ECONOMETRICS II, Fall, 2016
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Midterm Exam 2 - November 7, 2016

Each sub-question in the following carries equal weight.

1. (10%) a) Explain how the simple bootstrap estimator works.
b) Explain what a parametric bootstrap is.

2. (30%) Consider the Gauss program below.
a) Write down and explain the model that this program estimates by Maximum Likelihood.
b) In the program, imagine you set $\rho = 0$ in likelihood function (assume that this is the true value, so you will simply have one less parameter to estimate). The program then estimates two independent models at the same time. Explain what those models are and which samples they are estimated on.
c) Write down the log-likelihood functions for each of these models.

3. (20%)
a) Explain what a Heckman correction is. Write down the relevant linear model and explain why it needs a correction.
b) Derive the exact form of the Heckman correction term.

4. (10%) Consider the simultaneous equation model:

$$y_1 = \alpha_1 * y_2 + \alpha_2 x_1 + u_1,$$

and

$$y_2 = \alpha_3 * y_1 + \alpha_4 x_1 + \alpha_5 x_2 + u_2.$$

Assume you want to estimate the equation for y_1 using 2SLS. Econometrician A estimates the first stage equation

$$y_2 = \gamma_1 * x_1 + \gamma_2 x_2 + u_1,$$

and Econometrician B estimates the relation

$$y_2 = \delta_1 x_2 + u_2.$$

(They both estimate the second stage equation

$$y_1 = \alpha_1 * \hat{y}_2 + \alpha_2 x_1 + u_1,$$

Prove that the two econometricians get identical coefficients for α_1 if x_1 and x_2 are orthogonal.

5. (20%) Weak instruments.
a) In his survey, Michael Murray gives two formulas for various biases in IV-estimation. Write down those formulas and interpret them, carefully defining all the variables.
b) What is Stock and Yogo's rule of thumb for a nominal 5% test to not have size exceeding 10%?

6. (10%) Show, using a simple example (I assume you use the one I went over in class from my article in QE) how an IV estimator can estimate a local effect, known as a Local Average Treatment Effect (LATE).

```
new;
 output file = test.out reset ;
library optmum;

N = 150; let beta0 = .5; beta1=3 ; sigma1 = 1; beta3=1 ; beta4=4 ;
sigma2 = 2; rho=.2 ;

x=seqa(1,1,N)/N.*rndn(N,1) ; /* x is the "regressor," could be anything, but if not centered a
the estimates will not be well identified. As for OLS you would like ‘‘variation in the regres
which here mean that we want to observe a good spread between 0s and 1s */

z=ones(N,1)+5*rndn(N,1) ; /* z is another regressor for linear relation */

Nsim =10 ; "Number of simulations:" Nsim ; /* create a matrix to
hold the estimated values */

/*starting values*/ let sv = 1 1 1 .5 .5 .5 ;

results = zeros(Nsim,rows(sv)) ;

estim=0 ; do while estim < Nsim ; estim=estim+1 ;

u = sigma1*rndn(N,1);
epsilon=sqrt(1-rho^2)*sigma2*rndn(N,1) ;
v=(rho/sigma2)*u+epsilon ;

z0=beta0+beta1*x+u ;
z1=(z0.>0) ;

/*generate a linear relation */
y=beta3+beta4*z+v ;

__output=0;
{b_ml,f,g,retcode} = optmum(&logl,sv);
__output=1 ;
results[estim,.]=b_ml' ;
endo ;
" " ;
/*results of last estimation*/
```

```
"estimated parameters:"
"beta3:" b_ml[1] ;
"true beta3 is:" beta3;
"beta4:" b_ml[2] ;
"true beta4:" beta4 ;
"sigma2:" b_ml[3] ;
"true sigma2:" sigma2 ;
"" ;
"calculate Hessian";
h=hessp(&logl,b_ml); /*this is minus the hessian because we minimize -L*/
"variance matrix";
vmat=inv(h);
vmat;
"" ;
"beta4-hat, t-value):" b_ml[1] b_ml[1]/sqrt(vmat[1,1]);
"beta3-hat, t-value:" b_ml[2] b_ml[2]/sqrt(vmat[2,2]);
" " ;

/* averages and std dev of estimates */
"mean estimates" meanc(results);
"std of estimates" stdc(results) ;

" " ;

proc logl(b);
  local r,L,muvec,sigma2,beta0,beta1,beta2,beta3,beta4,rho, i;

beta0=b[5] ; beta1=b[6] ; muvec=beta0+beta1*x ;

beta3=b[1] ; beta4=b[2] ; sigma2=b[3] ; rho=b[4] ;

/*"rho" rho ;*/

L=0 ; i=0 ; do while i<N ;
  i=i+1 ;
  if z1[i]==1 ;
    L = L  -0.5*ln(sigma2^2) - 0.5*(y[i]-beta3-beta4*z[i])^2/sigma2^2+
    ln(cdfn((muvec[i]+rho*(y[i]-beta3-beta4*z[i])/abs(sigma2))/sqrt(abs(1-rho^2))));
  else ;
     L = L + ln(1-cdfn(muvec[i]));
```

```
  endif ;
endo ;
  retp(-L); /*optmum minimizes*/
endp;
output off ;
```