

Problem Set III: M-Estimation

1. Consider the Stata data set FERTIL.dta. The aim is to estimate the effects of education on women's fertility in Botswana. The response variable, *children*, is number of living children. The explanatory variables \mathbf{x} are years of schooling (*educ*), age of the woman (*age*), age squared (*agesq*), and binary indicators for ever married (*evermarr*), living in an urban area (*urban*), having electricity (*electric*), and owning a television (*tv*).

- (a) Estimate the model

$$E(\textit{children}|\mathbf{x}) = \exp(\mathbf{x}\boldsymbol{\beta}),$$

applying nonlinear least squares (Stata command: `nl`) with initial values of zero. Why may this model be more appropriate than linear OLS? (Hint: run OLS and view the predicted values.)

- (b) Re-estimate with different initial values. Discuss.
- (c) Compute the average partial effects of education and age, i.e., evaluate the partial effect

$$\frac{\partial E(\textit{children}|\mathbf{x})}{\partial x_k}$$

for each individual and compute its sample average.

- (d) Compute the partial effects of education and age at the sample average, i.e., evaluate the partial effects at the sample averages of \mathbf{x} . Interpret. What may be “problematic” with using a sample average?
 - (e) Compute the partial effects of education and age at *educ* = 5, *evermarr* = 0, *urban* = 0, *electric* = 0, *tv* = 0 for different ages of 15, 20, ..., 45 years. Interpret your results.
2. Consider the crime data set of Agresti and Finlay (1997) for the US states. For a brief description see [here](#). Suppose the violent crime rate *crime_i* (number of violent crimes per 100,000 people) can be explained by the covariates *poverty_i* (percent of population living under poverty line), *single_i* (percent of population that are single parents), and a constant. Assume there are no endogeneity problems like reverse causality.

- (a) Load the data set into Stata and perform a robust regression using the command `rreg crime poverty single`.
Stata then applies a robust regression technique that partially relies on the Huber estimator. Interpret the estimated parameter values. Are they statistically and economically significant?
- (b) Compare the results to an OLS regression. Is the difference in estimated effects relevant?
- (c) To understand why there are differences, regress $crime_i$ on $poverty_i$ using (i) robust estimation, (ii) OLS estimation, and (iii) OLS estimation excluding the last observation (`... if state!="dc"`). Predict $crime_i$ in each case. Then scatter $crime_i$ against $poverty_i$ and add the three regression lines to this scatter graph. Discuss your findings.