Preface

Maximum Likelihood Estimation with Stata, Third 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 10 and 11, 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.

Stata's `ml` command has been updated and extended since the first edition of this book was published. Here is a brief list of new features:

1. You can fit a model with linear constraints on the coefficients by defining your constraints with the `constraint` command and supplying them in the `constraints()` option of `ml model`. The `constraints()` option will also accept a constraint matrix.
2. `ml` can now be used to fit models to survey data, as long as the likelihood function meets the linear-form restrictions. You can use the `svy` option of `ml model` to pick up the survey characteristics you specified using `svyset`.
3. `ml model` accepts the `subpop()` option for analyzing survey data.
4. In addition to Stata's modified Newton–Raphson algorithm, `ml` now has three other optimization algorithms:
   - Berndt–Hall–Hall–Hausman (BHHH)
   - Davidon–Fletcher–Powell (DFP)
   - Broyden–Fletcher–Goldfarb–Shanno (BFGS)

   These algorithms are specified in the `technique()` option of `ml model`.
5. `ml` will switch between optimization algorithms if you specify more than one algorithm in the `technique()` option.
6. In addition to traditional and robust variance estimates, `ml` can compute variance estimates using the outer product of gradients (OPG).

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 is an overview of the `ml` command. Chapters 3–8 detail, step by step, how to use Stata to maximize user-written likelihood functions.

Chapter 9 describes how to package all the user-written code in a do-file so it can be conveniently reapplied to different datasets and model specifications. Chapter 10 details how to structure the code in an ado-file to create a new Stata estimation command. Chapter 11 shows how to add survey estimation features to existing `ml`–based estimation commands.

Chapter 12, 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

Appendices contain full syntax diagrams for all the `ml` subroutines, useful checklists for implementing each of the different maximization methods, and code listings of each estimation command covered in chapter 12.

William Gould
Jeffrey Pitblado
William Sribney

College Station, Texas
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