Practice Problems

1) You are asked to measure the effect of sex education courses on teenage sexual behavior. You are given data on a large number of families. For each family, you observe variables for each child once a year over the course of ten years. For each child, you observe some child characteristics, whether and when they took a sex education course, how they performed in the class, and various measures of their sexual behavior over the ten years. Suggest how to estimate the effect of sex ed on sexual behavior and to test whether sex ed is effective. Be very precise.

2) You are given data on a cross section of markets for hotel accommodations. For each market, you observe the sales of each firm in the market, the average price charged by each firm, some measures of quality of the hotels, and the geographic location of the market. Your assignment is to construct a model of supply and demand of hotel accommodations and then propose how to estimate the parameters of the model. You should consider that a) there are national hotel chains and regional chains with hotels in many markets, and there are also lots of “mom and pop” hotels; b) there may be some unobserved specific quality component; and c) price determination makes prices endogenous. Discuss what important issues you are ignoring (you do not need address them; only show me that you are aware of them).

3) You are again asked to measure the effect of sex education courses on teenage sexual behavior. Again, you are given data on a large number of families. But now, for each family, you observe variables for each child only once. For each child, you observe some child characteristics, whether they took a sex education course, how they performed in the class, and three measures of sexual behavior. You observe whether they were sexually active at age 16 (after they would have taken the course), whether they use birth control, and whether they had a pregnancy (or, if they were a boy, whether they got a girl pregnant). Suggest how to estimate the effect of sex ed on sexual behavior. Take into account correlation among the errors associated with the three sexual activity measures and any possible correlation across people. Write a likelihood function. Construct a test statistic to test if sex ed is effective.

4) You are given data on a large panel of data. For each person in your sample, you observe some (possibly time-varying) demographic characteristics and what state (e.g., Alabama) the individual lives in (also possibly varying over time). Your job is to construct a model of migration. What determines when people move and where they move. Your model should reflect the fact that most people do not move in any particular year and most people never move far from where they grew up. Once you have a model, provide a detailed method for estimating the parameters of your model with the data provided. You can add other reasonable data sources to help.
5) There has been a significant increase in the demand for low mileage vehicles (SUVs and vans) in the United States. Your goal is to estimate a model of vehicle choice and mileage. You have access to data on a repeated cross section of household expenditures. For each household in each year, you observe what vehicles it owns (brand and age of each car), how many annual miles it drives each car, and other household demographic characteristics including where the household lives.

a) Write a model of vehicle ownership choice and suggest how to estimate the parameters of the model. Be as precise as possible.

b) Write a model of mileage for each vehicle taking into account the portfolio of vehicles owned by the family and suggest how to estimate the parameters of the model. Be as precise as possible.

c) Write a model of mileage for each vehicle taking into account the endogeneity of vehicle ownership and suggest how to estimate the parameters of the model. Be as precise as possible.

6) Use survival analysis to construct and estimate a model of prepayment of mortgages and defaults of mortgages. Make sure to control for the effect of housing prices, interest rates, and observed and unobserved personal characteristics. Use your model to address questions of “redlining” and racial discrimination.

7) You are given a model with $I$ agents, $i = 1, 2, ..., I$. Each agent makes a decision,

$$y_i = g(x, E_i y_{-i}, u_i, \theta)$$

where $x$ is a vector of exogenous environmental characteristics, $y_{-i}$ is the vector of decisions of the other agents in the model, $E_i y_{-i}$ is the expectation of $y_{-i}$ given information $i$ has, $u_i$ is an error accounting for characteristics of $i$ unobserved by you or any of the other agents, and $\theta$ is a vector of parameters to estimate. There is the potential for multiple equilibria at some values of $x$ and $\theta$. Suggest a method to a) determine whether there are multiple equilibria at any particular value of $(x, \theta)$. Given some notion of a metric for $(x, \theta)$, construct a method for determining how common multiple equilibria are.