

## Guide to Quantitative Courses for Ecologists at CSU

Colorado State University has great breadth and depth in quantitative courses that are fundamental to ecological science. This document highlights several of the courses commonly used by graduate students in ecology, and provides a starting point for planning coursework for ecology degrees. Be sure to investigate course content directly with the instructor if you think you might want to take the course.

**STATISTICAL MODELING:** The general statistics series most commonly taken by ecology graduate students is ST511 and 512 Design and Data Analysis for Researchers. A variety of more specialized statistics courses that may be appropriate depending on the type of data analysis to be done (e.g., spatial statistics, time series analysis, etc.).

**ST430 Probability and Mathematical Statistics II or ST530 Mathematical Statistics:**

Explain the theoretical underpinnings of the applied statistics used everyday by most ecologists (e.g., regression, ANOVA, etc.). A course in probability theory is prerequisite.

**NR/ST 523 Quantitative Spatial Statistics:** Techniques in spatial statistics: point pattern analysis, spatial autocorrelation, trend surface and spectral analysis.

**FW662 Sampling and Analysis of Vertebrate Populations:** Covers statistical sampling and analysis theory for population biology, includes a laboratory with relevant software for these applications.

**NR575 Systems Ecology:** Teaches model development, analysis and evaluation. Includes dynamical systems models, with emphasis statistical methods such as parameter estimation, simulations and model evaluation, particularly using AIC (Akaike Information Criterion). Includes a laboratory emphasizing Maple and Visual Basic for Applications in Excel. This course provides both an introduction to general modeling and an emphasis on statistical approaches.

**GEOGRAPHIC INFORMATION SYSTEMS:** Most ecology in the 21<sup>st</sup> Century deals with spatially explicit organisms and locations – it matters where you are, and who and what are next to you.

**NR 423: Applications of Global Positioning Systems** Introduction to concepts and use of global positioning systems with applications to natural resources.

**NR 505: Concepts in GIS:** Concepts of geographic information systems and spatial data analysis.

### **SIMULATION MODELING:**

**ST420 Probability and Mathematical Statistics I or ST520 Introduction to**

**Probability Theory:** Provide a introductions to probabilities, distributions, understanding the moments of a distribution (mean, variance, etc.). Students gain a more thorough understanding of how statistics work in general, and develop the background needed for more advanced simulation work or mathematical statistics. ST520 is a graduate course for statistics students and is not for the feint of heart.

**ST321 Elementary Probabilistic – Stochastic Modeling or ST521 Stochastic Processes I:** Introduce the basic theoretical concepts underlying simulation modeling, but do not necessarily cover the logistics of coding a simulation. ST522 Stochastic Processes II may also be of interest.

**DYNAMICAL SYSTEMS MODELING:**

**M340 Introduction to Differential Equations:** Basic theory for differential equations models.

**BZ380/M380/BZ581 Theory of Population and Evolutionary Ecology:** Teaches dynamical systems (differential and difference equations), model development and analysis with a focus on biological interpretation of mathematical results. The computer lab teaches programming skills using Matlab. This course would be an appropriate graduate introduction to general modeling with an emphasis on dynamical systems.

**OTHER POTENTIAL COURSES OF INTEREST:**

**M229 Matrices and Linear Algebra**

**M331 Introduction to Mathematical Modeling** (expect a general course without many explicit links to biology)

**M332 Partial Differential Equations**

**M480 Mathematics and Medicine** (emphasis on partial differential equations with some ecological applications as well – note the course number will change soon)

**EY600 Population and Community Ecology** (covers some well known population ecology models)