GEORGE MASON UNIVERSITY
College of Science

BIOL 689 (3 credits)
Interdisciplinary tools in biosciences.

Instructor: Mariaelena Pierobon, MD MPH
Associate Professor
School of Systems Biology
Institute for Advanced Biomedical Research
10920 George Mason Circle, Room 2016
Manassas, VA 20110
Phone: 703-993-9839
Email: mpierobo@gmu.edu (preferred method)

Office hours: Monday 3:30-4:30 by appointment (link for office hours will be sent when after appointments have been scheduled). For urgent communications, please email at mpierobo@gmu.edu.

Course type: Hybrid format including synchronous online activities and in person meetings (see calendar for detailed schedule).

Catalogue Description: The purpose of this class is to provide experiential learning for the basic tools necessary for a scientist career development. The tools covered in this class span: A) basics for conducting biosciences research, B) identify unmet needs in science, C) perform scientific literature search, D) master the principles of experimental designs and state of the art -omics technologies, E) compute basic statistical analyses, F) interpretate scientific results, G) understand the principle of mathematical and GIS modeling and machine learning, and H) understand and practice oral and written scientific communication. Students will be guided on how to recognize emerging trends in science, and given the tools to creatively explore these trends so that their science will be timely and competitive. The format of this class will be serial modular lectures from the instructor and experts in different fields and group projects that will allow the students to practice the tools learned in a collaborative learning environment.

Course Goal and Objectives:

At the end of the course students will be able to:

- Understand, apply, and interpreted basic biostatistics tests;
- Explain how machine learning, geospatial and mathematical modeling can be used to solve a biomedical problem;
- Explain the role of -omic technologies and big data in biomedical research;
- Understand how to read, write, and interpreted biomedical literature;
- Formulate and conduct an original research project;
- Access and retrieve data from a publicly available database;
- Master basic presentation skills;
- Identify emerging trends in biomedical research.

Learning objectives will be achieved through a combination of lectures and group activities. Classes will be structured as synchronous or in person lectures (see calendar for detailed schedule) where course instructor and guest lecturers will explain why interdisciplinary tools are at the core of biomedical research.

Recommended text book: “Introduction to Health Research Methods: A Practical Guide” by Kathryn H.

Jacobsen. (ISBN-13: 978-1284197563; ISBN-10: 1284197565). Some copies of the book are available at the library.

Reading list

- Karczewski KJ, et al. Integrative omics for health and disease. Nat Rev Genet. 2018;19(5):299-310.
- Rosinger AY, et al. Secondary data analysis to answer questions in human biology. Am J Hum Biol. 2019;31(3):e23232.
- Ji Z, et al. Mathematical and Computational Modeling in Complex Biological Systems. Biomed Res Int. 2017;2017:5958321.
- Haas R, et al. Designing and interpreting 'multi-omic' experiments that may change our understanding of biology. Curr Opin Syst Biol. 2017;6:37-45.
- Musa GJ, et al. Use of GIS Mapping as a Public Health Tool-From Cholera to Cancer. Health Serv Insights. 2013;6:111-6.
- Benam KH, et al. Exploring new technologies in biomedical research. Drug Discov Today. 2019;24(6):1242-1247.

Grading and Class structure

Mid-term take home exam: 20 points
Project presentation: 20 points
Final Paper: 20 points
CITI training (Biomedical (Biomed) Basic): 10 points
Online discussion board: 24 points (8 discussion posts, each post will be graded on a scale of 0-3)
Class participation: 6 points.

Mid-term take home exam:

Students will be assigned 2 papers. Students will have one week to read and analyze the papers and provide a report. Instructions will be provided during the first part of the semester on how to critically review a scientific paper. This is an open book assignment to be carried out individually. **Group exams or exams containing plagiarized material will not count toward the final grade.**

Project presentation and final paper:

Students will be divided in small groups at the beginning of the semester. Each group will formulate a biological hypothesis and will then test the hypothesis using a publicly available dataset. Students will prepare a power point presentation and deliver it to the class during the final two weeks of the semester and write a report about their research finding. Final report should not exceed 6 pages.

Presentation and final report should be structure as a research article including:

1. Introduction with a description of the problem and hypothesis to be tested;
2. Method explaining which dataset was used to test the hypothesis, where the data was found, and how it was analyzed.
3. Results providing an interpretation of the main findings. This section should include table, chart, graphs, etc.
4. Discussion explaining why the proposed work is novel and relevant to the biomedical field and potential future directions.

Online discussions:

To help prepare for the presentation and final report each student will share their experience and project progresses through online discussion boards. Each student will post a progress report on the discussion board on selected weeks and provide feedback to at least two classmates' posts.

Make up exams will be discussed on a case-by-case basis for students facing emergencies and health related issues. Supporting documentation may be required.

Grading scale

A+	4.00	Satisfactory/Passing
A	4.00	Satisfactory/Passing
A-	3.67	Satisfactory/Passing
B+	3.33	Satisfactory/Passing
B	3.00	Satisfactory/Passing
B-	2.67	Satisfactory*/Passing
C	2.00	Unsatisfactory/Passing
F	0.00	Unsatisfactory/Failing

* Although a B- is a satisfactory grade for a course, students must maintain a 3.00 average in their degree program and present a 3.00 GPA for the courses listed on the graduation application.
Information about additional grade notations that apply to graduate students including "IN" Incomplete and "IP" In Progress as well as grading for undergraduate students may be found in the Academic Policies section of the catalog under Grading System.

Basic Course Technology Requirements
Activities and assignments in this course will regularly use web-conferencing software (Blackboard Ultra Collaborate). Students are required to have regular and reliable access to a computer with an updated operating system and a stable broadband internet connection.
In addition, students are required to have a device with a functional camera and microphone for in class activities. In an emergency, students can connect through a telephone call, but video connection is the expected norm.

Plagiarism
Plagiarism is the presentation of someone else's ideas or work as one's own. Students must give credit for any information that is not the result of original research or common knowledge. If a student borrows ideas or information from another author, the author must be acknowledged in the body of the text and on the reference page. Plagiarisms are subject to the penalties outlined in the Policies and Procedures section of the University Catalog, which include a hearing by the Honor Code Committee and may include a failing grade for the work in question or for the entire course. The following website provides helpful information concerning plagiarism for both students and faculty: http://oai.gmu.edu/the-mason-honor-code-2/plagiarism/

Classroom Policies
Students are expected to attend live session and to participate during discussions and group activities. Internet surfing should be limited during our discussion time.

Students must use their MasonLive email account to receive important University information, including communications related to this class. I will not respond to messages sent from or send messages to a non-Mason email address.

As a faculty member and designated "Responsible Employee," I am required to report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per university policy 1412. If you wish to speak with someone confidentially, please contact the Student Support and Advocacy Center (703-380-1434) or Counseling and Psychological Services (703-993-2380). You may also seek assistance from Mason's Title IX Coordinator (703-993-8730; titleix@gmu.edu).

Please familiarize yourself the GMU honor code at http://www.gmu.edu/facstaff/handbook/aD.html.
The requires all members of this community to maintain the highest standards of academic honesty and integrity. Cheating, plagiarism, lying, and stealing are all prohibited. All violations of the Honor Code will be reported to the Honor Committee. More information can be found at http://oai.gmu.edu/the-mason-honor-code-2/ for more detailed information.

Course Materials and Student Privacy
All course materials posted to Blackboard or other course site are private and should not be shared with anyone not enrolled in this class. By federal law, any materials that identify specific students (via their name, voice, or image) must also not be shared with anyone not enrolled in this class.

Students with Disabilities
Students with a disability requiring academic accommodations should talk to the instructor and contact the Disability Resource Center (DRC). Under the administration of University Life, Disability Services (DS) implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. If you are seeking accommodations, please visit https://ds.gmu.edu for detailed information about the Disability Services registration process.
Disability Services is located in Student Union Building I (SUB I), Suite 2500; Email: ods@gmu.edu Phone: (703) 993-2474. All academic accommodations must be arranged through the DRCS.

Ethics
Ethical behavior in all class related activities is required of every student.

Diversity
Learning to work with and value diversity is essential in every class. Students are expected to exhibit an appreciation for multinational, multiracial, and gender diversity in the classroom.

As a diverse community of learners, students must strive to work together in a setting of civility, tolerance, and respect for each other and for the instructor. Rules of classroom behavior (which apply to online as well as onsite courses) include but are not limited to the following:

- Conflicting opinions among members of a class are to be respected and responded to in a professional manner;
- Side conversations or other distracting behaviors including cell phone use or non-class online access are not to be engaged in during lectures, class discussions or presentations;
- Offensive comments, language or gestures will not be tolerated at any time; students not complying with class policies will be asked to cease immediately or leave the class session.

Course Schedule:

Week	Topic
Lecture 1 Jan 24	Course overview. Introduction to study and experimental design in bio-health (Virtual learning via Blackboard)
Lecture 2 Jan 31	Introduction to biostatistics part I: basic methods for displaying and analyzing biological data (Virtual learning via Blackboard)
Lecture 3 Feb 7	Introduction to biostatistics part II: introduction to programming languages for bio-scientists (Virtual learning via Blackboard)
Lecture 4 Feb 14	Overview of OMICS technologies: challenges and opportunities in the era of Big Data (Virtual learning via Blackboard)
Lecture 5 Feb 21	Overview of public access databases for biological data and tools for understanding -omics data (Virtual learning via Blackboard)
Lecture 6 Feb 28	Science communication 1: how to read and analyze a scientific paper, to pitch a scientific idea, to perform a scientific literature search, and manage citations (Virtual learning via Blackboard)
Lecture 7 March 7	Science communication 2: how to successfully prepare a scientific presentation (Virtual learning via Blackboard)
No Class March 14	Spring Break
Lecture 8 March 21	Take Home Mid-term Mathematical modeling of biological data (Virtual learning via Blackboard)
Lecture 9 March 28	Application of machine learning to biomedicine (Virtual learning via Blackboard)
Lecture 10 April 4	Role of GIS modeling in health (Virtual learning via Blackboard)
Lecture 11 April 11	Emerging topics in biosciences and bioengineering (Virtual learning via Blackboard)
Lecture 12 April 18	Creativity and innovation: how to identify unmet challenges (Class meets in person)
Lecture 13 April 25	Presentations (Class meets in person)
Lecture 14 May 2	Presentations (Class meets in person)
Lecture 15 May 9	Take Home Exam/Final paper