, CL, ELS) 1 to 6 credits.

This course is arranged with the consent of individual faculty member.

Statistics 5505-5605. Applied Statistics

Prerequisites: A previous statistical methods course, calculus, and/or consent of instructor.

Statistics from a data analytic viewpoint incorporating parametric and nonparametric methods, exploratory data analysis, graphical methods, one-sample problems, jackknifing, bootstrapping, robustness, two-sample problems, k-sample problems including one-way ANOVA, randomized block designs, two-way ANOVA, additivity, simple linear regression,

multiple linear regression, analysis of covariance, categorical data.

Statistics 5361. Statistical Computing

Prerequisite: Statistics 3025Q, 3445 or 5685 and/or consent of instructor.

An introduction to computing for statistical problems and research. Topics covered are basic numerical methods, nonlinear statistical methods, numerical integration and differentiation, random generation, and simulation. Should time allow, statistical graphics is considered.

Statistics 5525. Sampling Theory

Prerequisite: Statistics 5685 or 3445.

Concepts of sampling error, non-sampling error, bias, sampling designs, simple random sampling with replacement, simple random sampling without replacement, sampling with unequal probabilities stratified sampling, optimum allocation, proportional allocation, ratio estimators, regression estimators, systematic sampling, super population approaches, inference in finite sampling.

Statistics 5585-5685. Mathematical Statistics

Prerequisite: 3 semesters of calculus, the third possibly concurrent.

Distribution and density functions of random variables , conditional probability and independence, moment generating functions and moments, common families of distributions, multi-parameter exponential family, multiple random variables, change-of-variable techniques, models of convergence, central limit theorem, distribution of order statistics, sufficiency principle, minimal sufficiency, ancillarity, completeness, likelihood principle, point estimation, interval estimation, hypothesis testing, evaluation of estimators and tests.

Statistics 5625. Introduction to Biostatistics

Rates and proportions, sensitivity, specificity, two-way tables, odds ratios, relative risk, ordered and non-ordered classifications, trends, case-control studies, elements of regression including logistic and Poisson, additivity and interaction, combination of studies and meta-analysis.

Statistics 5635. Clinical Trials

Basic concepts of clinical trial analysis: controls, randomization, blinding, surrogate

endpoints, sample size calculations, sequential monitoring, side-effect evaluation and intention-to-treat analyses. Also, experimental designs including dose response study, multicenter trials, clinical trials for drug development, stratification, and cross-over trials.

Statistics 5645. Concepts and Analysis of Survival Data

Survival models, censoring and truncation, nonparametric estimation of survival functions, comparison of treatment groups, mathematical and graphical methods for assessing goodness of fit, parametric and nonparametric regression models.

Statistics 5665. Applied Multivariate Analysis

Prerequisite: Matrix algebra, a prior statistical methods course, Statistics 3375Q or 5585 or consent of instructor.

Multinormal techniques with applications, topics covered: Hotelling's T^2 test, multivariate analysis of variance, discriminant analysis, principal components, factor analysis, cluster analysis, introduction to and use of SAS computer package.

Statistics 5725. Linear Models I

Prerequisites: Statistics 5685 or 3445, linear algebra, consent of instructor.

Introduction to matrices with applications in statistics, multivariate distribution theory, distribution of quadratic forms, theory for the full rank and less than full rank model (including geometric developments), analysis of covariance, comparison of regression and dummy variable modeling.

Statistics 5825. Applied Time Series

Introduction to prediction using time-series regression methods with non-seasonal and seasonal data. Smoothing methods for forecasting. Modeling and forecasting using univariate autoregressive moving average models.

Stat. 6494. Applied Bayesian Data Analysis (PS, CL)

Prerequisite: STAT 5585 and STAT 5685 or equivalent.

The focus of this course is primarily on applications of Bayesian methods. Topics to be covered include fundamentals of Bayesian inferences, standard normal theory inference problems (regression and ANOVA), hierarchical models, Bayes estimation and hypothesis

testing (Bayes factor), summarizing and reporting of Bayesian analysis (Bayesian standard error, Bayesian credible interval, and HPD interval), prior elicitation, model identifiability, Bayesian model building, comparisons and diagnostics, basic simulation techniques such as rejection/acceptance algorithm and inverse CDF method, methods for sampling from posterior distributions such as Gibbs sampler and Metropolis-Hastings algorithm, and Monte Carlo integration, Bayesian sample size calculation and application of Bayesian methods to categorical data analysis may also be discussed when time permits. SAS and WinBUGS will be used in this course.

Stat. 6494. Bioinformatics I and II (PS, CL)

Computational and analytical methods for extracting embedded information from massive amount of DNA sequence data and protein structure data in genomics. Topics include sequence alignment, high throughput sequencing technology, RNA Sequence data analysis, gene expression studies, data mining, visualization, clustering, evolution and phylogenetics, proteomics and functional genomics, integrative genomics, and system biology and Bayesian network. Hands on experience with the R language will also be given.

Stat. 6494. Categorical Data Analysis (PS, CL)

Prerequisites: Stat 5585 and Stat 5685 or equivalent.

Sampling models for categorical data --- Poisson, multinomial, product multinomial, generalized hypergeometric, inter relationship; analysis for a 2 x 2 table, normal and chi-square approximations, continuity corrections, Fisher's exact test; prospective and retrospective studies, sensitivity, specificity; odds ratios and interval estimates --- the use of the ``delta'' method, exact interval estimates, Bayesian approaches; correlated 2 x 2 tables, McNemar's test, Simpson's paradox, combining 2 x 2 tables, Mantel-Haenszel approach, R x C tables, trend tests, association for R x C tables, log-linear models for R x C tables, log-linear models for three way tables, model selection, goodness of fit, residual analysis, logistic regression, probit regression, complementary log-log regression, other link functions (skewed versus symmetric), Poisson regression, correlated categorical (binary and ordinal) regressions, and Bayesian analysis.

Stat. 6494. Longitudinal Data Analysis (PS, CL)

Prerequisites: Stat 5585 and Stat 5685 or equivalent.

Modern methods for analyzing repeated measurements of subjects over time, regression analysis for correlated data, various programs in SAS including PROC MIXED, applications to real world studies.

Stat. 6494. Environmental Statistics (PS, CL)

Prerequisite: Applied statistics (STAT 5505/5605) or equivalent or consent of instructor.

This course covers the statistical analysis and modeling of spatial data with intended applications in environmental sciences. Analysis of three types of spatial data will be covered.

• Geostatistical data (point referenced data) are observed from sites that may or may not be regularly spaced in a continuous space. Geostatistics is a collection of statistical tools about modeling, identification and separation of small and large scale variations, prediction (or kriging) at unobserved sites, and reconstruction of whole underlying random field.

• Lattice data (areal data or data on a fixed network) are observed from sites indexed by a discrete non-random spatial set. Goals for these types of data include constructing and analyzing explicative models, quantifying spatial correlations, prediction and image restoration.

• Spatial point data are random sites in space. A central question in the statistical analysis of point pattern is to know if the distribution of points is essentially regular, completely random, or aggregated.

In addition, analysis of spatial extremes data, which are extreme value analysis in a spatial context, will be covered.

c. Indicate any requirements and arrangements for clinical affiliations, internships, and practice or work experienced. Describe how these will be administered and furnish the following assurances.

Consulting opportunities may be provided, but not required, at our Statistical Consulting Services that provide advice on design of experiments, statistical data analysis, and interpretation of results to our graduate students, faculty, and external clients. Internships will be encouraged and may be arranged, but not required, through our connections with the UConn Health Center, the Connecticut Institute for Clinical and Translational Sciences (CICATS), Center for Public Health and Policy (CPHHP), Center for Health, Intervention, and Prevention (CHIP), Agricultural, Business, Education, Engineering, and Nursing Schools, Pfizer, Boehringer Ingelheim, and other pharmaceutical companies. We require each student to take Stat5099 (Investigation of Special Topics, Student Seminar) before graduation. In this course, students will be encouraged to present a report on their consulting or internship projects.

7. RESOURCE CENTERS AND LIBRARIES

a. Number of volumes, periodicals, and other materials in the major field and related subject areas

The University of Connecticut Libraries have the largest public research collection in the state. The collection includes books, print and electronic periodicals, microfilm, maps, sound and video recordings, musical scores, and an ever growing array of electronic resources, including e-books, streaming audio and video collections, as well as art and photographic image databases. The Babbidge Library also houses a Map and Geographic Information Center (MAGIC), which is the largest public map collection in New England and a nationally acclaimed resource for geospatial data. MAGIC, in collaboration with several other campus departments, operates the Connecticut State Data Center, the state's official liaison to the U.S. Census Bureau, which provides a single portal for all socioeconomic data for the state and its municipalities. Also included are an Art & Design Library and reading room; the Roper Center Public Opinion Archives; comprehensive collections of current and retrospective Federal and Connecticut documents; extensive video and audio collections; and two video theaters. Other libraries on the Storrs campus include the Pharmacy Library in the Pharmacy/Biology building, and the Archives & Special Collections at the Thomas J. Dodd Research Center. (http://www.lib.uconn.edu/about/overview.html).

8. ADMISSION POLICIES

For the graduate program, describe specific admission requirements.

Graduate School regulations and policies will govern admission to the program. These regulations require

1. Completed Application for Graduate Admission and Residence Affidavit.
2. One set of official transcripts and certification that the degree has been awarded.
3. TOEFL (or IELTS) taken within two years from the date of application. A minimum score of 550 for the paper-based TOEFL, 213 for the computer-based TOEFL or 80 for the internet-based TOEFL. A minimum score of 6.5 of IELTS may be used to substitute for TOEFL.
4. Completed Course Summary Form
5. Three or four letters of recommendation, at least one of which should be from someone associated with the applicant's most recent academic program. (Letters need not be on special forms.)
6. Personal Statement, a letter describing the applicant's career goals.
7. Scores on verbal, quantitative, and analytic sections of the Graduate Record Examination (GRE) for all applicants.

8. There are no financial aids for students enrolled in this program. Exceptional students who will pursue Ph.D. in Statistics in the program may be considered for financial aids at a later time.

9. Early attention to each of the above items will speed the consideration of the application. The fall application deadline is June 1 (April 1 for international applicants).

9. FACILITIES AND EQUIPMENT

Describe any specialized physical facilities (classrooms, laboratories, offices) and specialized equipment which are necessary to initiate and maintain the program.

All facilities required for this program already exist at the University of Connecticut. With three new faculty and many more graduate students expected, we will need more office space for new faculty and new students.