Master of Science in Biomedical Sciences

Department Website: https://www.biomedicalsciences.bsd.uchicago.edu/

The Biological Sciences Division, in partnership with the Pritzker School of Medicine, offers a program of study leading to the degree of Master of Science in Biomedical Sciences. The curriculum focuses on the applications and innovations in clinical care and medical treatment, statistics, bioethics, and the American healthcare system, in addition to more specialized elective courses in science communication, biomedical data science, health systems science, clinical ethics, biomedical innovation, and biological sciences. The MsBmS program draws on UChicago's considerable strengths in neuroscience, cancer biology, immunology, microbiology, molecular metabolism and nutrition, ecology and evolution, biochemistry, medical education, and medical ethics.

Program Requirements

The program requires the successful completion of 9 graduate-level courses, including:

- Three required courses:
  - BMSC XXXXX: Foundations of Clinical Medicine: Anatomy, Physiology, and Disease
  - BMSC 45000: Introduction to Biomedical and Clinical Ethics I OR BMSC 45100: Introduction to Biomedical and Clinical Ethics II
  - A course in statistics or an equivalent methods course
- Three foundational courses, choosing from one of the following foundations:
  - Healthcare Foundation:
    - BMSC 32000: The American Healthcare System
    - BMSC 41200: Topics in Healthcare Delivery Science
    - BMSC 30003: Clinical Trials and Knowledge Creation
  - Bioscience Foundation:
    - BMSC 30011: Molecular and Cellular Foundations (*waiver option available)
    - BMSC 41500: Research in Biological Sciences
    - BMSC 41800: Inside the Cell: Advanced Mechanisms and Function
- A concentration consisting of three additional courses in the chosen field:
  - Science communication
  - Health systems science
  - Biomedical data science
  - Biomedical innovation
  - Biomedical ethics
  - Biological science

*Students may request a waiver for BMSC 30011 if they have successfully completed the following three undergraduate (or equivalent) courses with a grade of B+ or higher: one biology course, one chemistry course, and one additional biomedical sciences course (e.g., microbiology, immunology, etc.).

In addition to coursework, students are required to complete an independent project. The project provides students the opportunity to put into practice the knowledge and skills they learned during their coursework. The independent project is highly customizable and will differ depending on the individual student's chosen track, interest, and career objectives.

Students are also encouraged to participate in seminars and workshops that are of interest to them.

Application for Admission

The program recognizes multiple application deadlines for matriculation in Autumn Quarter. The application consists of an online application, copies of transcripts from all postsecondary education, TOEFL or IELTS scores (if applicable), three letters of recommendation, resume or curriculum vitae, and a personal statement.

Interested students should visit the program website at https://www.biomedicalsciences.bsd.uchicago.edu/.

Master of Business Administration-Master of Science Joint Degree (MBA-MS)

The joint degree program in biomedical sciences and business is an opportunity for students seeking to combine business expertise with foundational knowledge in biomedicine. Students in this program pursue both a Master of Business Administration (MBA) from Chicago Booth and a Master of Science (MS) in Biomedical

Sciences from UChicago. Students gain a strong understanding of the scientific substrate on which healthcare businesses are built to become leaders and innovators in the healthcare industry.

Program Structure

In order to earn a dual MBA and MS, students complete 14 Booth-only courses (+LEAD) and 6 MS-only courses over the course of two years.

Booth Courses

Leadership Effectiveness and Development (LEAD)

One course in Financial Accounting

One course in Microeconomics

One course in Statistics

700 units in Functions, Leadership & Management, and Business Environment

400 units of electives

BMS Courses

200 units of core coursework:

- BMSC XXXXX: Foundations of Clinical Medicine: Anatomy, Physiology, and Disease
- BMSC 45000: Introduction to Biomedical and Clinical Ethics I OR BMSC 45100: Introduction to Biomedical and Clinical Ethics II

300 units of foundational coursework. Choose one of the following foundations, or choose any three of the following six courses to satisfy your foundational requirements:

- Healthcare Foundation:
  - BMSC 41200: Topics in Healthcare Delivery Science
  - BMSC 32000: The American Healthcare System
  - BMSC 30003: Clinical Trials and Knowledge Creation
- Bioscience Foundation:
  - BMSC 30011: Molecular and Cellular Foundations (*waiver option available)
  - BMSC 41500: Research in Biological Sciences: Basic Research Writing and Grant Proposal
  - BMSC 41800: Inside the Cell: Advanced Mechanisms and Functions

Admissions Process

Applicants interested in the MBA/MS Biomedical Sciences Program should apply through our centralized, joint-application process. Applicants must apply using the Chicago Booth Full-Time MBA application in either Round Two or Round Three and should select the MBA/MS as their program of interest. Admissions decisions for each department are made independently and candidates can indicate in the application if they would like to be considered for Chicago Booth and/or the MS Biomedical Sciences independently if they are not admitted to the joint program.

As part of the online application, candidates will be required to submit a GMAT or GRE score for the joint program. International applicants may be required to submit proof of English language proficiency by submitting a TOEFL iBT or IELTS test score that meets the program minimum. Proof of English proficiency may be waived under certain criteria noted by UChicago GRAD Admissions (https://grad.uchicago.edu/admissions/apply/english-language-requirements/).

Eligibility Requirements: Students admitted to Booth's Full-Time MBA Program who wish to do the joint degree with BMS must be admitted to and begin both programs in the same academic year. Students who have already started their MS or MBA are not eligible for the joint degree.

Master of Science in Biomedical Informatics Courses

MSBI 30100. Introduction to Biostatistics Prerequisite. 000 Units.
This is an intensive course designed for students little to no background in statistics. It is also intended to be a refresher course for those who may have some statistical knowledge and may or may not have recently been engaged in statistics-related work or activities. The course will focus on understanding the concepts, include a reasonable level of theory and applications, and strive for a balance between these two. The objective of the course is to bring all students to the same level of statistical understanding and to ensure that they can apply these concepts using real data.

MSBI 30200. Overview of Clinical Care Systems Prerequisite. 000 Units.
MScBMI students need to have a good understanding of how big clinical settings work. This workshop is for non-clinicians to understand hospitals' basic workflow, systems, and terminology.

MSBI 30300. Introduction to R Programming. 000 Units.
This boot camp will teach individuals who have no prior experience with coding of any kind the basics of the R programming language with a focus on the beginnings of practical data science. Topics will begin with a primer on some fundamentals of programming, such as basic data structures and R Studio, and move into more advanced data structures and visualization. Asynchronous topics will be offered as a recorded supplement for students who want to know more about hot technical topics, such as generative AI in coding and academia, common pitfalls when dealing with data, and what to think about when designing code. Statistical analysis will not be covered.
Instructor(s): Jason Edelstein

MSBI 31100. Introduction to Biomedical Informatics. 100 Units.
This course will cover the fundamentals of informatics as it applies to health care and research. Specific topics will include: radiology, imaging, and nursing informatics; using clinical data for research; overview of bioinformatics; coding in clinical care and billing; terminologies and ontology mapping; security and privacy including HIPAA and HITECH; mobile health and telemedicine; human-computer interaction; decision support; meaningful use; quality reporting; the Affordable Care Act; and clinical laboratory informatics.

MSBI 31200. Leadership and Innovation for Informatics. 100 Units.
The goal of this course is to explore and understand the impact that leadership and innovation can have on individual, team, and organizational outcomes. Now more than ever, we are facing a world where disparities and inequities are notably starker than in even recent years, and where the possibilities for individuals and organizations making impacts far greater than before. Successful and effective biomedical informatics leaders must be resilient in the face of constant change, must be prepared to manage operational challenges with swift effectiveness, and engage their workforce and sphere of influence with adaptive, engaging, and innovative approaches. In this highly interactive course, we will evaluate how leadership qualities, management methods, and innovative mindsets can be learned and executed and make the whole difference between success and failure in real life.
Terms Offered: Summer Winter

MSBI 31300. Concepts in Computer Programming. 100 Units.
This course will provide an introductory and intermediate-level overview of computer science and programming for students not working in technology-based professions. Students will learn concepts in computer programming, how a programming language works, and theories behind information system design and management. Specific topics include Python programming language, fundamental data structure, algorithm design, and basic project management of development projects.

MSBI 31500. Ethics and Policy Questions: Genomics, Health Care, and Big Data. 100 Units.
This course will provide students with an understanding of critical ethical, legal, and social issues related to biomedical informatics, emphasizing policies in the US. Specific topics include balancing privacy and discovery in the context of big data analysis, data stewardship, human genomic data, implications of future innovation for privacy and ethics, and guarding against data misuse.

MSBI 31600. Advanced Concepts in Computer Programming. 100 Units.
This course will introduce students to advanced concepts in computer programming through real-world "end-to-end" case studies. Additionally, this course will provide a comprehensive introduction to the domain of biomedical informatics from a computer programming perspective. It will also provide implementation examples that are representative of problems that practitioners in the medical field have to solve. During the course, students will learn how biomedical informaticists access and process healthcare and medical data. Topics include common IT methods and tools, important numerical algorithms, commercial products, and open-source tools and libraries.

MSBI 31800. Introduction to Applied Data Analysis. 100 Units.
This course will introduce students to the concepts of research design, working with healthcare data, managing secondary data sets, and basic data analysis, including descriptive statistics and measures of association. The course will outline methods for identifying appropriate datasets and using tools to analyze data, evaluate hypotheses, and interpret results. The goal is to help students learn how to describe, present, summarize, and organize data effectively in biomedicine.

MSBI 32000. Intermediate Applied Data Analysis. 100 Units.
This course will enable students to focus on applying informatics methods to real-world scenarios. The course will be customized for students pursuing research or clinical informatics projects. In the research group, we will use a case-study-based approach to identify appropriate datasets, use analytic tools to analyze data, evaluate hypotheses, and interpret results. In the clinical group, we will focus on the methods of diagnosing issues within current or proposed clinical systems, using informatics to address issues, and evaluating the results.

MSBI 32100. HIT Integration, Interoperability Standards: Independent Study. 100 Units.
This course will teach students about healthcare information technology (HIT) standards and interoperability. Lessons will include a review of key standards such as the IHE initiative, HL7, DICOM, CCOW, and others; the role of non-medical standards (HTTP, XML, etc.) in biomedical informatics; policy issues related to data exchange

between institutions; use of service-oriented architecture (SOA); enterprise business integration; and HIPAA policies and standards.

MSBI 32300. Decision Support Systems & Health Care. 100 Units.
This course will give students an overview of computer-assisted management information and decision systems used in health organizations. Topics will include analyzing and designing databases for decision-making, data and information flow and reporting, security, privacy, and confidentiality in using decision support systems, and best practices for change management in decision support systems.

MSBI 32400. Introduction to Bioinformatics. 100 Units.
This course will provide students with an introduction to the tools and applications of bioinformatics. Examples will focus on genetic and genomic technologies, including basic Illumina molecular biology, utilities for DNA sequencing, and knowledge extraction engines.

MSBI 32500. Advanced Bioinformatics: Genome Analysis. 100 Units.
This course will follow the Introduction to Bioinformatics. It will include advanced topics such as Linux and high-performance computing, genomic data visualization, R programming in bioinformatics, and RNA sequencing data analysis.

MSBI 32600. Geographic Information Systems and Health Information: Independent Study. 100 Units.
Increasingly, healthcare professionals are integrating data and data analysis techniques into formulating strategies, approaches, and frameworks for addressing complex health issues. Among the various data analysis tools used in the health care and public policy fields, Geographic Information Systems (GIS) are unique in their ability to tie health data to a geographic location. This makes a GIS much more than mapping software; by providing users with a suite of tools for manipulating, analyzing, and spatially visualizing data, a GIS can reveal relationships, trends, and patterns that would not be apparent in other data analysis applications. GIS analysis methods can be used across disciplines to answer complex multi-dimensional questions frequently found in the healthcare field. In this class, students will learn about fundamental GIS concepts while building the basic skills necessary to integrate a GIS into a decision-making process. Concepts presented in the lecture will be put into practice through hands-on laboratory exercises utilizing QGIS, a cross-platform free and open-source desktop geographic information system. Additionally, the course will incorporate case studies into laboratory exercises to ground GIS analysis techniques in real-world learning scenarios.

MSBI 33100. Population Health Informatics. 100 Units.
With the US healthcare system rapidly moving towards value-based care payment models, payers and providers need to be able to better monitor, target and address specific needs of patient populations. However, the emergence of the population health functions has created an informatics skill gap at many organizations. This course provides both a hands-on introduction and conceptual foundation for population health informatics that can be applied in the public or commercial setting. Students will work with several data sets while furthering their understanding of the intersection of population health practice and informatics. This course will prove valuable for any student tasked with evaluating new data sets for monitoring the health and outcomes of populations.

MSBI 33200. Machine Learning for Biomedical Informatics. 100 Units.
This introductory course will present an overview of the basic concepts, techniques, and algorithms used in Machine Learning. Students will be introduced to the basic ideas and intuition behind modern Machine Learning techniques by taking this course. Students taking this course should be able to program in Python to complete the required assignments.

MSBI 38100. Independent Study. 100 Units.
TBD

MSBI 38200. Advanced Research. 000 Units.
TBD
Terms Offered: Autumn

MSBI 39901. Capstone Project Proposal. 100 Units.
As a culminating experience, students will put into practice the knowledge and skills they learned during their coursework through a Capstone Project. Students will be able to develop and implement a biomedical informatics project with an industry or University partner or in their workplace. Students will complete this project over three quarters in the program. The Capstone Project Proposal course will focus on planning the project and developing the proposal.

MSBI 39902. Capstone Project Implementation: Independent Study. 100 Units.
As a culminating experience, students will put into practice the knowledge and skills they learned during their coursework through a Capstone Project. Students will be able to develop and implement a biomedical informatics project with an industry or University partner or in their workplace. Students will complete this project over three quarters in the program. The Capstone Project Implementation course will focus on implementing the developed project.

MSBI 39903. Capstone Project Writing and Presentation. 100 Units.
As a culminating experience, students will put into practice the knowledge and skills they learned during their coursework through a Capstone Project. Students will be able to develop and implement a biomedical informatics project with an industry or University partner or in their workplace. Students will complete this project over three quarters in the program. The Capstone Project Writing and Presentation course will focus on creating the project write-up and presenting the capstone results to the MScBMI community.