MATH/BIOL/EECS 319 & BIOL/PHOL 419
Applied Probability and Stochastic Processes for Biology
Peter Thomas, Instructor
Fall 2008

Project Instructions

The course requires two projects. You will use numerical and analytic means to investigate a biological or biochemical system in which stochastic fluctuations influence its dynamical behavior. Examples could include: extending a standard differential-equations based model (such as the predator-prey equations) to include appropriate noise effects; simulating a stochastic version of the Hodgkin-Huxley action potential reflecting the activation and inactivation of individual ion channel subunits; comparing the dynamics of a simple autocatalytic chemical system, e.g. E+S<-->ES-->2 E; studying the sensitivity of a system of differential equations near a bifurcation point to noise applied to different variables; devising a stochastic model for the branching structure of a nerve cell's dendrites; or modeling a probabilistic measurement process such as genotyping malaria samples.

I encourage you to discuss your project ideas with me as you write them up. Your one-page proposal should include a paragraph about the background and motivation for your proposed work, references to the literature that will inform your modeling efforts, a description of the method(s) to be used, and a discussion of the results you hope to establish. The first project should be a simple, self-contained "warm-up"; the second project can build on the first or can go in a different direction. If you have access to experimental data that relates to your model I encourage you to incorporate comparisons and discussion of the data in your writeup as well. Students may work together in pairs or solo. In the case of team projects, care should be taken to identify individual contributions.

The project writeups should be organized along the lines of a standard research paper, including the following elements:

Introduction (background and motivation)
Methods (detail your computational and mathematical methods)
Results (including figures with appropriate captions, labels etc.)
Conclusions and Discussion (put the work in context, refer back to the original goals, outline future directions if relevant).
References

The total length should be 5-10 pages for the first project (5 is plenty!) and for the second project, 15-20, including figures and references.

Depending on the course schedule, there may be time for presentations, particularly for the second project. We will discuss this option in the second half of the semester.

Course:___________ Student(s):________________________ Date:______________

Grading Rubric for Student Projects

The project is worth up to 30 points, total.
Projects with presentations are worth 40, with the presentation worth 10 points.
Each of the six items below is worth up to five points.

Substance:

1. (5 pts) **Background or Introduction**
Is the problem motivated convincingly?
Is it described clearly?
Are the relevant equations derived appropriately?

2. (5 pts) **Methods**
Are the numerical and/or analytic methods described clearly, correctly and in sufficient detail?
(Numerical)
(Analytic)

3. (5 pts) **Results**
Are the results significant (given the level expected for the project)?
Are diagrams or figures (if any) clearly labeled and explained?
Are the results presented clearly?

4. (5 pts) **Conclusions**
What is the broader significance of the results?
Did the results turn out as expected?
Did the project members arrive at any new insights?
Do the conclusions follow from the results presented?

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Style:

5. (5 pts) **Composition**
Is the report written in clear English prose with correct grammar, spelling, punctuation and so on?

6. (5 pts) **Overall**
Does the narrative form a coherent whole? Is it organized? Does the report read well?
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