Mathematical Models in Biology

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Workshop Proposal for the TI-Nspire & Derive Strand

ABSTRACT

In this workshop we will share the pedagogy and methodology of a course based on Mathematical Models in Biology. The course utilizes difference equations, matrix algebra and Markov chains as the main mathematical tools and integrates a computer algebra system and cooperative learning. The main theme of the course is modeling of biological and ecological systems using linear and nonlinear difference equations as well as systems of difference equations. The target audiences of this course are freshmen life science and mathematics majors. Students work in small groups on carefully designed activities that guide them in discovery of mathematical concepts on their own and exploration of connection between biology and mathematics.

In this workshop the participants will be introduced to and will work on various models in biology. They will utilize the computer algebra system Derive or/and a spreadsheet to investigate and analyze the models that are represented by a single difference equation, a system of difference equations, or a matrix equation. We will investigate situations that are modeled by first-order linear difference equations such as population dynamics of a single species and drug administration. Models represented by nonlinear first-order difference equations such as logistic growth model, maximum sustainable yield, and harvest strategies will be explored. We introduce Markov chains and investigate a model of population movement between a city and its surrounding suburbs, as well as a model that utilizes Markov chains in genetics. We will discuss an innovative way of introducing eigenvalues and eigenvectors through age-structured population models.
We will conclude with some population models of interacting species.

Keywords

Mathematical models, difference equations, matrix algebra, CAS and cooperative learning.