Spring 2015

PUBH 7090 A - Selected Topics in Public Health: Advanced Infectious Disease Epidemiology

Isaac Chun-Hai Fung
Georgia Southern University, Jiann-Ping Hsu College of Public Health, cfung@georgiasouthern.edu

Georgia Southern University
Jiann-Ping Hsu College of Public Health
PUBH 7090-A – Selected Topics in Public Health:
Advanced Infectious Disease Epidemiology (3 credits)
Spring 2015

Instructor:	Isaac Chun Hai Fung, Ph.D.
Office:	Hendricks Hall, 2029.
Phone:	912.478.5079
E-Mail Address:	cfung@georgiasouthern.edu
Office Hours:	Wednesday – 1.00pm to 6.00pm (Spring semester, 2015); Appointments are highly recommended
Class Meets:	Thursday 2pm – 4.45pm, at [classroom to be confirmed].

DRAFT SYLLABUS: UPDATED as of February 11, 2015. Subject to further changes.

Disclaimer: Class schedule and module contents may be subject to changes during the semester. Students should attend classes and pay attention to any announcements given by the instructor.

Prerequisites: EPID 7135 Epidemiology of Infectious Disease or equivalent or permission from the instructor.

(Proposed) Catalog Description:

This course covers the use of mathematical and computational approaches to study infectious diseases. We will discuss models that address both the dynamics of infectious disease spread through populations and the dynamics of pathogens inside an infected individual. Students will learn how to build and analyze models for a variety of human and animal diseases. We will look at the impact of interventions on disease outcomes. Students will learn how to interpret results of modeling studies to make informed public health policy decisions.

Required Textbook:

Emilia Vynnycky and Richard G. White (2010). **An Introduction to Infectious Disease Modelling**. Oxford and New York: Oxford University Press. ISBN: 978-0-19-856576-5.

Required Software / Programming Language:

The **R** software is freely available at http://cran.r-project.org/ (for Windows, Mac or Linux).

R Studio is a free and open source integrated development environment for R. It is freely available at http://www.rstudio.com/.

JPHCOPH MPH Program Core Student Learning Outcomes:

At the completion of this program the student will be able to:

1. Demonstrate proficiency and effectiveness in the communication of core public health principles and practices, both oral and written.
2. Demonstrate proficiency in the integration of the core public health disciplines (Biostatistics, Epidemiology, Environmental Health, Health Policy/Management, and Social/Behavioral Science) in practice and research.
3. Demonstrate proficiency in problem solving, critical thinking, and public health leadership.

Epidemiology Concentration Student Learning Outcomes:

At the completion of this program the student will be able to:

1. Formulate population-based hypotheses and develop appropriate research designs to test these hypotheses.
2. Collect, analyze, and interpret data derived from population-based research.
3. Create and implement public health surveillance systems for population-based studies.
4. Recommend evidence-based interventions and control measures in response to epidemiologic findings.
5. Communicate epidemiologic principles and concepts to lay and professional audiences through both oral and written communication.

Course Learning Objectives:

At the completion of this course the student will be able to:

1. Understand the methods and approaches to building mathematical models of infectious diseases (Core activity #1) – Core 3; EPID 1,2
2. Understand how to interpret the results and limitations of mathematical modeling studies (Core activity #2) – Core 3; EPID 3
3. Identify research questions that can be addressed with mathematical modeling methods and choose an appropriate model type for a particular question (Core activity #3) – Core 3; EPID 1
4. Interpret and critique mathematical models of infectious diseases published in the scientific literature (Core activity #4) – Core 3; EPID 3
5. Discuss the practical applications of mathematical modeling, and the role of mathematical modeling in public health policy (Core activity #5) – Core 1,2; EPID 3,4,5

Instructional Methods:

Class meetings will be a combination of lecture and practicals. Homework assignments, participation in lectures and practicals, and a project constitute the basis of student evaluation. Students will be taught creating mathematical models in R and Excel.

Exam Schedule:

No examination will be given. In place of an examination, there will be a project.

<u>Assignments:</u>

Given the small size of the class, students work as one group.

<u>Comprehensive review of published mathematical models of an infectious disease (40% of Final Grade)</u>

Each group will be assigned a topic for a comprehensive review. Students are expected to systematically search for relevant papers, screen them and extract relevant information therein. The review should compare and contrast published mathematical models of infectious disease dynamics (either at the population level, or at the within-host level), in terms of their aims/objectives, their model strategies/structures and their parameter values.

An example of a review paper of mathematical models of infectious diseases is: Isaac Chun-Hai Fung (2014)**.** Cholera transmission dynamic models for public health practitioners. *Emerging Themes in Epidemiology.* 11:1. DOI:10.1186/1742-7622-11-1

Course Objectives: 1-5.

<u>Interview individuals on the use of mathematical models in public health (20% of Final Grade)</u>

The instructor will put the students in touch with 2 or 3 modelers who work in the field of public health. The student will interview them (via Skype or Google Hangout, for example) on their experiences of working as a modeler in public health. If the interviewee consents, the students can record the interview.

The goal of this exercise is to provide the students with better ideas of the real-use of models in public health, as well as the human experiences of working as a modeler in public health. This will also serve as a networking opportunity for the students.

Course Objectives: 5.

<u>Practicals and Modeling mini-project (30% of Final Grade)</u>

In-class practicals are created to enhance the understanding of the materials delivered in the lectures, and to provide opportunities to practise programming in R. Eventually, students will be able to create a simple model of their own (mini-project) for a given infectious disease and program it in R. The deliverable will be the R code and a written report.

Course Objectives: 1-5.

<u>Final Powerpoint presentation (10% of Final Grade)</u>

Students are expected to give a powerpoint presentation of around 30 minutes.

Course Objectives: 1-5.

Grading:

Weighting of assignments for purposes of grading will be as follows:

Comprehensive review of models	………………………………	40%
Interviews of modelers	………………………………	20%
Practicals and Modeling mini-project	………………………………	30%
Powerpoint presentation	………………………………	10%

The following point scale will be utilized in grading:

- A: 90- 100%
- B: 80% - 89.9%
- C: 70% - 79.9%
- D: 60% - 69.9%
- F: < 60.0%

All assignments will be graded and returned promptly so that students may accurately calculate their grades at any point in time during the semester.

Due time:

Electronic copies of assignments are due at 2pm on the due date (normally Thursday). Paper copies of assignments are due to be submitted in person to the instructor at 2pm (in class).

Late submission:

Reduction of 5% for every 24 hours. For example, for an assignment that is due on Thursday at noon, if someone submits it on the coming Saturday at 11.59am, then:

Final Grade = Grade * 90%

There are times when extraordinary circumstances occur (e.g., serious illness, death in the family, etc.). In such circumstances, please consult with the instructor within a reasonable amount of time. The instructor will consult the college administrators and verify the reported circumstances before any exemptions or extensions can be granted.

Nota Bene: Extensions are not guaranteed and will be granted solely at the discretion of the instructor.

Extra credit:

Students may earn extra credit by attending the Disease Dynamics Seminars that are held outside class time (1% of the Final Grade per seminar). Students who are unable to attend the seminars may submit a brief summary of the speaker's designated paper (or powerpoint; according to the specific instructions given by the instructor) in lieu of attendance and earn the extra credit.

For details about the Disease Dynamics Seminars, please visit:
https://sites.google.com/a/georgiasouthern.edu/fung/disease-dynamics-seminars

Academic Misconduct:

As a student registered at this University, it is expected that you will adhere to only the strictest standards of conduct. It is recommended that you review the latest edition of the *Student Conduct Code* book, as well as the latest *Undergraduate & Graduate Catalog* to familiarize yourself with the University's policies in this regard. Your continued enrollment in this course is an implied contract between you and the instructor on this issue; from this point forward, it is assumed that you will conduct yourself appropriately.

Academic integrity relates to the appropriate use of intellectual property. The syllabus, lecture notes, and all materials presented and/or distributed during this course are protected by copyright law. Students are authorized to take notes in class, but that authorization extends only to making one set of notes for personal (and no other) use. As such, students are not authorized to sell, license, commercially publish, distribute, transmit, display, or record notes in or from class without the express written permission of the instructor.

Plagiarism:

According to the Academic Dishonesty Policy of GSU, plagiarism includes but is not limited to:

A. Directly quoting the words of others without using quotation marks or indented format to identify them.
B. Using published or unpublished sources of information without identifying them.
C. Paraphrasing material or ideas without identifying the source.
D. Unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic material.

If you are accused of plagiarism, the following policy per the Judicial Affairs website (http://students.georgiasouthern.edu/judicial/faculty.htm) will be enforced:

PROCEDURES FOR ADJUDICATING ACADEMIC DISHONESTY CASES

First Offense - In Violation Plea

1. If the professor and the Dean of Students agree that the evidence is sufficient to warrant a charge of academic dishonesty, the professor should contact the Office of Judicial Affairs to determine if this is a first violation of academic dishonesty. The incident will be reported via the following website: http://students.georgiasouthern.edu/judicial/faculty.htm
2. If it is a first violation, the professor should talk with the student about the violation. If the student accepts responsibility in writing and the professor decides to adjudicate the case, the following procedures will be followed:
    a. The student will be placed on disciplinary probation for a minimum of one semester by the Office of Judicial Affairs.
    b. The student will be subject to any academic sanctions imposed by the professor (from receiving a 0 on the assignment to receiving a failing grade in the class).
    c. A copy of all the material involved in the case (Academic Dishonesty Report Form and the Request For Instructor to Adjudicate Form) and a brief statement from the professor concerning the facts of the case and the course syllabus should be mailed to the Office of Judicial Affairs for inclusion in the student's discipline record.

First Offense - Not In Violation Plea (student does not admit the violation)

1. If the professor and the Dean of Students agree that the evidence is sufficient to warrant a charge of academic dishonesty, the professor should contact the Office of Judicial Affairs to determine if this is the first or second violation of academic dishonesty. The student will be charged with academic dishonesty and the University Judicial Board or a University Hearing Officer would hear the case. If the student is found responsible, the following penalty will normally be imposed:
    a. The student will be placed on Disciplinary Probation for a minimum of one semester by the Office of Judicial Affairs.
    b. The student will be subject to any academic sanctions imposed by the professor.

Second Violation of Academic Dishonesty

1. If the professor and the Dean of Students agree that the evidence is sufficient to warrant a charge of academic dishonesty, and if it is determined this is the second violation, the student will be charged with academic dishonesty and the University Judicial Board or a University Hearing Officer would hear the case.
2. If the student is found responsible, the following penalty will normally be imposed:
    a. Suspension for a minimum of one semester or expulsion.
    b. The student will be subject to any academic sanctions imposed by the professor.

NOT RESPONSIBLE FINDING

When a student is found not responsible of academic dishonesty, the work in question (assignment, paper, test, etc.) would be forwarded to the Department Chair. It is the responsibility of the Department Chair to ensure that the work is evaluated by a faculty member other than the individual who brought the charge and, if necessary, submit a final grade to the Registrar. For the protection of the faculty member and the student, the work in question should not be referred back to the faculty member who charged the student with academic dishonesty.

In the case of a Department Chair bringing charges against a student, an administrator at the Dean's level will ensure that the student's work is evaluated in an appropriate manner.

Academic Handbook:
Students are expected to abide by the Academic Handbook, located at http://students.georgiasouthern.edu sta/guide/. Your failure to comply with any part of this Handbook may be a violation and thus, you may receive an F in the course and/or be referred for disciplinary action.

University Calendar for the Semester:
The University Calendar is located with the semester schedule, and can be found at: http://www.georgiasouthern.edu/current.php.

Attendance Policy:

Federal regulations require attendance be verified prior to distribution of financial aid allotments. Regular attendance is expected and will be recorded. *Failure to attend class will negatively impact your participation grade.*

Portfolio Inclusion:

Samples of your work may be reproduced for research purposes and/or inclusion in the professor's teaching portfolio. You have the right to review anything selected for use, and subsequently ask for its removal.

Retaining of Original Work:

All original examinations, papers, etc. may be retained by the instructor for documentation and accreditation purposes. If you wish to obtain a copy of your graded work that has been retained, come by the instructor's office and we will make a copy for your records.

Expectation of hours of work outside class time:

For this course, students are expected to spend **at least 6 hours per week** outside class time, to read their textbooks and other reading materials and to complete their assignments and other required tasks. Some students may need more time, depending on each student's abilities and circumstances.

Office hours:

Students are **highly recommended to make an appointment** with the instructor, even if they plan to meet him during office hours. The instructor may be meeting another student when you arrive at his office. Making appointments allow you to have priority over any students who do not make an appointment. This also allows the efficient use of your time and the instructor's time.

One Final Note:

The contents of this syllabus are as complete and accurate as possible. The instructor reserves the right to make any changes necessary to the syllabus and course material. The instructor will announce any such changes in class. It is the responsibility of the student to know what changes have been made in order to successfully complete the requirements of the course.

DRAFT: Proposed Class Schedule (accurate as of February 11, 2015)

(Subject to potential adjustments during the semester)

Week	Topics	R Practical	Readings
Part I: An Introduction to Mathematical Modeling of Infectious Diseases			
1 Jan 15	**Introduction** Uses of models in public health (Lofgren et al.) Introduction to infectious disease modeling methods (Vynnycky and White) Modeling practice as an inter-disciplinary professional practice (Mattila)	**R: Part 1**	Pre-class reading: May RM (2004). **Uses and abuses of mathematics in biology**. *Science*. 303:790-793 In-class reading and discussion: Lofgren ET et al. (2014) **Opinion: Mathematical models: A keytool for outbreak response.** *PNAS*. 111(51): 18095-18096 After class reading: Vynnycky and White, pp. 1-19. Optional references for sociology of science: Mattila E (2005). **Interdisciplinarity "In the Making": Modeling Infectious Diseases**, *Perspectives on Science*, 13(4): 531-553. Mansnerus E (2009). **The lives of 'facts' in mathematical models: a story of population-level disease transmission of Haemophilus Influenzae Type B bacteria.** *BioSocieties*. 4:207-222. *Other readings may be provided.*
2 Jan 22	**Optional activity: Modeling the Spread and Control of Ebola in West Africa: a rapid response workshop, @ Georgia Tech, Atlanta. Jan 22-23.**		
3 Jan 29	**Short term disease dynamics: Part 1.** The classic epidemic model Difference equations	**R: Part 2**	Vynnycky and White, pp. 19-40 *Other readings may be provided.*
4 Feb 5	**Short term disease dynamics: Part 2.** The classic epidemic model Complications to classic models Growth rate and R0 with random mixing	**R: Part 3**	Vynnycky and White, pp. 41-82 *Other readings may be provided.*
5 Feb 12	**Long term dynamics and use of sero-prevalence data** Properties of classic models Sero-prevalence data and average age of infection	**R: Part 4**	Vynnycky and White, pp. 82-101 *Other readings may be provided.*
6 Feb 19	**Modeling vaccine preventable diseases**	**R: Part 5**	Vynnycky and White, pp. 105-148 *Other readings may be provided.*

	Herd immunity Beneficial and perverse effects of vaccination		
7 Feb 26	**Integrating contact patterns in models** Theoretical and empiric contact pattern structures Age specific transmission Calculating R0 when mixing is not random	**R: Part 6**	Vynnycky and White, pp. 177-222 Mossong J et al. (2008). **Social contacts and mixing patterns relevant to the spread of infectious diseases**. *PLoS Med* 5(3):e74. Eames KTD et al. (2012). **Measured dynamic social contact patterns explain the spread of H1N1v influenza.** *PLoS Comput Biol* 8(3):e1002425. Fung ICH et al. (2015). **Modeling the Effect of School Closures in a Pandemic Scenario: Exploring Two Different Contact Matrices.** *Submitted to a journal*
8 Mar 5	**Modeling sexually transmitted diseases** Sexual mixing patterns		Vynnycky and White, pp. 223-268 *Other readings may be provided.*
9 Mar 12	**Modeling transmission of diarrheal diseases** The environment: what to do with a second transmission route Cholera Typhoid Cryptosporidium		Fung ICH (2014)**. Cholera transmission dynamic models for public health practitioners**. *Emerging Themes in Epidemiology.* 11:1. Bakach I, Just MR […] Gambhir M, Fung ICH (2015) **Mathematical modeling of typhoid fever: a historical perspective**. *Work in progress.* Eisenberg JNS et al. (1998). **An analysis of the Milwaukee Cryptosporidiosis outbreak based on a dynamic model of the infection process**. Epidemiology. 9(3):255-263.
10 Mar 19	**NO CLASS** Spring break: March 16-20		
11 Mar 26	**Modeling vector-borne disease** Ross-Macdonald model of malaria transmission		Smith DL et al. (2012) **Ross, Macdonald, and a Theory for the Dynamics and Control of Mosquito-Transmitted Pathogens.** *PLoS Pathogens* 8(4):e1002588; Reiner RC Jr et al. (2013) **A systematic review of mathematical models of mosquito-borne pathogen transmission: 1970-2010**. *J R Soc Interface*; 10:20120921. Perkins TA et al. (2013) **Heterogeneity,**

			Mixing, and the Spatial Scales of Mosquito-Borne Pathogen Transmission. *PLoS Comput Biol* 9(12): e1003327 Smith DL et al. (2014) **Recasting the theory of mosquito-borne pathogen transmission dynamics and control**. *Trans R Soc Trop Med Hyg* 108:185-197
Mar 27 (Fri)	**Optional – Extra Credit activity: Disease Dynamics Seminar** (12pm-1pm) Speaker: Bishwa Adhikari, PhD, CDC. **"Use of micro-needle patches in measles vaccination program: cost effectiveness analysis"** (Tentative)		
12 Apr 2	**As part of class: GUEST Lecture / Disease Dynamics Seminar** (2pm – 3pm) Speaker: Swati Debroy, PhD, University of South Carolina Beaufort. **"Mathematical models to estimate Underreporting of Visceral Leishmaniasis Deaths in Bihar, India"**		
	Within-host dynamics: HIV		Fung ICH et al. (2010). **Superinfection with a heterologous HIV strain per se does not lead to faster progression**. *Mathematical Biosciences*. 224(1):1-9. Fung ICH et al. (2012). **The Clinical Interpretation of Viral Blips in HIV Patients Receiving Antiviral Treatment: Are We Ready to Infer Poor Adherence?** *Journal of Acquired Immune Deficiency Syndrome (JAIDS)*. 60(1):5-11. *Other readings may be provided.*
Part II: Using Mathematical Models to Make Informed Policy Decisions			
13 Apr 9	**Modeling and policy: HIV (1)**		Garnett GP et al. (2011) **Mathematical models in the evaluation of health programmes.** Lancet 378:515. Blower SM et al. (2000) **A Tale of Two Futures: HIV and Antiretroviral Therapy in San Francisco**. *Science* 287:650-4. Houben RMGJ et al. (2014) **How can mathematical models advance tuberculosis control in high HIV prevalence settings?** *Int J Tuberc Lung Dis* 18(5):509-514. *Other readings may be provided.*
14 Apr 16	**Modeling and policy: HIV (2)** Coupling mathematical modeling with health economics		Fung ICH et al. (2007). **Modelling the impact and cost-effectiveness of the HIV intervention programme amongst commercial sex workers in Ahmedabad, Gujarat, India.** *BMC Public Health*. 7:195.

			Eaton JW et al. (2014) **Health benefits, costs, and cost-effectiveness of earlier eligibility for adult antiretroviral therapy and expanded treatment coverage: a combined analysis of 12 mathematical models**. *Lancet Global Health* 2:e23-34. *Other readings may be provided.*
15 Apr 23	**Modeling and policy: Influenza** Modeling efforts in an emergency response in a public health agency		*Tentative: a series of papers that documents the work of the CDC EOC Modeling Taskforce during the 2013 influenza A(H7N9) outbreak (to be submitted to a journal)*
16 Apr 30	**Modeling and policy: Ebola** *"Found in translation":* How to translate modeling results for policy-makers		Chowell and Nishiura (2014). **Transmission dynamics and control of Ebola virus disease (EVD): A Review**. *BMC Medicine* 12:196; WHO Ebola Response Team (2014). **Ebola Virus Disease in West Africa – The First 9 Months of the Epidemic and Forward Projections**. *NEJM*. DOI:10.1056/NEJMoa1411100; Meltzer MI et al. (2014) **Estimating the Future Number of Cases in the Ebola Epidemic – Liberia and Sierra Leone, 2014-15**. *MMWR*. 63: early release. *Other readings may be provided.* **Students' submission of project manuscript**
17 May 7	**Student presentation and discussion**		**Students' powerpoint presentations**