Course description

Course	Models in Population Biology
Department	Institute for Biology
Language	English
Nature	Optional
Year/semester	1st year, spring-term
Credits (ECTS)	2
Lectures (hour/semester)	28
Plenary lectures (hour/semester)	
Practicals (hour/semester)	
Responsible teacher	Dr. Kövér Szilvia
Teacher(s)	Dr. Kövér Szilvia
Prerequisites	

Learning outcome (include skills and competencies, if any)

Knowledge of basic models in population genetics, population dynamics and epidemiology, their dynamic behavior, equilibria and stability. Understanding the difference between discrete vs. continuous time models and deterministic vs. stochastic models. Being able to use to concepts of density and frequency dependence.

The mathematical skills needed to construct and analyze dynamic models: functions and approximations, calculus, graphical techniques, linear algebra and probability theory.

Outcome assessment

Oral exam when a collection of formulas can be used, however the students are supposed to choose, interpret and analyze the formulas belonging to a certain model.

The students are supposed to be able to draw the different graph types appropriate to analyze a certain model.

Weekly schedule of lectures and practicals

WEEK	Lecture topics
Week 1	Introduction: What is a model? Discrete-time models of population dynamics. Exponential and density dependent models of population growth.
Week 2	Fixed points and stability. Attractors, repellors, llimit cycles and chaotic dynamics. Graphical techniques appropriate to analyze discrete-time models.
Week 3	The cob-web graph of the recursion equation. Stability analysis of discrete-time models in general and of the discrete logistic and Ricker models in particular.
Week 4	Dynamics of age-structured populations.
Week 5	Haploid and diploid deterministic models of natural selection and mutation.
Week 6	Stability analysis of population genetic models. The graphs of allele frequency change and average fitness as a function of allele frequency.
Week 7	Modelling stochastic processes by random numbers. Genetic drift in the stochastic population genetic models.
Week 8	Modelling mutation, selection, recombination and reproductive modes in individual-based simulations. The general stucture of simulations.
Week 9	The concepts of recombination, linkage equilibrium and independence.
Week 10	Continuous-time models of population growth: exponential and logistic growth. Density change plotted against density and per capita change plotted against density.
Week 11	Lotka-Volterra predator-prey models and thetypes of the functional response of the predator.
Week 12	Lotka-Volterra models of competition. Stability analysis of contonuous-time models of two interacting populations.
Week 13	Spatially explicit models. SIR epidemiological models.
Week 14	Models of HIV and SARS-CoV-2.

Recommended literature

OTTO, S. P. & DAY, T.: A Biologist's Guide to Mathematical Modeling in Ecology and Evolution, Princeton University Press, 2007

GILLMAN, M.: An Introduction to Mathematical Models in Ecology and Evolution, Wiley-Blackwell, 2009

Note(s)