Course description

Course	Computer Modeling
Department	Institute for Biology
Language	English
Nature	Optional
Year/semester	1st year, spring-term
Credits (ECTS)	3
Lectures (hour/semester)	
Plenary lectures (hour/semest	
Practicals (hour/semester)	42
Responsible teacher	Dr. Kövér Szilvia
Teacher(s)	Dr. Kövér Szilvia
Prerequisites	Taking the course "Models in Population Biology" in the same semester or previously. (The former option is recommended.)

Learning outcome (include skills and competencies, if any)

Basic programming skills in R language: the structure of the code, loops, if-else statements, subrutines. Testing and debugging a code. Creating graphs suitable to analíse dynamic models.

Writing codes for simulations of difference equations and for numeric approximations of differential equations to solve the models learned in the course "Models in Population Biology". Generating random numbers of appropriate distribution to model stochastic events.

Outcome assessment

10 Small Tests, 5 points for each (altogether 50 points). Every course material can be used.

Assignment: building and analysing a model choosed by the student, writing a simulation code to solve it,
50 points (40 points for building the model, 5 points for readability. i.e. structuring the code and adding appropriate notes and 5 points for the pragps). Homework assignments: small tasks for 1-3 points, altogether max. 20 points.
Marks:
5: 90 points
4: 80-89.5 points
3: 65-79.5 points
2: 50-64.5 points

Weekly schedule of lectures and practicals

WEEK	Practical topics
Week 1	Discrete-time population dynamic models, geometric and logistic growth. Graphs: density against time. Variables, vectors, for loop.
Week 2	While loop. Function as a unit of commands. Matrices and theit usage for plotting the dependence of the solution on the initial condition. Graph: density against time starting from more than one initial condition.
Week 3	The cobweb figure: the next density as a function of the present density plus arrows to show the change in time. Function as a relation of continuous variables and the plots of them. Graph: the points of attractor against the intrinsic growth rate.
Week 4	Modeling age-structured population dynamics with leslie-matrix.
Week 5	Haploid and diploid onelocus deterministic models of mutation and selection.
Week 6	Graph: the averaga fitness and delta p as a function of p. (Adaptive landcsape of Wright.)
Week 7	Diploid onelocus stochastic model.

Week 8	Haplois multilocus stochastic model with mutation, selection and recombination. Mutant classes. Modeling genders. Modeling reproductive modes: panmixis, apomixis and selfing.
Week 9	Two-locus model of sexual selection. Graph: male trait, female choosiness and linkage disequilibrium as a function of time. when one should use a second y axis?
Week 10	Phase plane diagrams.
Week 11	Numeric approximation of differential equations of one variable to solve continuous-time models of population dynamics: exponential and logistic growth.
Week 12	Numeric approximation of differential equations of two variables to solve Lotka-Volterra models of predation and competition. 1st discussion about the Assignment.
Week 13	SIR epidemiological models. 2nd discussion about the Assignment.
Week 14	HIV and SARS-CoV-2 models. 3rd discussion about the Assignment.

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)