Research Associate Professors

Elena P. Bulgac. M.S. Kharkov (Russia), 1971; Ph.D. Leningrad State (Russia), 1974.

Peter E. Gibbs. B.S. Adelaide (Australia), 1973; Ph.D. 1978.

Elizabeth J. Grayhack. B.A. Lawrence, 1974; Ph.D. Cornell, 1981.

Mohammad Salim. B.S. Karachi (Pakistan), 1967; M.S. 1968; Ph.D. Glasgow (United Kingdom), 1972.

Assistant Professors

Ravi Basavappa. B.S. Duke, 1980; M.S. Clemson, 1983; Ph.D. Chicago, 1991.

Richard M. Bayer, part-time. B.S. Rutgers, 1963; M.S. 1965; Ph.D. 1969.

Fred Hagen, and Center for Oral Biology. B.S., University of California (Davis), 1981; Ph.D. Calgary (Alberta), 1989.

Steven Pascal. B.S. Nebraska Wesleyan, 1985; M.A. Kent State, 1989; Ph.D. Florida State, 1993.

David A. Pearce, and Center for Aging and Developmental Biology. B.Sc. Bath (United Kingdom.); Ph.D. 1990.

YiTao Yu. B.S. Fudan University (China), 1982; M.S. Chinese Academy of Science, 1987; Ph.D. Case Western, 1994.

Research Assistant Professors

Gurrinder Bedi. B.Sc. Panjab University (India), 1968; Ph.D. SUNY (Buffalo), 1981.

Karlene K. Gunter. B.S. Massachusetts Institute of Technology, 1961; Ph.D. University of California (Berkeley), 1968.

Leigh Ann Henrickson. B.S. St. Mary's College (Notre Dame); Ph.D. University of Iowa, 1995.

Scott D. Kennedy. B.A. Minnesota, 1981; M.S. 1984; Ph.D. Rochester, 1988.

Mesut Muyan. D.V.M. Ankara (Turkey), 1980; Ph.D. University of California (Davis), 1991.

Bogdan Polevoda. MS.D. Kiev State University (Ukraine), 1981; Ph.D. Academy of Science (USSR), 1985.

Yuriy Razskazovskiy. B.S. Moscow University, 1980; Ph.D. 1984.

Mark Sowden. B.Sc. Warwick, 1987; D.Phil. Oxford, 1990.

Ina Urbatsch. M.S. University of Kaiserslautern (Germany), 1987; Ph.D. 1990.

Hironao Wakabayashi. M.D. Fukushima, 1988; Ph.D. 1990.

Joachim H. Weber. M.S. Hanover (Germany), 1980; Ph.D. Lubeck, 1990.

Associates

Akiko Koide. B.S. University of Tokyo, 1985; M.S. 1987.

Kermit R. Mercer. B.S. SUNY (Brockport), 1971.

DEPARTMENT OF BIOSTATISTICS

The Division of Biostatistics was founded in 1972 and became a Department in 1990. The primary objectives of the Department are threefold: biostatistical research, collaborative research, and education.

The Department conducts a program of teaching and research in statistical methodology oriented toward the health sciences and in statistical theory and stochastic modeling growing out of research in the health sciences. Research interests include: survival analysis, clinical trial design, order restricted inference, analysis of spatial data, asymptotic methods, Bayesian inference, missing data methods, analysis of quantal response data, robust inference, linear models, higher-order approximations, and graphical methods.

The Department maintains a collection of over 1,100 texts and issues of the major statistical journals dating from 1950.

The Consulting Service of the Department provides services ranging from purely advisory activities to complete management of projects. The Consulting Service is staffed by biostatistics faculty assisted by a supporting staff of computer programmers and research associates and is used regularly by faculty, staff, and students from a wide range of Medical Center departments. Expertise is available in the areas of preclinical, clinical, and observational trial design and analysis; survey design; statistical analysis; computing; protocol development; dataforms development; database management; data quality control; and stochastic modeling. The Department of Biostatistics collaborates extensively in medical research—ranging from in-house and/or single center studies to international multicenter clinical trials and observational studies. Biostatistics faculty are currently active in projects in the Departments of Community and Preventive Medicine, Dental Research, Environmental Medicine, Medicine, Neurobiology and Anatomy, Neurology, Pathology and Laboratory Medicine, Pediatrics, and Psychiatry, as well as other units such as the Cancer Center, the Clinical Research Center, and the Rochester Area Pepper Center.

Up-to-date computer hardware and software are available to support biostatistical research and consulting. The Department operates a network of 22 Sun workstations running the Solaris (UNIX) operating system and 21 PCs running Windows NT. All machines have Internet connections. A full range of supporting hardware and peripherals is available. Statistical software includes SAS, S-Plus, SUDAAN, STATA, Minitab, Mathematica, IMSL, StatXact, EaSt, PASS, EGRET, Sigma Plot, LogXact, Deltagraph, and PEST. Other software includes TeX for technical document production, C++, Fortran 90 and Java compilers, SQL Server for database applications, DBMS Copy, and Office 2000.

Contribution to Medical Education

The Department of Biostatistics is a primary sponsor of the introductory course, Mastering Medical Information, taught at the beginning of the first year. The objective of this part of the course is to provide an appreciation of the use of statistical reasoning in drawing conclusions about populations or groups of individuals, which may then be applied to individual patients.

Biostatistics examines the principles underlying basic methods of statistical analysis, including descriptive statistics and the graphical presentation of data, the analysis of rates, elementary concepts of probability in the context of medical decision making, the analysis of means, linear regression analysis, and methods for the analysis of survival data. Concepts are discussed primarily through examples drawn from a variety of areas in medical research. Emphasis is placed on interpreting data from observational studies and clinical trials in human populations.

Occasional lectures and seminars are given to residents and fellows in various departments.

Contribution to Graduate Education

The Department offers three courses, BST 463, BST 464, and BST 465, open to all graduate students, fellows, and other researchers throughout the Medical Center. These courses cover introductory biostatistics, more advanced biostatistical methods, and design of clinical trials, respectively. See course descriptions below.

Doctoral and Postdoctoral Programs

The Department offers training in statistics and biostatistics at the predoctoral and postdoctoral levels. The doctoral program in statistics, offered in cooperation with faculty of the Program in Statistics in the College, includes a full range of graduate-level courses (see below). Admissions, stipends, and other administrative matters relating to the program may be found in the *Official Bulletin: Graduate Studies.*

Two National Institutes of Health training grants awarded to the Department support postdoctoral training in biostatistics. Researchers have come to the Department for postdoctoral work from programs at the University of Washington–Seattle, University of Arizona, Hebrew University, University of North Carolina–Chapel Hill, University of Chicago, and the University of Leiden. Individuals interested in postdoctoral training in biostatistics should contact Dr. David Oakes, Department of Biostatistics, Box 630, University of Rochester School of Medicine and Dentistry, Rochester, New York 14642-8630.

Courses Offered through the Department of Biostatistics

401. Probability Theory

Prerequisite: MTH 265 or equivalent (or permission)

Probability spaces. Independence. Distributions; characteristic functions; inversion theorems. Convergence; laws of large numbers; central limit theorem.

402. Stochastic Processes

Prerequisite: BST 401

Poisson processes. Markov chains. Birth-death processes. Renewal theory. Martingales. Brownian motion. Branching processes. With applications.

411. Statistical Inference

Prerequisites: STT 203 and MTH 265 or equivalent

Methods of mathematical statistics, including probability distributions, transformations, sampling distributions, statistical models, estimation, hypothesis testing, and confidence intervals for parametric models. Some large-sample methods.

412. Large-Sample Theory and Methods

Prerequisite: BST 411

Weak convergence, asymptotic linearity, local analysis. Large-sample estimation, MLE and M estimates and testing. Wald, likelihood, ratio and score tests. Nuisance parameters. Efficiency. Multinominal chi-square tests.

413. Statistical Decision Theory and Bayesian Analysis

Prerequisite: BST 411

Introduction to statistical decision theory: loss functions, admissibility, minimax, and Bayes procedures. Modern numerical techniques, including Markov chain Monte Carlo.

416. Applied Statistics

Prerequisite: STT 211 or STT 212 or BST 463 or equivalent

One- and two-way analysis of variance. Simple and multiple regression, including analysis of covariance. Analysis of residuals, use of transformations. Topics from contingency table analysis and nonparametric statistics. Emphasis on real examples from biomedical and social sciences. The MINITAB and/or SAS package is used extensively.

421. Sampling Theory

Prerequisite: STT 165 or STT 203

Sampling designs. Theories of inference in finite populations. Selected topics, including sampling with varying probabilities; stratified, systematic, multistage and multiphase sampling; estimation based on ratio and regression methods.

422. Design of Experiments
Prerequisite: BST 416 or BST 464 or BST 476

The design of experiments underlies the collection of data for scientific inference. This course shows basic designs and their principles, e.g., randomization, blocking, use of concomitant information.

426. Linear Models
Prerequisites: STT 203 and some knowledge of matrices

Least-squares theory and Gauss-Markov theorem; hypothesis testing, interval estimation and simultaneous inference in regression, analysis of variance and covariance models; prediction; correlation; generalized inverses; estimable functions; examination of assumptions; model selection techniques; orthogonal polynomials.

441. Applied Multivariate Analysis
Prerequisite: BST 426 or BST 476

Methodology and applications of multivariate analysis. Hotelling's T^2, multivariate regression and analysis of variance. Classification and discrimination. Principal components, clustering, multidimensional scaling. Use of computer packages, including SAS.

450. Robust Data Analysis
Prerequisites: BST 426 and knowledge of computer programming

Statistical analysis of data, with emphasis on interpretation and comparison of alternative models under nonstandard conditions. Efficiency comparisons.

451. Exploratory Data Analysis
Prerequisites: BST 426 and knowledge of computer programming

Statistical analysis, with emphasis on graphical techniques for comparing alternative models.

463. Introduction to Biostatistics

Review of basic statistical and data-analytic methods in medical and clinical research. Topics include summarizing and displaying data, diagnostic tests, hypotheis tests and confidence intervals, methods for comparing means and proportions, and regression analysis. The course is strongly use-oriented, stressing practical understanding and interpretation, not mathematical derivation.

464. Statistical Methods for Biomedical Applications
Prerequisite: BST 463 or equivalent

Statistical analysis of clinical trials and observational studies. Analysis of covariance, multiple regression, logistic regression, log-linear analysis, and survival analysis (Kaplan-Meier curves and the Cox models). Measurement error.

465. Design of Clinical Trials
Prerequisite: BST 463 or equivalent

Design, conduct, and analysis of clinical trials. Sample size, power, randomization. Coordination, data management, compliance, interim analysis, and reporting procedures.

470. Internship/Applied Project
Credit—eight hours

The student works on a medical research and statistical analysis project under the guidance of faculty in statistics/biostatistics or under supervision in an industrial setting. The student's work should form a coherent whole that can be summarized after two to three months of work. Students have contact with medical investigators as well as supervision by statisticians. Students present results in oral and written presentations.

476. Introduction to Linear Models
Prerequisite: STT 203 or STT 212

Vector variables, normal and related distributions. General linear model-matrix formulation. Estimation, prediction, testing and simultaneous inference. Applications to regression and to analysis of variance and covariance of experimental data.

477. Introduction to Statistical Software I
Credit—two hours

Introduction to a statistical programming environment. The software to be introduced may vary from semester to semester. Common choices are SAS and S. Some general theoretical and practical topics in computing are also presented. Individual projects on some advanced topics. This course is generally offered during the first half of a semester.

478. Introduction to Statistical Software II
Credit—two hours

Introduction to a statistical programming environment. The software to be introduced may vary from semester to semester. Common choices are SAS and S. Some general theoretical and practical topics in computing are also presented. Individual projects on some advanced topics. This course is generally offered during the second half of a semester.

479. Modeling Techniques

The generalized linear model, log-linear models for counts, including methods for catergorical data, ordered catergories, logistic and matched logistic regression. Survival analysis, including Kaplan-Meier, logrank, and proportional hazards. Nonlinear least squares.

491. Reading Course at the Master's Level
Credit varies

495. Research at the Master's Level
Credit varies

497. Seminar in Statistical Literature
Credit—one hour

511. Topics in Statistical Inference I
Prerequisite: BST 412 or 413

Advanced topics in statistical inference and/or decision theory.

512. Topics in Statistical Inference II
Prerequisite: BST 412 or 413

Advanced topics in statistical inference and/or decision theory.

513. Analysis of Longitudinal and Dependent Data
Prerequisites: BST 401 and BST 411 and BST 426

Modern approaches to the analysis of longitudinal data, including the random effects model and generalized estimating equation for both continuous and discrete outcomes.

514. Survival Analysis
Prerequisites: BST 411 and BST 412 or BST 402

Parametric, nonparametric, and semiparametric methods for the analysis of survival data. Right censoring Kaplan-Meier curves, logrank and weighted logrank tests. Survival distributions, accelerated life, and proportional hazards models for dependence on explanatory variables. Partial likelihood. Models for competing risks and multiple events.

531. Nonparametric Inference
Prerequisite: BST 411

Statistical procedures based on ranks, order statistics, signs permutations, runs. Testing randomness, symmetry, and independence. Invariance considerations and optimality. Treatment of ties. Distributional problems and asymptotic theory. U-statistics, Chernoff-Savage theorem. Robustness and efficiency.

536. Sequential Analysis
Prerequisite: BST 412

The Wald sequential probability ratio test and generalizations, tests of composite hypotheses, nonparametric sequential procedures. Sequential estimation and confidence intervals. Brownian motion-based sequential methods, with applications to clinical trials. Group sequential methods. Optimal stopping rules.

541. Multivariate Analysis
Prerequisite: BST 411

Multivariate normal distribution and associated distributions. Estimation. Invariance reduction and standard tests for typical hypotheses. Simultaneous confidence bounds. Simultaneous and step-down procedures. Optimality properties.

550. Topics in Data Analysis
Prerequisite: permission of the instructor

Advanced statistical and computer methods for analyzing data from the social and natural sciences.

570. Topics in Biostatistics

Advanced biostatistical techniques.

582. Introduction to Statistical Consulting

Formal instruction on developing and managing consulting relationships.

590. Supervised Teaching
Credit varies

One classroom hour per week of discussion and problem solving with University of Rochester students, under the guidance of a member of the faculty.

591. Reading Course at the Ph.D. Level
Credit varies

Special work for doctoral candidates, arranged individually.

592. Supervised Statistical Consulting
Credit varies

Supervised consulting in statistical analysis, stochastic models, and/or operations research.

595. Research at the Ph.D. Level
Credit varies

597. Statistics Seminar in Current Literature

A comprehensive listing of courses offered in the graduate program in statistics is contained in the *Official Bulletin: Graduate Studies*.

Faculty of the Department of Biostatistics

David Oakes . . . *Professor and Chair*, and Professor of Statistics. B.A. Trinity College, Cambridge (England), 1968; M.A. 1972; Ph.D. Imperial College, London University, 1972.

Professors

Christopher Cox, and Environmental Medicine and Psychiatry. B.A. Brown, 1966; M.A. Illinois (Urbana-Champaign), 1967; Ph.D. 1973.

William Jackson Hall, part-time, and Statistics, Emeritus. A.B. Johns Hopkins, 1950; M.A. University of Michigan, 1951; Ph.D. University of North Carolina, 1955.

Govind S. Mudholkar, and *Statistics.* B.Sc. Poona, 1956; M.Sc. 1958; Ph.D. University of North Carolina, 1963.

Poduri S. R. S. Rao, and *Statistics.* B.A. Kakinada India P.R. College, 1955; M.A. Karnatak University (India), 1957; Ph.D. Harvard, 1964.

Associate Professors

Michael P. McDermott, and Statistics, and Neurology. B.A. Boston College, 1983; M.A. Rochester, 1985; Ph.D. 1989.

Richard F. Raubertas, Oncology and Statistics. B.A. Princeton, 1976; M.A. University of Wisconsin, 1980; Ph.D. 1983.

Assistant Professors

Li-Shan Huang. B.S. National Central University (Taiwan), 1990; M.S. North Carolina (Chapel Hill), 1994; Ph.D. 1995.

Heng Li, and Dentistry. B.S. Zhejiang University (China), 1983; M.S. Harvard, 1989; Ph.D. 1996.

Derick R. Peterson. B.A. Oberlin, 1991; M.A. University of California (Berkeley), 1994; Ph.D. 1998.

Hongwei Zhao. University of Washington, 1994; M.S. Harvard, 1995; Sc.D., 1997.

Associate

Shirley W. Eberly, part-time. B.A. Stanford, 1960; M.S. 1961.

THE JAMES P. WILMOT CANCER CENTER

The James P. Wilmot Cancer Center at the University of Rochester serves the Rochester–Finger Lakes Health Systems of Upstate New York with a population of approximately 1.2 million residents. The Center has broad responsibilities for primary and consultative patient care and the conduct of coordinated programs in cancer education, oncology nursing, clinical research, and basic translational, clinical, and cancer control research.

The clinical research and treatment arms of the Center are part of the Strong Health Care system based at Strong Memorial and Highland Hospitals. Additional affiliate faculty members are at Unity Health System Genesee Street Campus, and Rochester General Hospital. The Cancer Center's Clinical Trials Office monitors and/or approves all clinical research studies conducted at Cancer Center affiliated institutions.

Basic laboratory research programs include signal transduction and transcription, immunology and immunotherapy, and cancer molecular genetics. The Cancer Center also has site-specific research programs in breast cancer, gastrointestinal oncology, genitourinary, and thoracic oncology, which are supported by strong programs in cancer control and prevention. The radiation and pediatric oncology research programs are focused on research relating to the long-term effects of chemotherapy and radiation therapy.

Fundamental research at the Center aims to elucidate the molecular mechanisms of cancer development and progression, and apply the knowledge gained to devising new strategies of detection, prevention, and therapy. Additionally, host responses for a variety of therapies