Short Course: Some Elements of Large-Sample Techniques Useful for Survey Statisticians

Registration link:

https://www.eventbrite.com/e/wss-short-course-elements-of-large-sample-techniques-useful-for-survey-stat-tickets-417513392797

Instructor

Dr. Jiming Jiang is a Professor of Statistics and former Director of Statistical Laboratory at the University of California, Davis. He is a prominent researcher in the fields of mixed effects models, small area estimation, model selection, and statistical genetics. He is the author of Linear and Generalized Linear Mixed Models and Their Applications (2007; 2nd ed. 2021, with T. Nguyen), Large Sample Techniques for Statistics (2010; 2nd ed. 2022), The Fence Methods (2016, with T. Ngyuen), Asymptotic Analysis of Mixed Effects Models: Theory, Applications, and Open Problems (2017), and Robust Mixed Model Analysis (2019). Jiming Jiang has been an editorial board member of The Annals of Statistics and Journal of the American Statistical Association, among others. He is a Fellow of the American Association for the Advancement of Science, the American Statistical Association, and the Institute of Mathematical Statistics, an Elected Member of the International Statistical Institute; and a Yangtze River Scholar (Chaired Professor, 2017-2020).

Brief Description

There is a misconception that large-sample theory is mainly relevant to a theoretical statistician. In fact, basic training in large-sample techniques is critically important even for a practitioner, including an applied survey statistician. Some aspects in this regard are listed below:

1. Large-sample theory provides guidance for a practitioner on what to expect, or whether something is incorrect or heading to a wrong direction.

2. Large-sample techniques can simplify our solution to difficult, sometimes intractable, problems. A practitioner with a solid training in large-sample techniques can carry theoretically guided derivations and approximations error-free. To do so, the concept of orders is very important, so that one knows what terms can be dropped without significantly impacting the outcome. Example: approximating the mean and variance of a nonlinear function of the sample mean.

3. Simple methods such as the Taylor series expansion in statistical applications can lead to useful formulae to use in practice. Example: Approximating the sampling distribution of a complex estimator and use it to construct a confidence interval.

4. In many practical problems the observations are correlated. For such observations, standard asymptotic results, especially in terms of the asymptotic distribution, may be misleading. Example: Linear mixed models are widely used in small area estimation (e.g., Rao and Molina 2015). Under a linear mixed model, the observations from the same small area (e.g., county, demographic group, or demographic group within a county) are correlated.

This short course consists of 8 hours of lectures covering some selected topics from Jiming Jiang's 2022 text, Large Sample Techniques for Statistics (2nd ed., Springer). We begin with a brief review of Taylor series expansion and some useful inequalities for asymptotic evaluation. We then go over some fundamental theorems regarding sum of independent random variables and martingales. These wrap up the first half of the short course.

The second half begins with some topics related to mixed effects models, including linear and generalized linear mixed models. The topics are closely related to small area estimation, a subject field closely related to surveys.

Prerequisites

A course in calculus and a first course in mathematical statistics.

Reference

Jiang, J. (2022), Large Sample Techniques for Statistics, 2nd ed., Springer, New York.
https://link.springer.com/book/10.1007/978-3-030-91695-4

Rao, J. N. K. and Molina, I. (2015), Small Area Estimation, 2nd ed., Wiley, New York.

Tentative Schedule/Topics

The short course is planned to be offered in early December 2022, tentatively, Dec. 1-2 for the first half, and Dec. 5-6 for the second half. On each of those days there's a two-hour lecture, as follows.

Day 1: Review of basic asymptotic techniques (Taylor series expansion and some useful inequalities)

Day 2: Fundamental limit theorems (sum of independent random variables, martingales)

Day 3: Mixed effects models (linear mixed models, generalized linear mixed models, restricted maximum likelihood, mixed model prediction)

Day 4: Small area estimation (basic small area models, measures of uncertainty, robust SAE)