# ECOL 8910 - PERSPECTIVES IN COMPUTATIONAL ECOLOGY

John M. Drake & Pej Rohani

Spring 2017

## Course Information

**Class time:** MWF 8:00-8:50am

**Location:** Ecology Computer Lab

**Instructors:** Dr. John Drake (Office: 133 Ecology, email: jdrake@uga.edu) & Dr. Pejman (Office: 36 Ecology, email: rohani@uga.edu)

**Course description.** Discussion-based course on computational concepts and methods in ecology. Course format emphasizes practical techniques relevant to research. The Spring 2017 section concerns multiscale dynamics in ecology, evolution, and epidemiology.

**Course objectives.** The student will be introduced to a range of techniques and scientific computing paradigms using the R statistical computing environment. The primary goal of this course is to develop new data analysis skills.

**Assignments and grading policy.** This course is graded on the S/U system. To receive a score of S you must perform satisfactorily on all assignments. Primary class activities include lectures (Mondays), discussion of contemporary literature (Wednesdays), and a class project (Fridays). Each student is expected to lead at least one discussion. Additionally, students are required each week to read one topical paper of their choosing, write a short summary, and post to the class website.

**Class project.** Class projects may be developed individually or in teams. A written proposal (including names of all team members) is due by January 30. A first draft is due March 27. The final paper is due on the last day of classes (April 26) and must be written as a reproducible workflow using R Markdown.

**Late assignment policy.** Paper summaries are due on Wednesdays. Class projects are due by reading day. Late assignments will not be accepted.

**Missed class policy.** Unless permission is obtained in advance or appropriate documentation is received (e.g., doctor's note), the instructor reserves the right to assign a grade of U if more than three classes are missed.

**Office hours & contact policy.** Office hours are by appointment; the primary means for out-of-class contact should be e-mail (jdrake@uga.edu and rohani@uga.edu).

**Reading assignments.** Students are assumed to have a basic understanding of R, equivalent to that in Crawley (2007) or Venables and Ripley (2002). Occasional readings will be assigned as background for lectures. Required and optional readings are listed in the schedule of topics below.

**Official University Policy.** The course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary. All academic work must meet the standards contained in *A Culture of Honesty*. Students are responsible for informing themselves about those standards before performing any academic work.

## Schedule of topics

| Week | Topic | Readings | Lecturer |
|---|---|---|---|
| Jan 2 | Syllabus | | |
| Jan 9 | What is multiscale modeling? | Meier-Schellersheim, Fraser, and Klauschen (2009) | |
| Jan 23 | Deriving transmissibility | Begon et al. (2002) | Rohani |
| Jan 30 | Within and between-host transmission | Mideo, Alizon, and Day (2008) | Drake |
| Feb 6 | Mean field theory | Black and McKane (2012) | Drake |
| Feb 13 | Coupled map lattice models | Earn, Levin, and Rohani (2000) | Rohani |
| Feb 20 | Heterogeneous environments | Melbourne and Chesson (2005) | Drake |
| Feb 27 | Slow-fast dynamics | Rinaldi and Scheffer (2000) | Drake |
| Mar 13 | Moment closure techniques | Keeling (2000) | Rohani |
| Mar 20 | Evolutionary consequences of spiral waves | Boerlijst, Lamers, and Hogeweg (1993) | Rohani |
| Mar 27 | Pattern formation | Klausmeier (1999) | Drake |
| Apr 3 | Integro-difference models | Kot, Lewis, and Driessche (1996) | Drake |
| Apr 10 | Multiple infections | Sofonea, Alizon, and Michalakis (2015) | Rohani |
| Apr 17 | Projects | | |
| Apr 24 | Projects | | |

## Readings


Begon, M., M. Bennett, R. G. Bowers, N. P. French, S. M. Hazel, and J. Turner. 2002. "A clarification of transmission terms in host-microparasite models: numbers, densities and areas." *Epidemiology and Infection* 129 (01). Cambridge University Press: 147–53. doi:10.1017/S0950268802007148.

Black, Andrew J., and Alan J. McKane. 2012. "Stochastic formulation of ecological models and their applications." *Trends in Ecology & Evolution* 27 (6): 337–45. doi:10.1016/j.tree.2012.01.014.

Boerlijst, Maarten C., Marcel E. Lamers, and Pauline Hogeweg. 1993. "Evolutionary Consequences of Spiral Waves in a Host–Parasitoid System." *Proceedings of the Royal Society of London B: Biological Sciences* 253 (1336).

Crawley, Michael J. 2007. *The R Book*. Wiley-Blackwell. doi:10.1002/9780470515075.

Earn, David J. D., Simon A. Levin, and Pejman Rohani. 2000. "Coherence and Conservation." *Science* 290 (5495).

Keeling, Matt J. 2000. "Metapopulation moments: coupling, stochasticity and persistence." *Journal of Animal Ecology* 69 (5). Blackwell Science Ltd: 725–36. doi:10.1046/j.1365-2656.2000.00430.x.

Klausmeier, Christopher A. 1999. "Regular and Irregular Patterns in Semiarid Vegetation." *Science* 284 (5421).

Kot, Mark, Mark A. Lewis, and P. van den Driessche. 1996. "Dispersal Data and the Spread of Invading Organisms." *Ecology* 77 (7). Ecological Society of America: 2027–42. doi:10.2307/2265698.

Meier-Schellersheim, Martin, Iain D. C. Fraser, and Frederick Klauschen. 2009. "Multiscale modeling for biologists." *Wiley Interdisciplinary Reviews: Systems Biology and Medicine* 1 (1). John Wiley & Sons, Inc.: 4–14. doi:10.1002/wsbm.33.

Melbourne, Brett A., and Peter Chesson. 2005. "Scaling up population dynamics: integrating theory and data." *Oecologia* 145 (2). Springer-Verlag: 178–86. doi:10.1007/s00442-005-0058-8.

Mideo, Nicole, Samuel Alizon, and Troy Day. 2008. "Linking within- and between-host dynamics in the evolutionary epidemiology of infectious diseases." *Trends in Ecology & Evolution* 23 (9): 511–17. doi:10.1016/j.tree.2008.05.009.

Rinaldi, Sergio, and Marten Scheffer. 2000. "Geometric Analysis of Ecological Models with Slow and Fast Processes." *Ecosystems* 3 (6). Springer-Verlag: 507–21. doi:10.1007/s100210000045.

Sofonea, Mircea T., Samuel Alizon, and Yannis Michalakis. 2015. "From within-host interactions to epidemiological competition: a general model for multiple infections." *Philosophical Transactions of the Royal Society of London B:*

*Biological Sciences* 370 (1675).

Venables, W N, and B D Ripley. 2002. *Modern Applied Statistics with S*. Springer New York. doi:10.1007/978-0-387-21706-2.