

M19-527: Development, Validation, and Application of Risk Prediction Models (3 credits)

Spring 2023, January 23 – May 1

Mondays, 2-5pm

INSTRUCTORS

Instructor:

Yikyung Park, Sc.D

Associate professor of surgery

Email: yikyungpark@wustl.edu

Ying Liu, Ph.D

Associate professor of surgery

Email: yliu3@wustl.edu

OFFICE HOURS

TBD

PREREQUISITES

Biostatistics I and II (M21-560 and M21-570) or equivalent

R software is required. Students can use other statistical software, but the lab sessions use R examples.

COURSE DESCRIPTION & OBJECTIVES

This course will present a detailed discussion of the methods of predictive modeling, with applications to clinical and population health settings. Risk prediction/stratification models are used to identify patients at risk for developing poor outcomes, which can help clinical decision-making. Risk prediction models are also used to assess eligibility for clinical trials and interventions and to guide prevention priorities. Building from traditional risk factor identification through regression analysis to model refinement and validation of prediction, a number of statistical approaches will be reviewed. Each method is motivated by clinical examples. Topics covered will include data source, statistical methods for model development, internal and external validation of models, model updating, other methods such as classification and regression trees, machine learning, and clinical usefulness. Students will critically read and discuss a range of prediction model manuscripts. Through examples, class discussion, practice lab, and homework, students will become familiar with the methods for development and validation, and use of prediction models.

COMPETENCIES

Develop the knowledge and skills to design, conduct, and analysis of risk prediction modeling, implement, and evaluate epidemiology-related, health services or clinical research projects of clinical or public health significance including:

- Obtain the knowledge and principles in basic issues involved in the clinical prediction rules, including design, development, validation, and interpretation of results for their application in clinical or public health settings.
- Develop the knowledge and skills with biostatistical methods and computer software for performing appropriate analyses of public health services or clinical outcomes data.
- Develop the knowledge and skills to critically evaluate existing risk prediction models and its translation to inform decision-making of clinicians and policymakers.
- Apply principles of study design and evaluation to clinical research and implementation projects.

TEXTBOOK

Clinical Prediction Models: A practical guide to development, validation, and updating (2nd edition). E. W. Steyerberg, Springer, 2019 (e-book available through the Bernard Becker Medical Library)

Additional resources:

The Elements of statistical learning. Data mining, inference, and prediction. Hastie T, Tibshirani R, Friedman J. Springer, 2009. (Reference for machine learning, e-book available through the Bernard Becker Medical Library)

Regression Modeling Strategies With Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis. Harrell, Jr., Frank E. 2nd ed. 2015. Springer International Publishing, 2015 (e-book available through the Bernard Becker Medical Library)

COURSE SCHEDULE

	Lecture	Practice lab
Week 1	Overview of risk prediction Study Design and Data Source	
Week 2	Model Development: Predictors, outcomes, and missing data	Lab 1
Week 3	Model Development: Statistical methods and modeling I	Lab 2
Week 4	Model Development: Statistical methods and modeling II	Lab 3
Week 5	Model Evaluation and Calibration	Lab 4
Week 6	Model Validation	Lab 5
Week 7	Guest lecture	Lab 6
Week 8	Updating Existing Risk Prediction Models	
Week 9	Model development and validation: Cox regression	Lab 7
Week 10	Clinical usefulness Guest lecture	
Week 11	Other methods Guest lecture	
Week 12	Machine learning for risk prediction 1	
Week 13	Machine learning for risk prediction 2	Lab 8
Week 14	Machine learning for risk prediction 3	Lab 9
Week 15	Student Presentation	

GRADING

Grading will be based on 1) class participation (5%), 2) Four homework assignments (15% each), and 3) a final project and presentation (35%).

Grading Scale: A+: 97-100; A: 93-96; A-: 90-92; B+: 87-89; B: 83-86; B-: 80-82; C+: 77-79; C: 73-76; C-: 70-72

ATTENDANCE

Class attendance is required. As a courtesy to other students, you are expected to arrive on time. More than two unexcused absences from class may result in a lowered grade.

CLASS PARTICIPATION: Focusing on applied learning, we will use published papers to promote class discussion. You must review each assigned paper in advance, be prepared to discuss the paper in class, and contribute to class discussion.

HOMEWORK: There will be four homework assignments, including data analysis and interpretation. Homework should be submitted by before the class on the due date.

FINAL PROJECT AND PRESENTATION: Students will write a final paper that proposes a risk prediction project or critique a published prediction model.

1. If a student has data available for risk prediction modeling:

A student analyzes data for model development, validation, or updating. The final paper should then describe the rationale and the method for developing, validating, or updating a risk prediction model; provide results, and include a discussion on the strengths and weaknesses of your method/model. The final paper should be no more than 4 pages (not including tables and figures) single-spaced using Arial font size 11 with 1" margins. Rationale/introduction should be less than 1 page. Students will present his/her final paper to the class on an assigned date.

2. If a student does not have access to data immediately, but plans to develop, validate, or update a prediction model in near future:

A student proposes a project. The paper should provide a rationale for developing, validating, or updating a risk prediction model; describe a proposed method and alternative strategies assuming your original plan did not work, and include a discussion on the strengths and weaknesses of your method/model. The final paper should be no more than 4 pages (not including tables and figures) single-spaced using Arial font size 11 with 1" margins. Rationale/introduction should be less than 1 page. Students will present his/her final paper to the class on an assigned date.

3. If a student has no immediate plan to develop a risk prediction model:

The final paper will be a critique of a published paper. Students will write a detailed critique following a guideline (to be provided). It will include a critical evaluation of the study design, data source, statistical approaches for model development, and model validation. The final paper also should include a discussion on the strengths and weaknesses of the study and suggestions for alternative strategies. The final paper should be no more than 5 pages single spaced using Arial font size 11 with 1" margins. Students will present his/her final paper to the class on an assigned date.

POLICY ON LATE ASSIGNMENTS

Late assignments will result in a deduction of one grade point (A+ down to A) for each day late (including weekends) unless prior approval is obtained from the instructor or a compelling situation prevents prior approval (i.e. documented health issues or family emergencies).

DROP DATES

You may drop for any reason during the course of the semester. However, you may only receive a partial or no tuition reimbursement depending upon how far into the semester you drop the course. See the [MPHS Student Handbook](#). Late withdrawals will appear on your transcript as a withdrawal.

MPHS Academic Policy Guidelines:

Guidelines regarding MPHS course registration and enrollment, grades, tuition obligation, and academic leave are consolidated in the [MPHS Student Handbook](#). Please review this document.

MPHS Guidelines for Academic and Non-Academic Transgressions:

By registering for this course you have agreed to the terms of the **MPHS Academic Integrity Policy, outlined below and in more detail in the [MPHS Student Handbook](#)**. Please review this policy before submitting your first graded assignment.

Academic Integrity/Plagiarism Policy:

- Academic dishonesty is a serious offense that may lead to probation, suspension, or dismissal from the University. Academic dishonesty includes plagiarism (the use of someone else’s ideas, statements, or approaches without proper citation). Academic dishonesty also includes copying information from another student, submitting work from a previous class for a new grade without prior approval from your instructor, cheating on exams, etc. You are responsible for reviewing [WashU’s academic integrity resources](#) to become aware of all the actions that constitute academic dishonesty.
- All instances of academic dishonesty will be reported to the Office of the Registrar for investigation and potential disciplinary action. In addition, the instructor will make an independent decision about the student’s grade on any assignment in question. The MPHS process regarding academic dishonesty is described in the [MPHS Student Handbook](#)

DISABILITY RESOURCES

It is the goal of Washington University to assist students with disabilities in removing the barriers their disabilities may pose and provide support in facing the challenge of pursuing an education at Washington University.

Washington University recognizes and accepts its professional, legal and moral responsibility to avoid discrimination in the acceptance and education of qualified students with disabilities and to provide reasonable accommodations to such students consistent with the principles embodied in the law. These guidelines apply to students seeking admittance as well as to those who become disabled while they are enrolled.

Washington University makes every effort to insure that all qualified applicants and students can participate in and take full advantage of all programs and opportunities offered within the university. Washington University encourages and gives full consideration to all applicants for admission. Washington University does not discriminate in access to its programs and activities on the basis of age, sex, sexual orientation, race, disability, religion, color or national origin.

To learn more about services provided to students with disabilities, initiate the process of formal documentation and/or to arrange for accommodations, please review the [Disability Resources](#) for the Med School at the start of the course.

MENTAL HEALTH RESOURCES

Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: shs.wustl.edu/MentalHealth.

SEXUAL ASSAULT RESOURCES

You can also speak confidentially and learn about available resources by contacting [Dr. Gladys Smith, PhD](#), Sexual Violence Prevention Therapist and Licensed Psychologist at the Medical Campus, (314) 362-2404. Additionally, you can report incidents to the Office of Student Affairs or by contacting WUSM Protective Services 314-362-4357 or your local law enforcement agency.

BIAS RESOURCES

The University has a process through which students and staff who have experienced or witnessed bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. For details see: diversityinclusion.wustl.edu/brss/.

Office of the Associate Vice Chancellor for Diversity, Equity and Inclusion (DEI)

The DEI Training Team designs, facilitates and leads diversity education programming for faculty, staff and students on a wide range of topics including: creating a climate of respect, the value of diversity and the role of biases in our day-to-day lives. diversity.med.wustl.edu/training/

The Office of Diversity Programs promotes diversity among and prepares medical students to lead in a global society. A priority for the Office of Diversity Programs is to cultivate and foster a supportive campus climate for students of all backgrounds, cultures and identities. mddiversity.wustl.edu/

The Diversity and Inclusion Student Council promotes an inclusive campus environment for all School of Medicine students. sites.wustl.edu/disc/

The Office for International Students and Scholars embraces the university's mission of welcoming promising students from around the world. wumma.wustl.edu/