University of Florida
College of Public Health & Health Professions Syllabus

PHC 6937, section 1836: Analytic Methods for Infectious Diseases

Semester: Spring 2023
Delivery Format: On-Campus

Instructor Name: Ira Longini
Additional Instructors: Tom Hladish, Derek Cummings, Carla Mavian, Matt Hitchings, Mingjin Liu
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Office Hours: : 11:00 am – 12:00 pm, Wednesdays
Preferred Course Communications (e.g., email, office phone): email

Class times and rooms: Tuesdays, Period 8 (3:00-3:50 pm), MAT0119
Thursdays, Periods 8-9 (3:00-3:50 pm, 4:05-4:55 pm), MAT0006

Prerequisites: Biostatistical Methods I and II, Applied Survival Analysis

PURPOSE AND OUTCOME

Course Overview: This course will introduce concepts of infectious disease epidemiology and study designs and analytic methods for evaluating interventions. Especially the relation between the underlying transmission dynamics and the design and evaluation of interventions will be discussed. Special emphasis will be on the design and evaluation of vaccination and vaccination programs. We will present methods for real-time statistical evaluation of interventions of emerging infectious diseases. Statistical and mathematical methods include survival analysis, likelihood methods, stochastic processes, network theory, and stochastic and deterministic transmission models. Examples include case studies in COVID-19, influenza, Ebola, dengue, Zika, cholera, and others. Presentations are largely statistical and mathematical, but with a focus on concepts.

Relation to Program Outcomes

Course Objectives and/or Goals: Upon successful completion of the course, students will be able to analyze infectious disease transmission and control from a mathematical and statistical point of view. In addition, they will be able of design and analyze infectious disease interventions including vaccine trials.

Instructional Methods: Lectures

Required Textbook: Halloran, M.E., Longini, I.M. and Struchiner, C.J.: *The Design and Analysis of Vaccine Studies*. Springer, New York, 387 pp. (2009) ISBN 978-0-387-68636-3.

DESCRIPTION OF COURSE CONTENT, Topical Outline/Course Schedule

Dates	Topic	Professor	Chapter in Halloran, et al.	Additional reading and materials
Jan 10	Introduction	Longini	1, 5	
12	R_0 and deterministic models	Longini	5	Hethcote (1976)
17	Binomial and Stochastic Transmission Model	Longini	4	Longini (2005)
19	Evaluating vaccines	Longini	2, 6, 13	
24	Vaccine action	Longini	7	Longini (1996)
26	Vaccine action	Longini	7	Halloran (1996)
31	Analysis emerging infectious disease threats	Longini		Dean (2019)
Feb 2	Ebola ring vaccine trial in Guinea	Longini		Henao (2015, 2017), Dean (2018)
7	Model design & contact network epidemiology	Hladish		Bansal (2007)
9	EpiFire program	Hladish		Hladish (2012)
14	Percolation with interventions	Hladish		Python tutorial
16	Fitting complex models to data	Hladish		Beaumont (2010)
21	Introduction to phylodynamics for infectious diseases	Mavian		Lemey (2009)
23	Phylodynamics case studies (SARS-Cov-2)	Mavian		Lemey (2014)
28	Selection bias adjustment in infectious disease outbreak data	Mingjin Liu		
March 2	Selection bias adjustment in infectious disease outbreak data	Mingjin Liu		
7	Stochastic models for arboviruses and COVID-19 modeling	Longini		Hladish (2016) Chinazzi (2020)
9	Stochastic models for arboviruses	Longini		Chao (2012)
14, 16	Spring break			
21	Uses of infectious disease modeling in the design of phase of randomized clinical trials	Hitchings		Halloran (2017)
23	Immune landscapes of influenza	Cummings		
28	The design and conduct of serosurveys	Hitchings		WHO (2017)
30	Catalytic models for seroprevalence data	Hitchings		
April 4	Study designs for evaluating vaccine efficacy	Hitchings	13	
6	Study designs for evaluating vaccine efficacy	Hitchings	13	
11	WHO R&D Blueprint to prevent epidemics	Longini		Dean (2019)
13	Combing analysis form individual and cluster randomized vaccine trials	Longini		
18	Transmission and control of cholera	Longini		Huq (2005), Longini (2007)
20	Special topic	Longini		
25	Review of important concepts	Faculty		

For technical support for this class, please contact the UF Help Desk at:

- helpdesk@ufl.edu
- (352) 392-HELP - select option 2
- https://helpdesk.ufl.edu/

Additional Academic Resources

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.

Library Support: Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.

Writing Studio*:* 2215 Turlington Hall*,* 352-846-1138. Help brainstorming, formatting, and writing papers.

Student Complaints On-Campus: Visit the Student Honor Code and Student Conduct Code webpage for more information.

On-Line Students Complaints: View the Distance Learning Student Complaint Process.

ACADEMIC REQUIREMENTS AND GRADING

Assignments

Students will write a single paper based on the knowledge they have gained in the course. Ideally, this will be a research project that they plan to carry out. Alternatively, they give a detailed synopsis of a scientific paper or papers selected by the instructor of the course. This will include an analysis of the methods base on course materials. The paper should be in scientific article format with references, and should be between 6 and 10 single-space pages*.*

Grading

Requirement	Due date	Points or % of final grade (% must sum to 100%)
Individual class project	End of course	100%

Point system used (i.e., how do course points translate into letter grades).

Percentage Earned	Letter Grade
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
Below 60	E

Please be aware that a C- is not an acceptable grade for graduate students. The GPA for graduate students must be 3.0 based on 5000 level courses and above to graduate. A grade of C counts toward a graduate degree only if based on credits in courses numbered 5000 or higher that have been earned with a B+ or higher. In addition, the Bachelor of Health Science and Bachelor of Public Health Programs do not use C- grades.

Letter Grade	Grade Points
A	4.0
A-	3.67
B+	3.33
B	3.0
B-	2.67
C+	2.33
C	2.0
C-	1.67
D+	1.33
D	1.0
D-	0.67
E	0.0
WF	0.0
I	0.0
NG	0.0
S-U	0.0

More information on UF grading policy may be found at:
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades
https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Policy Related to Required Class Attendance

Please note all faculty are bound by the UF policy for excused absences. For information regarding the UF Attendance Policy see the Registrar website for additional details: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Excused absences must be consistent with university policies in the Graduate Catalog (http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance). Additional information can be found here: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

STUDENT EXPECTATIONS, ROLES, AND OPPORTUNITIES FOR INPUT

Expectations Regarding Course Behavior

Students will be expected to participate and contribute to the learning community. Students will not use cell phones or laptops during the lectures.

Communication Guidelines

See http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf

Academic Integrity

Students are expected to act in accordance with the University of Florida policy on academic integrity. 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 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 additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/

http://gradschool.ufl.edu/students/introduction.html

Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

Recording Within the Course:

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Policy Related to Guests Attending Class:

Only registered students are permitted to attend class. However, we recognize that students who are caretakers may face occasional unexpected challenges creating attendance barriers. Therefore, by exception, a department chair or his or her designee (e.g., instructors) may grant a student permission to bring a guest(s) for a total of two class sessions per semester. This is two sessions total across all courses. No further extensions will be granted. Please note that guests are not permitted to attend either cadaver or wet labs. Students are responsible for course material regardless of attendance. For additional information, please review the Classroom Guests of Students policy in its entirety. Link to full policy:
http://facstaff.phhp.ufl.edu/services/resourceguide/getstarted.htm

Online Faculty Course Evaluation Process

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/.

SUPPORT SERVICES

Accommodations for Students with Disabilities

If you require classroom accommodation because of a disability, it is strongly recommended you register with the Dean of Students Office http://www.dso.ufl.edu within the first week of class or as soon as you believe you might be eligible for accommodations. The Dean of Students Office will provide documentation of accommodations to you, which you must then give to me as the instructor of the course to receive accommodations. Please do this as soon as possible after you receive the letter. Students with disabilities should follow this procedure as early as possible in the semester. The College is committed to providing reasonable accommodations to assist students in their coursework.

Counseling and Student Health

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The **Counseling and Wellness Center** 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: http://www.counseling.ufl.edu. On line and in person assistance is available.

- **U Matter We Care** website: http://www.umatter.ufl.edu/. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.

- The **Student Health Care Center** at Shands is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at Shands offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: https://shcc.ufl.edu/

- Crisis intervention is always available 24/7 from: Alachua County Crisis Center: (352) 264-6789

http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx

- **University Police Department**: Visit UF Police Department website or call 352-392-1111 (or 9-1-1 for emergencies).

- **UF Health Shands Emergency Room / Trauma Center**: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the UF Health Emergency Room and Trauma Center website.

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

Inclusive Learning Environment

Public health and health professions are based on the belief in human dignity and on respect for the individual. As we share our personal beliefs inside or outside of the classroom, it is always with the understanding that we value and respect diversity of background, experience, and opinion, where every individual feels valued. We believe in, and promote, openness and tolerance of differences in ethnicity and culture, and we respect differing personal, spiritual, religious and political values. We further believe that celebrating such diversity enriches the quality of the educational experiences we provide our students and enhances our own personal and professional relationships. We embrace The University of Florida's Non-Discrimination Policy, which reads, "The University shall actively promote equal opportunity policies and practices conforming to laws against discrimination. The University is committed to non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information and veteran status as protected under the Vietnam Era Veterans' Readjustment Assistance Act." If you have questions or concerns about your rights and responsibilities for inclusive learning environment, please see your instructor or refer to the Office of Multicultural & Diversity Affairs website: www.multicultural.ufl.edu

Course Materials and Technology

Some of the Reading Material (Check online materials for final reading for each lecture)

Bansal S, Grenfell BT, Meyers LA.: When individual behaviour matters: homogeneous and network models in epidemiology. Journal of the Royal Society Interface. 4(16):879-91 (2007).

Beaumont MA.: Approximate Bayesian computation in evolution and ecology. Annual review of ecology, evolution, and systematics. 41:379-406 (2010).

Chao, D.L., Halstead, S.B., Halloran, M.E., Longini, I.M.: Controlling dengue with vaccines in Thailand. PLoS Negl Trop Dis.; 6(10): e1876.doi:10.1371/journal.pntd.0001876 (2012)

Chinazzi M, Davis JT, Ajelli M, Gioannini C, Litvinova M, Merler S, Pastore y Piontti A, Mu K, Rossi L, Sun K, Viboud C, Xiong X, Yu H, Halloran ME, Longini IM, Vespignani A. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. Science. 10.1126/science.aba9757 https://science.sciencemag.org/content/early/2020/03/05/science.aba9757 (2020).

Dean NE: Informing vaccination programs: a guide to the design and conduct of dengue serosurveys. WHO (2017) http://www.who.int/immunization/documents/research/WHOhttp://www.who.int/immunization/documents/research/WHO_IVB_17.07/en/_IVB_17.07/en/

Dean NE, Halloran ME, Longini IM: Design of vaccine trials during outbreaks with and without a delayed vaccination comparator. Annals of Applied Statistics 12, 330-347 https://projecteuclid.org/euclid.aoas/1520564475. (2018)

Dean N, Gsell PS, Brookmeyer R, De Gruttola V, Donnelly CA, Halloran ME, Jasseh M, Nason M, Riveros X, Watson C, Henao-Restrepo AM, Longini IM: Considerations for the design of vaccine efficacy trials during public health emergencies. Science Translational Medicine 11, Issue 499, eaat0360, DOI: 10.1126/scitranslmed.aat0360 (2019).

Halloran, ME, Longini IM, Struchiner CJ: Estimability and interpretation of vaccine efficacy using frailty mixing models. American Journal of Epidemiology 144, 83-97 (1996).

Henao-Restrepo A-M, Longini IM, Egger M, Dean NE, et al.: Efficacy of a recombinant live VSV-vectored vaccine expressing Ebola surface glycoprotein: Interim results from the Guinea ring vaccination cluster-randomized trial. The Lancet, 38, 857–866 (2015). PMID: 26248676

Henao-Restrepo A-M, Camacho A, Longini IM, et al: Efficacy and effectiveness of an rVSV-vectored vaccine in preventing Ebola virus disease: final results from the Guinea ring vaccination, open-label, cluster-randomised trial (Ebola Ça Suffit!). The Lancet 389, 505-18 (2017).

Hethcote H: Qualitative analyses of communicable disease models. Math Biosci 28, 335-356 (1976).

Hladish T, Melamud E, Barrera LA, Galvani A, Meyers LA.: EpiFire: An open source C++ library and application for contact network epidemiology. BMC bioinformatics. 13(1):76 (2012).

Hladish TJ, Pearson CAB, Chao DL, Rojas DP, Recchia GL, Gomez HG, Halloran ME, Pulliam JR, Longini IM: Projected impact of dengue vaccination in Yucatan, Mexico. PLoS Neglected Tropical Diseases: http://dx.doi.org/10.1371/journal.pntd.0004661 PMCID: PMC4882069 (2016).

Huq, A., Sack, R.B., Nizam, A., Longini, I.M., et al.: Critical factors influencing the occurrence of Vibrio cholerae in the environment of Bangladesh. Applied and Environmental Microbiology 71, 4645-4654. PMCID: PMC1183289 (2005)

Kenah, E., Chao, D.L., Halloran, M.E., Matrajt, L., Longini, I.M.: The global transmission and control of influenza. PLoS One 10.1371/journal.pone.0019515 (2011).

Lemey, P., Rambault, A., Drummond, A.J., Suchard, M.A.: Bayesian phylogeography finds its roots. PLoS Computational Biology. https://doi.org/10.1371/journal.pcbi.1000520 (2009).

Lemey, P., Rambault, A., Bedford, T., et al.: Unifying viral genetics and human transportation data to predict the global transmission dynamics of human influenza H3N2. PloS Pathogens. https://doi.org/10.1371/journal.ppat.1003932 (2014).

Longini, I.M.: Chain Binomial Model in The Encyclopedia of Biostatistics. http://onlinelibrary.wiley.com/doi/10.1002/0470011815.b2a07008/full (2005).

Longini, I.M. and Halloran, M.E.: A frailty mixture model for estimating vaccine efficacy. Applied Statistics 45, 165-173 (1996).

Longini, I.M., Koopman, J., Monto, A.S. and Fox, J.P.: Estimating household and community transmission parameters for influenza. American Journal of Epidemiology 115, 736-751 (1982).

Longini, I.M., Nizam, A., Xu, S., Ungchusak, K., Hanshaoworakul, W., Cummings, D., Halloran, M.E.: Containing pandemic influenza at the source. Science 309, 1083-1087. PubMed PMID: 16079251 (2005)

Longini, I.M., Nizam, A., Ali, M., Yunus, M., Shenvi, N. and Clemens, J.D.: Controlling endemic cholera with oral vaccines. Public Library of Science (PloS), Medicine 4 (11): e336 doi:10.1371/journal.pmed.0040336. PMCID: PMC2082648 (2007).

Rhodes, P.H., Halloran, M.E. and Longini, I.M.: Counting process models for infectious disease data: Distinguishing exposure to infection from susceptibility. Journal of the Royal Statistical Society B 58, 751-762 (1996).

Tsang, et al.: Household transmission of influenza virus, Trends Microbiol 24, 123–133 (2016).

WHO: http://www.who.int/blueprint/en/

Yang, Y., Sugimoto, JD, Halloran, ME, Basta, NE, Chao, DL, Matrajt, L, Potter, G, Kenah, E, Longini, IM: The transmissibility and control of pandemic influenza A (H1N1) virus. Science 326, 729-33. PMCID: PMC2880578 (2009)

Yang, Y, Longini, I.M., Halloran, M.E., Obenchain, V: A Hybrid EM and Monte Carlo EM Algorithm and Its Application to Analysis of Transmission of Infectious Diseases. Biometrics 68, 1238–49 (2012).

Yang Y, Meng Y, M. Halloran ME, Longini IM: Dependency of vaccine efficacy on pre-exposure and age: A closer look at a tetravalent dengue vaccine. Clinical Infectious Diseases cix766, https://doi.org/10.1093/cid/cix766 (2017).

Software packages and data

EpiFire, network epidemic simulator: https://github.com/tjhladish/EpiFire/releases