AREC 815: Experimental and Behavioral Economics

Problem Set 1

Department of Agricultural and Resource Economics
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Fall 2016

Problem Set 1 is due by the end of the day on September 22.

1. Consider a dictator with social preferences that can be represented by a CES utility function of the form
$$u_s(\pi_s, \pi_o) = [\alpha(\pi_s)^\rho + (1-\alpha)(\pi_o)^\rho]^{1/\rho}$$
where π_s denotes the payoff to *self* and π_o denotes the payoff to *other*. If this dictator faces the binding budget constraint $p_s\pi_s + p_o\pi_o = m$, show that the CES expenditure function (after normalizing p_s to 1) is given by:
$$\frac{\pi_s}{m} = \frac{\left(\frac{\alpha}{1-\alpha}\right)^{1/(1-\rho)}}{p_o^{\rho/(\rho-1)} + \left(\frac{\alpha}{1-\alpha}\right)^{1/(1-\rho)}}$$
You may want to use the `equation`, `split`, or `align` environments in LaTeX.

2. The data set `arec815ps1data.dta` contains data on the choices of 1,002 ALP respondents who participated in the modified dictator games described in Fisman, Jakiela, and Kariv (2014). Familiarize yourself with the data set. Present histograms of (1) the fraction of the budget spent on tokens for self (π_s/m) at the decision-level and (2) the average fraction of the budget spent on tokens for self at the subject level. Make a table showing the means, medians, maxima, and minima of the individual-level CES parameter estimates (stored in the variables `alpha` and `rho`). Discuss the patterns that you see in the data.

3. If one assumes that a dictator' actual choices reflect this expenditure function plus a decision-specific error term that is normally distributed with mean zero, the structural parameters α and ρ can be estimated (in Stata) using non-linear least squares.

   Write a Stata program that estimates the $\hat{\alpha}_n$ and $\hat{\rho}_n$ for each subject, n. (To make your life easier, omit those subjects with extreme CES parameter values: $\hat{\rho}_n = -20$, $\hat{\rho}_n > 0.99$, or $\hat{\alpha}_n > 0.99$). Compare your results to the variables `alpha` and `rho` in the data set; these parameter estimates were generated via maximum likelihood estimation which adjusts for censoring at the boundaries of the parameter space. Present scatter plots showing the relationship between your NLS estimates of each CES parameter and the ML estimates of the same parameter. Discuss your findings.

4. An estimation procedure (like non-linear least squares) that does not adjust for censoring may be misspecified when subjects are relatively selfish. Explore this issue by generating 100 simulated subjects who are quite selfish ($0.95 < \alpha_n < 0.99$). You can decide how you wish

to generate the ρ values for your simulation: you can pull them from the actual subjects, or you can simulate them. However, you should make sure that your simulated sample includes a range of α_n and ρ_n values. Be sure to describe the procedure that you used to simulate your data in your write-up of your results.

It is fine to simulate the budget lines using the same rules used in the experiment: experimental budget lines are drawn at random by choosing maximum payoffs for *self* and *other* from the interval $[10, 90]$ subject to the restriction that at least one endpoint of the budget line must exceed 50. Generate 50 simulated budget lines for each subject.

When you do your simulations, be sure to set the seed in Stata so that rerunning your code generates exactly the same simulated decisions. What do these choices look like? If necessary, adjust for censoring of the expenditure share on tokens for *self* at one.

Present histograms of (1) the fraction of the budget spent on tokens for self (π_s/m) at the decision-level and (2) the average fraction of the budget spent on tokens for self at the subject level.

5. Now estimate $\hat{\alpha}_n$ and $\hat{\rho}_n$ for each of your simulated subjects using your non-linear least squares program from (2). Compare your estimates of the CES parameters to the actual parameters in your relatively selfish (simulated) sample, and present scatter plots showing the associations. Discuss your findings.

6. The budget share that a dictator with CES distributional preferences actually spends on tokens for *self* in choice situation j is given by: $\min\left\{s_j^* + \varepsilon_j, 1\right\}$, where $\varepsilon_j \sim \mathcal{N}(0, \sigma^2)$ and $s_j^* = \pi_s^*/m_j$ is only observed when it is less than $1 - \varepsilon_j$. As in all cases with censoring, we can express the likelihood function as:

$$\mathcal{L}(\theta) = \prod_{j \in \mathcal{J}} \left[f\left(s_j | p_o, m; \theta\right)\right]^{\mathbf{1}[s_j < 1]} \left[\Pr\left(s_j^* + \varepsilon_j \geq 1 | p_o, m; \theta\right)\right]^{\mathbf{1}[s_j = 1]} \tag{1}$$

where $\theta = (\alpha, \rho, \sigma)$. How would you specify the full likelihood for α, ρ, and σ (using the PDF and CDF of the standard normal)?

7. The MATLAB file `ps1q8.m` reads the choices of a single dictator into MATLAB and estimates $\hat{\alpha}_n$ and $\hat{\rho}_n$ via maximum likelihood without adjusting for censoring of the expenditure share at one. The `ps1q8.m` program calls the likelihood function, which is contained in `ll_ces.m`. Read through these two programs and make sure you understand what is going on. Write a Stata program that generates a simulated data set for a single subject who makes 1,000 decisions (comparable to the decisions in the experiment) for parameter values $\alpha = 0.5$, $\rho = 0.25$, and $\sigma = 0.1$. Export the results as a `.csv` file and confirm that `ps1q8.m` recovers the correct structural parameters.

8. Modify the MATLAB code to adjust for censoring of the expenditure share at one (using the likelihood function described above). Confirm that your new program recovers the correct parameters. Then, use your Stata simulation program to simulate the choices of a subject with $\alpha = 0.95$, $\rho = -0.25$, and $\sigma = 0.1$. Compare the parameter estimates generated by `ps1q8.m` to the parameters estimated using a likelihood function that adjusts for censoring. Discuss.

9. Export the decisions of the actual subjects included in `arec815ps1data.dta` so that they can be used in MATLAB. Pooling the data across subjects, generate parameter estimates using your censored and uncensored likelihood functions. Discuss.