

University of Florida
College of Public Health & Health Professions Syllabus
 Course Number: PHC 6937
 Title: **Computational Epidemiology in Population Science** (1 credit hours)
 Semester: Summer A; Year: 2016
 (May to June; once a week, Tue at 10am)
 Delivery Format: On-Campus
 Course Website or E-Learning *online material will be provided*

Instructor Name: Dr. Mattia Prospero
 Room Number: 4234
 Phone Number: 352-273-5860
 Email Address: m.prosperi@ufl.edu
 Office Hours: *On appointment* (Mon-Fri 9:00-17:00)
 Teaching Assistants: *TBA*
 Preferred Course Communications: *e-mail*

Prerequisites PHC 6000 Epidemiology Research Methods I, recommended PHC 6053 Regression Methods for Health and Life Sciences. Speak to the teacher for a prerequisite waiver or further info. Course is intended for PhD students, although MPH and other Master's students may attend.

PURPOSE AND OUTCOME

Course Overview This course covers topics in computational epidemiology. The course will blend both methodological and translational science aspects. The students will learn how to identify optimal modelling and analysis strategies for epidemiological study designs, including large and multi-source data sets. The course is not intended to provide statistical training, but rather to give the students the ability to recognize suitable computational approaches to make sense of the data. Given the current inflated growth of data bases in all biomedical sciences, particular focus will be given to 'big data analytics' in epidemiology and public health sciences, and how the inference of prediction models can concretize into 'precision medicine'. The methodologies will be explained by showing real-world examples and the mathematical details will be calibrated to the prerequisites.

Relation to Program Outcomes. This course covers new and interdisciplinary aspects of epidemiology in response to the growth of big data repositories, integrated multi-centric studies/cohorts, merges of heterogeneous data sources (genetics, clinical, surveillance, laboratory, sensors), and new data types (such as those from social media). This course ventures our Epi program in the 'next-generation' era of epidemiological research and data science, in compliance to up-to-date accreditation standards, and with translational relevance to clinical and professional practice.

Course Objectives and/or Goals

This course has the objective to provide the students training in computational models expressively for epidemiology, aiming at enabling them to formulate and test appropriate modelling hypotheses for large scale and heterogeneous study designs. This training is valuable for a PhD student who is interested into the 'next-generation' data science of epidemiology and biomedical modelling.

Upon successful completion of the course, students will be able to: (1) Identify data characteristics and issues by design; (2) Formulate (multiple) modelling hypothesis; (3) Design data analysis plans; (4) Parallelize analyses to reduce complexity; (5) Interpret prediction models and generalize findings.

Knowledge-based goals according to Bloom's taxonomy of educational objectives:

1. *Knowledge.* Recognition of computational learning techniques and health informatics terms/procedures, e.g. "What is a decision tree?"
2. *Comprehension.* Ability to extrapolate the functional value of computational models, e.g. "Is a decision tree a nonlinear classifier?"
3. *Application.* Ability to use a computational method in a specific context, e.g. "Can you extract data from the health record system following the study design and fit a decision tree on the study outcome?"

4. *Analysis*. Ability to test hypotheses using the data and different modelling approaches, e.g. “What happens if the prior probability is changed when we fit a Bayesian model?”
5. *Synthesis*. Ability to combine different computational models on the basis of a problem of interest, e.g. “For this problem, for which we found evidence of nonlinearity, we decide to use the alternating decision tree model to achieve better prediction performance yet maintaining an acceptable level of interpretability.”
6. *Evaluation*. Ability to formulate new evidence-based research questions; ability to evaluate the generalizability and translational importance of findings, e.g. “What information domains shall we look at when designing a prediction system for dengue infection risk in Haiti, and what would be the impact of a prediction model that includes modifiable variables for which an intervention could reduce incidence?”

Instructional Methods

Face-to-face lectures (using PPT/PDF presentations) divided in three parts: 1) methodological introduction, 2) applied/translational exemplification, 3) students' feedback (Q&A, reflections/commentaries, et cetera); homework; usage of printed/PDF textbook(s) and critical reading of scientific papers. Teaching material will be posted online. All course slides will be made available online for download, some accompanied by audio recording of what it has been taught in the class (up to 5 hrs).

DESCRIPTION OF COURSE CONTENT

Topical Outline/Course Schedule

The course is divided into 12 classes of 70 minutes each, for a total of 840 minutes. The lessons are accompanied by PPT/PDF slides and/or research papers. Usually the last part of the class is dedicated to interactive questions & answers and discussion on the topics presented.

Time frame for classes: Summer A, from May to June 2016, once a week (based on current class availability, two classes will be given every Tuesday starting from 10am, with ~10 minutes pause in between).

- CLASS 1. Eagle's view on computational epidemiology and biomedical modelling.
- CLASS 2. Identifying diagnostic pathways: a study on age-related macular degeneration.
- CLASS 3. Precision medicine: molecular medicine & multi-domain inference in healthcare.
- CLASS 4. Artificial intelligence in medicine: IBM's Watson, the doctor is a computer.
- CLASS 5. Tracing outbreaks and predicting their dynamics (1): trees.
- CLASS 6. Journal discussion (1): a volunteer -or randomly selected- student will chair a roundtable discussion on one computational epidemiology paper (session facilitated by the teacher).
- CLASS 7. Tracing outbreaks and predicting their dynamics (2): networks and agents.
- CLASS 8. Practical insights on big data in healthcare.
- CLASS 9. Discussion of assignment #1.
- CLASS 10. Journal discussion (2): a volunteer -or randomly selected- student will chair a roundtable discussion on one computational epidemiology paper (session facilitated by the teacher).
- CLASS 11. Conclusive remarks (research integrity, ethics).
- CLASS 12. Final assessment.

Note: Classes #6 and #10 (i.e. Journal discussion 1 and 2) are chaired by a student (or two students if they wish to do it as a collaboration) who will make a short presentation (10-15 minutes) illustrating the content of the article of choice and posing arguments and questions to be discussed in the following roundtable session with all the other students. The article will be circulated a few days prior the class so that the other students can read it. The teacher will facilitate the session and will encourage students to have a critical group discussion. A good presentation may result in a 1-2 bonus points for the final grading. No penalty points will incur in any case.

Course Materials and Technology

Course slides. Provided by the teacher and posted online.

Textbook(s): None mandatory (the course material and the suggested/assigned papers will be sufficient). Students may ask the teacher for a selection of interesting textbooks in computational epidemiology.

List of journal papers:

- Fraccaro P, Nicolo M, Bonetto M, Giacomini M, Weller P, Traverso CE, Prosperi M, OSullivan D. Combining macula clinical signs and patient characteristics for age-related macular degeneration diagnosis: a machine learning approach. *BMC Ophthalmol.* 2015 Jan 27;15:10. (for class 2)
- Alyass A, Turcotte M, Meyre D. From big data analysis to personalized medicine for all: challenges and opportunities. *BMC Med Genomics.* 2015 Jun 27;8:33. (for class 3)
- Borman N, Gillblad, D. Learning machines for computational epidemiology. *IEEE International Conference on Big Data*, 27-30 Oct. 2014, Washington, DC, pp. 1-5. (for class 3)
- Pybus OG, Tatem AJ, Lemey P. Virus evolution and transmission in an ever more connected world. *Proc Biol Sci.* 2015 Dec 22;282(1821). (for class 4)
- Patlolla P, Gunupudi V, Mikler AR, Jacob Rt. Agent-Based Simulation Tools in Computational Epidemiology. *Innovative Internet Community Systems*. Volume 3473 of the series *Lecture Notes in Computer Science* pp 212-223. (for class 5)
- Ferrucci D, Levas A, Bagchi S, Gondek D, Mueller ET. Watson: Beyond Jeopardy! *Artificial Intelligence 2013* 199-200:93-105. (for class 7)
- Herland M, Khoshgoftaar TM, Wald R. A review of data mining using big data in health informatics. *Journal Of Big Data* 2014; 1:2. DOI: 10.1186/2196-1115-1-2 (for class 8)
- Collins GS, Reitsma JB, Altman DG, Moons KG. Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): the TRIPOD Statement. *Eur J Clin Invest.* 2015 Feb;45(2):204-14.
- For assignments, discussion classes and deepening:
 - Su C, Andrew A, Karagas MR, Borsuk ME. Using Bayesian networks to discover relations between genes, environment, and disease. *BioData Min.* 2013 Mar 21;6(1):6.
 - Marshall BD, Galea S. Formalizing the role of agent-based modeling in causal inference and epidemiology. *Am J Epidemiol.* 2015 Jan 15;181(2):92-9.
 - Binder H, Blettner M. Big data in medical science -a biostatistical view. *Dtsch Arztebl Int.* 2015 Feb 27;112(9):137-42;
 - Hauser J, Rybakowski J. Three clusters of male alcoholics. *Drug Alcohol Depend.* 1997 Dec 15;48(3):243-50;
 - Dasgupta A, Sun YV, König IR, Bailey-Wilson JE, Malley JD. Brief Review of Regression-Based and Machine Learning Methods in Genetic Epidemiology: The Genetic Analysis Workshop 17 Experience. *Genet Epidemiol.* 2011; 35(Suppl 1): S5–11.
 - And a good selection here: <https://compepi.cs.uiowa.edu/index.php/Publications/Main>

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

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- <https://lss.at.ufl.edu/help.shtml>

ACADEMIC REQUIREMENTS AND GRADING

Homework

Students are supposed to review course material as suggested by the teacher. The teacher will clearly explain the pathway to acquire the knowledge, develop critical understanding, and explain the requirements for the Assignment(s)/Exam. The reading of all suggested papers (besides those assigned) is not enforced: a student may prefer to study on other texts or educational media if this facilitated their study.

Assignments

Assignment #1: Conduct a critical review, in writing of no more than two pages (normal page margins, 1.5 line spacing, Palatino Linotype font 11pt), of a scientific paper which addresses computational modelling and large data in epidemiology, population science, public health, or biomedical sciences. The instructor can provide a list of papers to review or the student can propose one. This assignment counts for 30% of the total; points' scale is in 30 units (see **Grading**). Submission is exclusively via e-mail to the instructor.

Grading

Requirement	Due date	Points or % of final grade (% must sum to 100%)
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Assignment #1	May 31 2016	30%
Exam	June 14 2016	70%

Point system used (i.e., how do course points translate into letter grades): Assignment #1 and the final exam will be assigned up to 30 points each. The final points-grade will be calculated as the weighted average of the assignments and the exam, i.e. $0.3*A_1+0.7*E$ where A_1 are the points received for the Assignment #1 and E are the points earned in the Final Exam. The final letter grade will be obtained by converting the final points-grade in accordance to the table below. Decimals will be rounded to the nearest integer.

Points Earned	30-29	28-27	26-25	24-23	22-21	20-19	18-17	16-15	14-13	12-11	10-9	9-0
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E

Letter grade to grade point conversion: Letter grade to grade point conversions are fixed by UF and cannot be changed.

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

For greater detail on the meaning of letter grades and university policies related to them, see the Registrar's Grade Policy regulations at: <http://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Exam Policy

Written exam. The student may not bring any didactic material, nor mobile devices. The student must write on paper sheets that the instructor will provide. Five questions, six points each. There will be two or three technical/methodological questions and two or three applied/discussion questions. The instructor will give examples of mock-up exams during classes to prepare the students.

Exam location(s)/dates(s)/times(s): *Same location of course lectures, same time; exam duration will be approximately 50 minutes.*

Policy Related to Make up Exams or Other Work

Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from LSS when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail me within 24 hours of the technical difficulty if you wish to request a make-up. Late submissions will not be generally accepted. Exceptions will be handled on an individual basis and may result in a 2 points penalty.

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>

Attendance will be verified by signature sheets available during the class. Excused absences can be reported to the instructor prior to or on the day of absence, not later. More than three absences will result in a failure.

STUDENT EXPECTATIONS, ROLES, AND OPPORTUNITIES FOR INPUT

Expectations Regarding Course Behavior

Keep cell phones silenced in class. Ask permission to teacher and students for using audio/video/image recording devices. Be educated and polite.

Communication Guidelines

Follow netiquette for online communications <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.

Online Faculty Course Evaluation Process

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/>.

Students' evaluations are important (e.g. for assessing instructors' performance on their teaching activities in relation to promotion) and they will be used to improve the course topics, materials, assignments, exams, and the instructor's teaching style.

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.
- You 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>

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.

SUPPORT SERVICES

Accommodations for Students with Disabilities

If you require classroom accommodation because of a disability, you must register with the Dean of Students Office <http://www.dso.ufl.edu> within the first week of class. 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 make sure you provide this letter to me by the end of the second week of the course. The College is committed to providing reasonable accommodations to assist students in their coursework.
