M19-527: Development, Validation, and Application of Risk Prediction Models (2 credits)
Spring 2021, January 19 – May 3
Mondays, 2-4pm

Due to COVID-19 outbreak, class will be held online. Most lectures will be synchronous live lectures. Some pre-recorded practice labs will be asynchronous sessions.

INSTRUCTORS
Instructor:
Yikyung Park, Sc.D
Associate professor of surgery
Email: yikyungpark@wustl.edu

Ying Liu, Ph.D
Assistant professor of surgery
Email: yliu3@wustl.edu

OFFICE HOURS
TBD

PREREQUISITES
Biostatistics I and II (M21-560 and M21-570) or equivalent
SAS software is required. Students can use other statistical software, but the lab sessions use SAS examples.

COURSE DESCRIPTION & OBJECTIVES
This course will present 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 to 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, and 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

Additional resources:


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 rationale and the method for developing, validating, or updating a risk prediction model; provide results; and include discussion on 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. Rational/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 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 discussion on 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. Rational/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 published paper. Students will write a detailed critique following a guideline (to be provided). It will include critically evaluation of study design, data source, statistical approaches for model development, and model validation. The final paper also should include discussion on 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).

**COURSE SCHEDULE**

| Week 1 (1/25) | 1. Overview of risk prediction  
2. Study Design and Data Source |  
Reading:  
- Chapter 2 & 3.1 in the Clinical Prediction Models  
| Week 2 (2/1) | 1. Model Development: Predictors, outcomes, and missing data  
Reading:  
- Chapter 7, 8 & 9 in the Clinical Prediction Models  
- Additional reading to be posted  
2. Practice lab  
SMART study data  
- Chapter 23 in the Clinical Prediction Models |
| Week 3 (2/8) | 1. Model Development: Statistical methods and modeling  
Reading:  
- Chapter 4, 10, & 11 in the Clinical Prediction Models  
- Additional reading to be posted  
2. Practice lab |
| Week 4 (2/15) | 1. Model Development: Modeling and modern estimation methods  
Reading:  
- Chapter 12 & 13 in the Clinical Prediction Models  
- Additional reading to be posted |
| Week 5 (2/22) | 1. Model Evaluation and Calibration  
Reading:  
- Chapter 5 & 15 in the Clinical Prediction Models |
| Week 6 (3/1) | 1. Model Validation  
Reading:  
- Chapter 17 & 19 in the Clinical Prediction Models  
| 2. Practice lab  
GUSTO-I data  
Reading:  
- Chapter 22 in the Clinical Prediction Models  

| Week 7 (3/8) | 1. Updating Existing Risk Prediction Models  
Reading:  
- Chapter 20 & 21  
2. Reporting and presentation a Prediction Model  
Reading:  
- Chapter 18 in the Clinical Prediction Models  
- Moons KG et al. Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis (TRIPOD): explanation and elaboration. Annals of internal medicine. 2015;162(1):W1-73. | HW3 due |

| Week 8 (3/15) | 1. Model development and validation : Cox regression  
Reading:  
- Chapter 4.5 & 20.7 in the Clinical Prediction Models  
- Additional reading to be posted  
2. Practice lab | |

| Week 9 (3/22) | 1. Clinical usefulness  
Reading:  
- Chapter 16 in the Clinical Prediction Models  
- Additional reading to be posted | HW4 due |
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<th>Week 10 (3/29)</th>
<th>Guest lecture: Margie Olsen, PhD, MPH</th>
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<td>Risk Prediction Models in infectious diseases</td>
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<th>Week 11 (4/5)</th>
<th>Other Approaches for Prediction: Classification and Regression Trees</th>
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<th>Week 12 (4/12)</th>
<th>Other Approaches for Prediction: Machine Learning</th>
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<th>Week 13 (4/19)</th>
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<th>Week 14 (4/26)</th>
<th>Application of Risk Prediction Models in Clinical Settings</th>
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<th>Week 15 (5/3)</th>
<th>Student Presentation</th>
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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/