

ST599 Missing data and causal inference

Winter 2025

Instructor info

Instructor: Rob Trangucci Office hours: F 12p-1p
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Teaching assistant: Frances Lin Office hours: NA
TBA

Class meetings

Lecture: T Th 2p-3:20p **Room:** Weniger 149
Both Tuesday and Thursdays will be in-class lectures.

Required textbooks

1. *Statistical Analysis with Missing Data*, 3rd edition, Little and Rubin
2. *Causal Inference for Statistics, Social, and Biomedical Sciences*, Imbens and Rubin

Optional textbooks

1. *Bayesian Inference for Partially Identified Models*, Gustafson

Course organization

I will use https://rtrangucci.github.io/st_599_w_25.html for organizing course assignments and notes. We will use Gradescope for assignment submission and grading.

Prerequisites

A minimum grade of C is required in ST 553 and ST 563.

Course objectives

Upon completion of this course, students should be able to critically evaluate how published literature handles (or does not handle) missing data, and analyze datasets that have missing values by designing models that account for missingness. Students should also be able to read published literature using randomized study designs, and assess whether researchers' causal conclusions are reasonable.

Course measurable learning outcomes

1. Differentiate between missing-completely-at-random, missing-at-random (MAR), and missing-not-at-random (MNAR) processes via assumptions about the joint distribution of missingness indicators, outcomes, and covariates.
2. Evaluate whether estimands of interest are identifiable for a given data generating process.
3. Derive the identification region and limiting posterior density for partially-identified models.
4. Derive a principal causal effect using the Neyman-Rubin causal model.
5. Construct and fit maximum likelihood (in R)/Bayesian models (in Stan) for MAR, MNAR, and causal models.

Course schedule

Week	Topic	Reading	LO	Assignments
1	Intro to missing data Maximum likelihood estimation and inference	1.1-1.4 6.1.1, 6.1.2, Frumento	1, 5	
2	Bayesian estimation and inference Likelihood methods for missing data	6.1.3, 6.1.4, 6.1.5 6.2, 6.3, 7.1	1, 2, 5	NA
3	Likelihood methods for ignorable missingness EM for missing data methods	7.2-7.4 8, 11.1-11.2.2	1, 2, 5	HW 1
4	Modern Bayesian computation	10.2, Casella, George, 11.5	5	NA
5	Models for ignorable missingness Non-ignorable missingness and selection models	11.4, 11.5 1.3, 15.1, 15.3	1, 2, 5	NA
6	Models for non-ignorable missingness Frequentist and Bayesian identifiability	15.3 G 1, 2	1, 2, 5	NA
7	Limiting posteriors for nonidentified models Identified models vs. misspecified models	G 2 G 3	2, 3, 5	HW 2
8	Neyman-Rubin causal model Causal inference as a missing data problem	IR 1, 3 Ding and Li, Mercer et al.	4, 5	HW 3
9	Model-based inference in randomized trials	IR 6, 7	4, 5	Proposal due
10	Noncompliance in randomized trials Principal stratification	IR 23 IR 25	4, 5	HW 4

R will be the programming language used in the course, and Stan will also be introduced as a tool for Bayesian inference.

Course activities and grade weighting

1. Weekly homework assignments: 50% of grade
2. Final project proposal: 10% of grade
3. Final project: 40% of grade

Grading scale

The tentative grading scale is below:

Percentage Range	Grade
93% - 100%	A
90% - 92.9%	A-
87% - 89.9%	B+
83% - 86.9%	B
80% - 82.9%	B-
77% - 79.9%	C+
73% - 76.9%	C
70% - 72.9%	C-
67% - 69.9%	D+
63% - 66.9%	D
60% - 62.9%	D-
0% - 59.9%	F

Course Statements

Academic Calendar

All students are subject to the registration and refund deadlines as stated in the Academic Calendar: <https://registrar.oregonstate.edu/osu-academic-calendar>

Statement Regarding Students with Disabilities

Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at <http://ds.oregonstate.edu>. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.”

Student Conduct Expectations

link: <https://beav.es/codeofconduct>

Student Bill of Rights

OSU has twelve established student rights. They include due process in all university disciplinary processes, an equal opportunity to learn, and grading in accordance with the course syllabus: <https://asosu.oregonstate.edu/advocacy/rights>

Reach Out for Success

University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at <https://oregonstate.edu/ReachOut>. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)

Student Evaluation of Courses

During Fall, Winter, and Spring term the online Student Learning Experience surveys open to students the Wednesday of week 9 and close the Sunday before Finals Week. Students will receive notification, instructions and the link through their ONID email. They may also log into the system via MyOregonState

or directly at beaves.es/Student-Learning-Survey. Survey results are extremely important and are used to help improve courses and the learning experience of future students. Responses are anonymous (unless a student chooses to “sign” their comments, agreeing to relinquish anonymity of written comments) and are not available to instructors until after grades have been posted. The results of scaled questions and signed comments go to both the instructor and their unit head/supervisor. Anonymous (unsigned) comments go to the instructor only.