m 5740. Mathematical Modeling: Preliminary Syllabus

Andrej Cherkaev. Spring 2013, JWB 208, MWF 9:40 - 10:30

1. Introduction. Principles of modeling. Great Model of the Universe.

   Paper. From observations and assumptions to equations.

   Project . How to split the class in several working groups

2. Growth and interaction of species. Population dynamics. Epidemic spread.

   Project a. Model of population dynamics after Marsian invasion.

   Project b. Model of epidemic disease and vaccination.

   Project c. PDE Model of population dynamics.

3. Wave model. Traffic: shock waves, stabilization factors. (Richard Haberman)

   Paper. Simulation of a traffic jam.

4. Modeling of conflicts: Games

   Project a. Best strategy, minimax

   Project b. How to fairly share a bounty. Cooperative games

   Project c. Models of social behavior. Evolutionary games.

5. Modeling using graphs

   Project a. Shortest path, Maximum flow.

   Project b. Transport problem

6. Model of shapes, smooth, space-fitting and fractal curves.

   Project: Quantify gerrymandering

7. Lattice models of complicated structures. Metamaterials

   Project. Shape changing active material.