MAT 6932 (Section 6566): Seminar in Biomath

Infectious disease and economic growth modeling

Course, class meetings and instructor information

Term	Fall 2018
Course	MAT6932
Section	6566
Credits	3
Days	Monday, Wednesday, Friday
Period	5
Time	11:45 am - 12:35 pm
Venue	LIT 223

Instructor	Calistus Ngonghala
Telephone	(352) 294-2335
Email	*calistusnn@ufl.edu*
Office	LIT 468
Office hours	1) Monday: 10:40-11:30 (4th period) 2) Wednesday: 10:40-11:30 (4th period) 3) Friday: 10:40-11:30 (4th period) 4) By appointment

Course webpage: https://people.clas.ufl.edu/calistusnn/courses/mat_6932_seminar_in_biomath/

Remark: *Don't feel constrained by the scheduled office hours. You are welcome to drop in or contact me by phone or e-mail for an appointment.*

Reading material

- Useful papers or links to useful papers will be provided in class. Although, it might not be mandatory to buy the textbooks below, students might find them useful for the course.
- M. J. Keeling and P. Rohani. Infectious diseases in humans and animals (Princeton University Press, 2008)
- R. M. Anderson and R. M. May. Infectious diseases of humans. Dynamics and Control (Oxford University Press, 1991)
- C. I. Jones and D. Vollrath. Introduction to economic growth (W. W. Norton & Company Inc., 2013)

Pre-requisites

Knowledge of nonlinear dynamical systems, basic statistics, and a programming language (MATLAB, R, Mathematica, Maple, C, C++, Python, etc.) will be useful.

Course Description

Infectious diseases are among the oldest natural enemies of humans. Using mathematical models to understand infectious disease dynamics and to inform disease control measures and the socio-economic impacts of infectious diseases on human populations is attracting much attention in public health, the epidemiological, ecological, immunological, medical, and social sciences. For example, mathematical models have been used in planning for and predicting outbreaks, understanding the impacts of outbreaks on populations, predicting the effects of disease mitigation measures, and in the design and implementation of better disease control strategies.

MAT6932 (Seminar in Biomath) is a 3 credit hours graduate-level course in infectious disease and economic development modeling that introduces students to 1) empirical and theoretical concepts of infectious diseases and 2) the methods and applications of infectious disease modeling from an epidemiological and socio-economic perspective. Examples, to include real-time disease outbreaks, will be drawn from directly and indirectly transmitted diseases. Specific topics will include review of basic mathematical concepts, introduction to infectious diseases and data, deterministic, stochastic, network, and agent-based models, parameter estimation and alternative approaches to model fitting, sensitivity analysis, model selection and identifiability, model evaluation, economic growth theory, coupled disease-economic systems, and formulation of research questions. The course will be broken into class lectures, presentations by students, and computer laboratory or tutorial sessions. The course also has a project component.

Course Objectives

Introduce students to infectious diseases and infectious disease models, relate infectious disease models to real-world disease data and integrate infectious disease and economic growth models in a meaningful way to address real-world questions in the ecological and social sciences. Students will use differential equation and stochastic models, as well as numerical techniques to investigate disease outbreak and control, interactions between infectious diseases and economic growth and infer possible intervention measures from the analyses of the models.

By the end of the course, students will be able to develop, analyze, and interpret the results of infectious disease models, analyze and interpret infectious disease data, use mathematical models to predict the effects of disease control measures, explore interactions between infectious diseases and economic development, and formulate and pursue important questions in infectious disease epidemiology and/or health economics.

Course outline

1. Review of useful mathematical concepts
    (a) Basic concepts from linear algebra, e.g., matrices, eigenvalues, eigenvectors, etc.
    (b) Review of ordinary differential equations
    (c) Review of equilibria, stability analysis and bifurcation theory
    (d) Gillespie Algorithm
2. Introduction
    (a) Introduction to infectious diseases and data
    (b) Introduction to mathematical modeling of infectious diseases
        i. directly transmissted diseases
        ii. indirectly transmitted diseases
3. Epidemiological models
    (a) The basic reproduction number
    (b) deterministic models
    (c) Stochastic models
    (d) Metapopulation models
    (e) Network models
    (f) Individual-based models
4. Other types of infectious disease models
5. (a) Local and global sensitivty analyses
    (b) Alternative model fitting approaches
    (c) Model evaluation
6. Introduction to economic growth theory
7. Coupled infectious disease economic growth models
8. Formulating research questions

Course Policies/Procedures

Student responsibilities
Students are expected to attend and play an active role in all class meetings. Please, do not hesitate to ask questions or seek additional assistance to ensure that you are staying on pace with the class.

Assessment
Students will be evaluated through in-class presentations, homework, and a project. Students are welcome to suggest their own projects or request for projects from the instructor. The pupose of the project will be to apply the concepts learned in class directly to real-world problems.

Grading and Grade Scale

Assessment item	Points
Presentations	100
Homework	120
Project	150
Attendance	30
Total	**400**

Grade	Range
A	360-400
B	320-359
C	280-319
D	240-279
E	000-239

Academic Honesty: Students should familiarize themselves with the University's Code of Conduct (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) and the university's policy on academic honesty, which may be found in the University of Florida Rules, 6C1-4.

Student Evaluation: Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.

In addition to the final evaluation, I encourage students to furnish me with feedback, either in person, by voice mail, by email, through a note left under my office door (LIT 468), etc., throughout the semester. I look forward to reading your constructive and objective comments.

Special Accommodations: Students requesting classroom accommodations or special arrangements during examinations must first register with the Dean of Students Office (352-392-8565, www.dso.ufl.edu/drc/). The Dean of Students Office will provide documentation. The student must then make arrangements with the instructor to meet the requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

U Matter We Care Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu, so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 911.