

Environmental Health Sciences PhD Curriculum
Emory University
Matriculation 2023

Read the Laney Graduate degree completion requirements: <http://www.gs.emory.edu/academics/completion/index.html>. Students must earn at least 54 credit hours at the 500 level or above to qualify for candidacy.

Courses in italics: some students may have already had these foundation courses in their MPH program. If not already taken, the course or an equivalent is required.

Name _____ ID _____ Advisor _____

EHS Required Courses

Course #	Title	Semesters Offered	Suggested Year	Credits	Semester Taken	
Integrated Research Skills https://atlas.emory.edu/						
There are three choices for the foundational BIOS courses. The default choice is the sequence BIOS 506 (Fall) and BIOS 507 (Spring). However, you can choose to take a more basic sequence, BIOS 500/501, or a more advanced one, BIOS 508/509, depending on your current skills and professional goals. We will help you determine which sequence is more appropriate for you. <i>A flow diagram of all the biostatistics courses and possible sequence is pasted on page 3.</i>						
BIOS 506 <i>and</i> BIOS 507	Foundations of Biostatistical Methods	Fall	1	4		
	Applied Regression Analysis (Prereq: BIOS 506 or equivalent)	Spring	1	4		
OR: BIOS 500 <i>and</i> BIOS 501	Statistical Methods I and Lab	Fall	1	4		
	Statistical Methods II and Lab	Spring	1	4		
OR: BIOS 508 <i>and</i> BIOS 509	Biostatistical Methods	Fall	1	4		
	Applied Linear Models (Prereq: BIOS 508 or equivalent)	Spring	1	4		
Plus one more Quantitative or Qualitative Methods course (description of course offerings at the end of the document)						
BIOS 502	Statistical Methods III and Lab (Prereqs: BIOS 500 and 501)	Fall	2	3		
BIOS 505	Statistics for Experimental Biology	Spring	2	4		
BIOS 521	Applied Survival Analysis (Prereqs: BIOS 506, BIOS 507, BIOS 510 or permission of Instructor or BIOS ADAP Required)	Fall	2	2		
BIOS 525	Longitudinal and Multilevel Data Analysis (Prereq: BIOS 506 and BIOS 507 or equivalent)	Fall	2	2		
BIOS 526	Modern Regression Analysis (Prereqs: BIOS 507 or instructor permission)	Fall	2	3		
BIOS OTHER						
BSHES 538/BSHES 539	Qualitative Methods for Research and Evaluation/Qualitative Data Analysis	Sequence Spring/Fall	Spr 1 & Fall 2	3/3		
GH 521/GH 522	Qualitative Methods 1 and 2	Sequence Spring/Fall	Spr 1 & Fall 2	3/3		
				Sub-total:	8-12	
Research Experience						
EHS 600R	Research Rotation	Fall, Spring, Summer	1	2	1.	
					2.	
					3.	
EHS 790R	Research Design & Management	Fall, Spring*	Fall & Spr 1 & 2	1	1.	
					2.	

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Course #	Title	Semesters Offered	Suggested Year	Credits	Semester Taken
					3.
					4.
EHS 798R	Pre-candidacy Research	Fall, Spring, Summer	2+	1-12	1.
					2.
					3.
					4.
EHS 799R*	Dissertation Research (Only students in candidacy may enroll in EHS 799R)	Fall, Spring, Summer	3+	1-12	1.
					2.
					3.
					4.
Course #	Title	Semesters Offered	Suggested Year	Credits	Semester Taken
PUBH 700	Public Health Foundations *for students without a previous CEPH accredited MPH	Fall	1	0	
PUBH 701	Public Health Research: Discovery to Practice	Fall	1	1	
JPE 600/610	Program for Scholarly Integrity Core Course (only LGS enrolls students during the class) / Workshops	Fall (August 1-day course)	1	0	
Sub-total:				Up to 29	

Biological Science https://atlas.emory.edu/					
EH 520	Human Toxicology	Fall	1	3	
EHS 740*	Molecular Toxicology (Prereq. EH 520 or instructor permission)	Spring	2	2	
Sub-total:				3-6	

Exposure Science https://atlas.emory.edu/					
EHS 710* (Alt years)	Advanced Laboratory & Field Methods in Exposure Science <i>Waived for students with an MPH from GDEH who took EH 510</i>	Spring	1	2	
Sub-total:				2	

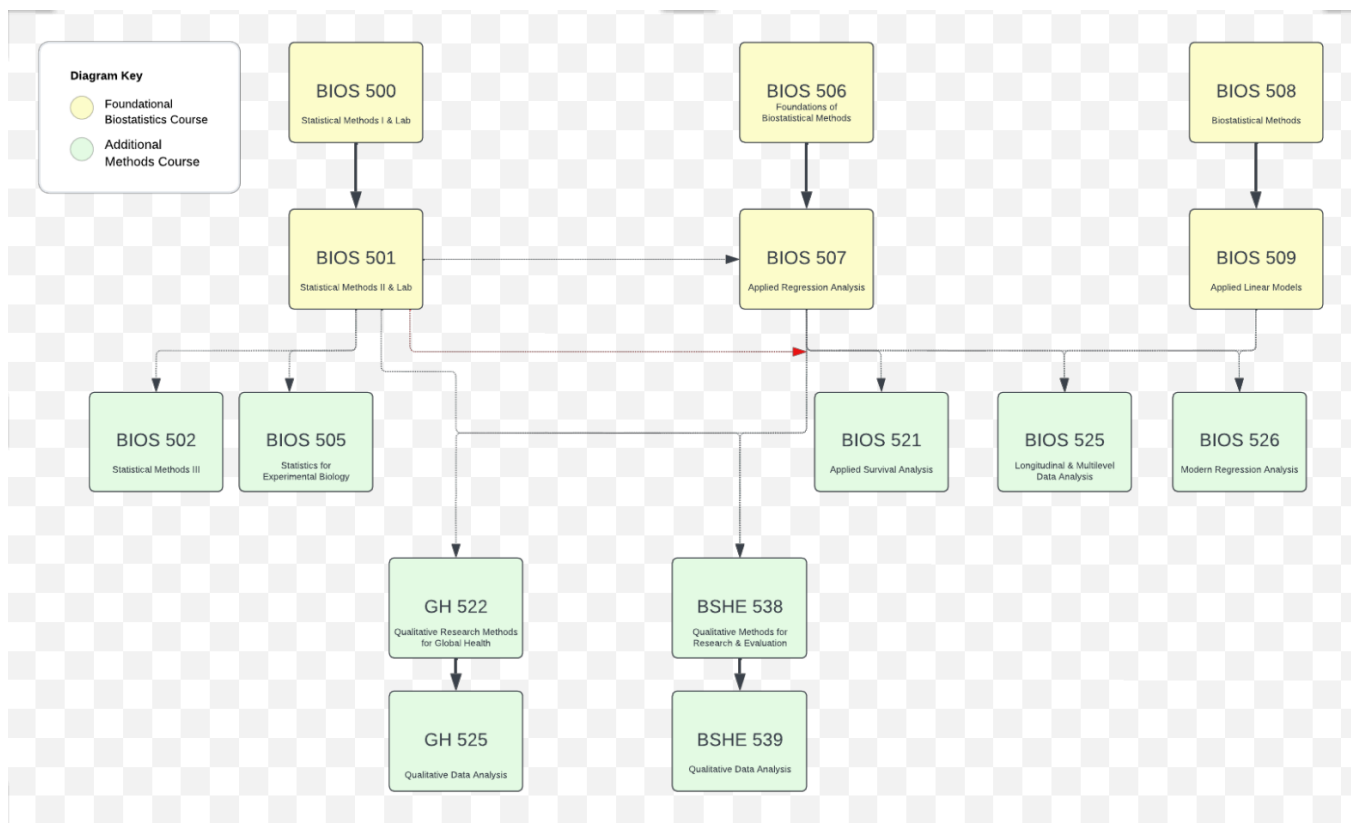
Population Science (recommended courses beyond required are at the end of document) https://atlas.emory.edu/					
EH 524*	Risk Assessment I	Fall	2	2	
EPI 530, 530L	Epidemiologic Methods I with Lab	Fall	1	4	
Plus choose at least one of the following:					
EH 530	Environmental & Occupational Epidemiology	Spring	1	2	
EPI 535	Designing & Implementing Epidemiologic Studies (Prereq: EPI 530)	Spring	1	2	
EPI 540 or	Epidemiologic Methods II (Prereqs: EPI 530, BIOS 500, EPI 534 and BIOS 591P or BIOS 501 concurrent)	Spring	1 or 2	4	
EPI 545	Advanced Epidemiologic Methods II with Lab (Prereqs: BIOS 500, EPI 530, EPI 534, BIOS 591P concurrent)	Spring	1 or 2	4	
Sub-total:				0-9	

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Teaching					
TATT 600	TATTO Training	Fall (2 days in August)	1 or 2	1	
TATT 605	Teaching Assistantship – Enroll under EHS	Fall or Spring	1 or 2	2	
TATT 610	Teaching Associateship – Enroll under EHS	Fall or Spring (can be completed after candidacy)	2	2	
Sub-total:				5	

*Tied to EHS Competency

Biostatistics courses' recommended sequence



*The red row between BIOS 501 and other BIOS courses (521, 525, 526) is possible but difficult. Our students recommend that if BIOS 500 and 501 are taken in the first year, the next courses are BIOS 502 and BIOS 505 before moving into the more advanced BIOS courses.

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List of Rotations and TATTO	Faculty/ Class/Semester/Notes	Contract Form Complete	Final Grade Form Complete
Rotation I			
Rotation II			
Rotation III			
TATTO 605			
TATTO 610			

Helpful Links

- [EHS Canvas site](#)
 - [Laney Graduate School Handbook](#)
 - [RSPH Course Catalog](#)
 - [Emory University Course Atlas](#)
 - [Emory Registrar](#) (Emory-wide calendars, transcript requests)
 - [OPUS \(site where you register for courses\)](#)
 - [EHS Webpage](#)
 - Past RSPH [Course Evaluations](#)
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- Check the course Atlas for pre-requisite requirements.
 - If a course is permission only, contact the course department's ADAP or instructors for permission, then email the permission to the EHS Program Administrator to register you.
 - Complete CITI Training Certificate (via IRB website: <http://www.irb.emory.edu/>) and provide your EHS Program Administrator a copy of your certificate of completion.

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SUGGESTED/SAMPLE SEQUENCE

Must be enrolled a minimum of 9 credits to be full-time

<u>COURSE NUMBER</u>	<u>COURSE NAME</u>	<u>CREDITS</u>
FALL 1		
BIOS 506 (500 or 508)	Statistical Methods	4
EHS 600R	Research Rotation	2
EHS 790R	Research Design & Management	1
PUBH 700	Introduction to Public Health (<i>only for students without a CEPH accredited MPH</i>)	0
PUBH 701	Public Health Research: Discovery to Practice (<i>S/U Grading Basis</i>)	1
JPE 600	Program for Scholarly Integrity Core Course (<i>1-day course</i>)	0
TATT 600	TATTO Summer Course (<i>2 days in August; if taking TATT 605 in Fall 1</i>)	2
Elective(s)	Elective(s) of your choice – DGS may help with selection	2+
	Semester Sub-total:	9+
If not already taken in a master's program, the following may also be required:		
<i>EH 520</i>	<i>Human Toxicology</i>	3
<i>EPI 530</i>	<i>Epidemiologic Methods I and lab</i>	4
	Semester Total:	9+
SPRING 1		
BIOS 507 (BIOS 501 or 509)	Statistical Methods II	4
BSHES 538 or GH 521	Qualitative Methods (optional methods course)	3
<i>EH 530 or</i>	<i>Envt. & Occ. Epidemiology (Prereq: EPI 530)</i>	2
<i>EPI 545</i>	<i>Adv. Epi. Methods II w/lab (also enroll in EPI 533 SAS)</i>	4
EHS 600R	Research Rotation	2
EHS 710	Advanced Laboratory & Field Methods in Exposure Science	2
EHS 790R	Research Design & Management	1
TATT 605	Teaching Assistantship (<i>or in year 2</i>)	2
	Semester Total:	9+
SUMMER 1		
EHS 600R	Research Rotation	2
EHS 798R	Pre-candidacy Research	7
FALL 2		
TATT 600	TATTO Summer Course (<i>2 days in August; if not already done in fall 1</i>)	2
TATT 605	Teaching Assistantship (<i>if not already done in yr 1</i>)	2
BSHES 539 or GH 522	Qualitative Analysis (optional methods course)	3
EHS 790R	Research Design & Management	1
EHS 798R	Pre-candidacy Research	1-9
Electives	Electives	2+
If not already taken in a master's program, the following may also be required:		
<i>EH 524</i>	<i>Risk Assessment</i>	2
	Semester Total:	9+

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<u>SPRING 2</u>		
EHS 740	Molecular Toxicology	2
EHS 790R	Research Design & Management	1
EHS 798R	Pre-candidacy Research	1-9
TATT 610	Teaching Associateship	2
Electives	Electives	
	Semester Total:	9+
<u>SUMMER 2</u>		
Comprehensive Exams		
EHS 798R	Pre-candidacy Research	9
<u>FALL 3</u>		
EHS 799R	Dissertation Credits	9
<u>SPRING 3</u>		
EHS 799R	Dissertation Credits	9
<u>SUMMER 3</u>		
EHS 799R	Dissertation Credits	9

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Suggested Electives

Students are free to choose electives in advanced coursework other than those listed below with approval from the DGS.

GDBBS (IBS courses): <http://staging.web.emory.edu/gdbbs-internal/students/course-listing.html>

RSPH (EH, EHS, EPI, BIOS, GH courses): <https://atlas.emory.edu/>

<u>Dept.</u>	<u>Number</u>	<u>Title</u>	<u>Semester</u>	<u>Credits</u>
BAHS	502	Human Physiology	Fall	4
BIOS	737	Spatial Analysis of Public Health Data	Spring (occasional)	2
BIOS	516	Introduction to Large- Scale Biomedical Data Analysis	Fall	1
BIOS	524	Introduction to Analytic Methods for Infectious Diseases	Spring	2
BIOS	534	Machine Learning	Spring	2
BIOS	540	Introduction to Bioinformatics	Fall	2
BIOS	544	Introduction to R programming for Non-BIOS students	Fall and Spring	2
BIOS	724	Analytic Methods for Infectious Disease Interventions	Fall	2
BSHES	555	Public Health Communication	Spring	2
EH	582	Global Climate Change: Health Impacts and Response	Fall	2
EH	583	Spatial Analysis in Disease Ecology	Fall	4
EH	523	Neurotoxicology	Spring	2
EH	570	Environmental Health Law and Policy	Spring	2
EH	571	Global Environmental Health Policy: Power, Science & Justice	Spring	2
EH	586	Advanced Seminar in Climate Change and Health: Research and Policy	Spring	2
EHS	730	Computational Systems Biology: Modeling Biological Responses	Fall	2
EHS	747	Advanced Environmental Epidemiology (cross-listed with EPI 747)	Fall	2
EHS	760	Advanced Risk Assessment	Spring	2
EHS/IBS	720	Introduction to Physiologically-Based Toxicokinetic (PBTK)/Pharmacokinetic (PBPK) Modeling	Spring	2
EHS/IBS	730/741	Computational Systems Biology: Modeling Biological Responses	Fall	2
EHS	750	Environmental Determinants of Infectious Disease	Spring	3
EPI	534	Statistical Programming SAS & R	Fall, Spring	2
EPI	535	Intro. To Designing & Implementing Epi Studies	Spring	2
EPI	545	Advanced Epidemiological Methods II	Fall	4
EPI	550	Epidemiologic Methods III SAS & R	Fall	4
EPI	560	Epidemiologic Methods IV	Spring 2021 and beyond	4
EPI	566	Vaccines and Immunization	Spring	2
EPI	743	Epidemiology of Cancer	Fall	2
EPI	761M	Introduction to Clinical and Translational Research Medicine	Occasional	
EPI	544	Epidemiology of Foodborne and Diarrheal Diseases	Fall	1
EPI	558	Global Issues in Antimicrobial Resistance	Spring	2

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EPI	570	Infectious Disease Dynamics: Theories and Models	Spring	3
EPI	746	Reproductive Epidemiology	Spring	2
GH	518	Emerging Infectious Disease	Spring	2
GH	591N	Antibiotic Resistance	Occasional	
IBS	506R	Basic Mechanisms of Neurological Diseases	Spring	4
IBS	513	Virology	Spring	2
IBS	531	Introduction to Molecular & Systems Pharmacology I	Fall	4
IBS	542	Concepts in Immunology	Fall	4
IBS	555	Basic Biomedical & Biological Sciences	Fall	6
IBS	556	Principles of Basic Biomedical and Biological Sciences II	Spring	6
IBS	591	Population Biology and Evolution of Disease	Spring	4
IBS	595	Ecology	Fall (Odd years)	4

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Qualitative Course Offerings at RSPH (<https://atlas.emory.edu/>)

BSHES 538 (3 credits) Qualitative Methods for Research and Evaluation

Prerequisite: BSHE 520 (Theory Driven Research and Practice). Focuses on the acquisition of interpretive, behavioral, and analytic strategies that social scientists use to understand social reality. Students are expected to undertake their own qualitative studies, as well as to learn the philosophical underpinnings of the method. Classic ethnographic studies, particularly those with applicability to public health, serve as models for learning techniques and conducting research

BSHES 539 (3 credits) Qualitative Data Analysis

Prerequisite: BSHE 538 (**Qualitative Methods for Research and Evaluation**). Allows students to develop mastery of a variety of practical techniques and theoretical approaches to qualitative data analysis, including the use of qualitative data analysis software (MAXqda). Students will be given the option of conducting lab exercises on an expanded set of secondary data or students' own data that was collected as part of their MPH or PhD thesis research.

BSHE qualitative courses would be better for students who want qualitative research methods to be one of their primarily research methods moving forward

Should take 538 and 539 as a sequence

GH521 (3 credits) Qualitative Methods 1: Data Collection

Spring. This course will provide students with practical skills and theoretical principles for conducting and evaluating qualitative research. Weekly sessions will focus on different tasks in the process of conducting qualitative research. This course will include theory and concepts underpinning qualitative research, qualitative research design, ethical considerations and challenges, instrument design, key data collection methods used in public health (interviewing, group discussions and observations), and summarizing and presenting data. The course provides instruction on the challenges of applying qualitative methods in international settings and guidance on fieldwork planning and implementation to assist students in preparing for their applied practice experience activities. This course uses a variety of approaches to foster the development of practical skills in qualitative research: formal lectures, interactive group sessions, discussions with experts, and task-based assignments. This course is a prerequisite for Qualitative Data Analysis (GH522).

GH522 (3 credits) Qualitative Methods 2: Data Analysis

Fall. Prerequisite: GH 522 or equivalent. This course is designed to provide students with the theoretical principles and practical skills for analyzing qualitative data. The course will provide an overview of the theoretical principles of qualitative data analysis, and practical tasks of data preparation, data analysis, writing and presenting data. Students will develop skills in using MAXQDA software to analyze qualitative data through weekly lab sessions. During the course students will learn techniques for analyzing qualitative data through guided classroom activities, lab sessions, and structured assignments. The course is ideal for second year MPH students who collected qualitative data during their summer APE; students without their own data may use a class data set. Each student will work with their individual data in course assignments.

GH qualitative courses are better for students who may want to employ qualitative research methods for their dissertation or want to know about how work is done, but may not want qualitative methods to be their primary research methods moving forward

HPM 533 (3 credits) Qualitative Methods for Health Services Research

Spring. This course introduces students to the theoretical and practical applications of qualitative research. Emphasis is placed on qualitative methods most commonly associated with health services research, including informant interviews, document reviews, and focus groups. Students will gain practical experience with qualitative methodology as well as learn the basic approaches to mixing qualitative and quantitative methods. Students will complete a research proposal by the end of the semester that reflects a mixed method study.

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Quantitative Methods Courses Offerings for EHS Curriculum (<https://atlas.emory.edu/>)

For students who take BIOS 500/501 in Year 1

BIOS 502 (3) Statistical Methods III: Prerequisites: [BIOS 500](#) & [BIOS 501](#) or permission of instructor. We start with data analytic methods not covered in [BIOS 500](#) & [BIOS 501](#) (Statistical Methods I & II). We then focus on multilevel modeling of intra- and inter-individual change. Other hierarchical models will also be examined to analyze other types of clustered data. As in the prerequisite courses, we will learn how to specify an appropriate model so that specific research questions of interest can be addressed in a methodologically sound way. Students will use SAS to perform the statistical analyses.

“Must Take” Courses for Epi Modeling

These courses are highly recommended as a sequence following BIOS 506/507 as the most valuable courses for students interested in honing their epi skills with quantitative methods and epi modeling. EPI 550 (previously EPI 740) is recommended first, to learn model types and apply what was learned in BIOS 506/507. EHS 747 is recommended as a must-take follow up course for model application, learned through case studies. Note that these courses do not cover longitudinal, clustered, or high dimensional data.

EPI 550 (4) Epidemiologic Methods III (Formerly EPI 740: Epidemiological Modeling) Fall. Prerequisites: EPI 530, 534, 540 or 545, BIOS 500 and 591P. Covers concepts, methods, and application of key mathematical modeling approaches used to evaluate multivariable data from epidemiologic studies: logistic regression, Cox regression, collinearity, modeling strategy for determining a best model, goodness of fit, and ROC curves. The course also teaches a broader philosophy and approach for constructing the appropriate models for answering the question under study.

EPI 747/EHS 747 (2) Advanced Environmental Epidemiology Fall. Prerequisites: EPI 530, EPI 540 or 545, BIOS 500, and BIOS 501 or 591P or permission of instructor. Explores design and analysis issues specific to occupational and environmental epidemiology. Case studies representative of a variety of exposures, outcomes, and study designs are used to illustrate the application of epidemiological principles to the study of exposures occurring in the workplace and in the general environment.

Additional courses for more advanced modeling:

Recommended that students choose additional modeling courses based on the type of data they will be working with (i.e., longitudinal course if they are intending to work with longitudinal data). Longitudinal and clustered data/models are not covered in EPI 550.

Currently Recommended: BIOS 526, comment: Useful introduction to wide array of more advanced modeling techniques but large knowledge gap between BIOS 507 and BIOS 526 impedes students' application of methods from this course.

BIOS 526 (3) Modern Regression Analysis Fall. Prerequisites: BIOS 509 and BIOS 513 or permission of instructor. This course introduces students to modern regression techniques commonly used in analyzing public health data. Specific topics include: (1) parametric and non-parametric methods for modeling non-linear relationships (e.g., splines and generalized additive models); (2) methods for modeling longitudinal and multi-level data that account for within group correlation (e.g., mixed-effect models, generalized estimating equations); (3) Bayesian methods; and (4) shrinkage methods and bias-variance tradeoffs. This course draws motivating examples from environmental and social epidemiology, health services research, clinical studies, and behavioral sciences. The course provides a survey of advanced regression approaches with a focus on data analysis and interpretation. Students will gain an understanding of methods that will facilitate future independent and collaborative research for modern research problems. Students will gain practical experience using the R language for statistical computing.

Longitudinal Data Courses: BIOS 525 and EPI 750 are recommended. BIOS 525 is more theoretical, focusing on the “whys” of longitudinal and cluster models, while EPI 750 is more application focused.

BIOS 525 (2) Longitudinal and Multilevel Data Analysis Fall. Prerequisites: BIOS 507 or permission of instructor. This course introduces students to regression techniques commonly used in analyzing longitudinal and multilevel data that are frequently encountered in biomedical and public health research. This course draws motivating examples from environmental and social epidemiology, health services research, clinical studies, and behavioral sciences. The course focuses on data analysis and interpretation. Students will gain practical experience using R/SAS/Stata for statistical computing.

Additional courses for more advanced epidemiological methods:

EPI 540 (4) Epidemiologic Methods II Spring. Prerequisites EPI 530, BIOS 500, EPI 534 and BIOS 591P or BIOS 501 concurrent. This course develops epidemiologic concepts introduced in EPI 530: Epidemiologic Methods I, providing a more advanced discussion of issues related to causality, bias, study design, interaction, effect modification and mediation. It will also provide opportunities for the application of these examples via analysis of epidemiologic data.

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EPI 545 (4) Advanced Epidemiologic Methods II Spring. Prerequisites EPI 530, BIOS 500, EPI 534, and BIOS 591P concurrent. MSPH and PhD students only. This course builds on the fundamental epidemiologic concepts introduced in EPI 530: Epidemiologic Methods I. Specifically, causality, bias (including confounding, information bias, and selection bias), and concepts of interaction will be revisited in greater depth. By the end of the course, students will be able to do the following: Formulate research questions to evaluate causality; evaluate the strengths and limitations of epidemiologic studies; assess how the strengths and limitations of a study affect interpretation of study results; utilize epidemiologic methods to address confounding; identify epidemiologic methods to address selection bias and information bias; calculate measures to assess interaction.

Bias Analysis (EPI 568): This course is useful for estimating the effects of bias on binary outcomes. Recommended as a course to audit or an additional add on course after taking other advanced epi and modeling courses.

EPI 568 (2) Applying Quantitative Bias Analysis to Epidemiologic Research Fall. Pre-requisites: EPI 530, EPI 534 and EPI 540 or 545 or instructor permission. Observational epidemiologic studies yield estimates of effect that differ from the true effect because of random error and systematic error. Epidemiologists design studies and analyses to minimize both sources of error. When presenting results, epidemiologists use statistics to quantify the impact of random error on estimates of effect, but often only qualitatively describe residual systematic error (uncontrolled bias). Bias analysis provides one method of quantifying residual systematic error. Students in this course will learn how to use simple, multidimensional, and probabilistic bias analyses to account for systematic error in their estimates of effect. Students should expect to gain new skills, as the emphasis of the course will be on the implementation and conduct of bias analysis, rather than statistical theory.

Recommended Course for Coding and Data Management

BIOS 544 (2) Introduction to R (Non-BIOS Student) Fall & Spring. For non-BIOS Students Only. The goal of the course is to will introduce R in organizing, analyzing, and visualizing data. Once you've completed this course, you'll be able to enter, save, retrieve, summarize, display, and analyze data.

INFO 550 (2) Data Science Toolkit Fall. Prerequisites: BIOS 544 or BIOS 545, R programming experience needed or permission of the instructor. This course is an elective for master's and PhD students interested in learning some fundamental tools used in modern data science. Together, the tools covered in the course will provide the ability to develop fully reproducible pipelines for data analysis, from data processing and cleaning to analysis to result tables and summaries. By the end of the course students will have learned the tools necessary to: develop reproducible workflows collaboratively (using version control based on Git/GitHub), execute these workflows on a local computer (using command line operations, RMarkdown, and GNU Makefiles), execute the workflows in a containerized environment allowing end-to-end reproducibility (using Docker), and execute the workflow in a cloud environment (using Amazon Web Services EC2 and S3 services). Along the way, we will cover a few other tools for data science including best coding practices, basic python, software unit testing, and continuous integration services.