THE DEPARTMENT OF BIOSTATISTICS

MASTER'S STUDENT HANDBOOK

2024–2025

COLUMBIA | MAILMAN SCHOOL OF PUBLIC HEALTH

Table of Contents

Information Key

Side Markers

Look for these colored markers on the central right hand side of each page as you scroll to quickly identify sections.

- Faculty Profiles
- MS - Clinical Research Methods
- MS - Statistical Genetics
- MS - Public Health Data Science
- Certificate Program
- Opportunities for Student Involvement
- MPH Information
- MS - Pharmaceutical Statistics
- MS - Theory & Methods
- MS - Patient -Oriented Research
- Course Descriptions
- Practicum Information

Colored Text

Within the text of each section there are several colors used to emphasize or call out information.

Green colored text is a clickable hyperlink
Blue colored text is a section header
Magenta colored text is the name of a course
Orange colored text emphasizes forms, requirements, or other improtant information

The Department of Biostatistics

Biostatistics is the science of developing and applying statistical methods for quantitative studies in biomedicine, health, and population sciences.

Biostatisticians play a crucial role in research design, collection and organization of data, analysis, presentation, and interpretation of results. Career opportunities are usually found in governmental agencies, private industry, and medical research institutions.

The Department of Biostatistics maintains collaborative relationships with other units of the University and with outside agencies and institutions. Among the many affiliated institutions and centers are: Columbia University Irving Medical Center, New York State Psychiatric Institute, the Department of Statistics at Columbia's Morningside Campus, the Gertrude H. Sergievsky Center (research in the field of neuroepidemiology), the Herbert Irving Comprehensive Cancer Center and Institute of Cancer Research, the HIV Center for Clinical and Behavioral Studies, and the Irving Center for Clinical Research.

Faculty in the Department of Biostatistics work at the frontier of public health, leading research teams that investigate some of today's most pressing health issues. Recruited from the top universities from around the world, the faculty bring to the school a wealth of experience that serves to inform their research and teaching.

HOWARD ANDREWS (PhD, Rutgers University)
Associate Professor at CUMC of Neuroscience (in Biostatistics)

Research interests: Clinical trials, data management systems, multi-level analysis, perinatal outcomes, environmental factors, Alzheimer's disease

SRIKESH ARUNAJADAI (PhD, University of California Berkeley)
Adjunct Assistant Professor of Biostatistics

Research interests: Statistical applications in solving problems in Biology, statistical research in time series, point processes, spatio-temporal processes, and modeling of various dynamic systems

KIROS BERHANE (PhD, University of Toronto)
Cynthia and Robert Citron-Roslyn and Leslie Goldstein Professor and Chair

Research interests: Longitudinal data modeling, multi-level growth curve models, nonparametric regression, multiple outcomes, quantile regression, mediation, applications to environmental data

MELISSA D. BEGG (ScD, Harvard University)
Professor of Clinical Biostatistics, and Dean of the Columbia School of Social Work

Research interests: Analysis of clustered data, oral health research, mental health statistics, clinical research training

XIAOYU CHE (PhD, Claremont Graduate University)
Assistant Professor of Biostatistics (in the Center for Infection and Immunity) at CUMC

Research interests: Design, development, and application of statistical methods for "multi-omics" analyses to bring new insights into the pathogeneses of chronic and neurodevelopmental diseases

QIXUAN CHEN (PhD, University of Michigan)
Associate Professor of Biostatistics

Research interests: Survey sampling, missing data, measurement error, Bayesian statistics, latent class modeling, integrative data analysis

BIN CHENG (PhD, University of Wisconsin-Madison)
Professor of Biostatistics at CUIMC

Research interests: Linear and generalized linear mixed models, statistical analysis of clinical trials, longitudinal non-normal data modeling, statistical computing, statistical inference on manifolds

YING-KUEN KENNETH CHEUNG (PhD, University of Wisconsin-Madison)
Professor of Biostatistics

Research interests: Design and analysis of clinical trials, methods in toxicology studies and bioassay, applications of Monte Carlo methods, nonparametric methods, bioethics

CODRUTA CHIUZAN (PhD, Medical University of South Carolina)
Adjunct Assistant Professor of Biostatistics

Research interests: Applications of statistical methods in psychiatric research, functional data analysis, statistical machine learning, treatment regime estimation and evaluation, integration of multi-source data

HANGA GALFALVY (PhD, University of Illinois)
Associate Professor of Biostatistics (in Psychiatry) at CUIMC

Research interests: Statistical methodology in psychiatric research, with a special focus on the prediction models for suicidal behavior from high-dimensional data, censored regression models, statistical genetics, and longitudinal data analysis in observational studies

JEFF GOLDSMITH (PhD, Johns Hopkins University)
Associate Professor of Biostatistics, and Associate Dean for Data Science

Research interests: Functional data analysis, high-dimensional regression, longitudinal data analysis, smoothing, Bayesian variable selection, neuroimaging, and accelerometry

PRAKASH GORROOCHURN (PhD, Monash University)
Associate Professor of Clinical Biostatistics at CUIMC

Research interests: Mathematical population genetics, genetic mapping of complex diseases

TIAN GU (PhD, University of Michigan)
Assistant Professor of Biostatistics

Research interests: Robust & efficient data integration in precision health research, methods for use in biobank data, COVID and disparity research

WENPIN HOU (PhD, University of Michigan)
Assistant Professor of Biostatistics

Research interests: Developing statistical machine learning methods, mathematical modeling of gene regulatory networks

JIANHUA HU (PhD, University of North Carolina-Chapel Hill)
Professor of Biostatistics (in Medicine and in the Herbert Irving Comprehensive Cancer Center)

Research interests: high-dimensional genomics/proteomics, imaging, and longitudinal data, modeling disease heterogeneity, and adaptive designs to achieve personalized treatments

IULIANA IONITA-LAZA (PhD, New York University)
Professor of Biostatistics (in Medicine and in the Center for Precision Medicine and Genomics)

Research interests: Statistical genetics and bioinformatics

HAOMIAO JIA (PhD, Case Western University)
Professor of Biostatistics (in Nuring) at CUMC

Research interests: Small area estimation, data smoothing, temporal-spatial analysis, survey sampling

ZHEZHEN JIN (PhD, Columbia University)
Professor of Biostatistics

Research interests: Survival analysis, resampling methods, ROC curves, smoothing methods, nonparametric regression, clinical trials

SEONJOO LEE (PhD, University of North Carolina-Chapel Hill)
Associate Professor of Clinical Biostatistics (in Psychiatry)

Research interests: Neuroimaging, cognitive neuroscience, machine learning, latent variable analysis, multivariate time series, stochastic process, and functional data analysis

SHING M. LEE (PhD, Columbia University)
Professor of Biostatistics at CUIMC

Research interests: Rapid dose finding techniques in Phase I trials, and the development of more sensitive endpoints (e.g. Toxicity Burden Scores) in Phase I Trials

CHENG-SHIUN LEU (PhD, Columbia University)
Professor of Biostatistics at CUIMC

Research interests: Adaptive design in Phase II clinical trials, clinical trials, design and analysis for clinical and behavioral studies.

MOLEI LIU (PhD, Harvard University)
Assistant Professor of Biostatistics

Research interests: High dimensional statistics, federated learning, distributed learning, transfer learning, semi-supervised learning, semi-parametric statistical methods and theory, electronic health record (EHR) data analysis

YING LIU (PhD, Columbia University)
Assistant Professor in Clinical Biostatistics, Mental Health Data Science, Department of Psychiatry

Research interests: Bridging Machine learning and Deep Learning to Biostatistical methodology research and land these methods to Psychiatry Research

ZHONGHUA LIU (PhD, Harvard University)
Assistant Professor of Biostatistics

Research interests: Statistical genetics/genomics, epigenetics, semiparametric efficiency theory, causal mediation analysis for integrative genomics and fairness, missing data problems, measurement error, and machine learning methods

SHAW-HWA LO (PhD, UC Berkeley)
Professor of Statistics and of Biostatistics

Research interests: Survival Analysis, Design of Clinical Trials, Resampling Methods, Coverage Problems, Analysis of Incomplete Data, Nonparametric Methods, Asymptotic Theory, Empirical Bayes Methodology. Statistical Genetics. Bioinformatics. Genetic network analysis.

XIN MA (PhD, Emory University)
Assistant Professor of Biostatistics at CUIMC

Research interests: High-dimensional statistics, variable selection, functional data analysis, measurement error, imaging applications, and deep learning methods

CHRISTINE MAURO (PhD, Columbia University)
Associate Professor of Biostatistics at CUIMC

Research interests: Analysis of clinical trials, longitudinal data analysis, statistical applications in mental health and substance use research, including evaluating state-level policies, statistics education

IAN MCKEAGUE (PhD, University of North Carolina at Chapel Hill)
Professor of Biostatistics

Research interests: Survival analysis, competing risks in HIV/AIDS studies, inference for stochastic processes, empirical likelihood, Markov chain Monte Carlo, functional data analysis, semiparametric efficiency, Bayesian statistics, and martingale and counting process methods

DANIEL MALINSKY (PhD, Carnegie Mellon University)
Assistant Professor of Biostatistics

Research interests: Causal inference, graphical models, missing data, stochastic processes, machine learning, algorithmic fairness, social & environmental determinants of health, health disparities

CALEB MILES (PhD, Harvard University)
Assistant Professor of Biostatistics

Research interests: Causal inference, HIV, Interference, Measurement error, Mediation analysis, Semiparametric inference

TODD OGDEN (PhD, Texas A&M University)
Professor of Biostatistics (in Psychiatry)

Research interests: Analysis of brain imaging data, functional data analysis, nonparametric regression, wavelet applications, statistical modeling

MARTINA PAVLICOVA (PhD, Ohio State University)
Associate Professor of Biostatistics at CUIMC

Research interests: Analysis of clinical trials, longitudinal data and analysis, multiple comparisons methods, hurdle and zero-inflated models, modern teaching methods

MIN QIAN (PhD, University of Michigan)
Associate Professor of Biostatistics

Research interests: Medical decision making, dynamic treatment regimes, variable selection/model selection for decision making, statistical machine learning, reinforcement learning, statistical inference, bootstrap, empirical processes, concentration inequalities, stochastic processes

YIFEI SUN (PhD, Johns Hopkins University)
Assistant Professor of Biostatistics

Research interests: General biostatistical methodology for survival, longitudinal and multivariate data, machine learning,electronic health record data, wearable device data

JOHN L.P. (SEAMUS) THOMPSON (PhD, University of California-Los Angeles)
Professor of Biostatistics and Neurology at CUMC

Research interests: Randomized clinical trials, trial design, neurology, data management systems

NAITEE TING (PhD, Colorado State University)
Adjunct Professor of Biostatistics

Research interests: Clinical development of new drugs, dose selection, Phase II

LINDA VALERI (PhD, Harvard University)
Assistant Professor of Biostatistics

Research interests: Causal inference, machine learning, statistical methods for measurement error, mediation analysis, missing data, multivariate survival, longitudinal and time series data, applications in perinatal epidemiology, mental health, environmental health, and health disparities

MELANIE WALL (PhD, Iowa State University)
Professor of Biostatistics (in Psychiatry)

Research interests: Latent variable modeling, spatial, and longitudinal data analysis

SHIKUN WANG (PhD, University of Texas, UTHealth Houston)
Assistant Professor of Biostatistics (in the Herbert Irving Comprehensive Cancer Center) at CUMC

Research interests: Developing novel statistical methods for health service research using joint modeling of longitudinal and survival data

SHUANG WANG (PhD, Yale University)
Professor of Biostatistics

Research interests: Statistical genetics, genetic epidemiology, quantitative trait loci analysis

YUANJIA WANG (PhD, Columbia University)
Professor of Biostatistics

Research interests: Machine learning, generative models, precision medicine, electronic health records, network analysis, mental health, and neurological disorders

YING WEI (PhD, University of Illinois-Urbana Champaign)
Professor of Biostatistics

Research interests: Quantile regression methods, growth charts estimation, longitudinal data analysis, semiparametric modeling, and robust statistics

XIAO WU (PhD, Harvard University)
Assistant Professor of Biostatistics

Research interests: Causal inference, environmental statistics, statistical learning, nonparametric statistics, Bayesian biostatistics, applications to climate science and health

Staff

PAUL MCCULLOUGH (pm2692@cumc.columbia.edu)
Director, Academic Programs

LUCIA LI (ll3414@cumc.columbia.edu)
Assistant Director, Academic Programs

ERIN ELLIOTT (ee2548@cumc.columbia.edu)
Program Coordinator (Communications)

KATY HARDY (ch336@cumc.columbia.edu)
Department Administrator

ANTHONY GUERRERO (gg292@cumc.columbia.edu)
Senior Grants Administrator

GEORGIA ANDRE (gg292@cumc.columbia.edu)
Administrative Coordinator

CAROLINA MELLADO (cm2556@cumc.columbia.edu)
Director, Personnel Operations

GESSIE MESAMOURS (gm3064@cumc.columbia.edu)
Executive Assistant to Chair, Dr. Kiros Berhane

LUMINITA HELLMANN (lh2023@cumc.columbia.edu)
Senior Financial Analyst

Master of Public Health degree program

The Department of Biostatistics offers the two-year Master of Public Health (MPH) degree program. The MPH prepares specialists in public health who use and adapt statistical procedures for health and medical care programs, or serve in a technical capacity as resource person and collaborators in field and programmatic studies.

Upon satisfactory completion of the MPH Biostatistics, graduates will be able to:

- Describe the roles biostatistics serves in the discipline of public health.
- Describe the basic concepts of probability, random variation and commonly used statistical probability distributions.
- Describe preferred methodological alternatives to commonly used statistical methods when assumptions are not met.
- Distinguish among the different measurement scales and the implications for selection of statistical methods to be used based on these distinctions.
- Apply descriptive techniques commonly used to summarize public health data.*
- Apply common statistical methods for inference.*
- Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question.*
- Apply basic informatics techniques with vital statistics and public health records in the description of public health characteristics and in public health research and evaluation.
- Interpret results of statistical analyses found in public health studies.*
- Develop written and oral presentations based on statistical analyses for both public health professionals and educated lay audiences.*

** denotes departmental competencies to be fulfilled during APEx (see Columbia MPH description)*

Columbia MPH

Director: Martina Pavlicova, PhD

The Columbia Masters in Public Health in Biostatistics (MPH) is a two-year program designed to enhance the quantitative skills of public health practitioners who will use statistics frequently in their work.

Course Requirements

The structure of the degree program includes five components, which are all carefully timed and integrated so that learning in one part of the program informs activities and assignments in another:

1. Discipline - courses required by your home department
2. Core - curriculum that provides the broad, interlocking foundation of knowledge needed for a career in public health
3. Integration of Science and Practice - two semester long course that bridges the gap between what you traditionally learn in a classroom and the real-world experience of working as a public health professional
4. Leadership & Development - course aims to develop and improve MPH students' abilities in three key areas: leading teams in a variety of settings, working effectively as a team member, and implementing fresh, innovative ideas within an organization or larger community.
5. Applied Practice Experience (APEx) - supervised practical experience in the field.
6. Culminating Experience- combination of two capstone courses that are designed to connect the skills and knowledge acquired throughout the degree program

Certificate

Every student in the two-year MPH program enrolls in a certificate program which provides training in a focused area of expertise—in addition to the student's departmental discipline—and leads to a Columbia University approved credential. The certificate programs have been developed in consultation with public health employers and other key stakeholders and reflect today's most sought-after skills and knowledge.

Students taking the Columbia MPH within the Department of Biostatistics are able to select a certificate from various school-wide certificate programs listed below. You can also find requirements and sample coursework for each certificate using the Certificate Requirements Database.

Advanced Epidemiology
Child Youth and Family Health
Climate and Health
CEOR
Environmental Health Policy
Epi of Chronic Disease
Global Health (3 month)
Health and Human Rights
Health Communication
Health of an Aging Society
Health Policy and Practice
Health Promotion Research and Practice
History, Ethics, Law
Infectious Disease Epidemiology
Injury Prevention and Control
Molecular Epi
Public Health Research Methods
Sexuality, Sexual, and Repro Health
Social Determinants of Health
Toxicology

Applied Practice Experience (APEx)

One term of practical experience (APEx) is required of all students, intended to provide educational opportunities that are different than and supplementary to the more academic aspects of the program. The APEx may be completed over the summer after the first year. MPH students are required to do a minimum of 280 hours in a public health setting.

All MPH students must complete the APEx Scope of Work (SOW) form prior to starting a APEx experience. The SOW, which is managed by the Mailman's Office of Careers and Practice, is an important tool for planning the APEx and meeting the School's requirements for engaging in a structured APEx process. Students must fill out a APEx SOW form in collaboration with the practicum organization.

Students along with their APEx supervisor must identify at least 3 foundational MPH competencies (see link) and 2 departmental competencies (see page 9) that their APEx will fulfill. These competencies and how they will be fulfilled must be described in the proposed SOW form. In addition, the student along with their APEx supervisor must identify at least two deliverables expected at the close of the APEx and describe them in detail in the proposed SOW form.

The SOW must be approved by the student's faculty advisor and the Assistant Director of Academic Programs before the start of the APEx. After the completion of the APEx, a copy of the two deliverables described in the SOW form must be submitted to the Director of Academic Programs.

Students will present their experience at the annual Biostatistics Practicum/APEx Symposium which will be held towards the end of the second spring semester.

Culminating Experience

A formal culminating experience is required for graduation. The MPH culminating experience consists of a combination of the Capstone Consulting Seminar and the Integrative Capstone Experience, which are both taken during the student's second spring semester.

The Capstone Consulting Seminar (P8185) is a one-credit course that requires students to attend at least one session of the Biostatistics Consulting Service and present the consultation to the class for discussion. The Biostatistics Consulting Service, which is run by faculty in the Department of Biostatistics, offers advice on data analysis and appropriate methods of data presentation for publications, and provides design recommendations for public health and clinical research, including preparation of grant proposals and manuscripts.

The Integrative Capstone Experience (P8170) is a two-credit course in which students produce a written high quality report that describes, interprets, and compares multiple analyses of relevant data using statistical techniques learned during the course of the MPH program

Curriculum

Required Discipline Courses		Points
P6110	Statistical Computing Using SAS	3
P8100	Applied Regression I	3
P8107	Introduction to Mathematical Statistics	3
P8110	Applied Regression II	3
P8120	Analysis of Categorical Data	3
P8185	Capstone Consulting Seminar	1
P8170	Integrative Capstone Experience	2
	TOTAL POINTS FROM REQUIRED COURSES	18

Elective Courses Choose courses from this list or from alternatives approved by the program director.		Points
89260	Building Interdisciplinary Research models	2
P8101	Introduction to Health Data Science	3
P8105	Data Science I	3
P8106	Data Science II	3
P8140	Randomized Clinical Trials	3
P8142	Clinical Trial Methodology	3
P8144	Pharmaceutical Statistics	3
P8158	Latent Variable and Structural Equation Modeling for Health Sciences	3
P8160	Topics in Advanced Statistical Computing	3
P8180	Relational Databases and SQL Programming for Research and Data Science	3

Timeline

Fall I	Spring I	Fall 2	Spring 2
MPH Core	Integration of Science and Practice	P8107 Introduction to Mathematical Statistics	Applied Practicum Experience (APEx)
	Leadership and Development	P8110 Applied Regression II	Certificate Requirements
	P6110 Statistical Computing Using SAS	Certificate Requirements	P8185 Capstone Consulting Seminar
	P8100 Applied Regression I		P8170 Integrative Capstone Experience
	P8120 Analysis of Categorical Data		

Master of Science degree programs

The Department of Biostatistics offers two Master of Science degree programs: the MS in Biostatistics and the MS in Patient Oriented Research. Students pursuing the MS in Biostatistics degree select one of five tracks of specialization: Clinical Research Methods, Pharmaceutical Statistics, Public Health Data Science, Statistical Genetics, and Theory & Methods. The MS in Patient Oriented Research degree program is also housed in the department. Whether the focus of the degree is to prepare for doctoral research training, to advance the skills critical for clinical scientists, or as a biostatistician in public health or the pharmaceutical industry, our programs require a facility for quantitative reasoning and a true enjoyment of working with data.

Upon satisfactory completion of the MS in Biostatistics or the MS in Patient Oriented Research, graduates will be able to:

Data Analysis and Computing

- Formulate and produce graphical displays of quantitative information that effectively communicate analytic findings
- Explain general principles of study design in attempting to identify risk factors for disease, isolate targets for prevention, and assess the effectiveness of one or more interventions
- Select and perform appropriate hypothesis tests for comparing two or more independent exposure groups, or two or more groups of matched/clustered subjects, with respect to a discrete or continuous response measurement of interest
- Interpret associations estimated via linear regression, logistic regression, and Cox models for survival data
- Apply the basic tenets of research design and analysis for the purpose of critically reviewing research and programs in disciplines outside of biostatistics
- Interpret quantitative findings in accurate, accessible language for colleagues outside of biostatistics, as well as for broader dissemination to the public and other public health professionals

Public Health and Collaborative Research

- Translate research objectives into testable hypotheses
- Compare and contrast different study designs and their implications for inference in medical/public health research
- Describe basic principles and the practical importance of key concepts from probability and inference to colleagues without extensive statistical training
- Develop and execute power and sample size calculations for research studies utilizing simple random sampling
- Evaluate research reports and proposals for research funding on the basis of their scientific integrity, validity, and the strength of the quantitative analysis

A brief comparison of the MS Degree Programs

Degree Program	Track	Minimum Credits	Typical Duration	Practicum	Capstone
Master of Science in Biostatistics	Clinical Research Methods Track (MS/CRM)	30	4 semesters	No	Yes
Master of Science in Biostatistics	Pharmaceutical Statistics Track (MS/PS)	35	4 semesters	Yes	Yes
Master of Science in Biostatistics	Statistical Genetics Track (MS/SG)	36	4 semesters	Yes	Yes
Master of Science in Biostatistics	Theory and Methods Track (MS/TM)	36	4 semesters	Yes	Yes
Master of Science in Biostatistics	Public Health Data Science Track (MS/PHDS)	36	4 semesters	Yes	Yes
Master of Science in Patient Oriented Research	Patient Oriented Research Program (MS-POR)	30	5 semesters (including summer)	No	Yes

Clinical Research Methods

Director: Todd Ogden, PhD

The Master of Science in Biostatistics - Clinical Research Methods (MS/CRM) provides formal, rigorous training in skills critical to the design and analysis of clinically oriented research studies. It is intended for physicians, nurses, dentists, psychologists, pharmacists, and other health care professionals who plan careers or are actively engaged in clinical research. MS/CRM students will hone their quantitative talents to better pursue research objectives in their chosen fields. As the level of competitiveness for limited research support increases, it is now more important than ever to develop a well-designed study with a strong analytic plan. Mastery of applied biostatistical methods improves the likelihood of assembling compelling and effective clinical research projects and promoting good research practices.

Course Requirements

The required courses are intended to enable degree candidates to gain proficiency in study design, application of commonly used statistical procedures, facility with statistical software packages, and ability to successfully interpret and communicate the results of an analysis. Students must complete a minimum of 30 points to earn the MS/CRM degree, of which 24 points must be taken at the Mailman School of Public Health. Up to two electives may be taken pass/fail, intended to encourage students to take courses outside their field of experience.

Note that some courses in the required curriculum may be waived based on prior coursework with approval of the course instructor. In this event, the student may substitute another, more advanced course in place of the waived course. Students interested in completing the program in 1.5 years would be well served to begin coursework by enrolling in the Columbia Summer Research Institute which allows students to complete 10 credits over 5 weeks.

In advance of beginning the MS program, any student who has not previously completed a bachelor's or master's degree in public health from a CEPH-accredited school or program, will need to complete the Introduction to Public Health non-credit, asynchronous requirement (administered by the Office of Educational Initiatives). Since this is not a course, you do not need to register. Throughout the requirement, you are expected to be actively engaged in the material and approach the work with the same effort you would a for-credit course.

Students' progress will be reviewed after each semester. Those students whose academic performance falls below a B average (3.0 GPA) in required courses may not be allowed to graduate without remedial course work.

Capstone Experience

As part of the MS/CRM training, each student is required to enroll in Master's Essay—Clinical Research Methods (P9160). This research component of the MS/CRM program should be completed during the final year of study. Conducted in workshop style, students in this course will participate in regular seminars geared towards enhancing research skills. At the end of the term, each student will be required to submit a research paper of publishable quality that summarizes their research project. Before beginning P9160, each student must have a data set of interest available to them, as well as permission (and IRB approval) to analyze and publish results from an analysis of these data. Most P9160 sessions will be devoted to discussion of individual research projects. Students will present their topics, plans for analysis, and interpretation of their findings to the class for evaluation and peer feedback. The completion and submission of this research paper satisfies the student's capstone requirement.

Curriculum (TOTAL POINTS: 30 OR MORE)

Required Courses		Points
P6104	Introduction to Biostatistical Methods	3
P6400	Principles of Epidemiology	3
P8100	Applied Regression I	3
P8110	Applied Regression II	3
P8120	Analysis of Categorical Data	3
P8140	Introduction to Randomized Clinical Trials	3
P8438	Epidemiology II: Design and Conduct of Observational Epidemiology	3
P9160	Master's Essay - Clinical Research Methods	3
	TOTAL POINTS FROM REQUIRED COURSES	24

Elective Courses Choose 2 or more courses from this list or from alternatives approved by your track director.		Points
P6110	Statistical Computing with SAS	3
P6530	Issues and Approaches in Health Policy and Management	3
P8104	Probability	3
P8105	Data Science I	3
P8109	Statistical Inference	3
P8112	Systematic Review and Meta-analysis	1.5
P8142	Clinical Trial Methodology	3
P8144	Pharmaceutical Statistics	3
P8149	Human Population Genetics	3
P8157	Analysis of Longitudinal Data	3
P8158	Latent Variable and Structural Equation Modeling for Health Sciences	3
P8180	Relational Databases and SQL Programming for Research and Data Science	3
P8307	Molecular Epidemiology	3
P8308	Molecular Toxicology	3
P8404	Epidemiology of Genetics and Aging	3
P8405	Genetics in Epidemiology	3
P8406	Epidemiology of Infections Diseases I	3
P8414	Cancer Epidemiology	3
P8417	Selected Problems of Measurement in Epidemiology	3
P8432	Environmental Epidemiology	3
P8440	Epidemiology of Cardiovascular Diseases	3
P8449	Optimization for Interventions	1.5
P8482	Outcomes Research: Methods and Public Health Implications	3
P8545	Analysis of Large Scale Data Sets	1.5

Sample Timeline

Fall I	Spring I	Fall II	Spring II
P6104 Introduction to Biostatistical Methods	P8100 Applied Regression I	P8110 Applied Regression II	P8438 Epidemiology II
P6400 Principles of Epidemiology	P8120 Analysis of Categorical Data	P8140 Introduction to RCTs	P9160 Master's Essay
	Elective	Elective	

Pharmaceutical Statistics

Director: Bin Cheng, PhD

The Master of Science in Biostatistics degree program - Pharmaceutical Statistics (MS/PS) provides study design, research, and biostatistics skills to individuals who are currently working in the pharmaceutical research industry and those seeking to begin a career in the industry. MS/PS students will understand the challenges and modern methods relevant to translational research and clinical trials.

Course Requirements

Students must complete a minimum of 35 credits of coursework to earn the MS/PS degree, of which 30 points must be taken at the Mailman School of Public Health. Up to two electives may be taken pass/fail, especially to encourage students to take courses outside their field of experience.

Note that some courses in the required curriculum may be waived based on prior graduate level coursework with approval from the course instructor. In this event, the student may substitute another, more advanced course in place of the waived course. Credits from waived courses do not count towards the degree.

In advance of beginning the MS program, any student who has not previously completed a bachelor's or master's degree in public health from a CEPH-accredited school or program, will need to complete the Introduction to Public Health non-credit, asynchronous requirement (administered by the Office of Educational Initiatives). Since this is not a course, you do not need to register. Throughout the requirement, you are expected to be actively engaged in the material and approach the work with the same effort you would a for-credit course.

Students' progress will be reviewed after each semester. Those students whose academic performance falls below a cumulative B average (3.0 GPA) in required courses may not be allowed to graduate without remedial course work.

International students are required to be registered for at least 12 credits during their second and third semesters.

Request for a track change must be made before the start of a student's second semester. Tracks cannot be changed once the second semester has begun.

Practicum Requirement

One term of practical experience is required of all students, providing educational opportunities that are different from and supplementary to the more academic aspects of the program. The practicum may be fulfilled during the school year or over the summer. Arrangements are made on an individual basis in consultation with faculty advisors who must approve both the proposed practicum project prior to its initiation, and the report submitted at the conclusion of the practicum experience. Students will be required to make a presentation at the department's Annual Biostatistics Practicum/APEx Symposium which is held in late April/early May. See the practicum information section at the back of the handbooks for more details.

Capstone Experience

A formal culminating experience is required for graduation. The capstone consulting experience is designed to enable students to demonstrate their ability to integrate their academic studies with the role of biostatistical consultant/collaborator, which will comprise the major portion of their future professional practice. Students register for Capstone Consulting Seminar (P8185), a one-semester, one-credit course during their final spring semester. The course requires students to attend at least one session of the Biostatistics Consulting Service and present the consultation to the class for discussion. The Consulting Service, which is run by faculty in the Department of Biostatistics, offers advice on data analysis and appropriate methods of data presentation for publications, and provides design recommendations for public health and clinical research, including preparation of grant proposals and manuscripts.

Curriculum (TOTAL POINTS: 35 OR MORE)

Required Courses		Points
P6110	Statistical Computing with SAS	3
P6170	New Drug Development: A Regulatory Overview	3
P6400	Principles of Epidemiology	3
P8104	Probability	3
P8120	Analysis of Categorical Data	3
P8130	Biostatistical Methods I	3
P8140	Introduction to Randomized Clinical Trials	3
P8142 *	Clinical Trial Methodology	3
P8144	Pharmaceutical Statistics	3
P8180	Relational Databases and SQL Programming for Research and Data Science	3
P8185	Capstone Consulting Seminar	1
	TOTAL POINTS FROM REQUIRED COURSES	31

Elective Courses Choose 2 or more courses from this list or from alternatives approved by your track director.		Points
P6503	Introduction to Health Economics	3
P8105	Data Science I	3
P8108 **	Survival Analysis	3
P8109	Statistical Inference	3
P8116	Design of Medical Experiments	3
P8133	Bayesian Analysis and Adaptive Designs in Clinical Trials	3
P8157 **	Analysis of Longitudinal Data	3
P8401	Pharmacoepidemiology	3
G4010	Responsible Conduct of Research and Related Policy Issues	1
GU4200	Biopharmaceutical Development and Regulation	3
W4201	Seminar in Biopharmaceutical Development and Regulation	3

* P8142 may be replaced by P8133, which requires P8104 and P8109
** requires P8104 and P8109

Sample Timeline

Fall I	Spring I	Fall II	Spring II
P6400 Principles of Epidemiology I	P6170 New Drug Development	P6110 Statistical Computing in SAS	P8144 Pharmaceutical Statistics
P8104 Probability	P8120 Analysis of Categorical Data	P8142 Clinical Trial Methodology (or P8133 Adaptive Designs)	P8185 Capstone Consulting Seminar
P8130 Biostatistical Methods I	P8140 Introduction to RCTs	P8180 Research Data Coordination	Complete practicum requirements
	Elective	Elective	

Statistical Genetics

Director: Prakash Gorroochurn, PhD

The Master of Science in Biostatistics - Statistical Genetics (MS/SG) prepares well-qualified students to use advanced modern statistical genetic methods to dissect complicated human genetic archeology with cutting-edge technologies. Students begin with a rigorous grounding in statistical theory and practice, and then incorporate modern analytic methods into their toolbox via new coursework.

Course Requirements

MS/SG students are expected to gain proficiency in genetic study design and analysis as represented by the courses listed below. Students must complete a minimum of 36 academic credits to earn the MS/SG degree, of which 30 points must be taken at the Mailman School of Public Health. Up to two electives may be taken pass/fail, especially to encourage students to take courses outside their field of experience.

Note that some courses in the required curriculum may be waived based on prior graduate level coursework with approval from the course instructor. In this event, the student may substitute another, more advanced course in place of the waived course. Credits from waived courses do not count towards the degree.

In advance of beginning the MS program, any student who has not previously completed a bachelor's or master's degree in public health from a CEPH-accredited school or program, will need to complete the Introduction to Public Health non-credit, asynchronous requirement (administered by the Office of Educational Initiatives). Since this is not a course, you do not need to register. Throughout the requirement, you are expected to be actively engaged in the material and approach the work with the same effort you would a for-credit course.

Students' progress will be reviewed after each semester. Those students whose academic performance falls below a cumulative B average (3.0 GPA) in required courses may not be allowed to graduate without remedial course work.

A student is considered full-time in the MS/SG program if he or she takes a minimum of 12 credits per semester.

International students are required to be registered for at least 12 credits during their second and third semesters.

Request for a track change must be made before the start of a student's second semester. Tracks cannot be changed once the second semester has begun.

Practicum Requirement

One term of practical experience is required of all students, providing educational opportunities that are different from and supplementary to the more academic aspects of the program. The practicum may be fulfilled during the school year or over the summer. Arrangements are made on an individual basis in consultation with faculty advisors who must approve both the proposed practicum project prior to its initiation, and the report submitted at the conclusion of the practicum experience. Students will be required to make a presentation at the department's Annual Biostatistics Practicum/APEx Symposium which is held in late April/early May. See the practicum information section at the back of the handbook for details and links to required forms.

Capstone Experience

A formal culminating experience is required for graduation. The capstone consulting experience is designed to enable students to demonstrate their ability to integrate their academic studies with the role of biostatistical consultant/collaborator, which will comprise the major portion of their future professional practice. Students register for Capstone Consulting Seminar (P8185), a one-semester, one-credit course during their final spring semester. The course requires students to attend at least one session of the Biostatistics Consulting Service and present the consultation to the class for discussion. The Consulting Service, which is run by faculty in the Department of Biostatistics, offers advice on data analysis and appropriate methods of data presentation for publications, and provides design recommendations for public health and clinical research, including preparation of grant proposals and manuscripts.

Curriculum (TOTAL POINTS: 35 OR MORE)

Required Courses

Core Biostatistics Courses		Points
P6400	Principles of Epidemiology	3
P8104	Probability	3
P8105	Data Science I	3
P8109	Statistical Inference	3
P8130	Biostatistical Methods I	3
P8131	Biostatistical Methods II	3
Core Genetics Courses		
P8119	Adv. Statistical and Computational Methods in Genetics & Genomics	3
P8139	Statistical Genetics Modeling	3
P8149	Human Population Genetics	3
P8185	Capstone Consulting Seminar	1
	TOTAL POINTS FROM REQUIRED COURSES	28

Elective Courses

Choose courses from this list or from alternatives approved by your track director.

		Points
P8160	Topics in Advanced Statistical Computing	3
P8405	Genetics in Epidemiology	3
P8438	Epidemiology II: Design and Conduct of Observational Epidemiology	3
W4761	Computational Genomics	3
W4771	Machine Learning	3

Sample Timeline

Fall I	Spring I	Fall II	Spring II
P8104 Probability	P8109 Statistical Inference	P6400 Principles of Epidemiology I	P8185 Capstone Consulting Seminar
P8105 Data Science I	P8131 Biostatistical Methods II	P8119 Advanced Statistical & Computational Methods	Complete practicum requirements
P8130 Biostatistical Methods I	P8139 Statistical Genetics Modeling	Elective	
P8149 Human Population Genetics	Elective	Elective	

Theory and Methods

Director: Christine Mauro, PhD

The Master of Science in Biostatistics - Theory and Methods (MS/TM)

prepares individuals for a career applying statistical methods in the biomedical sciences. The MS/TM program is the appropriate program for a student whose goal is to work effectively as a biostatistician in a biomedical, clinical, or laboratory research setting; or for a student who plans to pursue a PhD in biostatistics.

Course Requirements

MS/TM students are expected to master certain mathematical and biostatistical concepts and techniques as represented by the courses listed below. Students must complete a minimum of 36 points to earn the MS/TM degree, of which 30 points must be taken at the Mailman School of Public Health. Up to two s/electives may be taken pass/fail (i.e., one selective and one elective or two electives).

Note that some courses in the required curriculum may be waived based on prior graduate level coursework with approval from the course instructor. In this event, the student may substitute another, more advanced course in place of the waived course. Credits from waived courses do not count towards the degree.

In advance of beginning the MS program, any student who has not previously completed a bachelor's or master's degree in public health from a CEPH-accredited school or program, will need to complete the Introduction to Public Health non-credit, asynchronous requirement (administered by the Office of Educational Initiatives). Since this is not a course, you do not need to register. Throughout the requirement, you are expected to be actively engaged in the material and approach the work with the same effort you would a for-credit course.

Students' progress will be reviewed after each semester. Those students whose academic performance falls below a cumulative B average (3.0 GPA) in required courses may not be allowed to graduate without remedial course work.

A student is considered full-time in the MS/TM program if he or she takes a minimum of 12 credits per semester.

International students are required to be registered for at least 12 credits during their second and third semesters.

Request for a track change must be made before the start of a student's second semester. Tracks cannot be changed once the second semester has begun.

Practicum Requirement

One term of practical experience is required of all students, providing educational opportunities that are different from and supplementary to the more academic aspects of the program. The practicum may be fulfilled during the school year or over the summer. Arrangements are made on an individual basis in consultation with faculty advisors who must approve both the proposed practicum project prior to its initiation, and the report submitted at the conclusion of the practicum experience. Students will be required to make a presentation at the department's Annual Biostatistics Practicum/APEx Symposium which is held in late April/early May. See the practicum information section at the back of the handbook for details.

Capstone Experience

A formal culminating experience is required for graduation. The capstone consulting experience is designed to enable students to demonstrate their ability to integrate their academic studies with the role of biostatistical consultant/collaborator, which will comprise the major portion of their future professional practice. Students register for Capstone Consulting Seminar (P8185), a one-semester, one-credit course during their final spring semester. The course requires students to attend at least one session of the Biostatistics Consulting Service and present the consultation to the class for discussion. The Consulting Service, which is run by faculty in the Department of Biostatistics, offers advice on data analysis and appropriate methods of data presentation for publications, and provides design recommendations for public health and clinical research, including preparation of grant proposals and manuscripts.

Curriculum (TOTAL POINTS: 36 OR MORE)

Required Courses		Points
P6400	Principles of Epidemiology	3
P8104	Probability	3
P8105	Data Science I	3
P8109	Statistical Inference	3
P8130	Biostatistical Methods I	3
P8131	Biostatistical Methods II	3
P8185	Capstone Consulting Seminar	1
	TOTAL POINTS FROM REQUIRED COURSES	19

Selective Courses Choose 1 course from each group. Additional courses beyond this can also be taken as electives.		Points
GROUP 1:	Principles of Statistical Design	
P8116	Design of Medical Experiments	3
P8140	Randomized Clinical Trials	3
P8142	Clinical Trial Methodology	3
P8144	Pharmaceutical Statistics	3
P8133	Bayesian Analysis and Adaptive Designs in Clinical Trials	3
P8123	Analysis of Health Surveys	3
GROUP 2:	Advanced Statistical Methods	
P8108	Survival Analysis	3
P8157	Analysis of Longitudinal Data	3
P8122	Statistical Methods for Causal Inference	3
P8124	Graphical Models for Complex Health Data	3
	TOTAL POINTS FROM SELECTIVE COURSES	6

Additional Elective Courses Choose courses from this list or from alternatives approved by your track director.		Points
P6110	Statistical Computing with SAS	3
P8106	Data Science II	3
P8119	Adv Statistical and Computational Methods in Genetics & Genomics	3
P8149	Human Population Genetics	3
P8158	Latent Variable and Structural Equation Modeling for Health Sciences	3
P8160	Topics in Advanced Statistical Computing for Health Sciences	3
P8180	Relational Databases and SQL Programming for Research and Data Science	3
P9120	Topics in Statistical Learning and Data Mining I	3

Sample Timeline

Fall I	Spring I	Fall II	Spring II
P6400 Principles of Epidemiology	P8109 Statistical Inference	Selective/Elective	P8185 Capstone Consulting Seminar
P8104 Probability	P8131 Biostatistical Methods II	Selective/Elective	Complete practicum requirements
P8105 Data Science I	Selective/Elective	Selective/Elective	
P8130 Biostatistical Methods I	Selective/Elective	Selective/Elective	

Public Health Data Science

Director: Min Qian, PhD

The Master of Science in Biostatistics - Public Health Data Science

(MS/PHDS) prepares students interested in careers as biostatisticians applying statistical methods in health-related research settings. The track provides core training in biostatistical theory, methods, and applications, but adds a distinct emphasis on modern approaches to statistical learning, reproducible and transparent code, and data management.

Course Requirements

MS/PHDS students are expected to gain proficiency in genetic study design and analysis as represented by the courses listed below. Students must complete a minimum of 36 academic credits to earn the MS/PHDS degree, of which 30 points must be taken at the Mailman School of Public Health. Up to two electives may be taken pass/fail, especially to encourage students to take courses outside their field of experience.

Note that some courses in the required curriculum may be waived based on prior graduate level coursework with approval from the course instructor. In this event, the student may substitute another, more advanced course in place of the waived course. Credits from waived courses do not count towards the degree.

In advance of beginning the MS program, any student who has not previously completed a bachelor's or master's degree in public health from a CEPH-accredited school or program, will need to complete the Introduction to Public Health non-credit, asynchronous requirement (administered by the Office of Educational Initiatives). Since this is not a course, you do not need to register. Throughout the requirement, you are expected to be actively engaged in the material and approach the work with the same effort you would a for-credit course.

Students' progress will be reviewed after each semester. Those students whose academic performance falls below a cumulative B average (3.0 GPA) in required courses may not be allowed to graduate without remedial course work.

A student is considered full-time in the MS/TM program if he or she takes a minimum of 12 credits per semester.

International students are required to be registered for at least 12 credits during their second and third semesters.

Request for a track change must be made before the start of a student's second semester. Tracks cannot be changed once the second semester has begun.

Practicum Requirement

One term of practical experience is required of all students, providing educational opportunities that are different from and supplementary to the more academic aspects of the program. The practicum may be fulfilled during the school year or over the summer. Arrangements are made on an individual basis in consultation with faculty advisors who must approve both the proposed practicum project prior to its initiation, and the report submitted at the conclusion of the practicum experience. Students will be required to make a presentation at the department's Annual Biostatistics Practicum/APEx Symposium which is held in late April/early May. See the practicum information section at the back of the handbook for details.

Capstone Experience

A formal culminating experience is required for graduation. The capstone consulting experience is designed to enable students to demonstrate their ability to integrate their academic studies with the role of biostatistical consultant/collaborator, which will comprise the major portion of their future professional practice. Students register for Capstone Consulting Seminar (P8185), a one-semester, one-credit course during their final spring semester. The course requires students to attend at least one session of the Biostatistics Consulting Service and present the consultation to the class for discussion. The Consulting Service, which is run by faculty in the Department of Biostatistics, offers advice on data analysis and appropriate methods of data presentation for publications, and provides design recommendations for public health and clinical research, including preparation of grant proposals and manuscripts.

Curriculum (TOTAL POINTS: 36 OR MORE)

Required Courses		Points
P6400	Principles of Epidemiology	3
P8104	Probability	3
P8105	Data Science I	3
P8106*	Data Science II	3
P8109	Statistical Inference	3
P8130	Biostatistical Methods I	3
P8131	Biostatistical Methods II	3
P8180	Relational Databases and SQL Programming for Research and Data Science	3
P8185	Capstone Consulting Seminar	1
	TOTAL POINTS FROM REQUIRED COURSES	25

* Students who have strong math background and/or have taken basic machine learning methods, can substitute the P8106 Data Science II with P9120 Topics in Statistical Learning and Data Mining I.

Elective Courses Choose courses from this list or from alternatives approved by your track director.		Points
P6110	Statistical Computing with SAS	3
P8108	Survival Analysis	3
P8119	Adv Statistical and Computational Methods in Genetics & Genomics	3
P8123	Analysis of Health Surveys	3
P8124	Graphical Models for Complex Health Data	3
P8157	Analysis of Longitudinal Data	3
P8158	Latent Variable and Structural Equation Modeling for Health Sciences	3
P8160	Topics in Advanced Statistical Computing for Health Sciences	3
P9120	Topics in Statistical Learning and Data Mining I	3

Sample Timeline

Fall I	Spring I	Fall II	Spring II
P6400 Principles of Epidemiology	P8109 Statistical Inference	P8180 Relational Databases and SQL Programming	P8185 Capstone Consulting Seminar
P8104 Probability	P8106 Data Science II	Elective	Complete practicum requirements
P8105 Data Science I	P8131 Biostatistical Methods II	Elective	
P8130 Biostatistical Methods I	Elective	Elective	

Patient Oriented Research

Director: Todd Ogden, PhD

The Master of Science in Patient Oriented Research (MS/POR) degree provides training in the fundamentals of clinical and translational investigation, with a view to enabling young researchers to compete more effectively for research funding. MS/POR students are trained in the design, conduct, and evaluation of clinical research studies. The program is comprised of an interdisciplinary series of courses and colloquia that reflects both the public health faculty's expertise in design and conduct of research studies and the clinical faculty's intimate knowledge of human health and patient care.

Course Requirements

The required courses are intended to enable degree candidates to gain proficiency in study design, application of commonly used statistical procedures, facility with statistical software, and ability to successfully interpret and communicate the results of an analysis. The overall goal is to make graduates more competitive in pursuit of research funding. The two-year MS-POR curriculum consists of 30 credits in total and a culminating Master's Essay. Up to two s/electives may be taken pass/fail (i.e., one selective and one elective or two electives).

MS/POR candidates must begin study during their first summer by enrolling in the Columbia Summer Research Institute (CSRI). In the CSRI, students will earn 10 credits, completing courses in biostatistics, epidemiology, NIH grant writing, health disparities research and decision analysis. With this, students earn one-third of the required credits in the first summer, allowing greater flexibility and fewer scheduling commitments over the remaining months.

Note that some courses in the required curriculum may be waived based on prior graduate level coursework with approval from the course instructor. In this event, the student may substitute another, more advanced course in place of the waived course. Credits from waived courses do not count towards the degree.

In advance of beginning the MS program, any student who has not previously completed a bachelor's or master's degree in public health from a CEPH-accredited school or program, will need to complete the Introduction to Public Health non-credit, asynchronous requirement (administered by the Office of Educational Initiatives). Since this is not a course, you do not need to register. Throughout the requirement, you are expected to be actively engaged in the material and approach the work with the same effort you would a for-credit course.

Students' progress will be reviewed after each semester. Those students whose academic performance falls below a cumulative B average (3.0 GPA) in required courses may not be allowed to graduate without remedial course work.

Capstone Experience

As part of the MS/POR training, each student is required to register for Master's Essay-Patient Oriented Research (PUBH P9165) and complete a master's essay that consists of an NIH-style grant application. The student is supervised by a Project Sponsor from biostatistics and by a clinical mentor from the student's field of expertise. At the end of the term, each student will submit a research grant proposal, following NIH guidelines for applications. Each proposal will be reviewed by the program leaders, followed by a formal presentation to the TRANSFORM (Training And Nurturing Scholars For Research that is Multidisciplinary) Advisory Board. The completion, submission, and presentation of the research proposal fulfill the capstone requirement.

Curriculum (TOTAL POINTS: 30 OR MORE)

Required Courses		Points
P6104	Introduction to Biostatistical Methods (CSRI)	3
P6400	Principles of Epidemiology (CSRI)	3
P8103	Colloquium on Patient Oriented Research (taken over four semesters)	2
P8120	Analysis of Categorical Data	3
P8182	Writing a Successful Grant Application (CSRI)	1
P8568	Decision Analysis for Clinical and Public Health Practices (CSRI)	2
P8750	Race and Health (CSRI)	1
P9165	Master's Essay - Patient Oriented Research	0
G4010	Responsible Conduct of Research and Related Policy Issues	1
M9780	Funding for Research Activities: Basic Issues in Obtaining Support	1
89260	Building Interdisciplinary Research Models (also G9260 or N9260)	2
	TOTAL POINTS FROM REQUIRED COURSES	19

In addition to the 11 courses listed above, students are required to take at least two of the following courses of which at least one course has to be from the Biostatistics and Epidemiology list. Other courses related to precision medicine, statistical genetics, molecular biology mechanisms, data and computing, dissemination/implementation, biostatistics, or epidemiology may count towards fulfilling the selective requirement as long as they are approved in advance by the MS/POR Advisory Committee.

Restricted electives (selectives)		Points
Precision Medicine and Genetics Electives		
M7208	Precision Medicine	3
P6385	Principles of Genetics and the Environment	3
P8119	Adv Statistical & Computational Methods in Genetics & Genomics	3
P8405	Genetics in Epidemiology	3
Mechanisms/Molecular Electives		
G4500	Cancer Biology 1	3
G6003	Mechanisms in Human Disease I	4.5
P8307	Molecular Epidemiology	3
P8308	Molecular Toxicology	3
P8312	Fundamentals of Toxicology	3
P8319	Biological Markers of Chemical Exposure	3
Data and Computing Electives		
G4001	Introduction to Computer Application in Health Care & Biomedicine	3
P6110	Statistical Computing Using SAS	3

MSPOR elective courses continued
on next page

curriculum CONTINUED

P8101	Introduction to Health Data Science	3
P8105	Data Science I	3
P8180	Relational Databases and SQL Programming for Research and Data Science	3
P8451	Introduction to Machine Learning for Epidemiology	3
Dissemination & Implementation Science and Community-based Participatory Research Electives		
P8792	Dissemination and Implementation Science	3
P8771	Community Based Participatory Research	3
Biostatistics and Epidemiology Electives		
P8100	Applied Regression I	3
P8110	Applied Regression II	3
P8112	Systematic Review and Meta-analysis	1.5
P8122	Statistical Methods for Causal Inference	3
P8140	Randomized Clinical Trials	3
P8142	Clinical Trials Methodology	3
P8400	Epi III: Applied Epidemiological Analysis	3
P8401	Pharmacoepidemiology	3
P8438	Epi II: Design and Conduct of Observational Epidemiology	3
P8450	Clinical Epidemiology	3
P8777	Survey Research Methods	3
P8902	Introduction to Mixed Methods	3

Elective Courses. Students will choose elective courses from one or more of the following:

- Departments of Epidemiology or Biostatistics, or other departments at the School of Public Health
- From the list of restricted electives (selectives) – see above
- Elective courses from other Columbia schools – see list below

Electives in Clinical and Translational Research outside of Mailman School of Public Health

Electives in Biostatistics		Points
B8128	Healthcare Investment and Entrepreneurship	1.5
B8342	Healthcare Investment and Deal-making	1.5
B8692	Pharmaceutical Drug Commercialization: Strategy & Practice	1.5
B8745	Forecasting for Drug Development Strategy	1.5
E6893	Topics in Information Processing: Big Data Analytics	3
G4006	Translational Bioinformatics	3
G4062	Public Health Informatics	1

Sample Timeline

Summer I	Fall I	Spring I	Fall II	Spring II
P6104 Intro to Biostatistical Methods	P8103 Colloquium (0.5)	P8103 Colloquium (0.5)	P8103 Colloquium (0.5)	P8103 Colloquium (0.5)
P6400 Principles of Epidemiology	Elective	P8120 Analysis of Categorical Data	Elective	M9780 Funding for Research Activities
P8182 Writing a Successful NIH Grant	Selective	G4010 Responsible Conduct of Research	P9165 Master's Essay (POR Capstone)	
P8568 Decision Analysis		Selectives/Elective		89260 Building Interdisciplinary Research Models
P8750 Race and Health				

Department of Biostatistics Courses

These are the courses offered by the Department of Biostatistics. Due to faculty commitments, the frequency of the courses changes from time to time. Students are advised to check the current schedule of courses listed on the MSPH web page: www.mailman.columbia.edu/academics/courses. Students may also review the course offerings of the Statistics Department at the Morningside Campus in the Graduate School of Arts and Sciences: www.stat.columbia.edu.

Students are encouraged to meet with their faculty advisors at least twice a year (in the fall and in the spring). Permission is not required for approved courses in a student's approved program of study. Students must first obtain permission from their faculty advisors to take courses outside the approved program. Failure to comply with these guidelines may jeopardize plans for graduation.

P6103 Introduction to Biostatistics 3 points

Prerequisites: Permission of the instructor required for all non-Public Health students.

Biostatistics is essential to ensuring that findings and practices in public health and biomedicine are supported by reliable evidence. This course covers the basic tools for the collection, analysis, and presentation of data in all areas of public health. Central to these skills is assessing the impact of chance and variability on the interpretation of research findings and subsequent recommendations for public health practice and policy. Topics covered include: general principles of study design; hypothesis testing; review of methods for comparison of discrete and continuous data including ANOVA, t-test, correlation, and regression.

P6104 Introduction to Biostatistical Methods 3 points

Prerequisites: Instructor's permission for non-Biostatistics students

An enriched core course for students concentrating in biostatistics and others who expect to take additional courses in biostatistics beyond the two main second-level courses (P8100 and P8120). It covers in greater depth all of the topics in P6103 and is the best preparation for students anticipating a quantitative orientation in their degree programs. Topics covered include standard distributions, measures of central tendency and dispersion, hypothesis testing, point estimation, confidence intervals, and an introduction to correlation and regression.

P6110 Statistical Computing with SAS 3 points

Prerequisites: P6104, P8130 or MPH Quantitative Foundations core course

A logical follow-up course to an introductory biostatistics course. Covers uses of the computer in cleaning, summarizing, and cross-classifying data. Enhancement of the material covered in P6103/P6104— including regression, correlation, and contingency table analysis, and the analysis of variance–with data analysis carried out using SAS software.

P6170 New Drug Development: A Regulatory Overview 3 points

Prerequisite: P6104, P8130 or MPH Quantitative Foundations core course and P6400

Provides our CTSA fellows and scholars with insights into and understanding of the process of patient oriented/translational research and gives them an opportunity to meet active investigators from academia and industry, and learn about some career enhancing resources available at CUMC. Active researchers from various clinical disciplines and public health are invited to speak on research techniques, design, and laboratory methodology as applied to current studies. They present their experiences in conducting patient orientated research on the Health Sciences campus and elsewhere. Also features speakers from both the pharmaceutical and biotech industries who discuss drug development, and preclinical and clinical trials. Other lectures deal with FDA regulations, patent law, and the Institutional Review Board and ways to effectively build and succeed in a clinical/translational academic career.

P8100 Applied Regression I 3 points

Prerequisites: P6104 or MPH Quantitative Foundations core course. (Not open to MS/TM, PHDS, PS, or SG tracks)

This course will provide an introduction to the basics of regression analysis. The class will proceed systematically from the examination of the distributional qualities of the measures of interest, to assessing the appropriateness of the assumption of linearity, to issues related to variable inclusion, model fit, interpretation, and regression diagnostics.

P8101 Introduction to Health Data Science 3 points

Prerequisites: P6104, P8130 or MPH Quantitative Foundations

This course will introduce students to core data science skills and concepts through the exploration of applied biostatistics. The course will begin with an introduction to the R programming language and the RStudio IDE, focusing on contemporary tidyverse functions and reproducible programming methods. Then, the course will instruct students in contemporary data manipulation and visualization tools while systematically covering core applied biostatistics topics, including confidence intervals, hypothesis testing, permutation tests, and logistic and linear regression. Finally, the semester will end with an introduction to machine learning concepts, including terminology, best practices in test/training sets, cross-validation, and a survey of contemporary classification and regression algorithms.

P8103 Colloquium on Patient Oriented Research 2 points (0.5 points x 4 semesters)

Prerequisite: MS-POR students only

Provides our CTSA fellows and scholars with insights into and understanding of the process of patient oriented/translational research and gives them an opportunity to meet active investigators from academia and industry, and learn about some career enhancing resources available at CUMC. Active researchers from various clinical disciplines and public health are invited to speak on research techniques, design, and laboratory methodology as applied to current studies. They present their experiences in conducting patient orientated research on the Health Sciences campus and elsewhere. Also features speakers from both the pharmaceutical and biotech industries who discuss drug development, and preclinical and clinical trials. Other lectures deal with FDA regulations, patent law, and the Institutional Review Board and ways to effectively build and succeed in a clinical/translational academic career.

P8104 Probability 3 points

Prerequisites: P6104 or P8130 (may be corequisite), working knowledge of calculus

Topics include: Fundamentals, random variables, and distribution functions in one or more dimensions; moments, conditional probabilities, and densities; Laplace transforms and characteristic functions. Infinite sequences of random variables, weak and strong large numbers; central limit theorem.

P8105 Data Science I 3 points

Prerequisites: Experience in R programming (or programming in another language) and data analysis is recommended

Contemporary biostatistics and data analysis depends on the mastery of tools for computation, visualization, dissemination, and reproducibility in addition to proficiency in traditional statistical techniques. The goal of this course is to provide training in the elements of a complete pipeline for data analysis.

P8106 Data Science II 3 points

Prerequisites: P8105

With the explosion of "Big Data" problems, statistical learning has become a very hot field in many scientific areas. The goal of this course is to provide the training in practical statistical learning. It is targeted to MS students with some data analysis experience.

P8107 Introduction to Mathematical Statistics 3 points

Prerequisities: MPH Quantitative foundations or P6104 (Not open to MS/TM, PHDS, or SG tracks)

The first portion of this course provides an introductory-level mathematical treatment of the fundamental principles of probability theory, providing the foundations for statistical inference. Students will learn how to apply these principles to solve a range of applications. The second portion of this course provides a mathematical treatment of (a) point estimation, including evaluation of estimators and methods of estimation; (b) interval estimation; and (c) hypothesis testing, including power calculations and likelihood ratio testing.

P8108 Survival Analysis 3 points

Prerequisites: P8104, P8109, and P8130

This course focuses on methods for the analysis of survival data, or time-to-event data. Survival analysis is a method for survival data or failure (death) time data, that is time-to-event data, which arises in a number of applied fields, such as medicine, biology, public health, epidemiology, engineering, economics, and demography. A special course of difficulty in the analysis of survival data is the possibility that some individual may not be observed for the full time to failure. Instead of knowing the failure time t, all we know about these individuals is that their time-to-failure exceeds some value y where y is the follow-up time of these individuals in the study. Students in this class will learn how to make inference for the event times with censored.

P8109 Statistical Inference 3 points

Prerequisites: P8104, working knowledge of calculus and linear algebra

This course covers a review of mathematical statistics and probability theory at the Masters level. Students will be exposed to theory of estimation and hypothesis testing, confidence intervals and Bayesian inference. Topics include population parameters, sufficient statistics, basic distribution theory, point and interval estimation, introduction to the theory of hypothesis testing, and nonparametric procedures.

P8110 Applied Regression II 3 points

Prerequisites: P6104 or MPH Quantitative Foundations core course, and P8100 (Not open to MS/TM, PHDS, or SG tracks)

An introduction to the application of statistical methods in survival analysis, generalized linear models, and design of experiments. Topics to be covered include estimation and comparison of survival curves, regression models for survival data, log-linear models, logit models, analysis of repeated measurements, and the analysis of data from blocked and split-plot experiments. Examples are drawn from the health sciences.

P8112 Systematic Review and Meta-Analysis 1.5 points

Prerequisites: P6104, P8130 or MPH Quantitative Foundations core course and P6400

Research synthesis using systematic review and meta-analysis is one of the most valuable of research endeavors, and can be a particularly rewarding experience for junior investigators who want to develop expertise in a specific area of public health or medicine by producing a product with significant scientific impact. This course will combine lecture and workshop elements to introduce students to the principles and practices of systematic review and metaanalysis. It will be targeted to students who have previously been introduced to the concepts of basic biostatistics, epidemiology, and clinical trials.

P8116 Design of Medical Experiments 3 points

Prerequisites: P8104, P8109, and P8130

This course covers the fundamental principles and techniques of experimental designs in clinical studies. Topics include reliability of measurement, linear regression analysis, parallel groups design, analysis of variance (ANOVA), multiple comparison, blocking, stratification, analysis of covariance (ANCOVA), repeated measures studies; Latin squares design, crossover study, randomized incomplete block design, and factorial design.

P8119 Advanced Statistical and Computational Methods in Genetics and Genomics 3 points

Prerequisites: P6104 or P8130

This course introduces students to advanced computational and statistical methods used in the design and analysis of high-dimensional genetic data, an area of critical importance in the current era of Big Data. The course starts with a brief background in genetics, followed by in depth discussion of topics in genome-wide linkage and association studies, and next-generation sequencing studies. Additional topics such as network genetics will also be covered. Examples from recent and ongoing applications to complex traits will be used to illustrate methods and concepts.

P8120 Analysis of Categorical Data 3 points

Prerequisites: P6104 or P8130 or MPH Quantitative Foundations core course, and P6400 (Not open to MS/TM, PHDS, or SG tracks)

A comprehensive overview of methods of analysis for binary and other discrete response data, with applications to epidemiological and clinical studies. Topics discussed include the fourfold table, significance versus magnitude of association; estimation of relative risk; matching in design and analysis; interrater agreement; logistic regression analysis.

P8122 Statistical Methods for Causal Inference 3 points

Prerequisites: P8100 and P8110 or P8130 and P8131

This class will introduce students to both statistical theory and practice of causal inference. As theoretical frameworks, we will discuss potential outcomes, causal graphs, randomization and model-based inference, causal mediation, and suf ficient component causes. We will cover various methodological tools including randomized experiments, matching, inverse probability weighting, instrumental variable approaches, dynamic causal models, sensitivity analysis, statistical methods for mediation and interaction.

P8123 Analysis of Health Surveys 3 points

Pre-requisites: P8131 (or P8110) and P8104 (or P8107)

This is an applied statistical methods course. The course will introduce main techniques used in sampling practice,including simple random sampling, stratification, systematic sampling, cluster sampling, probability proportional to size sampling, and multistage sampling. Using national health surveys as examples, the course will introduce and demonstrate the application of statistical methods in analysing across-sectional surveys and repeated and longitudinal surveys, and conducting multiple imputation for missing data in large surveys. Other topics will include methods for variance estimation, weighting, post-stratification, and non-sampling errors. If time allows, new developments in small area estimation and in the era of data science will also be discussed.

P8124 Graphical Models for Complex Health Data 3 points

Pre-requisites: P8105 and P8109 or instructor's permission

This is a course at the intersection of statistics and machine learning, focusing on graphical models. In complex systems with many (perhaps hundreds or thousands) of variables, the formalism of graphical models can make representation more compact, inference more tractable, and intelligent data-driven decision-making more feasible. We will focus on representational schemes based on directed and undirected graphical models and discuss statistical inference, prediction, and structure learning. We will emphasize applications of graph-based methods in areas relevant to health: genetics, neuroscience, epidemiology, image analysis, clinical support systems, and more.

P8130 Biostatistical Methods I 3 points

Prerequisites: Students are required to have working knowledge of calculus and linear algebra

This course introduces basic applied descriptive and inferential statistics. The first part of the course includes elementary probability theory, an introduction to statistical distributions, principles of estimation and hypothesis testing, methods for comparison of discrete and continuous data including chi-squared test of independence, t-test, analysis of variance (ANOVA), and their non-parametric equivalents. The second part of the course focuses on linear models (regression) theory and their practical implementation.

P8131 Biostatistical Methods II 3 points

Prerequisites: P8130

Regression analysis is widely used in biomedical research. Non-continuous (e.g., binary or count-valued) responses, correlated observations, and censored data are frequently encountered in regression analysis. This course will introduce advanced statistical methods to address these practical problems. Topics include generalized linear models (GLM) for non-Gaussian response, mixed-effects models and generalized estimating equations (GEE) for correlated observations, and Cox proportional hazards models for survival data analysis. Examples are drawn from biomedical sciences.

P8133 Bayesian Analysis and Adaptive Designs for Clinical Trials 3 points

Prerequisites: P8104,P8109, and P8140

An introduction to sequential analysis as it applies to statistical problems in clinical trials, hypothesis testing, selection, and estimation. Emphasis is placed on a study of procedures, operating characteristics, and problems of implementation, rather than mathematical theory. Students obtain an overview of currently available sequential designs and the advantages and disadvantages they offer in comparison with classical designs.

P8134 Stochastic Approximation and Modern Dose-Finding 3 points

Prerequisites: P8104 and P8109 or their equivalents

Provides an in-depth study of statistical designs for dose-finding clinical trials of new drugs. This course is designed for advanced Master's, DrPH, and PhD students in biostatistics. The overall learning objective is to equip students with the techniques to construct, evaluate, and critique dose-finding designs. The course consists of two parts. The first is a review of modern dose-finding techniques with a focus on the continual reassessment method (CRM) and its clinical applications. The second part presents advanced topics on stochastic approximation and its related theory. Connections between the dose-finding methods (part 1) and the stochastic approximation (part 2) will be drawn. The practical implication of these connections is two-fold. First, the stochastic approximation will provide a versatile and mathematically rigorous framework for tailoring dose-finding designs to specific clinical situations. Second, the well-studied theory of stochastic approximation will be an effective analytical tool to approximate the theoretical properties of the CRM.

P8139 Statistical Genetics Modeling 3 points

Prerequisites: P6103 or P6104 or P8130, a working knowledge of calculus

Present to students statistical tools so that they can grasp the fundamentals of the design, conduct and analysis of genetic association studies. The course will thoroughly discuss current methods that are being used to map genes for common complex diseases. Great emphasis will be placed on candidate-gene and genome-wide association studies, but linkage methods will also be treated. Another key feature of this course will be a detailed treatment of the major findings of the Human Genome Project and HapMap Project.

P8140 Introduction to Randomized Clinical Trials 3 points

Prerequisites: P6104, P8130 or MPH Quantitative Foundations core course

Fundamental methods and concepts of the randomized clinical trial: protocol development, randomization, blindedness, patient recruitment, informed consent, compliance, sample size determination, crossovers, collaborative trials. Each student prepares and submits the protocol for a real or hypothetical clinical trial.

P8142 Clinical Trial Methodology 3 points

Prerequisites: P6104 or P8130

The main objective of this course is to provide students and investigators with a working knowledge of certain methodological issues that arise in designing a clinical trial in order to conduct complex study designs that yield valid and reliable results. With emphasis on several methodological and practical issues related to the design and analysis of clinical experiments, topics include: the design of small studies (Phase I and II studies), interim analyses and group sequential methods, survival studies, multiple outcome measures, surrogate outcomes, multicenter studies, issues in data analysis, and reporting and interpreting study results.

P8144 Pharmaceutical Statistics 3 points

Prerequisites: P6104, P8130 or MPH Quantitative Foundations core course. SAS knowledge recommended.

Drug development from compound discovery to marketing and commercialization registration is a lengthy and complex process in which statisticians play an important role from beginning to end. The main objective of this course is to provide students with working knowledge of the methodological and operational issues that arise in different stages of drug development that involve statistical contributions.

P8149 Human Population Genetics 3 points

Prerequisites: P8104 and the instructor's permission.

This course will cover all statistical aspects of population genetics. Upon completion of this course, the students will be able to model and do inference of underlying population genetic mechanisms and apply acquired knowledge about population genetics to the analyses of phenotypes.

P8157 Analysis of Longitudinal Data 3 points

Prerequisites: P8104, P8109, and P8130

The course will introduce students to statistical models and mthods for longitudinal data, i.e., repeatedly measured data over time or under different conditions. The topics will include design and sample size calculation, Hotelling's T2, multivariate analysis of variance, multivariate linear regression (generalized linear models), models for correlation, unbalanced repeated measurements, mixed effects models, EM algorithm, methods for non-normally distributed data, generalized estimating equations, generalized linear mixed models, and missing data.

P8158 Latent Variable and Structural Equation Modeling for Health Sciences 3 points

Prerequisites: P6104, P8130 or MPH Quantitative core course

This course is designed for those students (or any researchers) who want to gain a significant familiarity with a collection of statistical techniques that target the measurement of latent variables (i.e. variables that cannot be measured directly) as well as methods for estimating relationships among variables within causal systems. This course covers: both continuous and categorical latent variable measurement models (i.e. exploratory and confirmatory factor analysis, item response theory models, latent class and finite mixture models), as well as estimation of relationships in hypothesized causal systems using structural equation modeling. Data analysis examples will come from health science applications and practical implementation of all methods will be demonstrated using predominately the Mplus software, but also the R software.

P8160 Topics in Advanced Statistical Computing 3 points

Prerequisites: P8109, a basic understanding of Bayesian inference, working knowledge of a programming language

As statistical models become increasingly complex, it is often the case that exact or even asymptotic distributions of estimators and test statistics are intractable. With the continuing improvement of processor speed, computationally intensive methods have become invaluable tools for statisticians to use in practice. This course covers the basic modern statistical computing techniques and how they are applied in a variety of practical situations. Topics include numerical optimization, random number generation, simulation, Monte Carlo integration, permutation tests, jackknife and bootstrap procedures, Markov Chain Monte Carlo methods in Bayesian settings, and the EM algorithm.

P8170 Integrative Capstone Experience 2 points

Prerequisites: Biostatistics MPH students only

Required capstone course forall MPH students in Biostatistics. In this course, students will produce a written report that describes an analysis of relevant data using statistical techniques learned during the course of the MPH program.

P8180 Relational Databases and SQL Programming for Research and Data Science 3 points

Prerequisites: P6104, P8130 or MPH Quantitative Foundations core course, and the instructor's permission.

This class provides an overview of the specific techniques available to collect, store, retrieve, and control the quality of data in research projects. Students will be introduced to these concepts through a combination of lecture videos and a substantial hands-on component consisting of structured computer-based exercises. Spreadsheet and database technologies will be reviewed in detail to establish guidelines as to the appropriateness of their use to manage data in research.

P8182 Writing a Successful Grant Application 1 points

Prerequisites: Concurrent enrollment in the Columbia Summer Research Institute. Required for MS-POR students.

This seminar-style course will lead students through the process of writing an NIH-style grant application. By the end of the course, each student submits a research proposal outline following NIH guidelines for either an R01 or K (career development) award. The emphasis in this course is on the quality of the proposed research, taking into account feasibility, relevance, innovation, ethical foundation, and public health impact. As a culminating experience, students make oral presentations summarizing their research proposals to an invited panel of senior, experienced CUMC faculty, and receive feedback on their proposed research aims and approaches.

P8185 Capstone Consulting Seminar 1 point

Prerequisites: At least 15 points of required coursework in biostatistics. Biostatistics MS/MPH students only.

Required capstone course for the MS/PS, MS/SG, MS/TM and 2-year MPH students in Biostatistics. Provides experience in the art of consulting and in the proper application of statistical techniques to public health and medical research problems. Enables students to translate research objectives into statistical hypotheses, devise appropriate study designs, perform sample size calculations for studies employing simple random sampling, formulate and prepare written plans for statistical analysis for a research proposal, compose summaries of quantitative analyses, and communicate results clearly to public health colleagues. Based on seminars requiring active student participation.

P9104 Probability for Biostatisticians 3 points

Pre-requisites: P8109 and P8110, advanced calculus. Instructor's permission needed for MS students

The biostatistical field is changing with new directions emerging constantly. Doing research in these new directions, which often involve large data and complex designs, requires advanced probability and statistics tools. The purpose of this new course is to collect these important probability methods and present them in a way that is friendly to a biostatistics audience. This course is designed for PhD students in Biostatistics. Its primary objective is to help the students achieve a solid understanding of these probability methods and develop strong analytical skills that are necessary for conducting methodological research in modern biostatistics. At the completion of this course, the students will a) have a working knowledge in Law of Large Numbers, Central Limit Theorems, martingale theory, Brownian motions, weak convergence, empirical process, and Markov chain theory; b) be able to understand the biostatistical literature that involves such methods; c) be able to do proofs that call for such knowledge.

P9109 Theory of Statistical Inference I 3 points

Prerequisites: P8104, P8109. Instructor's permission needed for MS students

This course offers a general introduction to essential materials in advanced statistical theory for doctoral students in biostatistics. The course is designed to prepare doctoral students in biostatistics for their written theory qualifying exam. Students in this course will learn theory of estimation, confidence sets and hypothesis testing. Specific topics include a quick review of measure-theoretic probability theory, concepts of suf ficiency and completeness, unbiased estimation (UMVUE), least squares principle, likelihood estimation, a variety of estimators and their asymptotic properties, confidence sets, the Neyman-Pearson lemma and uniformly most powerful tests. If time permits, the likelihood ratio test, score test and Wald test, and sequential analysis will be covered.

P9110 Theory of Statistical Inference II 3 points

Prerequisites: P8104, P8109, and P9109. Instructor's permission needed for MS students

This course continues the introduction to mathematical statistics for doctoral students in biostatistics. Topics to be covered include: principles of decision theory, Bayesian estimation, Hypothesis testing, asymptotics, M-estimation, Wald tests, and score tests.

P9111 Asymptotic Statistics 3 points

Prerequisites: P8104, P8109, P9109, and P9110. Instructor's permission needed for MS students

The choice of topics will vary from year to year, but will typically include: empirical processes and M-estimation, bootstrap methods, empirical likelihood, contiguity, local asymptotic normality, counting process methods in survival analysis, semiparametric inference and efficiency.

P9120 Topics in Statistical Learning and Data Mining I 3 points

Prerequisites: Intended for Biostatistics PhD students and theoretically inclined MS students

Provide students a systematic training in key topics in modern supervised statistical learning and data mining. For the most part, the focus will remain on a theoretically sound understanding of the methods (learning algorithms) and their applications in complex data analysis, rather than proving technical theorems. Applications of the statistical learning and data mining tools in biomedical and health sciences will be highlighted.

P9130 Advanced Biostatistical Methods I 3 points

Prerequisites: Advanced calculus, linear algebra, basic probability, statistical inference and instructor's permission for MS students

The course will provide a solid foundation of the theory behind linear models and generalized linear models. More emphasis will be placed on concepts and theory with mathematical rigor. Topics covered including linear regression models, logistic regression models, generalized linear regression models and methods for the analysis contingency tables.

P9160 Master's Essay in Biostatistics: Clinical Research Methods 3 points

Prerequisites: At least 15 points of required coursework. MS/CRM students only.

Students produce a Master's essay in the form of a research article of publishable quality, supervised by faculty members from Biostatistics and from the student's own clinical field.

P9165 Master's Essay in Biostatistics: Patient Oriented Research 0 points

Prerequisites: At least 15 points of required coursework. MS/POR students only

Students produce a Master's essay in the form of an NIH-style grant application, supervised by a project sponsor from Biostatistics and a mentor from the student's own clinical field. A formal presentation to the POR advisory board is required for successful completion of the course.

P9185 Statistical Practices and Research for Interdisciplinary Sciences (SPRIS) 3 points

Prerequisites: DrPH and PhD Biostatistics only

Required course for the DrPH and PhD students in biostatistics. Provides experience in the art of consulting and in the proper application of statistical techniques to public health and medical research problems. Enables students to translate research objectives into statistical hypotheses, devise appropriate study designs, perform sample size calculations for studies employing simple random sampling, formulate and prepare written plans for statistical analysis for a research proposal, compose summaries of quantitative analyses, and communicate results clearly to public health colleagues. Based on seminars requiring active student participation.

P9186 Statistical Practices and Research for Interdisciplinary Science (SPRIS) II 1.5 points

Prerequisites: P9185

Students will apply the concepts and methods introduced in Statistical Practices and Research for Interdisciplinary Science (SPRIS) I to a real research setting. Each student will be paired with a Biostatistics faculty member. The student will participate in one of the mentor's collaborative projects to learn how to be an effective member of an interdisciplinary team. Student experience will vary depending on the assigned faculty member, but all students will gain exposure to preparing collaborative grant applications, designing research studies, analyzing real data, interpreting and presenting results, and writing manuscripts. Mentors will help to develop the student's data intuition skills, ability to ask good research questions, and leadership qualities. Where necessary, students may replicate projects already completed by the faculty mentor to gain experience.

P8190/P9190 Tutorials in Biostatistics 1 to 6 points

For appropriately qualified students wishing to enrich their programs by undertaking literature reviews, special studies, or small group instruction in topics not covered in formal courses. Hours to be arranged.

89260 Building Interdisciplinary Research Models 2 points

Interdisciplinary research is an approach to advancing scientific knowledge requiring mastery of specific competencies. This seminar will introduce the students to competencies in interdisciplinary research through a combination of readings and lectures in each necessary aspect, chosen from fields essential to successful interdisciplinary research. This course will assist learners to understand why and how different professional disciplines, each representing a body of scientific knowledge, must work together to generate and disseminate knowledge. Learners will develop a set of skills specific to be an effective member and leader of an interdisciplinary research team, and will become familiar with the advantages of team science.

P8449 Optimization for Interventions 1.5 points

Prerequisites: Quantitative portion of the MPH Core curriculum or the equivalent.

Students will learn how to apply engineering-inspired concept of optimization to the study of behavioral, biobehavioral and biomedical interventions across public health fields. The course will be grounded in the multiphase optimization strategy (MOST) framework. Under the optimization phase of the MOST framework, the course will introduce experimental designs with an emphasis on sequential, multiple assignment randomized trial (SMART) which is a way to develop high-quality adaptive interventions. Micro-randomized Trails which are referred to as MRTs, a way to develop mHealth Just-in-Time Adaptive Interventions (JITAIs) also will be covered.

Opportunities for Student Involvement

Colloquia

During the Fall and Spring semesters, the Department of Biostatistics holds seminars on a wide variety of topics which are of interest to both students and faculty. The speakers are occasionally departmental faculty members themselves but very often are invited guests who spend the day of their seminar discussing their research with Biostatistics faculty and students. While all students are strongly urged to attend, doctoral student attendance is mandatory.

Consulting Service

All MS/PS, MS/SG, MS/TM, MPH are required to participate in the Biostatistics Consulting Service. This program is designed to enable students to demonstrate their ability to integrate academic studies with the role of biostatistical consultant/collaborator. The Biostatistics Consulting Service offers advice on data analysis and appropriate methods of data presentation for publications, and provides design recommendations for public health and clinical research, including preparation of grant proposals.

Participation in the Biostatistics Consulting Service meets the capstone requirement while providing students with an opportunity to gain invaluable experience working with a diverse clientele on a variety of statistical problems.

Teaching Assistantships

Each semester, the Department makes available a limited number of Teaching Assistant (TA) positions to our Masters students. Upon completion of one full semester of course work, eligible students may apply for a TA slot. Students are advised to carefully consult the following policy on qualification, selection, and compensation of TAs before considering one of these positions. All TA candidates must apply to the Director of Academic Programs.

To qualify for a TA position, students must:

- be registered as a full-time student during the the semester of the TA opportunity
- NOT be employed by another department at Columbia University for more than 20 hours/week
- have successfully completed the course of interest
- maintain a GPA of 3.3 or better
- is meeting Student Academic Progress, nor received any disciplinary action from student conduct.
    - Note: As part of the vetting process, TA candidates are submitted to the Office of Student Affairs for vetting.
- be able to devote several hours per week to TA duties. This includes, but is not limited to:
    - Attending class for lectures
    - Recitation periods (for core teaching assistants)
    - 1-2 regularly scheduled office hours
    - Homework grading and preparation of teaching materials

Selection of TAs is made by the instructor. Priority is given to students in doctoral programs, students with greater seniority, and students with previous TA experience who have received good evaluations from their former students and course instructors.

TA compensation is taxable and is paid out over the course of the semester.

Practicum Information

The Practicum Requirement

The intent of the practicum requirement is to engage students in activities aligned with their career goals, as well as activities that demonstrate application of biostatistical methods and public health concepts relevant to the student's area of interest. Students will seek out activities that further develop their skill set and add new tools to their professional toolkit. Upon completion of the practicum, the student will be able to provide evidence of application of these skills to potential employers. Practicum placements are made on an individual basis in consultation with faculty advisors who must approve both the proposed practicum prior to its initiation. Students and mentors must complete an evaluation at the conclusion of the practicum experience.

Goals of the Practicum are:

For the Department of Biostatistics

- To provide the University with a part of the formative assessment of the student's ability to function as a Biostatistician; and
- To serve as a means of continually evaluating the relevance and effectiveness of the curriculum, leading to modifications of the formative and summative assessments when necessary.

For the Student

- To provide a continuing series of practical experiences geared to his or her level of expertise, which will offer a chance to apply principles, skills, and techniques that have been acquired;
- To help the student learn how to assume professional roles in a variety of practice settings while becoming accustomed to a range of organizational structures, working relationships, and job expectations; and
- To help the student develop professional identification as a Biostatistician and gain experience in fulfilling his or her role as a team member working with other professionals.

For the Mentoring Institution/Organization

- To provide mentorship input into the university program and, thereby, allow staff to share in the development of future Biostatisticians;
- To serve as a growth experience for the mentor's staff through interaction with the students; and
- To provide the mentor an opportunity to recruit employees and reduce the time needed for on-the-job training of any students who, upon graduation, are hired.

Practicum Roles

The student is responsible for identifying potential practicum sites and making arrangements for his or her practicum experience at an appropriate site. Appropriate sites will offer professional training and specialization. The practicum project can include but not limited to:

- Statistical analysis or application of data science that can lead to significant scientific findings
- Computational software/tools development for statistical analysis
- Simulation study to compare existing methods
- Novel application of existing statistical methods
- Collaborative research that can lead to significant scientific findings
- Statistical methods development

Sites must be approved by the student's faculty advisor. Students and the practicum advisors must sign the practicum agreement form. All the practicum projects need to be health related or motivated by health applications. Ideally, the practicum placement should be approved no less than a month before the beginning of the practicum.

In addition to the student, there are three individuals with roles in the practicum experience, they are:

1. Faculty Advisor: the student's assigned advisor reviews and approves the proposed practicum as being relevant to the student's program track and career interests. The advisor must also endorse the student's suitability as well as his or her cognitive ability for a given practicum experience.

2. Practicum Advisor the field supervisor who provides the educational experience and mentorship, which are at the heart of the practicum experience. Practicum advisors should be motivated to host practicum experiences from a sense of professional commitment to help students achieve professional skills and status. For the purposes of the practicum, a qualified practicum advisor may include public health professionals, researchers, professors, doctors, etc. It is necessary, that a mentor fully operate effectively at a professional level in his/her field.

Student Requirements for Completing the Practicum Requirements

1. The student is responsible for finding a practicum. MS students must complete the Practicum Approval Form, at least one month before the start of the practicum. The form should be submitted no later than December 1st of the student's second year. MPH students must also complete a Scope of Work (SOW) form with the Office of Field Practice as well as the department's practicum form.

2. Once approved, the student begins his or her practicum experience. Before completing the practicum, the student and his or her advisor should meet at the midpoint to discuss progress.

3. After the completion of the practicum, the MS student submits a practicum report to his or her advisor for approval. MPH and MS students will present his or her practicum experience at the Annual Practicum Symposium which is held in late April/early May.

4. Links to the appropriate forms can be retrieved from the Director of Academic Programs.

Note to International Students

CPT and OPT forms must be obtained from ISSO and submitted to the Director of Academic Programs. Keep in mind that CPT is only authorized for dates that are within a semester. If you have already completed a CPT but have another opportunity that is different from your completed practicum, then you must register for Public Health Practice Seminar (PUBH 8086) (0.5 cr).

Practicum FAQS

Q: Which degree programs are required to do a practicum in the Biostatistics Department?
A: MPH and MS/Pharmaceutical Statistics, Public Health Data Science, Statistical Genetics, and Theory & Methods tracks.

Q: What is the process to apply for a Practicum?
A: It is the student responsibility to locate and secure a practicum by December 1st of the students second year. Once the practicum is secured the student must fill the Practicum Approval Form with the details of practicum and obtain approval from his or her academic advisor. The Practicum Approval Form can be requested from the Assistant Director of Academic Programs.

International students will be required to complete a CPT form if the practicum experience is outside of Columbia University. Once the CPT form is completed, the student will then send to Lucia Li, Assistant Director of Academic Programs in a pdf form. You will receive the signed CPT form from Lucia Li, and you will begin loading all required documents in Compass on the ISSO website.

Q: How many hours are required for a practicum in the department?
A: For MS students, there is no set number of hours required. For MPH students, you are required to work at least 280 hours in your practicum. During the academic year, full-time students can work no more than 20 hours/week. During the summer students can work over 20 hours/week at their practicum site.

Q: What is the Scope of Work (SOW)?
A: Completed by MPH students only. The SOW, which is managed by the Mailman's Office of Careers and Practice (OCP), is an important tool for planning the practicum and meeting the School's requirements for engaging in a structured practicum process. Students must develop a practicum SOW in collaboration with the practicum organization.

Q: How many Clinical Practice Trainings (CPT) am I allowed to do?
A: Students are allowed two CPT's. One will suffice, however if students need to do another one for more practice or to extend for more time they can do so. You will need to submit a new application if you change employers or need to extend the time. Students who are seeking to extend or do a second practicum is expected to resubmit a new application and will need to enroll in the PUBH 8086 Seminar Course, 0.5 credit hours with Heather Krasna in the Office of Career Services. Student must be registered for course prior to receiving approval and signature on second CPT form submission.

Q: When should students apply for CPT?
A: Apply at least 10 business days before your requested start date. CPT cannot be authorized retroactively, so plan ahead!

Q: What is expected to be on the CPT employer letter when gathering ISSO documents are the following:
A:

- be on official company letterhead
- have a specific start date and a specific end date
- include the complete US address of your employer even if you are working remotely
- include the number of hours per week you will work
- include a detailed description or list of position duties
- be signed and dated by your employer

Practicum FAQs Continued

Q: How far in advance can I change my practicum for CPT?
A: Students will not be allowed to change their practicum 45 days before the final submission is due. If students submit in time, the student is expected to review the details of the project with their assigned faculty advisor and resubmit a new practicum proposal form with approval from the Biostatistics Practicum Coordinator

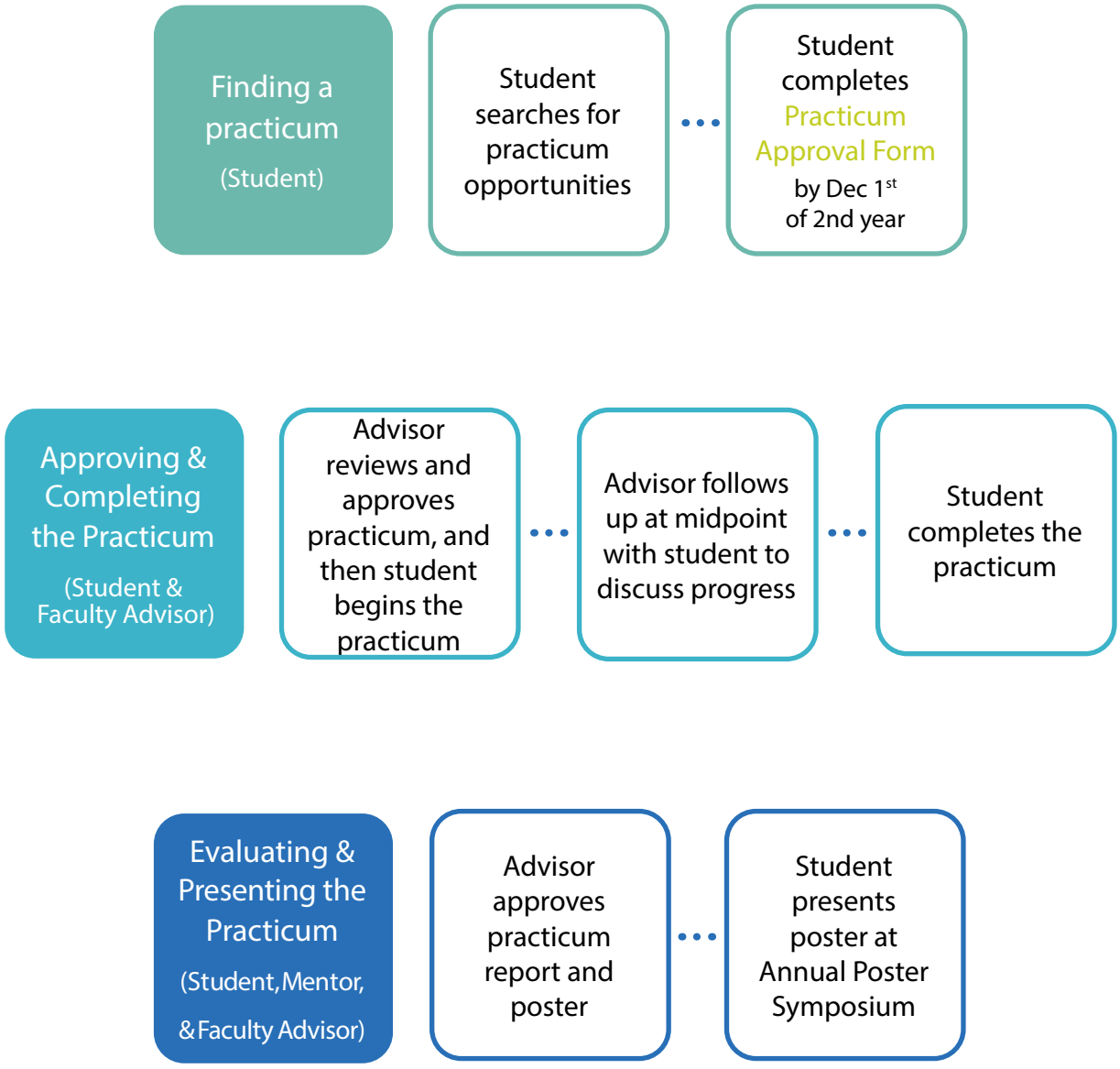
Q: I'm an international student, when should I apply for Optional Practical Training (OPT)?
A: By, regulation, the earliest you may apply for pre-completion OPT is 90 days before your requested OPT start date. We recommend requesting a start date a few weeks earlier than the actual date you want to begin employment.

Q: When can I use OPT?
A: You may use OPT during and/or after your degree program if it is longer than one academic year (2 semesters)

Q: What's the maximum time allowed for an OPT?
A: You get 12 months of OPT for each higher degree level you complete (Bachelor's, Master's, and PhD Degree).

Q: Do I need a job offer to apply for an OPT?
A: Yes

The Process of Completing the Practicum Requirement



COLUMBIA | MAILMAN SCHOOL OF PUBLIC HEALTH

BIOSTATISTICS

2024–2025 STUDENT HANDBOOK

revised August 1, 2024