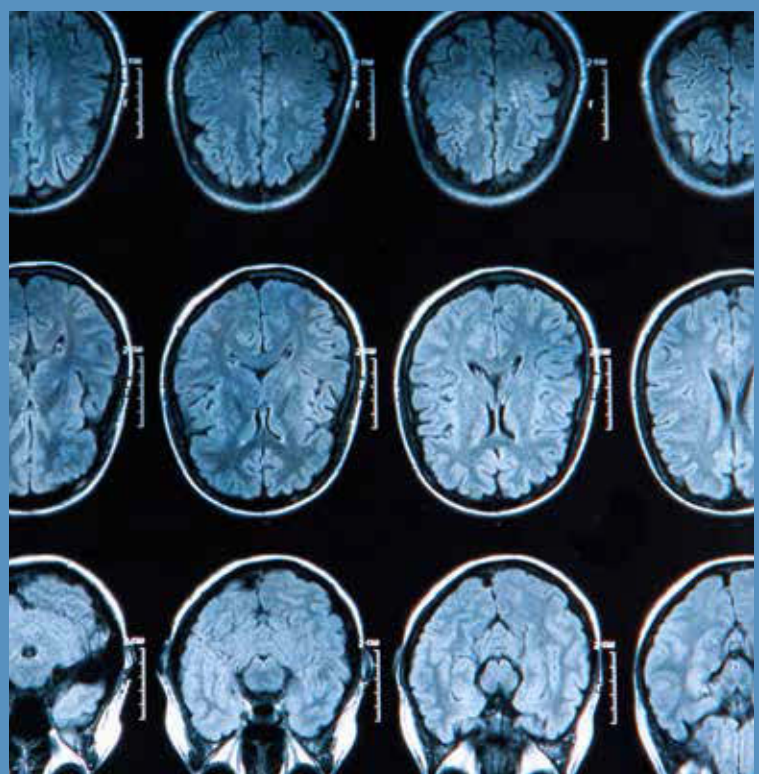
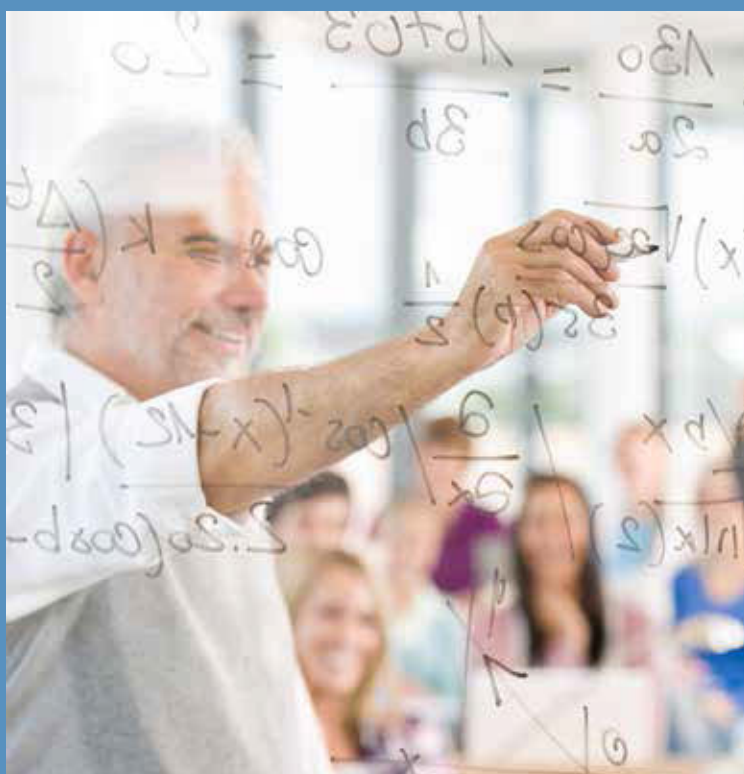
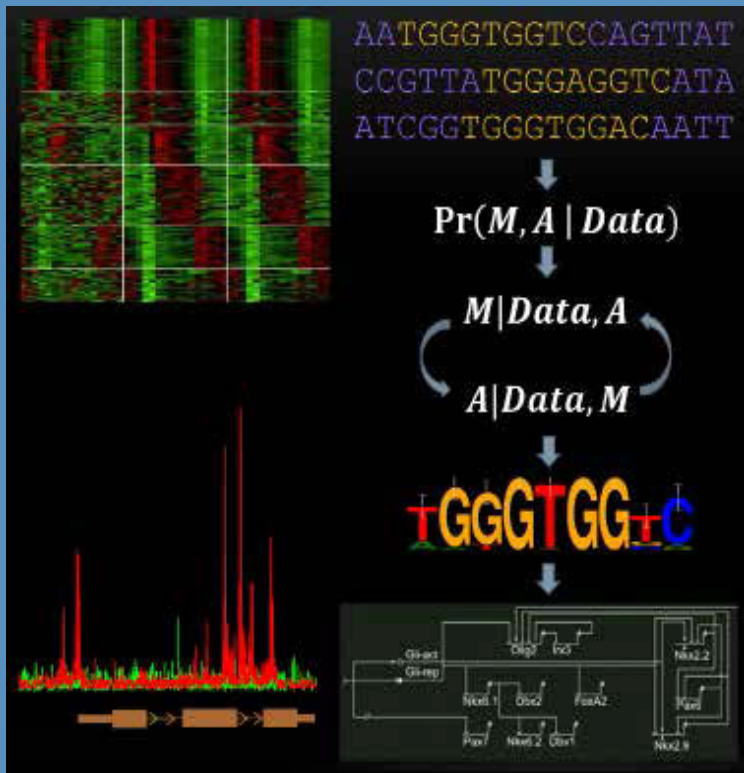


BIOSTATISTICS

THE CAMPAIGN FOR JOHNS HOPKINS





RIISING TO THE CHALLENGE: A CALL TO ACTION

Rising to the Challenge: The Campaign for Johns Hopkins will raise unprecedented levels of support to attract, sustain, and empower the students and faculty of Johns Hopkins, who through their work improve the lives of millions around the world. Together with our philanthropic partners we will:

ADVANCE DISCOVERY AND CREATIVITY

through support of our exceptional faculty. Their innovative work drives the development of new knowledge, new forms of expression, and new ways to save lives and

improve health across our core disciplines in science and technology, the humanities and arts, and public health and medicine.

ENRICH THE STUDENT EXPERIENCE by investing in scholarships and fellowships, inspirational spaces for collaborative learning and social opportunities, and new programs that will enhance student-faculty interactions, ensure diversity on campus, link learning in the classroom to life after graduation, and strengthen connections between our students and our communities.

SOLVE GLOBAL PROBLEMS AS ONE

UNIVERSITY by creating new cross-disciplinary solutions in crucial areas such as sustaining global water resources, revitalizing America's cities, advancing the health of individuals and populations, and understanding how we learn and teach.

With your help, the Bloomberg School will play a key role in the success of the campaign.

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

DEPARTMENT AT A GLANCE



Chair: Karen Bandeen-Roche, PhD

History: World's first department of biostatistics, in the world's oldest and largest school of public health, consistently ranked #1 by *U.S. News & World Report*. Ranked first among all graduate departments of statistics in the U.S.

Size and scope: 37 full-time faculty and 60+ students. NIH-funded training programs in Statistical Methods in Environmental Epidemiology and Epidemiology and Biostatistics of Aging.

Centers: Biostatistics Center

DEPARTMENTAL PROFILE

Will this drug work, and will it work for you? Does air pollution make us sick? Is aging inevitable? How does the brain work? Is it possible to develop stem cell therapies without initiating tumors, and how? To answer questions like these, biomedical and public health researchers must rely heavily on biostatistical reasoning and methods to help them accurately interpret data as evidence. Biostatistics is a science and a toolset for designing ways to learn from data—addressing questions about biology, health, and medicine and then quantifying and interpreting the results. Biostatisticians regard themselves as guardians of scientific validity.

Biostatistics is at the center of understanding all types of risk factors for health and substantiating their danger in order to make informed decisions. During the public health revolution of the last century, scientists in laboratories identified the specific bacteria and viruses that invariably caused infectious diseases such as tuberculosis and polio. The task of determining the single or multiple risk factors that trigger chronic diseases and genetic disorders poses an exponentially more complex riddle. In the digital age, biostatistics holds the power to productively channel a vast sea of data that must be analyzed for clues to solve our most urgent public health problems.

THE POWER OF COLLABORATION

In the past and present, the Department of Biostatistics has built its reputation for excellence by working shoulder to shoulder with world-class public health and medical researchers at Johns

Hopkins. Biostatistics was born at the Johns Hopkins School of Public Health (JHSPH). In 1930, **Lowell J. Reed** coined the term with the change of his department's name from Vital Statistics to Biostatistics, describing a potent new discipline encompassing the statistical framework of all biological processes across science, medicine, and public health. Without uniform coding of statistics on death and disease, which resulted from the herculean efforts of Reed and other collaborators, there could be no statistical analysis on which all public health depends.

In the 1950s and 1960s, former chairs **William G. Cochran** and **Jerome Cornfield** were key players in the controversy with **R.A. Fisher** over the relationship between smoking and lung cancer. This legacy continued under subsequent chair **Scott L. Zeger**, who applied groundbreaking statistical approaches exposing the risks of smoking in the 1990s. His partnership with Hopkins epidemiologist **Jonathan Samet** established second-hand smoke as a major public health hazard for non-smokers.

Today, Biostatistics continues to pride itself on working at the interface of biostatistics and other health sciences. **Karen Bandeen-Roche** and **Mei-Cheng Wang**, current faculty partnering with colleagues in gerontology, use multivariate survival analysis to estimate the rates at which physiological or mental dysfunction in multiple domains occurs or recurs over time in a population, and what characteristics increase or decrease the odds of decline or recovery. **Dan Scharfstein** collaborates with health policy experts to determine

RIISING TO THE CHALLENGE



HELEN ABBEY, ONE OF THE SCHOOL'S MOST BELOVED FACULTY

the extent of timely trauma-specific care in improving recovery outcomes for victims of catastrophic injuries.

THE POWER OF EDUCATION

The addition of two of Reed's doctoral students, **Helen Abbey**, ScD '51, and **Margaret Merrell**, ScD '30, to the faculty cemented the reputation of Biostatistics as one of the best teaching departments at Johns Hopkins and the go-to source for statistical expertise. Merrell and Reed developed Statistical Methods in Epidemiology, perhaps the School's all-time greatest course. Merrell's many students responded enthusiastically to her creative use of real-life raw data, engaging them in interpretation of current public health trends.

Abbey was an expert on research design and statistical analysis for epide-

miologic and genetic studies of human disease. She taught these principles to over 4,000 students and read over 700 doctoral theses. Many of her students later joined the JHSPH faculty, including former Dean Al Sommer. Legend has it that you can parachute anywhere in the world and be within fifty miles of a Helen Abbey student.

Following in these inspiring footsteps, **Marie Diener-West**, PhD '84, is a four-time recipient of the JHSPH Golden Apple Award as well as national teaching awards from the American Public Health Association and Association of Schools of Public Health. Diener-West has made significant contributions to statistical education and to multicenter clinical trials. As the primary instructor for the introductory biostatistics courses on campus and on-

line, **John McGready** has helped lead Biostatistics and JHSPH into the new frontier of distance education.

Today, Biostatistics faculty members have earned more teaching awards than those in any other JHSPH department. In all its collaborative endeavors, a main departmental goal is to inculcate students and researchers with a passion for good data and a healthy skepticism toward any scientist's claim to know the truth.

THE POWER OF LEADERSHIP

The current chair, Karen Bandeen-Roche, defines biostatistics as "the science of learning from data involving appreciable uncertainty or variability." Navigating this uncertainty and variability requires researchers to construct statistical methods that accurately capture complex, irregular phenomena that are imperfectly reflected by observable data.

In the years before World War II, Merrell, as the principal statistician for the penicillin trials and statistical consultant to the U.S. Public Health Service (PHS), emerged as a premier expert on statistical analysis. Cochran and Cornfield transformed the way data from clinical trials and case-control epidemiological studies are analyzed. Current faculty members **Constantine Frangakis** and **Michael Rosenblum** are designing new treatment strategies that adapt to patients' changing health status and methods to evaluate their safety and efficacy.

In 1957, **Paul Meier** wrote the milestone paper with Edward Kaplan proposing the estimator of the survival function that bears their names,

and continues to be one of the most widely used statistical techniques in all of medical research. Thirty years later, Zeger and **Kung-Yee Liang** developed generalized estimating equations, a novel regression methodology that transformed the analysis of data from longitudinal and family studies. Their foundational work has been among the world's most cited mathematical contributions for the last two decades.

Many seminal contributions have followed. **Richard Royall** led a transition in statistical reasoning from decision methods toward likelihood methods, which quantify scientific evidence. In the late 1980s, **Ronald Brookmeyer** developed statistical models to accurately forecast the magnitude and course of the global HIV/AIDS epidemic, which allowed policymakers and health care providers to target their efforts. In the early 2000s, Frangakis with **Donald Rubin** introduced principal stratification for learning about treatment or risk factor effects from longitudinal studies in the presence of intervening factors that may bias the observed data.

THE POWER OF THE FUTURE

The ability to analyze massive-scale data sets and merge multiple sources of data will be fundamental to solving the most important public health problems on the horizon. JHSPH's expertise in big data is a pillar of Johns Hopkins' unmatched reputation in the biostatistics and epidemiology communities. Biostatistics faculty have enabled researchers from across the schools of Public Health and Medicine to develop new methods to extract meaning from massive, linked longitudinal data; to



BIostatistics faculty are helping to evaluate the effectiveness of physical activity and other interventions to prolong health in older adults

“President Obama’s recently announced BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies) is creating significant new demand—and unmatched opportunity—for “neuro-quants,” biostatisticians working in the neurosciences.”

—Brian Caffo, Martin Lindquist, and Ciprian Crainiceanu, *Huffington Post Science Blog*, Aug. 13, 2013

unravel the etiology of complex conditions; and to chart and analyze portentous changes in risk factors over time.

Brian Caffo, Ciprian Crainiceanu, Martin Lindquist, Vadim Zipunnikov, and their colleagues are advancing methods to interpret data of massive scope that arise in modern health measurement through advanced research technologies such as neurological imaging and accelerometers. In the data-rich field of genomics, **Ingo Ruczinski** and his colleagues are identifying genetic determinants of

cancers, asthma, cleft palate, and other diseases and creating strategies to detect biomarkers. **Hongkai Ji, Jeff Leek**, and **Kasper Hansen** are discovering better ways to measure gene expression and leading methodologic and software advances for the analysis of next-generation gene sequencing data.

Roger D. Peng is developing state-of-the-art statistical models and applying them to very large datasets in order to understand the health effects of ambient air pollution and climate change, which can individually or together

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THE ENTIRE SCHOOL RELIES ON HIGH-QUALITY TEACHING IN BIOSTATISTICS

change the distribution of known risk factors such as extreme heat episodes, floods, droughts, aero-allergens, and vector- and rodent-borne diseases.

OPPORTUNITIES TO SUPPORT BIOSTATISTICS

The Department of Biostatistics must grow and change to ensure its next century of leadership surpasses its last. A more diversified funding base is critical to training first-class biostatisticians

and forging ahead in scientific inquiry. Biostatistics must build its endowment in order to generate a greater share of stable income and reduce its reliance on grant money. Constant pressure to raise support for salaries drains time and energy from teaching and research.

More reliable *core support for faculty and students* is essential for maintaining high-quality teaching in Biostatistics, on which the entire School relies. Moreover, the Department sup-

plies academic and scientific institutions in the U.S. and around the world with highly qualified experts. Biostatistics seeks two types of support for students: endowments for doctoral fellowships and current use funds for the ScM internships, which address the critical need for biostatistical expertise to support health research and practice in the nation and worldwide. Scholarships have an impact far beyond an individual career, enabling Johns Hopkins graduates to strengthen the public health and scientific missions of a wide spectrum of organizations.

Consistent, sustained funding for *faculty support* is essential for the Department's long-term stability. Endowed professorships are highly attractive incentives for retaining and recruiting renowned faculty to anchor existing programs or nucleate new ones. Four key areas needing professorships include:

Causation and inference—the foundational study of how we learn from health data

Genomics—means through which we may discover, and influence, the foundational physiological bases for health and disease

Modern health measurement—for which biostatistical expertise is crucial to leverage its promise for improved population assessment, monitoring, and health promotion

Population health modeling—a tool through which we better characterize disease, discover its etiology, and describe its impacts

At the other end of the career spectrum, the Department is constantly at risk for losing its most promising

faculty. Two types of funding will help mitigate this problem and aid in attracting and retaining the most talented scholars. An *emerging scholar chair* would enable junior faculty to “jump off the treadmill” by providing three years of early career funding to support intensive research without the significant stress and time commitment of grant-seeking. *Innovation funding* also provides support for productive, promising investigators with lapsed grant funding. In today’s funding climate, even proposals with high priority scores from reviewers succumb to budget cuts.

A *Center for Physical Activity Measurement* would build on our commanding knowledge of big data and multi-site clinical trials. The Hopkins medical campus currently lacks a physical performance laboratory with state-of-the-art devices for measurement, calibration, and normalization of functional performance data. This new Center would constitute an invaluable cross-disciplinary platform. A core group of big data specialists in Biostatistics and Epidemiology, along with University-wide resources in high-performance computing, high-density data analysis, and visualization, will provide the ideal knowledge base to reap the maximum scientific and health-promoting benefits of complex data from contemporary wearable devices.

A *Center for Quantitative Neuroimaging* would seek to bring together the people and tools necessary for addressing some of the most difficult problems in neuroscience today and in the future. There has been explosive interest in the use of neuroimaging techniques (e.g., PET, fMRI, DTI,

EEG) in recent years. The rapid pace of development and the interdisciplinary nature of the resulting problems present an enormous challenge to researchers. Moving the field forward requires collaborative teams with expertise in psychology, neuroanatomy, neurophysiology, physics, biomedical engineering, statistics, signal processing, and a variety of other disciplines depending on the research question.

A *Data Science Lab* would simultaneously address three pressing needs for the Department of Biostatistics and for the School of Public Health:

- Taking the statistical methods developed by faculty from prototype to product in a way that bridges the gap between the vision of faculty and the requirements of average users
- Expanding biostatistics expertise across the institution through the development of polished software products that can be used by nonexperts for more routine statistical analyses
- Raising the profile of the Biostatistics Department, in collaboration with the School’s Office of Communications and Marketing, by organizing the Department’s productivity on a modern, user-friendly website would provide a place where anyone in the world could come to learn about statistics and data science

Will the Center for Physical Activity Measurement yield breakthroughs in biostatistical science on the order of the first randomized controlled trials of penicillin therapy? Will a future student discover the first reliable preclinical biomarker of pancreatic cancer? Only time will tell, but Hopkins Biostatistics will lead the way.

CAMPAIGN GOALS FOR BIostatISTICS

\$250,000	Annual current use funds for ScM internship
\$1 million	Annual current use innovation funding
\$1 million	Endowed Emerging Scholar chair for a promising junior professor
\$1 million	Core funds for the JHU Center for Aging and Health
\$1 million	Current use funds for Data Science Lab (\$330,000 for 3 years)
\$1 million	Center for Quantitative Neuroimaging
\$2 million	Center for Physical Activity Measurement
\$2.5 million	Endowed professorship in Genomics
\$2.5 million	Endowed professorship in Modern Health Measurement
\$2.5 million	Endowed professorship in Causation and Inference
\$2.5 million	Endowed professorship in Population Health Modeling
\$6 million	4 doctoral scholarships at \$1.5 million per endowment



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