Math 361
Course Outline, Winter 2001

Part I: Biological processes in discrete time: difference equations

I.1. Linear difference equations

I.1.1. Introductory examples

I.1.2. The simplest case: exponential growth in one variable

I.1.3. Systems of linear difference equations

I.1.4. Some linear algebra

I.1.5. Back to population dynamics: eigenvalues and eigenvectors as exponential growth rates and stable age distributions

I.1.6. Some general remarks

I.2. Non-linear difference equations

I.2.1. Dimension 1: Graphical and analytical stability analysis

I.2.2. Period-doubling route to chaos

I.2.3. Stability analysis in systems of non-linear difference equations

I.2.4. Chaos control

Biological examples discussed in Part I include: population dynamics, dynamics of cognition, dynamics of red blood cells, population genetics

Part II: Biological processes in continuous time: differential equations

II.1. Dimension 1

II.1.1. The simplest case: linear differential equations

II.1.2. Non-linear differential equations

II.1.3. Bifurcations in a model for gene regulation

II.1.4. Some remarks about delay differential equations

II.2. Systems of differential equations

II.2.1. Stability analysis in Lotka –Volterra competition models

II.2.2. Some basic facts about systems of linear differential equations

II.2.3. Oscillations in predator-prey models

II.2.4. Hopf bifurcations and Poincare-Bendixson theory

II.2.5. Oscialltory dynamics in chemical reactions

II.2.6. Excitability and oscillations in neurophysiological models

Examples discussed in Part II include: logistic population growth, gene regulation, competition between chemical and biological species, predator-prey models, chemical reactions, neurophysiology

Part III: Biological processes in continuous time and space: partial differential equations

III.1. Diffusion

III.1.1. The conservation equation

III.1.2. The diffusion equation

III.1.3. Dispersal and random movement in population models

III.1.4. Travelling waves

(**III.2. Pattern formation**)