Intercollegiate Biomathematics Alliance
500-Level Graduate Courses

Courses are arranged by the four areas of emphasis: mathematical modeling, biological sciences, data analysis, and computer science. Those students completing a certificate in Option I or II will also need IBA 599 listed at the end under the heading "Culminating Project".

MATHEMATICAL MODELING

IBA 511   Differential Equations with Modeling   (3 credits)

A modern study of differential equations including mathematical modeling and numerical solutions. Topics include the formulation of differential equations and interpretation of solutions, first-order linear and separable equations, dynamical systems approach to linear and nonlinear first order systems, numerical methods, and qualitative analysis. Applications and modeling of real world phenomena will be integrated throughout. Prerequisites: Calculus and Linear Algebra.

IBA 512   Applied Linear Algebra   (3 credits)

A course in matrix and vector methods for studying systems of linear equations, with an emphasis on concrete calculations and applications. Specific topics to be covered include matrix algebra, linear systems of equations, vector spaces, linear dependence, rank of matrices, determinants, linear transformations, eigenvalues and eigenvectors, diagonalization, inner products and orthogonal vectors, and symmetric matrices. Computational tools will be integrated throughout the course to complement the mathematical content. Prerequisite: Calculus.

IBA 513   Discrete Mathematics with Applications   (3 credits)

Introduction to basic techniques and modes of reasoning for discrete problem solving. Set theory, recurrence relations, counting, graphs and lattices, number theory. Prerequisite: Calculus

BIOLOGICAL SCIENCES

IBA 521   Modern Biology, Dynamics of Life   (3 credits)

Introduction to structure and function of the major groups of microorganisms, plants, and animals, emphasizing evolutionary relationships among the major groups. Introduction to molecules, processes, and cellular organization of living organisms.

IBA 522   Ecology   (3 credits)

A study of interactions that determine the distribution and abundance of living organisms. The basic principles of ecology are presented in order to develop an understanding of the nature of these interactions at the individual, population, and community levels of biological organization. Prerequisite: Introductory Biology.

IBA 523   Environmental Science   (3 credits)

Introduction to the relationship of humans and the environment. Selected aspects of current thinking and research concerning the impact of industrialization and urbanization on environmental quality, including the population explosion; the potential decline of the affluent society by the depletion of natural resources; the pollution of air, land surface, and water; the public agencies and policies designated to solve environmental problems.

DATA ANALYSIS

IBA 531   Mathematical Statistics for Scientists   (3 credits)

Sample spaces, discrete and continuous random variables, probability functions, density, moment generating functions, important distributions. Multivariate distributions, Central Limit Theorem. Statistical estimation. Point and interval estimators. Consistency, unbiasedness, minimum variance. Hypothesis testing. Likelihood ratio tests. Regression, analysis of variance. Prerequisite: Calculus.

IBA 532   Statistics for Modeling   (3 credits)

Choosing, fitting, assessing and using statistical models. Simple linear regression, multiple regression, analysis of variance, general linear models, logistic regression and discrete data analysis will provide the foundation for the course. Classical interference methods. Prerequisite: Elementary Statistics.

COMPUTER SCIENCE

IBA 541   Python with Applications   (3 credits)

Basics of programming in a high level language. Control structures, functions, arrays, and pointers before objects and classes. The examples and problems used in this course are drawn from diverse scientific areas.

IBA 542   Problem Solving with C++   (3 credits)

Introduction to the C++ programming language and its subset, the C programming language. Program structure, blocks, storage types, console and file I/O, functions, arrays, strings, pointers, call-by-reference, call-by-value, and dynamic memory allocation will be discussed. The concept of classes will be introduced. This course is designed to teach students the C++ programming language and introductory and intermediate programming concepts with examples and applications using the C++ programming language.

IBA 543   Programming with Java   (3 credits)

An introduction to programming using the Java programming language. Students will learn the fundamentals of Java. The focus is on developing high quality, working software that solves scientific problems.

CULMINATING PROJECT

(For students in Option I or II)

IBA 599   Culminating Experience Project   (3 credits)

Capstone project integrating aspects from mathematical modeling, data analysis, computer science, and biological sciences. May involve replicating or extending results from primary literature. Prerequisites: IBA 51x, IBA 52x, IBA 53x, and IBA 54x.