Simulation Analysis of Forest Ecosystems (3 credits)

FOR 6156

Lectures and Discussion: MWF 8.30 – 9.20 am, Frazier-Rogers Hall 129.

Instructors:

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Office Hours: After class or by appointment. See us for help with programming, homework and projects. Email questions and programs.

Course Description

This course is designed to explore the conceptual basis, evaluation, implementation, testing, and analysis of forest and tree simulation models. Each student will develop and present a modeling project based on their research or other approved topics.

Course is Designed For: Graduate Students

Prerequisites: Undergraduate course(s) in ecology, plant physiology. Ability to use Algebra.

Course Resources:

Books (recommended) :

Modeling Biological Systems. Principles and Applications. J. W. Haefner. 1996. Chapman and Hall, NY. 473 pp.

Python programming books:

Learning Python. Mark Lutz, David Ascher. 1999. O'Reilly and Associates, Inc. 366 pp. OR

How to Think Like a Computer Scientist. Learning with Python. 2002. A.Downey, et. Al. Green Tea Press. Wellesley, Mass. (pdf)

Gauld, A. Learning to program. http://www.alan-g.me.uk/l2p/

Python Programs: example programs provided that illustrate each topic

Web Resources:

http://www.python.org/ (free download of Python for windows, mac, and Unix); Tutorials

https://www.anaconda.com/distribution/ (download of Anaconda, an open source (free) platform for Python, recommended for this course)

https://docs.anaconda.com/anaconda/ (explanation of Anaconda products)

https://en.wikibooks.org/wiki/Non-Programmer%27s_Tutorial_for_Python_3

http://sourceforge.net/projects/numpy (free download of Numerical Python, but note that the download from Anaconda includes NumPy)

http://matplotlib.sourceforge.net/ (free download of Matplotlib, but note that the download from Anaconda includes Matplotlib)

Lecture and Discussion Topics:

Introduction to Modeling.

What is a model?
How are models made?
Testing and Evaluation of models.

Haefner Chapt 1 - 3.
Jorgensen, S.E. 2008. Overview of the model types available for development of ecological models. Ecol. Model. 215:3-9.
Caswell, H. 1988. Theory and models in ecology: A different perspective. Ecological Modelling 43:33-44.

Introduction to Python programming.

complete Python tutorial.
turn in first problem set program.

Introduction to Matrix Algebra and Matrix Models

Tree Population modeling
Forest succession modeling
Landscape Transition (Markov) modeling

Pinard, M. 1993. Biotropica 25(1):2-14
Anderson, P.J. and F.E. Putz 2002. For. Ecol. Manage. 170:271-283.

Cropper, W.P. and D. DiResta. 1999. Ecol. Modelling 118:1-15.
Cropper, W.P. and E.L. Loudermilk. 2006. Ecol. Model. 198:487-494.
Dalva, M., et al. 1999. Ecology 80(8):2635-2650
Acevedo, M.F. et al. 1995. Ecological Applications 5(4):1040-1055
Lytle, D.A. and D.M. Merritt 2004. Ecology 85:2493-2503.
Holm et al. 2008. Biotropica 40:550-558.
Haefner Chapter 13

Some useful functions.

Haefner Chapter 4

Introduction to Numerical Integration.

integration error
Introduction to Stella and Berkeley Madonna
simulation packages.
Introduction to Excel spreadsheet for simulation.

Anderson, R.M. et al. 1981. Nature 289:765-771
Ferguson et al. 2003. Nature 425:681-685
Madden, L.V. et al. 2002. BioScience 52:65-74
Earn, D.J.D. 2000. Science 287:667-670.
Hastings, A. 1993. Annu. Rev. Ecol. Syst. 24:1-33
Harwell et al. 1981. Ecological Modelling 12:105-131

Haefner Chapter 6

Disease Modeling.

Differential equation models
Cellular Automata
Agent-based Individually-Based Models

Ferguson et al. 2006. Nature 442:452
Silk, Matthew J., et al. "Using Social Network Measures in Wildlife Disease Ecology, Epidemiology, and Management." *BioScience* 67.3 (2017): 245-257.

Chaos.

Logistic Map (Difference Equation)
Lorenz Chaos (Differential equations)
Matrix population models (Density-Dependent)

Becks et al. 2005. Nature 435:1226-1229
May 1974. Science 186:645-647.
Haefner Chapter 17

Gap Phase Individual-Based Succession Models.

Examples: Jabowa, Linkages

Haefner p. 338
Post, W.M. and J.Pastor. 1996. Climatic Change 34:253-261
Wyckoff, P.H. and J.S. Clark. 2002. Journal of Ecology 90:604-615.
Liu, J. and Ashton. 1995. Forest Ecology and Management 73:157-175.

Landscape Modeling.

Higgins, S.I., et al. 2000. Ecological Applications 10:1833-1848
Fitz, H.C. et al. 1996. Ecological Modelling 88:263-295
Loudermilk, and Cropper. 2007. Can. J. For. Res. 37:2080-2089
Haefner Chapter 15, 16, and 18

Modeling Plant Competition.

Competition and coexistence - the effects of resource transport and supply rates.

Huston M.A., DeAngelis D.L. 1994. Amer. Nat. 144 (6): 954-977.
Loreau, M. 1998. Proc. Natl. Acad. Sci. 95:5632-5636.

Haefner Chapter 14

Modeling Soil Nitrogen Dynamics and Decomposition.

Nitrification
Denitrification
Mineralization
Uptake

Muller, C. Modelling Soil-Biosphere Interactions.
CABI Publishing. Chapt. 2
Gholz et al. 1985. For. Sci. 31:463-478.
Kruys et al. 2002. Ecol. Applications 12:773-781.
Comerford et al. 2006. Can. J. Soil Sci. 86:665-673.
Allison and Martiny. 2008. PNAS 105:11512-11519.

Biological Inspired Modeling: Neural Nets and Genetic Algorithms

Cropper and Anderson 2004. Ecol. Modelling 177:119-127
Cropper and Comerford 2005. Ecol. Modelling 185:271-281
Lek and Guegan. 1999. Ecol. Modelling 120:65-73.

Haefner Chapters 19 and 20

Modeling Tree Physiology.

assimilation
respiration
transpiration
estimation of parameters

van den Berg, M. et al. 2002. Ecol. Mod. 148:233-250.
Chen, J.M. et al. 1999. Ecol. Mod. 124:99-119.
Friend, A.D. 2001. Global Ecol. Biog. 10:603-619.
Wang, Y.-P. et al. 1998. Global Change Biology 4:797-807
Wang, YP and Jarvis. 1990. Ag. For. Met. 51:257-280.
Cropper, W.P. and Gholz. 1993. Ecol. Mod. 66:231-249
Cropper, W.P. 2000. For. Ecol. Man. 126:201-212.

Course Requirements:

Although collaboration is an important part of science, learning modeling techniques is best done individually. No collaboration (except with the instructor) is expected for the weekly problem sets or modeling project.

Problem sets (25%)

Presentation and leading discussion of published forest modeling paper (25%)

Modeling project and oral presentation. A written report describing objectives, significance, model structure, and results and discussion is due on the last day of class. (50%)

Participation is required; discussions of topics, homework, assigned papers and projects are an essential part of this course.

Grading Scale:

93% - 100% A
90% - 92.9% A-
86% - 89.9% B+
83% - 85.9% B
80% - 82.9% B-
76% - 79.9% C+
73% - 75.9% C
70% - 72.9% C-
60% - 69% D
Below 60% E

UF grading policies:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Minus grades: http://www.isis.ufl.edu/minusgrades.html

Course Policies

Students are expected to attend class, engage in discussion, and submit assignments on time. Problem sets may be revised after initial grading without penalty. A new due date will be assigned for revised problem sets. A 10% late penalty will be assessed for work turned in or presented after the due date. Students must complete a written report of the modeling project, as well as an in class presentation to receive credit for the project. You must receive an A on the project to receive an A for the course.

This syllabus represents current plans and objectives for this course. As the semester progresses, changes may need to be made to accommodate timing, logistics, or to enhance learning. Such changes, communicated clearly, are not unusual and should be expected.

Course evaluations

Student assessments are an important part of efforts to improve teaching and learning.
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/.
Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

University of Florida Policies

Academic Honesty

As a result of completing the registration form at the University of Florida, every student has signed the following statement: "I understand that the University of Florida expects its students to be honest in their academic work. I agree to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University." (See https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/)

UF Counseling Services

Resources are available on campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. These resources include:

Counseling and Wellness Center, 392-1575 (personal and career counseling), http://www.counseling.ufl.edu/cwc;
Student Health Care Center, 301 Peabody Hall, 392-1171 (personal counseling);
Center for Sexual Assault /Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161 ext. 4231 (counseling related to

sexual assault and abuse);
Career Connections Center, Reitz Union, 392-1601
(career development assistance and counseling), http://career.ufl.edu/.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Accommodations for Students With Disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center (0001 Reid Hall, 352-392-8565, https://disability.ufl.edu/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. **Students with disabilities should follow this procedure as early as possible in the semester.**

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html