The M.S. with a concentration in Biostatistics is a two-year program that provides training in clinical trials, epidemiologic methodology, implementation science, data science, statistical genetics, and mathematical models for infectious diseases. Students have a choice of three pathways: the Biostatistics Standard Pathway, the Biostatistics Implementation and Prevention Science Methods Pathway, and the Biostatistics Data Science Pathway. In contrast to the more general M.P.H. degree, the M.S. degree emphasizes the mastery of biostatistical skills from the beginning of the plan of study. While graduates of this program may apply to the Ph.D. degree program, the M.S. degree is itself quite marketable as a terminal degree. Part-time enrollment is permitted.

**DEGREE REQUIREMENTS**

The Biostatistics concentration requires the completion of fifteen required and elective courses (excluding the Seminar, BIS 525/BIS 526; the Summer Internship, BIS 695; EPH 100, EPH 101, and EPH 600).

The Graduate School requires an overall grade average of High Pass, including grades of Honors in at least two full-term graduate courses for students enrolled in a two-year program. In order to maintain the minimum average of High Pass, each grade of Pass on the student's transcript must be balanced by one grade of Honors. Each grade of Fail must be balanced by two grades of Honors. If a student retakes a course in which the student has received a failing grade, only the newer grade will be considered in calculating this average. The initial grade of Fail, however, will remain on the student's transcript. A grade awarded at the conclusion of a full-year course in which no grade is awarded at the end of the first term would be counted twice in calculating this average.

**CURRICULUM**

**Required Courses for All Pathways**

(or substitutions approved by the student’s adviser and the DGS)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS 525</td>
<td>Seminar in Biostatistics and Journal Club 1</td>
<td>0</td>
</tr>
<tr>
<td>BIS 526</td>
<td>Seminar in Biostatistics and Journal Club 1</td>
<td>0</td>
</tr>
<tr>
<td>BIS 623</td>
<td>Advanced Regression Models</td>
<td>1</td>
</tr>
<tr>
<td>or S&amp;DS 612</td>
<td>Linear Models</td>
<td></td>
</tr>
<tr>
<td>BIS 628</td>
<td>Longitudinal and Multilevel Data Analysis</td>
<td>1</td>
</tr>
<tr>
<td>BIS 630</td>
<td>Applied Survival Analysis</td>
<td>1</td>
</tr>
<tr>
<td>or BIS 643</td>
<td>Theory of Survival Analysis</td>
<td></td>
</tr>
<tr>
<td>BIS 695</td>
<td>Summer Internship in Biostatistical Research 1</td>
<td>0</td>
</tr>
<tr>
<td>EPH 100</td>
<td>Professional Skills Series 1</td>
<td>0</td>
</tr>
<tr>
<td>EPH 101</td>
<td>Professional Skills Series 1</td>
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</tr>
<tr>
<td>EPH 508</td>
<td>Foundations of Epidemiology and Public Health 2</td>
<td>1</td>
</tr>
<tr>
<td>EPH 600</td>
<td>Research Ethics and Responsibility 1</td>
<td>0</td>
</tr>
<tr>
<td>EPH 608</td>
<td>Frontiers of Public Health 2</td>
<td>1</td>
</tr>
<tr>
<td>S&amp;DS 541</td>
<td>Probability Theory 3</td>
<td>1</td>
</tr>
<tr>
<td>or S&amp;DS 551</td>
<td>Stochastic Processes</td>
<td></td>
</tr>
<tr>
<td>or S&amp;DS 600</td>
<td>Advanced Probability</td>
<td></td>
</tr>
<tr>
<td>S&amp;DS 542</td>
<td>Theory of Statistics 3</td>
<td>1</td>
</tr>
<tr>
<td>or S&amp;DS 610</td>
<td>Statistical Inference</td>
<td></td>
</tr>
</tbody>
</table>

1. These courses do not count toward the fifteen required courses.
2. Students entering the program with an M.P.H. or relevant graduate degree may be exempt.
3. These courses are offered in the Graduate School of Arts and Sciences.

**Additional Required Courses: Standard Pathway**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS 678</td>
<td>Statistical Practice I</td>
<td>1</td>
</tr>
<tr>
<td>BIS 679</td>
<td>Advanced Statistical Programming in SAS and R</td>
<td>1</td>
</tr>
<tr>
<td>BIS 681</td>
<td>Statistical Practice II</td>
<td>1</td>
</tr>
</tbody>
</table>

Two of the following suggested electives:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS 557</td>
<td>Computational Statistics</td>
<td>1</td>
</tr>
<tr>
<td>BIS 567</td>
<td>Bayesian Statistics</td>
<td>1</td>
</tr>
</tbody>
</table>
BIS 643  Theory of Survival Analysis 1  
BIS 646  Nonparametric Statistical Methods and Their Applications 1  
BIS 691  Theory of Generalized Linear Models 1  

1 Cannot fulfill elective credit if substituted for BIS 630.

Three electives in Statistics and Data Science. Suggested electives are:

S&DS 563  Multivariate Statistical Methods for the Social Sciences 1  
S&DS 565  Introductory Machine Learning 1  
S&DS 612  Linear Models 1, 2  
Any other graduate-level S&DS course 1  

1 These courses are offered in the Graduate School of Arts and Sciences.

2 Cannot fulfill elective credit if substituted for BIS 623.

Students wishing to complete a thesis may enroll in BIS 649 and BIS 650, Master’s Thesis Research. This would be an additional requirement and cannot replace any of the required courses noted above. All students who complete a thesis will be required to present their research during a public seminar to the Biostatistics faculty and students in order to graduate.

Additional Required Courses: Implementation and Prevention Science Methods Pathway

BIS 629  Advanced Methods for Implementation and Prevention Science 1  
BIS 678  Statistical Practice I 1  
BIS 679  Advanced Statistical Programming in SAS and R 1  
BIS 681  Statistical Practice II 1  
EMD 533  Implementation Science 1  

1 A master’s thesis is strongly recommended in place of BIS 681 and one elective. All students who complete a thesis will be required to present their research during a public seminar to the Biostatistics faculty and students in order to graduate.

At least one of the following:

BIS 536  Measurement Error and Missing Data 1  
BIS 537  Statistical Methods for Causal Inference 1  
BIS 631  Advanced Topics in Causal Inference Methods 1  

Up to two of the following:

CDE 516  Principles of Epidemiology II 1  
CDE 534  Applied Analytic Methods in Epidemiology 1  
EMD 538  Quantitative Methods for Infectious Disease Epidemiology 1  
HPM 570  Cost-Effectiveness Analysis and Decision-Making 1  
HPM 586  Microeconomics for Health Policy and Health Management 1  
HPM 587  Advanced Health Economics 1  
HPM 611  Policy Modeling 1  
SBS 541  Community Health Program Evaluation 1  
SBS 574  Developing a Health Promotion and Disease Prevention Intervention 1  
SBS 580  Qualitative Research Methods in Public Health 1  
SBS 676  Questionnaire Development 1  

1 These courses are highly recommended.

Additional Required Courses: Data Science Pathway

BIS 620  Data Science Software Systems 1  
BIS 687  Data Science Capstone 1  

Two of the following:

BIS 555  Machine Learning with Biomedical Data 1  
BIS 557  Computational Statistics 1
BIS 634  Computational Methods for Informatics  1
BIS 646  Nonparametric Statistical Methods and Their Applications  1

One of the following machine learning courses (if not taken from the list above):
BIS 555  Machine Learning with Biomedical Data  1
BIS 557  Computational Statistics  1
BIS 634  Computational Methods for Informatics  1
BIS 646  Nonparametric Statistical Methods and Their Applications  1
CB&B 555  Unsupervised Learning for Big Data  1
CB&B 567  Topics in Deep Learning: Methods and Biomedical Applications  1
CB&B 667  Deep Learning Theory and Applications  1
CB&B 745  Advanced Topics in Machine Learning and Data Mining  1
S&DS 563  Multivariate Statistical Methods for the Social Sciences  1
S&DS 565  Introductory Machine Learning  1

One of the following database courses:
BIS 638  Clinical Database Management Systems and Ontologies  1
CPSC 537  Introduction to Database Systems  1

1  These courses are offered in the Graduate School of Arts and Sciences.

Two additional electives are required from the machine learning or database list, or from BIS, S&DS, or CB&B. Alternative courses from Public Health, Computer Science, or other departments must be approved by the Data Science Pathway director and the DGS.

Students wishing to complete a thesis may enroll in BIS 649 and BIS 650, Master’s Thesis Research. This would be an additional requirement and cannot replace any of the required courses noted above. All students who complete a thesis will be required to present their research during a public seminar organized by the Biostatistics department.

COMPETENCIES
Upon receiving an M.S. in the Biostatistics concentration of Public Health, the student will be able to:

• Select from a variety of analytical tools to test statistical hypotheses, interpret results of statistical analyses, and use these results to make relevant inferences from data.
• Design efficient computer programs for study management, statistical analysis, as well as presentation using R, SAS, and other programming languages.
• Demonstrate oral and written communication and presentation skills to effectively communicate and disseminate results to professional audiences.