Program Co-Directors

Biostatistics Concentration	**Bioinformatics Concentration**
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Mission

The mission of the MS in Health Data Science is to train the next generation of leaders and practitioners in public health and medicine. Students in the program develop practical skills for innovative data analysis and will be trained in becoming excellent communicators of scientific findings in public health and biomedical research. The program takes advantage of the rich biostatistical and bioinformatics resources at GWU and in the Nation's Capital and is designed to prepare students to be independent practitioners and collaborators in interdisciplinary research.

MS Competencies

Upon completion of the MS program in Health Data Science students will possess the following competencies.

Biostatistics Concentration Competencies:

1. **Statistical Programming**: Use statistical software to perform programming tasks for the purposes of statistical analysis of public health and biomedical data.
2. **Biostatistical Methodology**: Summarize and evaluate biostatistical methodology applied in public health and biomedical research.
3. **Communication**: Communicate principles of statistical theory and study design to interprofessional team members.
4. **Applied Statistics**: Apply the principles of biostatistical methodology to perform analyses of public health and biomedical data.
5. **Scientific Writing**: Develop components of the statistical analysis section of public health and biomedical research proposals.

Bioinformatics Concentration Competencies:

1. **Programming:** Develop skills in programming, data structures, algorithms, machine learning, high-performance computing and apply these skills to create approaches that facilitate biological data analysis.
2. **Biology:** Develop a basis of knowledge in biology and evaluate biological data generation technologies.
3. **Statistics:** Apply statistical research methods in the context of molecular biology, genomics, medical, and population genetics research.

4. **Foundational Knowledge:** Interpret and synthesize the various foundational concepts of bioinformatics, including genomics, algorithms, and other key tools used in bioinformatics.
5. **Conceptual Integration:** Integrate concepts and data across fields of computer science, statistics, data science, biology, and health sciences through bioinformatics.

Minimum Program Requirements

Biostatistics Concentration
The program requires a total of 36 credit hours of course work and research, with a minimum of 35 credits of courses and a minimum of 1 credit of thesis research. Students in the program must hold an undergraduate degree from an accredited institution of higher learning and should have some background in mathematics. The minimum prerequisite for consideration of the application for admission is completion of two semesters of calculus and one semester of undergraduate statistics. The full prerequisite includes an additional semester of multivariable calculus and a semester linear algebra. Students who apply without the minimum prerequisite will not be considered for admission. Students who apply without the full prerequisite will be asked to complete multivariable calculus and/or linear algebra in their first semester.
Bioinformatics Concentration
The program requires a total of 36 credit hours of course work including a minimum of 2 credits of research and Master's Thesis work. Students in the program must hold an undergraduate degree from an accredited institution of higher learning and should have a strong background in mathematics, statistics, biology, bioengineering, and/or computer science.

Concentration-Specific Prerequisites

Biostatistics Concentration	Bioinformatics Concentration
Minimum Pre-requisite • Calculus I and II (GW equivalent is MATH 1231 and 1232) • Undergraduate Statistics (GW equivalent is PUBH 3142 or STAT 1051) Full Pre-requisite (in addition to above) • Calculus III (GW equivalent is MATH 2233) • Linear Algebra (GW equivalent is MATH 2184)	• a course in undergraduate statistics • a course in undergraduate biology • a course in undergraduate computer science

All applications are submitted through SOPHAS.org. Information about Milken Institute SPH Admissions and policies are available online at http://publichealth.gwu.edu/admissions/graduate-admissions. For reporting GRE general test scores use the following institutional code: 5268.

Program Requirements

Biostatistics Concentration

The curriculum includes practical development of applied data analysis skills as well as coverage of specific biostatistical topic areas and issues in the conduct of biostatistical and medical research. The program requires a total of 36 credit hours of coursework including one credit for the Master's Thesis.

Course Distribution Summary	Credits
Required Courses	27
Elective Courses	7
Consulting and Thesis • Biostatistical Consulting (1 credit) • Master's Thesis (1 credit)	2
Total credits	**36**

Bioinformatics Concentration

The curriculum includes broad training across core areas of bioinformatics, including statistics, biology, computer science, and ethical issues in the conduct of biomedical research. The program requires a total of 36 credit hours of coursework including a minimum of 2 credits of research and Master's Thesis work.

Course Distribution Summary	Credits
Required Courses	24
Elective Courses	10
Master's Thesis and additional research courses (minimum required)	2
Total credits	**36**

	Department of Biostatistics and Bioinformatics **MS in Health Data Science** **2024-2025** Note: All curriculum revisions will be updated immediately on the website http://www.publichealth.gwu.edu

Required Core Courses — Common to Both Concentrations (6 Credits)

Course	Course Name	Semester	Credits
PUBH 6080	^Pathways to Public Health	Fall, Spring	0
PUBH 6850	Introduction to SAS for Public Health Research	Fall, Spring	1
PUBH 6851	Introduction to R for Public Health Research	Fall, Spring	1
PUBH 6852	Introduction to Python for Public Health Research	Fall, Spring	1
PUBH 6860	Principles of Bioinformatics	Fall	3

Required Courses —Biostatistics Concentration (21 Credits)

PUBH 6862	Applied Linear Regression Analysis for Public Health Research	Fall	3
PUBH 6864	Applied Survival Analysis for Public Health Research	Fall	3
PUBH 6865	Applied Categorical Data Analysis for Public Health Research	Spring	3
PUBH 6866	Principles of Clinical Trials	Spring	3
PUBH 6887	Applied Longitudinal Data Analysis for Public Health Research	Spring	3
PUBH 8870	Statistical Inference for Public Health Research I	Fall	3
PUBH 8871	Statistical Inference for Public Health Research II	Spring	3

Required Courses —Bioinformatics Concentration (18 Credits)

PUBH 6859	High Performance and Cloud Computing	Spring	3
PUBH 6861	Public Health Genomics	Spring	3
PUBH 6884	Bioinformatics Algorithms and Data Structures	Spring	3
PUBH 6854	Applied Computing	Fall	3
PUBH 6868	Quantitative Methods	Spring	3
PUBH 6886	Statistical and Machine Learning for Public Health Research	Fall	3

Elective Courses
Biostatistics Concentration - 7 Credits
Bioinformatics Concentration – 10 Credits*

Elective Courses — Common to Both Concentrations
Pre-Approved Courses Shown Below
Other courses can be selected with advanced advisor approval.

PUBH 6853	Statistical Packages for Data Management and Data Analysis	Fall, Spring	3
PUBH 6856	Advanced SAS	Summer	1
PUBH 8885	Computational Biology	Fall	3
PUBH 6899	Topics in Biostatistics and Bioinformatics	Fall, Spring	3
PUBH 6899	Topics in Biostatistics and Bioinformatics: Data Visualization with R	Fall	1

PUBH 8875	Linear Models in Biostatistics (permission of instructor required)	Spring	3
PUBH 8877	Generalized Linear Models in Biostatistics (permission of instructor required)	Fall	3
STAT 6223	Bayesian Statistics: Theory and Applications	Spring	3
Elective Courses — Biostatistics Options			
PUBH 6003	Principles and Practice of Epidemiology	Fall, Spring	3
PUBH 6299	Cost Effectiveness in Public Health Research	Summer	1
PUBH 6861	Public Health Genomics	Spring	3
PUBH 6863	Applied Meta-Analysis	Fall	1
PUBH 6886	Statistical and Machine Learning for Public Health Research	Fall	3
PUBH 6899	Topics in Biostatistics and Bioinformatics: Advanced Clinical Trials	Fall	2
PUBH 8879	An Introduction to Causal Inference for Public Health Research	Spring (alternating years)	3
STAT 6227	Survival Analysis	Fall, Spring	3
Elective Courses — Bioinformatics Options			
BIOC 6240	Next Generation Sequencing	Spring	2
CSCI 6221	Advanced Software Paradigms	Fall, Spring	3
CSCI 6231	Software Engineering	Spring	3
PUBH 6238	Molecular Epidemiology	Fall	1
PUBH 6244	Cancer Epidemiology	Spring	2
PUBH 6262	Introduction to Geographic Information Systems	Spring	1
PUBH 6263	Advanced GIS	Spring	1
PUBH 6276	Public Health Microbiology	Fall	3
PUBH 6278	Public Health Virology	Spring	3
PUBH 6894	Research Analytics	Online	3
PUBH 8870	Statistical Inference for Public Health Research I	Fall	3
PUBH 8871	Statistical Inference for Public Health Research II	Fall, Spring	3
PUBH 8878	Statistical Genetics	Fall	3
Required Consulting/Research/Thesis **Biostatistics Concentration - 2 Credits** **Bioinformatics Concentration - 2 Credits (minimum)**			
PUBH 6869	Principles of Biostatistical Consulting *Biostatistics Concentration ONLY*	Spring	1
PUBH 6897	Research in Biostatistics and Bioinformatics *Bioinformatics Concentration ONLY*	Fall, Spring, Summer	1-4
PUBH 6898	Master of Science Thesis *BOTH Concentrations*	Fall, Spring, Summer	1-3

Elective credits for the Bioinformatics concentration may vary depending on PUBH 6897 and PUBH 6898 chosen credits

^ Students without a prior public health degree from an accredited school of public health are required to successfully complete the zero-credit, online course Pathways to Public Health (PUBH 6080) within one year of matriculation. There is no fee for this course.

MS Graduation Requirements

Graduation

While degrees are awarded at the end of each semester, formal commencement ceremonies occur only in May. Students are eligible to participate in graduation activities only after they have completed all degree requirements and have no financial obligations to the University. Students may include MS designation after their name upon completion of all degree requirements.

Graduation Requirements

1. **Credits**: Successful completion of 36 credits.

2. **Master's Thesis or Research Report:** Successful defense of a Master's Thesis or presentation of a Research Report. The defense of a Master's Thesis is different from the PUBH 6898 Master of Science Thesis course, which is a requirement for both concentrations.

3. **Grade point average**: A minimum overall grade-point average of B (3.0).

4. **Time Limit Requirement**: The degree must be completed within five years.

5. **Transfer Credits**: No transfer credits will be accepted.

6. **Pathways to Public Health**. Must be successfully completed unless waiver received.

7. **Ethics/Professional Skills Requirement:** Participate in department-led ethical and professional skills training.

8. **Professional Enhancement requirement**: Students must participate in 8 hours per degree program of advisor pre-approved Public Health-related lectures, seminars, symposia and/or conferences related to the appropriate field of study specifically focused on research and research ethics. Students must submit documentation of Professional Enhancement activities to the SPH Office of Student Records. Instructions can be found here: https://publichealth.gwu.edu/academics/forms

9. **CITI Training requirement**: All students in the GWSPH are required to complete training regarding human subject protection regulation and the Health Insurance Portability and Accountability Act of 1996 (HIPAA). To fulfill this requirement, a student must complete the Collaborative IRB Training Initiative (CITI) Course in The Protection of Human Research Subjects. All GWSPH students are required to complete the CITI module Social and Behavioral Researchers or the Biomedical track which can be found under Human Subjects Research Training. CITI coursework must be completed before the end of their first semester/two modules. Students must complete the CITI course before they are approved to begin the Applied Practice Experience and/or Practicum (MPH students) or any other field or research-related activities. This course is available online. Students should print out the certificate of completion for the CITI course and keep a copy for their records. Students will need this documentation for any IRB submission package. Documentation of completion is also required for graduation clearance. Students will submit these documents to the Office of Student Records, gwsphrecords@gwu.edu. Additional training requirements exist for students who plan to conduct some types of research (e.g., clinical research). Students are strongly encouraged to complete the Biomedical Investigators module.

To get started:
1. Go to www.citiprogram.org
2. Click: Register for the CITI course

3. Select Institution (GW is under All Others, a drop-down list)
4. Create a new username and password.
5. Enter contact information

For a quick video tutorial on how to access CITI click <u>here</u>.

10. **Integrity Quiz & Plagiarism Requirement**: All students are required to review the George Washington University Code of Academic Integrity and take the quiz within their first semester of study. The Code of Integrity and step-by-step instructions can be found here:
<u>http://publichealth.gwu.edu/integrity</u>

Sample Schedule HDS-MS Biostatistics Track

Year	Semester	Course	Title	Credits
Year 1	Fall	PUBH 6850	Introduction to SAS for Public Health Research	1
		PUBH 6851	Introduction to R for Public Health Research	1
		PUBH 6852	Introduction to Python for Public Health Research	1
		PUBH 6080	Pathways to Public Health	0
		PUBH 6862	Applied Linear Regression for Public Health Research	3
		PUBH 8870	Statistical Inference for Public Health Research I	3
	Spring	PUBH 6865	Applied Categorical Data Analysis for Public Health Research	3
		PUBH 6866	Principles of Clinical Trials	3
		PUBH 8871	Statistical Inference for Public Health Research II	3
Year 2	Fall	PUBH 6864	Applied Survival Analysis for Public Health Research	3
		PUBH 68xx	Elective	3
		PUBH 6860	Principles of Bioinformatics	3
	Spring	PUBH 68xx	Elective	4
		PUBH 6887	Applied Longitudinal Data Analysis for Public Health Research	3
		PUBH 6869	Principles of Biostatistical Consulting	1
		PUBH 6898	Master of Science Thesis	1
TOTAL CREDITS				**36**

Sample Schedule HDS-MS Bioinformatics Track

Year	Semester	Course	Title	Credits
Year 1	Fall	PUBH 6850	Introduction to SAS for Public Health Research	1
		PUBH 6851	Introduction to R for Public Health Research	1
		PUBH 6852	Introduction to Python for Public Health Research	1
		PUBH 6080	Pathways to Public Health	0
		PUBH 6860	Principles of Bioinformatics	3
		PUBH 6854	Applied Computing in Health Data Science	3
	Spring	PUBH 6859	High Performance and Cloud Computing	3
		PUBH 6861	Public Health Genomics	3
		PUBH 6884	Bioinformatics Algorithms and Data Structures	3
Year 2	Fall	PUBH 6886	Statistical and Machine Learning for Public Health Research	3
		PUBH 8885	Computational Biology	3
		PUBH 68xx	Electives	3
	Spring	PUBH 6868	Quantitative methods	3
		PUBH 68xx	Electives	4
		PUBH 6897	Research in Biostatistics and Bioinformatics (minimum required)	1
		PUBH 6898	Master of Science Thesis (minimum required)	1
TOTAL CREDITS				**36**