Problem Set I

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1. Use the law of large numbers to prove that the sample BLP is consistent for the population BLP. Show that the BLP is also unbiased if $E[y_i|x_i]$ is linear.

2. Show that the BLP residual is homoscedastic if (i) the CEF is linear and (ii) the conditional variance function, $V[y_i|x_i]$, is constant; but that neither of these conditions alone is sufficient for homoscedasticity (use counter-examples).

3. Use the delta method to derive the limiting distribution of the sample BLP. Check this with an alternative calculation that uses Slutsky theorems.

4. Consider a situation where the BLP residual, ε_i, has conditional variance function, $E[\varepsilon_i^2|x_i] = \sigma(x_i)$. Write the textbook GLS estimator for this problem using the Chamberlain notation we work with in class. Show that GLS is a weighted MMSE predictor of $E[y_i|x_i]$, but that it differs from the (unweighted) BLP we discussed in class. Provide a sufficient condition for the weighted and unweighted BLPs to be equal.

5. Discuss the relationship between regression and matching, as described below:

a. Suppose all covariates are discrete and you are trying to estimate a treatment effect. Prove that if the regression model for covariates is saturated, then matching and regression estimates will estimate the same parameter (i.e., have the same *plim*) in either of the following two cases: (i) treatment effects are independent of covariates; (ii) treatment assignment is independent of covariates.

b. Propose a weighted matching estimator that estimates the same thing as regression.

c. Why might you prefer regression estimates over matching estimates, even if you are primarily interested in the effect of treatment on the treated? Justify with a simple two-cell example.

d. (extra credit) Calculate matching and regression estimates in the empirical application of your choice. Discuss the difference between the two estimates with the aid of a figure like the one used in Angrist (1998) for this purpose.