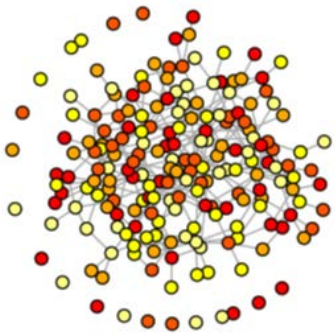

Impact through Networks

PLP 6701

2 credit hours

Class meetings: Tuesday and Thursday, Period 5 (11:45-12:35), 2564 Fifield Hall

Fall semester 2019, and alternate years

Prerequisites

There are no specific prerequisites.

It will be helpful to have general knowledge of agricultural, ecological, or epidemiological systems, and experience from graduate or advanced undergraduate courses applying quantitative concepts and tools (such as courses addressing statistics, mathematics, or engineering)

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Course materials access: http://elearning.ufl.edu/

Office hours

By appointment in advance, 2-4 Tuesday and 3-5 Wednesday, or additional times as needed

Course overview

Outcomes in systems such as agriculture, natural ecosystems, and health care are often determined by processes that act through networks. Networks can describe the

spread of pathogens, invasive species, consumer goods, ideas, and technologies. Networks can also describe associations, interactions, and transactions among people, species, and other agents. This course addresses how to analyze the impact of system changes in networks, such as the introduction of new species or new management techniques. This course provides an introduction to network science in the R programming environment, and a review of applications in biological and social sciences, including current methods used to evaluate impact. The course includes a combination of lectures to provide background information, discussion of current literature, computational analysis workshops to illustrate concepts, and individual projects to allow participants to apply ideas to systems that particularly interest them.

The course emphasizes concepts and use of existing tools, while at the same time it will offer a basis for the development of new tools for participants interested in further steps.

Course learning objectives

Participants who have completed this course will be able to…

- ❖ explain how networks are defined and applied in agriculture, ecology, and epidemiology
- ❖ explain basic principles of impact analysis in these systems
- ❖ identify and discuss key points in journal articles describing networks in these systems
- ❖ evaluate dynamic networks and study processes in networks
- ❖ collect data for characterizing networks that enable testing the fit of network models
- ❖ apply network analysis to ask questions about their own systems using R

Course outline (***as of 15 August 2019 – subject to minor changes***)

Course assignments to be turned in or presented by students are indicated in bold

	Tues: often a short lecture and discussion of a paper	**Thurs**: often a short lecture and a workshop for network analysis in R
Aug 20, 22	First class: Course overview, and examples of what can be done with skills from this class	Intro to R, Part 1
Aug 27, 29	Intro to R, Part 2	Intro to networks and matrices in R (**quiz**)
Sept 3, 5	Networks and adjacency matrices Epidemic networks, Part 1	Describing nodes in R (**quiz**)
Sept 10, 12	Microbiome networks	Visualizing and describing networks in R, Part 1 (**quiz**)
Sept 17, 19	Networks of association in R	Visualizing and describing networks in R, Part 2 (**quiz**)
Sept 24, 26	Epidemic networks, Part 2	Networks and meta-populations in landscapes (**quiz**)

Oct 1, 3	Gene networks	Preparing project proposals Bayesian networks in R (**quiz**)
Oct 8, 10	Statistical models of networks in R Impact assessment	Mathematical models of networks in R, part 1 (**quiz**)
Oct 15, 17	Survey of other network types ('omics, economics, ecology, communication, etc.)	Mathematical models of networks in R, part 2 (**quiz**)
Oct 22, 24	Multilayer networks	Multilayer networks in R (**quiz**)
Oct 29, 31	**Proposal presentations**	**Proposal presentations**
Nov 5, 7	Social networks Value of information	Exponential random graph models (ERGMs) in R (**quiz**)
Nov 12, 14	Processes in networks	Simulating network scenarios in R (**quiz**)
Nov 19, 21	***Paper discussion***	***Paper discussion***
Nov 26, 28	***Paper discussion***	***---- Thanksgiving vacation***
Dec 3	***Paper discussion***	
Finals week	**Final project presentations**	

Grading

10% Class discussions
20% Weekly quizzes and assignments
30% Project proposal
10% Journal article presentation and discussion
30% Final project

Class discussions. When scientific papers are discussed, all participants will be expected to contribute to the discussion (even when not leading the discussion). When project proposals are presented, all participants are expected to contribute feedback for the projects. Discussions are evaluated based on a course rubric for contributing to discussions.

Brief quizzes covering recent course topics are given most weeks, to help participants keep up with the course material. The lowest three quiz scores will be dropped from the grade.

The project proposal will give students an opportunity to show how they can apply the course concepts and tools to an area of particular interest to them. The project proposal is presented in class (approximately 10 minutes per student, depending on course enrollment), and covers a topic of particular interest to an individual student,

drawing on course material about network analysis. The project proposal outlines the analysis that the student will later present as the final project. The project proposal is evaluated based on a course rubric for proposal presentation.

Each participant will lead or co-lead a journal article discussion for the group. The discussion is evaluated based on a course rubric for leading article discussions.

Final projects will be presented and discussed in the class (approximately 20 minutes per student, depending on course enrollment). The final project builds on the material presented in the project proposal, including analyses of real data or simulated data provided for students to analyze when appropriate real data are not yet available. (For example, if a student is planning to collect a particular type of data in future semesters, the student could temporarily work with a similar simulated data set for purposes of this class project.) The final project is evaluated based on a course rubric for project presentation.

If the grade on an assignment appears incorrect, the process for requesting reconsideration of the grade is to prepare a written statement describing where the error lies, to be turned into the instructor within one week of receiving the grade.

Grades and Grade Points: For information on current UF policies for assigning grade points, see
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Grading scale: 94-100 A; 90-93.99 A-; 87-89.99 B+; 84-86.99 B; 80-83.99 B-; 77-79.99 C+; 74-76.99 C; 70-73.99 C-; 67-69.99 D+; 64-66.99 D; 60-63.99 D-; 0-59.99 E

Required course materials

There is no required textbook for this course. Journal articles for discussion will be provided to the class. The journal articles will be chosen in discussion with the participants who will be leading discussions, to represent the range of topics in the schedule above.

Examples of review articles and original research articles for discussion include the following:

Agler et al. 2016. Microbial hub taxa link host and abiotic factors to plant microbiome variation. PLOS Biology 14:e1002352.

Bensimon et al. 2012. Mass spectrometry-based proteomics and network biology. Annual Review of Biochemistry 81:379-405.

Chadès et al. 2011. General rules for managing and surveying networks of pests, diseases, and endangered species. PNAS 108:8323-8328.

Cumming and Peterson. 2017. Unifying research on social-ecological resilience and collapse. Trends in Ecology & Evolution 32:695-813.

Dormann et al. 2017. Identifying causes of patterns in ecological networks: Opportunities and limitations. Annual Review of Ecology, Evolution, and Systematics 48:559-584.

Garrett et al. 2018. Network analysis: A systems framework to address grand challenges in plant pathology. Annual Review of Phytopathology 56:559-580.

Henry and Vollan. 2014. Networks and the challenge of sustainable development. Annual Review of Environment and Resources 39:583-610.

Luke and Harris. 2007. Network analysis in public health: History, methods, and applications. Annual Review of Public Health 28:69-93.

Luke and Stamatakis. 2012. Systems science methods in public health: Dynamics, networks, and agents. Annual Review of Public Health 33:357-376.

Shaw and Pautasso. 2014. Networks and plant disease management: Concepts and applications. Annual Review of Phytopathology 52:477-493.

Shi et al. 2016. The interconnected rhizosphere: High network complexity dominates rhizosphere assemblages. Ecology Letters 19:926-936.

Tylianakis and Morris. 2017. Ecological networks across environmental gradients. Annual Review of Ecology, Evolution, and Systematics 48:25-48.

Good references

For network analysis in R, both of the following books are good references. It's recommended that course participants use at least one of these two books as a reference.

1. This one takes more of a statistical perspective, with more careful mathematical definitions and denser information:

Kolaczyk and Csárdi. 2014. Statistical Analysis of Network Data with R. Springer.

2. Luke has a lot of experience in public health applications, and writes more toward non-statisticians:

Luke. 2015. A User's Guide to Network Analysis in R. Springer.

Participants might be interested in the following book for reference, which provides much more information about general network applications than will be covered in this course:

Newman. 2010. Networks: An Introduction. Oxford University Press.

The following is a good reference on social networks, authored by UF's own Jeffrey C. Johnson:

Borgatti, Everett, and Johnson. 2013. Analyzing Social Networks. Sage Publications.

A good reference for data science in R is the following, with a lot of good information available at http://r4ds.had.co.nz/

Wickham & Grolemund. 2017. R for Data Science. O'Reilly.

A good general reference for R with many examples of statistical analysis:

Crawley. 2012. The R Book. Wiley.

Garrett's teaching philosophy

I think of teaching as a process that occurs in a network (of course). An individual could create a pretty good learning experience by finding a good set of books and papers on a topic, and trying out some R code on their own. However, this course is designed to offer a fuller experience and more efficient learning by linking participants to key literature, to relevant R packages, and to each other and the instructors through discussions and feedback. Engaging with a group of people interested in a topic can also be a lot of fun and boost creativity.

The course is designed to support participants in engaging with projects, rather than emphasizing testing. The quizzes are intended to provide some structure to help keep participants up to date and engaged in the discussions. Most of the course activities will engage knowledge and creativity in developing projects. The teachers will work to help each student develop a project that they will find useful in their current or future research.

Attendance and make-up policies

This is a synchronous course, to make the most of interactions among participants. Discussion among course participants is an important part of the learning experience, so attendance is required. Three course meetings can be missed without explanation (with the exception of dates when the participant has a particular responsibility, such as leading discussions or presenting). Please alert the instructors if there is a serious health problem or other emergency.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Accommodations for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, **www.dso.ufl.edu/drc/**

On-line evaluation of courses

UF Policy: Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. These evaluations are conducted online at https://evaluations.ufl.edu. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.

Materials and supplies fees

None

UF Policy on Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.” You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to

appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

UF Policy on 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.

Campus helping resources

Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/
    - Counseling Services
    - Groups and Workshops
    - Outreach and Consultation
    - Self-Help Library
    - Training Programs
    - Community Provider Database
- U Matter We Care, www.umatter.ufl.edu/
- Career Connections Center, First Floor JWRU, 392-1601, https://career.ufl.edu/

Student complaints

If there is an issue in the course, please bring it to the instructor's attention. UF policies about more serious complaints are described in these documents.

- Residential Course: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf
- Online Course: http://www.distance.ufl.edu/student-complaint-process