Preface to the fifth edition

Maximum Likelihood Estimation with Stata, Fifth Edition is written for researchers in all disciplines who need to compute maximum likelihood estimators that are not available as prepackaged routines. To get the most from this book, you should be familiar with Stata, but you will not need any special programming skills, except in chapters 13 and 14, which detail how to take an estimation technique you have written and add it as a new *command* to Stata. No special theoretical knowledge is needed either, other than an understanding of the likelihood function that will be maximized.

Like the rest of Stata, the tools one uses to implement maximum likelihood estimators in Stata have undergone many enhancements over the years, and a new version of this book reflecting those changes is warranted. The core of the book continues to focus on the `ml` suite of commands. We have also added a new chapter for the `mlexp` command, which is useful not only for pedagogical and prototyping purposes but also for implementing relatively simple estimators with zero programming. For those who are familiar with Mata, Stata's matrix programming language, we have also included a new chapter describing the `moptimize()` suite of functions for implementing maximum likelihood estimators entirely within Mata.

Chapter 1 provides a general overview of maximum likelihood estimation theory and numerical optimization methods, with an emphasis on the practical implications of each for applied work. Chapter 2 covers the `mlexp` command for implementing relatively simple estimators with no programming skills required. Chapter 3 is an introduction to the `ml` command, which provides substantially more flexibility than `mlexp` and can be used to implement arbitrarily complex maximum-likelihood estimators. Chapter 4 is an overview of the `ml` command and the notation used throughout the rest of the book. Chapters 5–11 detail, step by step, how to use Stata to maximize user-written likelihood functions. Chapter 12 describes how to package all the user-written code in a do-file so that it can be conveniently reapplied to different datasets and model specifications. Chapter 13 details how to structure the code in an ado-file to create a new Stata estimation command. Chapter 14 shows how to add survey estimation features to existing `ml`-based estimation commands.

Chapters 15 and 16 are more advanced and show how to use Mata to implement maximum likelihood estimators. Chapter 15 shows how to write your likelihood evaluator in Mata while continuing to use the `ml` command to specify your model, maximize the likelihood function, and report results. Chapter 16 shows how to implement an estimator using Mata's `moptimize()` function and bypass `ml` altogether.

Chapter 17, the final chapter, provides examples. For a set of estimation problems, we derive the log-likelihood function, show the derivatives that make up the gradient and Hessian, write one or more likelihood-evaluation programs, and so provide a fully functional estimation command. We use the estimation command to fit the model to a dataset. An estimation command is developed for each of the following:

- Logit and probit models
- Linear regression
- Weibull regression
- Cox proportional hazards model
- Random-effects linear regression for panel data
- Seemingly unrelated regression
- Bivariate Poisson regression

Appendices contain full syntax diagrams for all the `ml` subroutines, useful checklists for implementing each maximization method, and program listings of each estimation command covered in chapter 17.

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