

Maximum Likelihood Estimation

IPSA Summer School in Sao Paulo Brazil

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Overview: This week-long course is intended to follow a previous course on building parametric statistical models. In addition to deepening knowledge of how to build statistical models appropriate to a wide variety of data and estimate their parameters by maximizing an appropriate likelihood function, it will introduce methods for estimating the uncertainty of the maximum likelihood estimator, producing substantively meaningful interpretations of the estimated model parameters and simulating uncertainty around those substantive effects.

Each day of the course will involve about three hours of lecture time with breaks, then lunch, then three to four hours of exercises and hands on instruction in analysis using STATA. Data sets for assignments will be provided. The first day will be devoted to a thorough review of the material from the first week course.

We will move at a pace set by you. It is more important that you understand the material, than we cover many topics. I usually find that repeated presentations of some of material, as well as study outside of class, is necessary.

Course Prerequisites: The previous week long course on Building Statistical Models is expected.

Course Readings: Lecture Notes will be available for download.

Background reading: Gary King Unifying Political Methodology: The Likelihood Theory of Statistical Inference” Michigan University Press. 1998

<http://www.amazon.com/Unifying-Political-Methodology-Likelihood-Statistical/dp/0472085549>

Topic 1: Properties of the Maximum Likelihood Estimator (MLE)

- The Distribution of the MLE
- Estimating the Variance of the MLE
- Hypothesis Tests and Confidence Intervals
- What can go wrong

Topic 2: Simulating Confidence Intervals around Predictions and Substantive Effects

- The Parametric Bootstrap

- The Delta Method
- Implementation in Stata

Topic 3: Putting it all together: Ordered Data

- Overview of models for ordered data
- Practice using the general strategies learned so far for count models
- Examples: Ordered logit

Topic 4: Putting it all together: Models of Counts

- Overview of models for count data
- Practice using the general strategies learned so far for count models
- Examples: Poisson-Exponential, Negative Binomial-Exponential

Topic 5: Putting it all together: Models of Durations

- Overview of models for duration data
- Practice using the general strategies learned so far for duration models
- Dealing with censored durations
- Examples: Exponential-Exponential, Weibull-Exponential, competing risk models

Topic 3: Strategies for Building a Statistical Model: The Stochastic Component

- Building the Stochastic Component of a Statistical Model
 - The shallow way
 - From “first principals”
- Examples
 - Deriving the Bernoulli-Logistic Model from first principles
 - Binomial-Logistic Model
 - Double Truncated Normal Model

Topic 4: Strategies for Building a Statistical Model: The Systematic Component

- Moments of a Probability Distribution
- The Linear-aggregator function
- Functions in the Systematic Component
- Choosing Covariates to include in the Systematic Component
- Nominal, Polynomial, and Interactive Covariates