STA5934-0005: Meta-Analysis

Course Description: Meta-analysis is a statistical tool to combine and contrast findings from multiple independent studies. In recent years, it has been increasingly used in many scientific fields, including comparative effectiveness research and evidence-based medicine. It plays an important role for improving precision of research results and resolving seemingly contradictory research outcomes. This course will focus on statistical methods for meta-analysis. It will help students understand basic concepts and methods, recent advances, and directions for future developments in meta-analysis. Class sessions are lectures. The grade depends mostly on a final class project, conducted by each student individually. This project can be on any topic on meta-analysis that the instructor and student agree on. Students present their projects in class and hand in a written version.

Course Objectives: After taking this course, students will: know basic concepts and statistical methods for meta-analysis; know how to perform a meta-analysis and how to apply the methods in practice using appropriate software; be able to describe unsolved and partly-solved problems in meta-analysis and approaches to working such problems.

Instructor: Lifeng Lin
Email: llin4@fsu.edu
Office: OSB 411
Office Hour: Zoom link (https://fsu.zoom.us/j/3756231835) by appointment

Class Website: https://fsu.instructure.com/

Course Outline/List of Topics:
- Week 1: introduction to systematic reviews and meta-analyses (overview of steps for performing a systematic review, including research topic, literature search, study eligibility criteria, assessment of study quality, the PRISMA statement, the MOOSE checklist, etc.);
- Week 2: effect measures and their statistical properties (e.g., mean differences and standardized mean differences for continuous outcomes, odds ratios, relative risks, and risk differences for binary outcomes, hazard ratios for survival data, etc.);
- Week 3: approaches to transforming effect measures for data synthesis (e.g., transformations between standardized mean differences and odds ratios, approximating sample means and variances from medians, ranges, and interquartile ranges, etc.);
- Weeks 4 and 5: conventional methods for meta-analyses (e.g., the common-effect model, random-effects model, Bayesian approaches for various outcome types, methods for rare events, etc.);
- Weeks 6 and 7: assessment of heterogeneity between studies (e.g., the Q test, heterogeneity measures such as the I^2 statistic, prediction intervals, proper priors for Bayesian meta-analyses, etc.);
- Weeks 8 and 9: assessment of publication bias and small-study effects (e.g., the funnel plot, contour-enhanced funnel plot, Egger's test, Peters' test, many alternative tests, etc.);
- Weeks 10–12: multivariate methods for meta-analysis with multiple outcomes and/or multiple treatments (e.g., network meta-analysis, contrast-based model, arm-based model,

treatment ranking measures such as SUCRA, assessment of evidence inconsistency, modeling for variance-covariance structure, etc.);

- Week 13: meta-analysis of individual patient data (e.g., merits and limitations of individual patient data compared to aggregate data);
- Week 14: presentations of final projects by students.

Prerequisite: Students should have a background that includes regression models and statistical theory of maximum likelihood methods (STA 5167 and STA 5327).

Textbook: There is no required textbook. The following books are optional:

- *Statistical Methods for Meta-Analysis*, by Larry V. Hedges, Ingram Olkin. Academic Press, 1985.
- *Cochrane Handbook for Systematic Reviews of Interventions* (2nd Edition), by Julian P.T. Higgins, James Thomas, Jacqueline Chandler, Miranda Cumpston, Tianjing Li, Matthew J. Page, Vivian A. Welch. John Wiley and Sons, 2019.
- *Introduction to Meta-Analysis*, by Michael Borenstein, Larry V. Hedges, Julian P.T. Higgins, Hannah R. Rothstein. John Wiley & Sons, 2009.
- *Handbook of Meta-Analysis*, by Christopher H. Schmid, Theo Stijnen, Ian White. Chapman and Hall/CRC, 2020.

Homework: There will be about three homework assignments. They should be submitted online via Canvas. Students are strongly encouraged to prepare the solutions using LaTeX (preferred) or Word. Please compile all answers in a single PDF file for each homework assignment for facilitating the grading. Unless otherwise directed, you may discuss homework problems with other students according to the following policy. No student should ask for or offer assistance from any other student until that student has made a serious effort to solve the problem. After such an effort has been made, then students may seek help from the instructor, fellow students or others. Appropriate cite all sources that provided significant aid in your solution. All work must be written up individually. Late homework will not be accepted unless prior arrangement has been made with the instructor.

Project: There will be a final project at the end of the semester, which contributes to the majority of the final grade. Around the middle of the semester, you will select a research topic on meta-analysis for your final project, and submit a proposal to introduce the background and your plans for conducting the project. This topic can be any topic you are interested in (within the area of meta-analysis); if you cannot decide it, the instructor will provide some potential topics. Each student will have an individual meeting with the instructor to discuss about the project; the instructor will give suggestions about whether the topic is appropriate and the plans are feasible. At the end of the semester, students will submit a written version of the final project (prepared using LaTeX or Word). In the last week, each student will give a presentation for the final project (in about 20 to 30 minutes).

Final Grade: The final grade will be determined by a weighted average of the following items: (1) homework 20%; (2) oral presentation of the final project 60%; (3) written version of the final project 20%. The overall percentage will correspond to grades as 90–100 = at least A or A-, 80–

89 = at least B- to B+, 70–79 = at least C- to C+, 60–69 = at least D- to D+, < 60 = F. Final grades may be adjusted.

Course Policies
- **University Attendance Policy:** Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.
- **Academic Honor Policy:** The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to "...be honest and truthful and...[to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at http://fda.fsu.edu/Academics/Academic-Honor-Policy)
- **Americans with Disabilities Act:** Students with disabilities needing academic accommodation should: (1) register with and provide documentation to the Office of Accessibility Services; and (2) bring a letter to the instructor indicating the need for accommodation and what type; (3) meet (in person, via phone, email, skype, zoom, etc...) with each instructor to whom a letter of accommodation was sent to review approved accommodations. Please note that instructors are not allowed to provide classroom accommodation to a student until appropriate verification from the Office of Accessibility Services has been provided. This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the: Office of Accessibility Services, 874 Traditions Way, 108 Student Services Building, Florida State University, Tallahassee, FL 32306-4167; (850) 644-9566 (voice); (850) 644-8504 (TDD), oas@fsu.edu, https://dsst.fsu.edu/oas/
- **Syllabus Change Policy:** Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.