MASTER OF SCIENCE DEGREE
PROGRAM OF
BIOINFORMATICS & BIOSTATISTICS

GRADUATE STUDENT
HANDBOOK

Updated 7/18/2013
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OVERVIEW

The Program in Bioinformatics & Biostatistics is housed in the University at Buffalo (UB), Roswell Park Cancer Institute (RPCI) Graduate Division. The roots of the program derive from the Biometry program that was discontinued in 1998. In August 4, 2009 the program was revived and updated in order to better align it with current standards. The program now has a strong emphasis in bioinformatics. The program is a joint collaboration between the Department of Biostatistics at RPCI, RPCI’s Division of Bioinformatics and the Department of Biostatistics at UB with contributions from several other departments on campus.

These affiliations, in addition to collaborations with researchers in the Center of Excellence in Bioinformatics, the College of Medicine and Biomedical Sciences, the College of Nursing, the College of Dentistry, the School of Engineering and Applied Sciences, the School of Pharmacy and the School of Public Health and Health Professions, provide a rich environment for the education and training of bioinformaticians and biostatisticians. In addition to their classroom studies, the Program’s students have opportunities to gain practical training through mentored, hands-on data analyses in the context of exciting biological, medical and health science research projects. The program in Bioinformatics and Biostatistics began enrolling students in Fall 2010. It is an exciting environment and an exciting time for bioinformatics and biostatistics at the Roswell Park Cancer Institute.
MISSION OF THE PROGRAM

The mission of the Program of Bioinformatics & Biostatistics is to educate and train bioinformatics and biostatistics scientists; to collaborate with researchers in the basic, medical, and clinical sciences; to conduct methodological research; to collaborate with local, state, or national health institutions; and to serve our Institute, University and the bioinformatics, biostatistics and health-care professions.

TEACHING AND TRAINING PHILOSOPHY

Our philosophy of education is that students best learn what they apply and what they teach. Practical training requirements are included in the MS program. The Program seeks to provide opportunities for students to communicate their knowledge to others, either through classroom presentations, student seminars, or assignment to teaching assistantships.

Faculty bring a philosophy to the classroom and to their mentoring that is consistent with the Program’s goals to promote and extend the proper use of quantitative thinking and skills in the medical sciences, to contribute substantively and methodologically to the advancement of knowledge in medical related disciplines, and to aid the advance of data-driven, evidenced-based medicine, healthcare, public health practice and policy making. This emphasis brings a high degree of relevance to the classroom and enhances students’ opportunities to work as apprentices with faculty. Faculty and students together work with collaborators in the Roswell Park Cancer Institute, the Gynecologic Oncology Group, the University at Buffalo, and at the Hauptman Woodward Institute. Students receive practical training in these environments in parallel to their formal coursework.

We believe in a holistic approach to education. The Program is dedicated to providing a wide variety of educational, research, and collaborative opportunities to students in a friendly, respectful, nurturing, and stimulating environment that promotes intellectual and professional development.

RESEARCH ACTIVITIES

The Program faculties engage in theoretical, methodological, and applied bioinformatics and biostatistical research. This work is often motivated by their collaborations with medical and health science researchers. There is ongoing involvement in medical informatics, cancer research, maternal and child health, research on addictions, and epidemiology. Projects span a wide range of topics such as translational bioinformatics, computational genomics, statistical genetics, genetic epidemiology, microarray and next-generation sequencing data analysis, pattern recognition and classification, proteomics, metabolomics and clinical trials to assess the efficacy of cancer diagnosis and treatments, epidemiologic studies of environmental risk factors, and outcomes research.
PERSONNEL

Associate Dean for Graduate Studies, Roswell Park Graduate Division

Norman J. Karin, Ph.D.
Email: norman.karin@roswellpark.org
Phone Number: 716-845-4630

FACULTY

Chair and Professor

Alan D. Hutson, Ph.D. University of Rochester
Biostatistics, clinical trials design, epidemiological modeling, Bioinformatics, computational methods and order statistics

Vice Chair and Associate Professor

Gregory E. Wilding, Ph.D. University of Rochester
Resampling techniques, Goodness-of-Fit Tests, distributional characterizations, permutation tests, copulas, tests of independence, Biostatistics

Graduate Program Director, Vice Chair and Associate Professor

Song Liu, Ph.D. University at Buffalo
Translational bioinformatics, Computational Genomics and Nonparametric modeling

Associate Professors

Lili Tian, Ph.D. University of Rochester
Design of Clinical Trials, Survival Analysis, statistical genetics, skewed data analysis, analysis of medical expenditure data, cancer research, behavioral studies, health policy issues

Jeffrey Miecznikowski, Ph.D. Carnegie Mellon University
Multiple testing methods, Cancer biomarker development, Image analysis

David Tritchler, Ph.D. Harvard University
Statistical genetics, genomics, high-dimensional data analysis, graphical models
Assistant Professors

Austin Miller, Ph.D. University at Buffalo
Clinical trial, measurement error model, bio-dosimetry and biostatistics

Jianmin Wang, Ph.D. Iowa State University
Sequence analysis, especially next generation sequence analysis, comparative genomics, computational cancer genomics, array analysis and algorithm design

Qianqian Zhu, Ph.D. University at Buffalo
Statistics genetics, genetic epidemiology, pharmacogenomics, high-throughput genetic analysis such as those from genome-wide association and next-generation sequencing studies, rare variant analysis

Rachael Hageman Blair, Ph.D. Case Western Reserve University
Statistical genetics, bioinformatics, data mining, inverse problems, MCMC methods, probabilistic graphical models

William Brady, Ph.D. University at Buffalo
Clinical trial design, exact methods for categorical data, biostatistics, epidemiology

Mina Rho, Ph.D. Indiana University
Sequence Bioinformatics, genomics, especially metagenomics, probabilistic graphical models, machine learning, data mining

Kristopher Attwood, Ph.D. University at Buffalo
Clinical, observational and diagnostic studies, and operations research

STAFF
Ellen Sander – Department Administrator
Pamela Jarrett – Principal Secretary
Dan Wang – Senior Bioinformatician
Li Yan – Senior Bioinformatician
Maochun Qin - Senior Bioinformatician
Adrienne Groman – Senior Biostatistician
Wei Tan - Senior Biostatistician
Lori Shepherd – Project Coordinator

GRADUATE STUDENT ASSISTANTSHIPS AND BENEFITS

General information about financial support is available from the graduate School website: www.grad.buffalo.edu/current
Those students who are not New York residents but who can become residents are required to do so as soon as possible, but no earlier than one year after their initial appointment (http://studentaccounts.buffalo.edu/policies/residency.php).

**Student Health Insurance.** All students are required to demonstrate health insurance coverage. The University at Buffalo offers student health insurance plans for both domestic and international students (http://subboard.com/insurance/).

**ADVISEMENT AND SUPERVISION**

Each student is assigned a faculty advisor to assist in planning a program to meet his/her educational goals and to answer questions relating to graduate studies.

Students are expected to consult with the advisor prior to registration each semester. Failure to do so could result in a student’s program not meeting the requirements necessary for graduation, which may delay or prevent degree conferral.

Administrative questions should be directed to the Program’s Director of Graduate Studies.

If a student wishes to change advisors, he/she should submit a request in writing to the Director of Graduate Studies. Changes will be made with the approval of the new advisor and the Director of Graduate Studies. The program will try to accommodate all student requests.

**GRADUATE PROGRAMS IN BIOINFORMATICS & BIOSTATISTICS**

**MASTER OF SCIENCE DEGREE**

Coursework leading to a Master of Science degree in Bioinformatics & Biostatistics typically takes two years to complete. A minimum of 36 credit hours with cumulative GPA 3.0 or better is required. The student must prepare a thesis for his/her committee and pass a final oral exam, which is a presentation and defense of their thesis project report.

**Core Course Requirements**

- STA 503 Regression Analyses (3)
- STA 521 Introductions to Theoretical Statistics I (3)
  Or
- STA 502 Introduction to Statistical Inference (3)
- STA 525 Statistics for Bioinformatics (3)
- RPN 541 Ethics Seminar (1)
- RPN 530 Oncology for Scientists I (4)
- RPN 532 Oncology for Scientists II (4)
Completion or demonstrated knowledge of the material in STA 511 (Mathematical Analysis for Biostatistics) is a prerequisite for STA 521. Students who have not satisfied this prerequisite must take STA 511 in their first semester in the program. Three semesters of calculus and linear algebra are required before entry into the program.

**Elective Requirements**

Students must take at least 18 hours of masters electives (ME). The following is a list of courses offered by the Program that can be used to satisfy this requirement:

- BCH/Bio 519  Introduction to Bioinformatics (3)
- CSE 503  Computer Science for Non Majors I (3)
- CSE 536  Computational Biology (3)
- CSE 601  Data Mining and Bioinformatics (3)
- PTR 525  Cancer Epidemiology (3)
- SPM 501  Principles of Epidemiology (4)
- SPM 561  Advanced Cancer Epidemiology and Prevention (3)
- STA 509  Statistical Genomics (3)
- STA 511  Mathematical Analysis for Biostatistics (3)
- STA 522  Introduction to Theoretical Statistics II (3)
- STA 504  Statistical Comparisons and Associations (3)
- STA 515  Distribution-Free Inference (3)
- STA 517  Categorical Data Analysis (3)
- STA 526  Design and Analysis of Clinical Experiments (3)
- STA 531  Theory and Methods of Sample Surveys (3)
- STA 536  Statistical Design and Analysis (3)
- STA 537  Sequential Analysis (3)
- STA 545  Statistical Data Mining I (3)
- STA 546  Statistical Data Mining II (3)
- STA 551  Stochastic Processes (3)
- STA 561  Longitudinal Data Analysis and Time Series Analysis (3)
- STA 567  Bayesian Analysis (3)
- STA 571  Special Topics in Statistics (3)
- STA 575  Survival Analysis (3)
- STA 581  Multivariate Data Analysis (3)
- STA 609  Advanced Statistical Genetics (3)

**Supervisory Committee**

The student’s M.S. supervisory committee must be appointed prior to the third semester of study. This committee will advise the student, check on qualifications and progress, evaluate the student’s written report and oral presentation satisfying the practical training requirement, and conduct the final oral exam. This committee must include at least three faculty members from the Program of Bioinformatics & Biostatistics. Students are strongly encouraged to add an
additional committee member from outside the program in their second year, ideally one associated with their practical training project.

**Thesis**

A student who completes the master’s thesis may substitute up to six research hours (STA 600) for two master’s elective courses, provided they complete at least 12 credits of master’s elective courses. A Master’s thesis with general content pre-approved by the student’s advisory committee is required. To replace practical training hours the thesis must include an in-depth analysis of data from the health or biological sciences. An oral presentation of the thesis must be given to the supervisory committee at a seminar announced to all faculty and students of the Program of Bioinformatics & Biostatistics. Two bound copies of the thesis must be submitted to the Graduate School and one bound copy to the Program. Copies should be bound in boards covered with blank imitation leather, with the title and author’s name embossed, not printed, on the front in gold and the author’s last name, degree and year of conferral of the degree on the spine (also in gold). See the section entitled Dissertation and Final Defense for Guidelines for Thesis Preparation.

**ADMINISTRATIVE REQUIREMENTS**

These can be found at [www.grad.buffalo.edu/policies](http://www.grad.buffalo.edu/policies) (see University policy)

**Time Limit to Complete the Degree.** The time limit for obtaining the master’s degree is four years from the date of matriculation in the program, not counting official leaves of absence. Students unable to complete the master’s program within the time limit must petition the Graduate School for an extension of time to complete the degree. Students must provide a detailed description of work completed to date as well as a timeline for completion of the thesis/degree. Normally, extensions are approved for a maximum of one year. A total of more than two years will not be approved. Requests for extensions should be made at least two weeks prior to the deadline for registration in that semester. Graduate Student Petition Forms are available at [http://www.grad.buffalo.edu/forms/select.php](http://www.grad.buffalo.edu/forms/select.php). Be sure to indicate the dates of the extension, the reason for the request, and the intended date of degree completion. The Graduate School will not approve an extension for ‘personal reasons’. You must be specific and present strong justification for your request.

**Application to Candidacy.**

The Application to Candidacy is a document that includes a summary of courses to be applied toward a degree and usually is competed after three semesters. The ATC is available at [http://www.grad.buffalo.edu/forms/students/atc.pdf](http://www.grad.buffalo.edu/forms/students/atc.pdf). Once the ATC has been approved, a student is not required to enroll for 12 credits (9 credits if supported on an assistantship) to be considered full-time for tuition scholarship or student loan purposes. However, no further enrollment in classroom courses will be permitted if seeking full-time status when registered for fewer than 12 (or 9) credit hours. To be certified full time, a student must submit a Certification of Full-Time Status Form. (See section on Certification of Full-Time Status).
**Read Carefully:** The Application to Candidacy (ATC) form must be submitted to the Program a minimum of FOUR weeks before the Graduate School deadline. If the ATC form is not submitted one month prior to the deadline, we cannot guarantee that it will be reviewed and approved in time for the student to graduate as planned.

The Application to Candidacy should be submitted to the program with an unofficial UB transcript and, if applicable, a description of Informal Graduate Coursework Form for any independent study coursework, (i.e. STA 600).

**M-Form.** The *M-form* (Multi-Purpose) is prepared by the Graduate Program Coordinator and given to the student after all degree requirements have been completed. You must provide the title and abstract of your project or thesis to the Graduate Program Coordinator. This form must be signed by the major professor, committee members, and the Director of Graduate Studies to certify that the student has satisfactorily completed ALL academic requirements for the degree. A copy of the *M-Form* is placed in the student’s file. The original must be received at the Graduate School by the following deadlines:

- Friday before spring classes for a February 1 degree conferral
- Last day of spring exams for a June 1 degree conferral
- Friday before fall classes for a September 1 degree conferral

**CHECKLIST FOR M.S. DEGREE CONFERRAL**

- 36 graduate credit hours (including core courses) are completed with at least an overall ‘B’ (3.0) average.

- Satisfactory completion of oral exams (Data Analysis Project or Thesis option).

- Continuous registration from the date of matriculation (unless on an approved leave of absence).

- If beyond the four-year time limit for completion of degree, an approved petition for extension of time to complete the degree is on file in the Graduate School.

- An approved *Application to Candidacy* is on file in the Graduate School with all necessary attachments, including original transcripts.

- *M Form* submitted to the Graduate School within the established deadlines with all necessary attachments.
**EXAMPLE PROGRAMS OF STUDY**

*Master of Sciences Degree*

Note that the sample program of study for the Master of Sciences Degree is meant for students who are receiving partial and/or full tuition stipends and are required to take 9 credit hours per semester. Those students who are not on stipend are required to take 12 credit hours per semester in order to be considered full-time, and may complete the degree program sooner.

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^a This elective may be used for the purpose of preparing the thesis under the course number STA 600.
COURSE DESCRIPTIONS

The course is comprised of required and elective courses from the UB Department of Biostatistics, Department of Social and Preventive Medicine, the RPCI Department of Biostatistics, the RPCI Division of Bioinformatics, the UB Department of Computer Science, the UB Department of Biochemistry, and from UB’s Center for Computational Research (CCR). Also, courses will be contributed from the Roswell Park Cancer Institute (RPCI) graduate programs in Cancer Pathology and Prevention and Cellular and Molecular Biology.

Course Prefix Definitions
BCH -- Courses administered through the UB Biochemistry Department
BYR -- Courses administered through the UB Bioinformatics & Biometry Program
CSE -- Courses administered through the UB Computer Science & Engineering Department
RPN -- administered through the Roswell Park Cancer Institute Interdisciplinary Master of Science Program in Biomedical and Natural Sciences
SPM -- Courses administered through the UB Department of Social and Preventive Medicine
STA -- Courses administered through the UB Biostatistics Program

* Indicates a course that is not available for credit toward a MA degree in biostatistics.

Unless otherwise specified, courses are 3 credit courses.

502 INTRODUCTION TO STATISTICAL INFERENCE
Introduces basic principles of probability and distribution theory and statistical inference. Topics include axioms of probability theory, independence, conditional probability random variables, discrete and continuous distributions, functions of random variables, moment generating functions, central limit theorem, point and interval estimation, maximum likelihood methods, tests of significance, and the Neyman-Pearson theory of testing hypotheses. LEC

503 REGRESSION ANALYSIS
Regression analysis and introduction to linear models. Topics: Multiple regression, analysis of covariance, least square means, logistic regression, and non-linear regression. This course includes a one hour computer lab and emphasizes hands-on applications to datasets from the health sciences. LEC/LAB
Prerequisite: MTH 142 or second course in calculus or permission of instructor.

504 STATISTICAL COMPARISONS AND ASSOCIATIONS
Advanced presentation of statistical methods for comparing populations and estimating and testing associations between variables. Topics: Point estimation, confidence intervals, hypothesis testing, ANOVA models for 1, 2, and k way classifications, multiple comparisons, chi-square test of homogeneity, Fisher’s exact test, McNemar’s test, measures of association, including odds ratio, relative risks, Mantel-Haenszel tests of association, and standardized rates, repeated measures ANOVA, simple regression and correlation. This course includes a one hour computing lab and emphasizes hands-on applications to datasets from the health related sciences. LEC/LAB
Prerequisite: STA 503
*505 INTRODUCTION TO BIOSTATISTICS
(4 CREDITS)
Basic concepts of statistical reasoning, data description, and fundamental methods of statistical
inference applicable to epidemiology with an overview of special topics. LEC/REC
Prerequisite: Enrollment limited to students in the SPM Graduate Program. Concurrent
registration in STA 506 is strongly recommended.

*506 INTRODUCTION TO STATISTICAL COMPUTING
The purpose of this course is to familiarize students with PC-based statistical computing
applications for public health. It is a companion course for STA 505: Introduction to Biostatistics.
The course will develop basic skills in the use of a statistical package through classroom
demonstrations and independent lab assignments that will complement the material covered in
STA 505. The course will emphasize data definition, verification, descriptive and inferential
statistics and graphical presentation. The course will familiarize the students with the use of a
statistical package and give them the skills needed for effective data management, data
manipulation, and data analysis at a basic level. LEC
Prerequisite: STA 505 or 527 or permission of instructor. Concurrent registration in
prerequisite is admissible.

509 STATISTICAL GENOMICS
Statistical tools for analyzing experiments involving genomic data. Topics: Basic genetics and
statistics, linkage analysis and map construction using genetic markers, association studies,
Quantitative Trait Loci analysis with ANOVA, variance components analysis and marker
regression (including multiple and partial regression), QTL mapping with interval mapping and
composite interval mapping, LOD test, supervised and unsupervised methods for gene
expression microarray data across multiple conditions. LEC
Prerequisites: STA 505 and STA 506 or STA 527 and STA 506 or STA 503

511 MATHEMATICAL ANALYSIS FOR BIOSTATISTICIANS
This course provides the background in special topics in mathematics required to succeed in the
biostatistics graduate programs and is required for students who have not had an advanced
calculus and/or matrix algebra course. The basic mathematical concepts relevant to statistical
studies will be discussed. Topics: convergence of sequences of sets, numbers, and functions,
convergence of series, uniform convergence, power series, term by term integration and
differentiation, matrix algebra, and other topics as time permits. LEC
Prerequisite: MTH 241. (Third semester calculus) or permission of instructor.

515 DISTRIBUTION-FREE INFERENCE
Introduces alternate methods for designing and analyzing comparative studies that may be used
when some or all of the assumptions underlying the usual parametric method are questionable.
Topics: 1-, 2-, and k-sample location problems, randomized block and repeated measures designs,
the independence problem, rank transformation tests, randomization tests, the 2-sample dispersion
problem, and other topics as time permits. LEC
Prerequisite: Undergraduate Probability and Statistics course.
517 CATEGORICAL DATA ANALYSIS
This course provides students with useful methods for analyzing categorical data. Topics: Cross-classification tables, tests for independence, log-linear models, Poisson regression, ordinal logistic regression, and multinomial regression for the logistic model. LEC
Prerequisite: STA 504 and STA 522. Concurrent registration in prerequisites is admissible.

521 INTRODUCTION TO THEORETICAL STATISTICS I
Provides student with probability and distribution theory necessary for study of statistics. Topics: axioms of probability theory, independence, conditional probability, random variables, discrete and continuous probability distributions, functions of random variables, moment generating functions, Law of Large Numbers and Central Limit Theorem. LEC
Prerequisite: MTH 431 (Advanced calculus) or concurrent enrollment in STA 511

522 INTRODUCTION TO THEORETICAL STATISTICS II
Introduces principles of statistical inference. Classical methods of estimation, tests of significance, and Neyman-Pearson Theory of testing hypotheses, maximum likelihood methods, and Bayesian statistics are introduced and developed. LEC
Prerequisite: STA 521.

526 DESIGN AND ANALYSIS OF CLINICAL EXPERIMENTS
Introduction to fundamental principles and planning techniques for designing and analyzing statistical experiments. Recommended for students in applied fields. Topics: Justification for randomized controlled clinical trials, methods of randomization, blinding and placebos, ethical issues, parallel groups design, crossover trials, inclusion of covariates, determining sample size, sequential designs, interim analyses, repeated measures studies. LEC
Prerequisite: STA 505 and STA 506, or STA 504 or permission of instructor.

*527 INTRODUCTION TO MEDICAL STATISTICS
(4 CREDITS)
Topics: Descriptive statistics, probability concepts (independence, conditional probability), probability distributions of random variables, sampling distributions, estimation, confidence intervals, hypothesis testing, analysis of variance procedures, linear regression, nonparametric methods. Computers and statistical packages will be used throughout the course. No extensive computer experience is required. LEC/REC
Prerequisite: one Semester of calculus.

531 THEORY AND METHODS OF SAMPLE SURVEYS
Introduction to theory and practice of sample surveys involving collection of statistical data from planned surveys. LEC
Prerequisite: STA 503 or permission of instructor

536 STATISTICAL DESIGN AND ANALYSIS OF EXPERIMENTS
Introduces factorial experiments, fractional factorial experiments, confounding, lattice designs, various incomplete block designs, efficiency of experimentation, and problems of design construction. LEC
Prerequisite: STA 504 or permission of instructor.
537 SEQUENTIAL ANALYSIS
Deals with statistical methods for estimation and testing hypotheses when samples are observed and analyzed sequentially. LEC
Prerequisite: STA 522.

545 STATISTICAL DATA MINING (I)
This course presents the topic of data mining from a statistical perspective, with attention directed towards both applied and theoretical considerations. The focus will be on supervised learning, which concerns outcome prediction from input data. Students will be introduced to a number of methods for supervised learning, including: linear and logistic regression, shrinkage methods, lasso, partial least squares, tree-based methods, model assessment and selection, model inference and averaging, and neural networks. Computational applications will be presented using R and high dimensional data to reinforce theoretical concepts. LEC
Prerequisite: STA 511 or permission of instructor.

546 STATISTICAL DATA MINING (II)
This course presents the topic of data mining from a statistical perspective, with attention directed towards both applied and theoretical considerations. An emphasis will be placed on unsupervised learning methods, especially those designed to discover and exploit hidden structures in high-dimensional data. Topics include: hierarchical and center-based clustering, principal component analysis, data visualization, random forests, directed and undirected graphical models, and special considerations when n>>p. Computational applications to high-dimensional data will be presented using Matlab and R to illustrate methods and concepts. LEC
Prerequisite: STA 511 or permission of instructor.

551 STOCHASTIC PROCESSES
For graduate students who have had an introduction to probability theory and advanced calculus. Concepts, properties, basic theory, and applications of stochastic processes. LEC
Prerequisite: STA 521 or permission of instructor.

561 LONGITUDINAL DATA ANALYSIS AND TIME SERIES
Introduction to methods for analyzing longitudinal and time series data. Topics: Random coefficient regression models, growth curve analysis, hierarchical linear models, general mixed models, autoregressive and moving average models for time series data, and the analysis of cross-section time series data. LEC
Prerequisite: STA 504

567 BAYESIAN STATISTICS
The Bayesian approach to statistical design and analysis can be viewed as a philosophical approach or as a procedure-generator. The use of Bayesian design and analysis is burgeoning. In this introduction to Bayesian methods, we consider basic examples of Bayesian thinking and formalism on which more complicated and comprehensive approaches are built. These include adjusting estimates using related information, the use of Bayes Factors in testing of hypotheses, the relationship of the prior and posterior distributions, and the key steps in a Bayesian analysis. We consider the Bayesian approach that requires a data likelihood (the sampling distribution)
and a prior distribution. From these, the posterior distribution can be computed and used to inform statistical design and analysis. Applications of this technique are presented. LEC

**Prerequisite:** STA 521

### 571 SPECIAL TOPICS IN STATISTICS

Special topics courses provide regular classroom instruction in evolving areas of biostatistics. They are used to educate students on topics that have not yet been included in permanent course offerings. LEC

**Prerequisite:** permission of instructor.

### 575 SURVIVAL ANALYSIS

Provides an advanced course on the use of life tables and analysis of failure time data. Topics: Use of Kaplan-Meier survival curves, use of log rank test, Cox proportional hazards model, evaluating the proportionality assumption, dealing with non-proportionality, stratified Cox procedure, extension to time-dependent variables, and comparison with logistic regression approaches. LEC

**Prerequisite:** STA 504 and 522.

### 581 MULTIVARIATE DATA ANALYSIS

Presents methods for analyzing multiple outcome variables simultaneously, and for classification and variable reduction. Topics: Multivariate normal distribution, simple, partial, and multiple correlation; Hotelling’s T-squared, multivariate analysis of variance, and general linear hypothesis, and discriminant analysis, cluster analysis, principal components analysis, and factor analysis. LEC

**Prerequisite:** MTH 142 (second semester calculus) and STA 505 or STA 527, or STA 503.

### 589 STATISTICAL CONSULTING

(1 CREDIT per semester)
Principles and practices of statistical and biostatistical consulting; supervised experience in consultation; report writing and other aspects of consulting; case studies; participation in discussion of actual cases. LAB

**Prerequisites:** STA 504 or permission of instructor

### 599 GRADUATE STUDENT SEMINAR

(1 CREDIT per semester)
SEM

### 600 INDEPENDENT STUDY

(1-8 CREDITS per registration)
TUT

### 609 ADVANCED STATISTICAL GENETICS

Issues involving whole-genome analysis, model selections for genetic architecture and advanced statistical pattern recognition tools. Topics: Bayesian modeling for genomic data; MCMC and non parametric linkage analysis in pedigree analysis, genetic mapping of complex traits by the EM algorithm; HMM for DNA sequence analysis; Time course models and neural networks for microarray data and so on. LAB
Prerequisites: STA 509 and STA 522, or permission of instructor

RPN 530 ONCOLOGY FOR SCIENTISTS I (4 credits)
First semester of two semester track. Oncology for Scientists Series: Cancer Oncology (Oncology for Scientists) is team-taught by the faculty of the Roswell Park Graduate Division. "Oncology for Scientists" is designed as a two-semester introductory graduate level course on cancer covering the whole range of the disease process from the molecular level to clinical management. The first semester defines the morphological and molecular structure of the cancer cell, covering topics such as the cell cycle, cancer-associated genes, regulation of cancer cell expression, cancer genetics, carcinogenesis, metastasis, apoptosis, and laboratory research techniques. Lectures on cancer epidemiology, prevention, statistics, bioinformatics, and clinical treatment (chemotherapy, diagnostic imaging, radiation therapy, photodynamic therapy) are also presented.

RPN 532 ONCOLOGY FOR SCIENTISTS II (4 credits)
Overview: Second semester of two semester track. The second semester builds upon the theoretical basis of the previous semester, with lectures covering the immune system, hormones, chemotherapy and drug development. A large part of the semester is taught by the Institute medical staff and deals with the clinical and pathological description of various organ systems. Lectures on cancer epidemiology, prevention, statistics, bioinformatics, and clinical treatment (chemotherapy, diagnostic imaging, radiation therapy, photodynamic therapy) are also presented.

RPN 505 ETHICS SEMINAR (1 credit)
Overview: The topics covered include: scientific writing and data handling, biohazards and the worker's right to know, animal use in research, research with human subjects, peer review, proprietary rights, conflict of interest/science and industry, human genome project, science and the media, medical and health care ethics, and identifying and reporting misconduct.

CSE 503 COMPUTER SCIENCE FOR NON MAJORS I
Overview: This course introduces students to algorithm design and implementation in a modern, high-level, programming language (currently, Java). It emphasizes problem-solving by abstraction. There will also be a brief coverage of the social and ethical aspects of computing. Topics include data types, variables, expressions, basic imperative programming techniques including assignment, input/output, subprograms, parameters, selection, iteration, Boolean type, and expressions, and the use of aggregate data structures including arrays and records. Students will also have an introduction to the basics of abstract data types and object-oriented design, as well as the mathematics of computer science such as Boolean algebra, basic number theory, etc.

CSE 536 COMPUTATIONAL BIOLOGY
Overview: Computational Biology studies the problems arising from Biology using algorithmic techniques. Typical problems include: sequencing and alignment of DNA and protein sequences; construction and comparison of evolutionary trees. These problems are of central importance in Biology. The course provides insights that will help students gain a comprehensive understanding of computational problems in Biology, and techniques for designing efficient algorithms for solving these problems. Prerequisite: Basic understanding of programming, or molecular biology and genetics.
CSE 601 DATA MINING AND BIOINFORMATICS
Overview: This course focuses on data mining and data warehousing techniques and their applications in bioinformatics. The course explains the broad scope of bioinformatics, discusses the theory and practice of computational methods and software, and provides insight that will help students gain a comprehensive understanding of the bioinformatics field. Major topics include biological data storage, retrieval, and modeling; data mining literature for biology; distributed and parallel biological databases; visualization tools for biological data analysis; statistical methods for gene expression analysis; molecular sequence analysis; protein-protein interaction analysis; identification and classification of genes and regulatory elements; and biological information integration, interoperability, and bio-ontology.

PTR 525 CANCER EPIDEMIOLOGY
Overview: Provides an in-depth overview of the epidemiology on various cancer sites. Standard methodologies and analytic techniques used in cancer epidemiology will be covered. Attention given to critical review of known or suspected cancer risk factors.

SPM 501: PRINCIPLES OF EPIDEMIOLOGY (4 credits)
Overview: Introduction to the basic principles, methods and uses of epidemiology.

SPM 561: ADVANCED CANCER EPIDEMIOLOGY AND PREVENTION
Overview: Designed for advanced students who are interested in focusing their research on the epidemiology and prevention of neoplastic diseases. Major emphasis will be on understanding of and critical evaluation of current literature regarding epidemiology in etiology, prevention and prognosis of cancer as well as understanding of methodological issues in the epidemiology of benign and malignant neoplastic lesions, their etiology and prevention. Prerequisites: SPM 501, SPM 502.

UNIVERSITY REGULATIONS
See www.grad.buffalo.edu/policies/index.php

TRANSFER CREDIT
Each graduate program determines the applicability of graduate courses offered for transfer credit. Only those graduate courses completed with a minimum grade of ‘B’ (3.0) are eligible as transfer credit. Courses with ‘S’ or ‘P’ grades are not transferable unless the transcript specifically states they are equivalent to a ‘B’ grade or higher. Credits earned in correspondence or undergraduate courses may not be transferred.

Students requesting approval for transfer credit should make their request in writing to the Director of Graduate Studies at the first opportunity after admission to the program and within the first semester of study. A copy of the course outline and description should also be provided. A maximum of 6 credit hours of graduate work may be transferred for the MS. Thesis guidance and research credits are not transferable.
AGE LIMIT FOR PRIOR COURSEWORK

All coursework (whether transfer or UB credits) more than 10 years old must be petitioned at the time of admission to the program. If these credits were included in an approved extension of time limit petition, they are valid only until the expiration date of that petition. Any further extension of the approved time limit for degree completion will require, concurrently, a re-petition for approval of these older courses. Requests for approval of courses more than 10 years old must be petitioned through the Graduate School by completing the Graduate Student Petition Form located on the web at http://www.grad.buffalo.edu/forms/select.php. Appropriate justification of how the course(s) relate to the student’s program and how the student has kept current with the subject matter of each course must be provided.

Prior Coursework Checklist:

- complete (type) Section 1.G. Reason for Petition: Other
- complete Section 2. Justification
- sign Section 3
- forward to the Program (do not send directly to the Graduate School)

REGISTRATION

All students are required to consult their advisor prior to registration, and to register at the beginning of each Fall and Spring semester while matriculated in the program according to the procedures and within the deadlines established by the Office of the Registrar. This includes semesters in which formal courses are taken, and also semesters in which a student is working on their thesis/dissertation/project. No credit will be allowed for work done without proper registration. It is important that students verify their registration.

Registration Deadlines. The registration timetable, course offerings and class schedules are posted on the University’s web site. Continuing students may take advantage of early registration by registering in November for the Spring semester and April for the Fall semester. Registration is continuous through the last day of drop/add. It is financially advantageous to register before the University’s first billing in the third week of July (for Fall) and the third week in December (for Spring).

Registration Checklist:

- verify registration before the add/drop deadline each semester
REQUIREMENTS FOR FULL-TIME REGISTRATION

- Full-time registration is defined as 12 credit hours per semester for students without an assistantship, or 9 credit hours per semester for those students with an assistantship or grant support.
- Full-time registration is a necessary condition of appointment for an assistantship and/or tuition waiver.
- International students must maintain full-time registration as a condition of their student visa.

CONTINUOUS REGISTRATION AND LEAVES OF ABSENCE

- Both full-time and part-time students must register each Fall and Spring semester for a minimum of one credit hour until all degree requirements are met (including the final defense of the thesis/dissertation/project). A zero credit course does not fulfill the requirement for continuous registration.
- Students must register for a minimum of one credit hour in the semester following an approved leave of absence and in the semester of degree conferral.
- Students must be registered in the semester they defend their thesis. They may not be on a leave during the semester the degree is conferred. If a leave of absence terminates at the end of the spring semester, registering for a minimum of one credit hour for the summer session is required for a September degree conferral.

If continuous registration is not possible at any time, the student must secure a leave of absence at least two weeks prior to the start of the semester in which the leave is to begin. Approval for a leave of absence must be petitioned through the Graduate School by completing the Graduate Student Petition Form located on the web at http://www.grad.buffalo.edu/forms/select.php.

- The Graduate School will not approve a leave of absence for ‘personal reasons,’ you must be specific and present strong justification for your request.
- The Graduate School will not approve a leave of absence if a student is not in good academic standing.
- Students may not petition for a leave of absence after the leave has occurred.
- Students returning from a leave of absence are considered re-entering students and must be re-instated in the program in order to register (see section on Re-Entry).

It should be noted that, normally, leaves are approved for a maximum of one year. A total of more than two years will not be approved. Students who are not on a leave of absence and fail to register for a semester are considered having left the University and must reapply to the program in order to re-enter. Financial penalties will apply. The program reserves the right to accept or deny readmission, and to decide what prior course work can be applied to the degree. Therefore, it is important to maintain continuous registration.
NOTE: No credit will be allowed for work done without proper registration.
Leave of Absence Checklist:

- complete (type) Section 1.A. Reason for Petition: Leave of Absence
- complete Section 2. Justification
- sign Section 3
- forward to the Program (do not send directly to the Graduate School)

RE-ENTRY

When a student returns from an approved leave of absence, he/she must request to have their status reactivated by the Program. This request should be made a minimum of two weeks before the start of the semester.

Re-entry Checklist:

- request the Program forward a Student Data Form to the Office of Records and Registration

GRADUATE COURSE CREDIT

Graduate Courses for Graduate Credit is granted only for 500, 600 and 700 level courses provided proper registration requirements are met.

Undergraduate Courses for Graduate Credit requires prior petition and approval by the Dean of the Graduate School. Graduate Student Petition Forms are located on the web at http://www.grad.buffalo.edu/forms/select.php.

The petition must be filed at the time of registration and before the end of drop/add week. A maximum of two undergraduate courses at the 400 level may be taken for graduate credit. All 400 level undergraduate courses that carry four or more credit hours will receive a maximum of three credit hours of graduate credit.
### Undergraduate Courses for Graduate Credit Checklist:

- Complete (type) Section 1.D. Reason for Petition: Undergraduate Course for Graduate Credit
- Provide description of additional work required of the student
- Obtain signature of course instructor
- Complete Section 2. Justification
- Sign Section 3
- Forward to the Program (do not send directly to the Graduate School)

### GRADING

- Students are expected to maintain at minimum a ‘B’ average (3.0)
- Students receiving two or more ‘C’ (or lower) grades may be dismissed from the program.
- Students electing to receive an S/U grade for a course must inform the instructor in writing by the fourth week of the semester, or the letter grade system will prevail. If the instructor approves the request, a copy of the approval should be sent to the program for the student’s file. An ‘S’ grade will be awarded only in those instances where a student’s letter grade would be ‘C’ or better.
- ‘S’ grades are not acceptable for required courses.
- ‘L’ grades are assigned for thesis/dissertation courses where continuing work is to be indicated instead of a final grade. ‘L’ grades automatically convert to ‘S’ grades at degree conferral.

**‘J’ grades denote an invalid grade. Students should immediately consult with the professor to validate their grade or the ‘J’ will revert to a grade of ‘F’ at the end of the following year.**

### REPEATING REQUIRED COURSES

- Students who repeat a course must officially register for it.
- Students are responsible for the tuition for repeated courses even if they are currently receiving a tuition waiver.
- The initial grade will remain on the student’s transcript and be used in calculating the cumulative grade point average (GPA). The first grade from the repeated course will not be used in calculating the degree GPA.
- The repeated course grade will be used in the process of certifying that a student is qualified to graduate, i.e. the Application to Candidacy (ATC) form.
INCOMPLETE GRADES

- A grade of ‘Incomplete’ (‘I’) may be assigned only when the student has been unable to complete all the assigned projects and/or examinations in a course. Such circumstances must be communicated to the faculty member as soon as known, but no later than the end of the semester during which the course is taken.
- A grade of ‘Incomplete’ (‘I’) is not available to students who have not performed a “C” or better in the course material completed.
- A grade of ‘Incomplete’ (‘I’) can not be assigned for thesis/dissertation guidance.
- If an ‘I’ is given, a letter grade must be assigned within two semesters (May 15 for the Spring semester and December 15 for the Fall semester.) If the course requirements are not completed by the deadline, the ‘Incomplete’ will automatically default to an ‘Unsatisfactory’ ‘U’ or ‘F’ grade.

Individual instructors may set their own conditions for removing ‘I’ grades providing the time limit is not longer than specified by the University. Each instructor must clearly state such policy if it differs from that of the University. If there is a valid reason for extending the deadline for removing an ‘Incomplete’ grade, the student may petition the Graduate School prior to the deadline using the Graduate Student Petition Form located on the web at http://www.grad.buffalo.edu/forms/select.php.

**Incomplete Grade Checklist:**

- Be sure to verify the change of grade has been made in the Office of Records and Registration

STUDENT GENERAL PROGRESS REPORTS

The academic progress of each student is reviewed by their advisor at the end of the Spring semester. This review is designed to develop a program most suitable for each student, to discuss their coursework and plans for upcoming registration, and to advise a student of any deficiency in their progress toward degree conferral. Students receive a copy of their progress report for their review and signature. (See Appendix General Progress Report.)

PROGRAM PROBATION

Students who receive a grade of ‘U’, ‘D’ or ‘F’ in any course required for their degree, or whose cumulative GPA falls below 3.0 will have immediate academic review and may be placed on academic probation. Students placed on probation will be notified in writing the terms of the probation and its removal. Students not meeting the written terms of their academic probation may be dismissed from the University.

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COURSE RESIGNATIONS

All course resignations processed within the official deadlines will be indicated as officially resigned by the notation ‘R’ on grade reports, transcripts, and other official University documents. There are no quality points attached to an ‘R’ designation. Resignation from all courses should be done by filing a Graduate Student Exceptional Registration Change Form located on the web at www.grad.buffalo.edu/grad-docs/.

Course Resignation Checklist:

✓ complete Exception Registration Change Form
✓ obtain signature of course instructor(s) indicating approval of the addition(s)/resignation(s)
✓ forward to the Program (do not send directly to the Graduate School)

AUDITING COURSES

A student wishing an “Audit” (N) grade in a course must officially register for the course. The student must also submit a written request to the instructor by the fourth week of class. The instructor’s decision will be final and will be transmitted to the student in writing. A copy of the approval must also be forwarded to the program for the student’s file. A student may re-register for the course at a later date and receive a grade and academic credit for work completed in the re-registered course.

INDEPENDENT STUDY (STA 600)

This course is available as an elective when appropriate to the student’s educational goals. Students must receive approval from both their supervising faculty and the Director of Graduate Studies before registering. Students must provide their supervising faculty with a copy of the Description of Informal Course Work Form (available from the Program) which includes the following (see checklist). The form is signed by both faculty and student and forwarded to the Director of Graduate Studies for approval. A copy of the approved form is placed in the student’s file and the original returned to the student. The Description of Informal Course Work Form must be appended to the Application to Candidacy when filed (see section on Application to Candidacy.)
Independent Study Checklist:

- brief summary of the goals and objectives of the independent study
- syllabus outlining activities to be carried out
- tangible mechanism for assessing student performance, e.g., test, term paper or a grant proposal
- ability to demonstrate that the independent study includes an amount of effort equivalent to the number of credits requested.

CERTIFICATION OF FULL-TIME STATUS

Students who are required to maintain full-time status for the purpose of tuition assistantship/scholarship, loan deferral or immigrant status may be certified as full time when registering for fewer than 12 graduate credit hours (or 9 if receiving a graduate assistantship) if the following conditions have been met:

- all coursework has been completed
- student has maintained full-time status since matriculation in the program
- registration will include a minimum of one credit hour per semester
- student is engaged in full-time research on their thesis/dissertation/project
- the Application to Candidacy form has been completed and signed by all committee members

NOTE: It is not required that the proposal be defended at this time. A photocopy of the signed ATC should be attached to the Certification of Full-Time Status Form and forwarded to the program. The student should retain the original ATC until the proposal has been successfully defended and the committee has approved the abstract form. (See section on Application to Candidacy.)

The Certification of Full-Time Status form is located on the web at http://www.grad.buffalo.edu/forms/select.php. Students must be registered for the semester in which they are filing. M.S. students must file each semester (two semester maximum) in order to be considered full time.

Certification of Full-time Status Checklist:

- complete (type) the Certification of Full-Time Status Form
- obtain signature of academic advisor
- attach photocopy of the ATC form signed by all committee members
- forward to the Program (do not send directly to the Graduate School)

ADDITIONAL INFO ABOUT GRADUATE STUDIES AT UB/RPCI
ACADEMIC HONESTY

ACADEMIC INTEGRITY

The development of intelligence and strengthening of moral responsibility are two of the most important aims of education. Fundamental to the accomplishment of these purposes is the duty of the student to perform all of his or her required work without illegal help.

Academic Integrity at UB Means:
"The University has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect for others' academic endeavors. By placing their name on academic work, students certify the originality of all work not otherwise identified by appropriate acknowledgments."
(Adapted from University of Wisconsin, "Student Disciplinary Guidelines," and University of Delaware, "Academic Comment Honesty and Dishonesty.")

A. The following actions constitute major forms, but not exclusively all forms, of academic dishonesty among students: (a) submission: submitting academically required material that has been previously submitted in whole or in substantial part in another course, without prior and expressed consent of the instructor; (b) plagiarism: copying or receiving material from a source or sources and submitting this material as one's own without acknowledging the particular debts to the source (quotations, paraphrases, basic ideas), or otherwise representing the work of another as one's own; (c) cheating: receiving information, or soliciting information, from another student or other unauthorized source, or giving information to another student, with the intent to deceive while completing an examination or individual assignment; (d) falsification of academic materials: fabricating laboratory materials, notes, reports, or any forms of computer data; forging an instructor's name or initials; resubmitting an examination or assignment for reevaluation which has been altered without the instructor's authorization; or submitting a report, paper, materials, computer data, or examination (or any considerable part thereof) prepared by any person other than the student responsible for the assignment; (e) procurement, distribution or acceptance of
examinations, laboratory results, or confidential academic materials without prior
and expressed consent of the instructor.

PLAGIARISM

DO NOT simply cut-and-paste information from the world wide web or anywhere else and
insert.  www.grad.buffalo.edu/policies/academicintegrity.php

“Falsification of academic materials. Fabricating laboratory materials, notes, reports, or any
forms of computer data; forging an instructor's name or initials; resubmitting an examination or
assignment for reevaluation which has been altered without the instructor's authorization; or
submitting a report, paper, materials, computer data, or examination (or any considerable part
thereof) prepared by any person other than the student responsible for the assignment.”

INFORMATION ABOUT BUFFALO

About RPCI:
http://www.roswellpark.org  Roswell Park Cancer Institute
http://www.roswellpark.org/Education  Graduate Education
http://www.roswellpark.org/Research/Departments/Biostatistics  Department of Biostatistics

About UB:
http://www.buffalo.edu/  University at Buffalo
http://www.phhp.buffalo.edu/  School of Public Health and Health Professions
http://phhp.buffalo.edu/biostat/  Department of Biostatistics
http://gsa.buffalo.edu/  Graduate Student Association

Health/Bioscience Research in Buffalo
http://www.bnmc.org/  Buffalo Niagara Medical Campus
http://www.roswellpark.org/  Roswell Park Cancer Institute
http://www.bioinformatics.buffalo.edu/  Center of Excellence in Bioinformatics
http://www.ria.org/  Research Institute on Addictions
http://www.buffalo.edu/news/fast-execute.cgi/article-page.html?article=60580009
http://www.buffalo.edu/research/
http://www.photonics.buffalo.edu/  
http://www.cubs.buffalo.edu/  
http://www.cognigencorp.com/  
http://www.gaymar.com/  
http://www.fstrf.org/  

About Buffalo
http://www.buffalo.com/  
http://www.buffaloresearch.com/offbeat.html
http://www.onlinebuffalo.com/  
http://www.elmwoodartfest.org  
http://www.bpo.org/  

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http://www.erie.gov/parks/
http://www.buffalozoo.org/
http://www.holidayvalley.com/
http://www.waldengalleria.com/
http://www.broadwaymarket.com/
http://www.buffalonews.com/
http://www.iambuffaloniagarajobs.com/
http://www.nfta.com/Routes/  
Public Transportation
http://www.buffalonet.org/  
History of Buffalo

18,000+ Photos of the Buffalo Area
http://www.webshots.com/search?media=photo&query=Buffalo%2C+NY&