Retake of the Final Exam in the Course:

Intermediate Econometrics

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SoSe 2013

14 October 2013

You have to provide answers to problem 1 and to two of the three problems 2 to 4. If you answer all three problems 2 to 4, then only the answers to the problems 2 and 3 will count.

The maximum number of credits is 40. Note that problem 1 involves 20 credits (= 50% of the total) while problems 2 to 4 each involve 10 credits.

The exam lasts 120 minutes.

Please write your name and your immatriculation number, if applicable (“Matrikelnummer”), on top of all answer sheets.

The exam consists of 17 pages including the cover page. Please check the completeness.

Admitted aids: A copy of the textbook by Wooldridge (Introductory Econometrics – A Modern Approach), one sheet of paper with hand-written notes in your own handwriting, calculator.

Good Luck!
Note: You must answer Problem 1.

Problem 1

The Appendix for Problem 1 provides results for an econometric analysis of the determinants of housing prices based on a cross section of \( n = 88 \) houses in the US.

The basic variables used in the analysis are:

- **price**: house price, 1000s of US Dollars ($)
- **assess**: assessed value, 1000s of US Dollars ($)
- **bdrms**: number of bedrooms
- **lotsize**: size of lot in square feet
- **sqrft**: size of house in square feet
- **colonial**: =1 if home is colonial style, =0 else

Further variables are defined in the program.

Answer the following questions based on the results in the Appendix for Problem 1. Always explain your answer and say on which part of the computer output (e.g. which estimated equation corresponding to the numbers in the TSP output) your answer is based upon.

a) What do the variables COLLOTSIZE and COLLLOTSIZE stand for? 
   These variables are defined in the program. [1 credit]

b) Interpret the estimated equation 1. Which coefficients are significant? What is the economic meaning of the estimated coefficients? What is the average partial effect of the variable COLONIAL? What is the average partial effect of the variable LOTSIZE? Explain how the average partial effects are calculated and interpret the estimated values for the average partial effects in your own words. [6 credits]

c) Based on equation 1, what is the predicted value of the house price, when LOTSIZE=25.000, SQRFT=3000, BDRMS=4, and the house is not in colonial style? [1 credit]

d) Is the error term in equation 1 heteroscedastic? Interpret the results of the heteroscedasticity test provided by TSP and the results in equation 2? Based on your findings for heteroscedasticity, are the results reported in equation 3 to be preferred to the results reported in equation 1. Does your economic interpretation of equation 3 change compared to your interpretation in part b)? [3 credits]

< Continued on next page >
e) Now consider the estimates reported in equation 4. Interpret the estimated equation 4. Which coefficients are significant? What is the economic meaning of the estimated coefficients? Do any of the substantive findings change compared to equation 1? Is the error term in equation 4 heteroscedastic? Discuss as to whether equation 4 provides a better description of the determinants of housing prices compared to equation 1? [4 credits]

f) Discuss as to whether equation 4 is correctly specified. Explain and interpret the findings of the RESET test reported in equation 6. [2 credits]

g) Does the assessment of the house price given by the variable ASSESS provide an unbiased estimate (Wooldridge calls this a rational valuation) of the house price? To answer this question, explain and interpret the results reported in equation 7 and the subsequent hypothesis test. [3 credits]

[20 credits]

Note: You must answer two problems out of Problems 2 to 4.

Problem 2

Consider the population regression function

\[ E(y|x_1, x_2) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 \]

for scalar random variables \( x_1, x_2, \) and \( y. \)

a) Find the partial effects of \( x_1 \) and \( x_2 \) on \( E(y|x_1, x_2) \) and interpret your result. If you wanted to test for constant partial effects, what would be the null hypothesis? [2 credits]

b) Let \( \mu_1 \equiv E(x_1) \) and \( \mu_2 \equiv E(x_2) \) be the population means of the explanatory variables. Let \( \delta_1 \) and \( \delta_2 \) be the average partial effects of \( x_1 \) and \( x_2 \) on \( E(y|x_1, x_2) \), respectively. Find \( \delta_1 \) and \( \delta_2 \). [1 credit]

c) Rewrite the population regression function so that \( \delta_1 \) and \( \delta_2 \) appear directly as coefficients to be estimated. Verify your result from part b). What is the advantage of the rewritten regression function over (1)? Explain. (Hint: Think about how to center the regressors \( x_1 \) and \( x_2 \).) [3 credits]

d) Suppose that \( x_1 \) and \( x_2 \) are two dummy variables. Show that \( \beta_3 \) in (1) is the difference–in–differences population parameter. Illustrate your answer using your favorite economic example. [4 credits]

[10 credits]
Problem 3

Suppose you might want to study the Keynesian consumption function. You received quarterly data for West Germany for the time period 1969,I to 1994,IV for the following time series:

- $conr$: real consumption (bn DM)
- $ydr$: real disposable income (bn DM)
- $r$: real interest rate

Use the Appendix for Problem 3 to answer the following questions. Variables that you need for the empirical analysis are generated at the beginning of the TSP program.

a) Interpret the estimated equation 1. Which coefficients are significant? What is the economic meaning of the estimated coefficients? Do you expect the coefficient estimates on $ydr$ and $r$ to be downward or upward biased when you omit $t$ from the regression? Explain. [3 credits]

b) How do you test whether the residuals from equation 1 exhibit autocorrelation of up to order 4? If there is evidence for higher order serial correlation in the residuals, can you use the usual standard errors from equation 1? Explain. If not, what alternative would you suggest? Provide a short explanation. [3 credits]

c) Interpret the estimated equation 2. What is the short-run and long-run impact of $gydr$ on $gconr$? Are they significant? How would you test whether $gydr$ and $gconr$ are I(1) series? [4 credits]

Problem 4

Consider the following model to estimate the effect of exercise and other variables on individual health:

$$
(2) \quad health_i = \beta_0 + \beta_1 age_i + \beta_2 weight_i + \beta_3 height_i + \beta_4 work_i + \beta_5 exercise_i + u_i,
$$

where $health$ is some quantitative measure of the individual’s health, $work$ is weekly hours worked, and $exercise$ is the hours of exercise (fitness activity) per week. The remaining variables $age$, $weight$, and $height$ are self-explanatory.

a) Why might you expect exercise to be correlated with the error term $u$? What might be the problem with OLS estimation? [2 credits]
b) Suppose you can collect data on two additional variables, $disthome$ and $distwork$, measuring the distances from home and from work to the nearest health club or gym. Discuss whether these two variables are likely to be uncorrelated with $u$. [2 credits]

c) Assume that $disthome$ and $distwork$ are in fact uncorrelated with $u$. Write down the reduced form for $exercise$. What other assumption must $disthome$ and $distwork$ satisfy to be valid instruments for $exercise$? How can this other identification assumption be tested? [2 credits]

d) Explain the idea of 2SLS in estimating the parameters in (2). Describe how you can test for the endogeneity of $exercise$ in (2)? [4 credits]

[10 credits]
Appendix for Problem 1

TSP Program

\[
\text{msd(terse) price assess bdrms lotsize sqrft colonial;}
\]
\[
\text{collotsize = colonial*lotsize;}
\]
\[
\text{lprice = log(price); llotsize = log(lotsize); lsqrft = log(sqrft);}
\]
\[
\text{collotsize = colonial*llotsize;}
\]
\[
\text{ols price c lotsize sqrft bdrms colonial collotsize;}
\]
\[
\text{res2 = @res*@res; phat = @fit; phat2 = @fit*@fit;}
\]
\text{title 'Partial Effects';}
\[
\text{pe_col = @coef(5) + lotsize*@coef(6);}
\]
\[
\text{pe_lotsize = @coef(2) + colonial*@coef(6);}
\]
\[
\text{msd(terse) pe_col pe_lotsize;}
\]
\text{title 'Prediction';}
\[
\text{set predict1 = @coef(1) + @coef(2)*25000 + @coef(3)*3000 + @coef(4)*4;}
\]
\[
\text{set predict2 = @coef(1) + @coef(2)*25000 + @coef(3)*3000 + @coef(4)*4}
\]
\[
\hspace{1cm} + @coef(5) + @coef(6)*25000;}
\]
\[
\text{print predict1 predict2;}
\]
\text{title 'Heteroscedasticity';}
\[
\text{ols res2 c phat phat2;}
\]
\text{title 'Test Statistic and P-Value';}
\[
\text{set n = @nob; set dfn = 2;}
\]
\[
\text{set LMstat = n*@rsq ;}
\]
\[
\text{cdf(chisq,df= dfn) LMstat ;}
\]
\[
\text{ols(robust) price c lotsize sqrft bdrms colonial collotsize;}
\]
\[
\text{frml f5 colonial;}
\]
\[
\text{frml f6 collotsize;}
\]
\[
\text{analyz(nocons) f5 f6;}
\]
\text{title 'Estimation in logs';}
ols lprice c llotsize lsqrft bdrms colonial colllotsize;

res2 = @res*@res; lphat = @fit; lphat2 = @fit*@fit;

title 'Heteroscedasticity';

ols res2 c lphat lphat2;

title 'Test Statistic and P-Value';
set n = @nob; set dfn = 2;
set LMstat = n*@rsq ;
cdf(chisq,df=dfn) LMstat ;

title 'Reset Test';

ols lprice c llotsize lsqrft bdrms colonial colllotsize lphat2;

title 'Correct assessment?';
lassess = log(assess);
ols lprice c lassess llotsize lsqrft;

frml f1 c;
frml f2 lassess-1;
frml f3 llotsize;
frml f4 lsqrft;
analyz(nocons) f1 f2 f3 f4;
TSP output based on the above program sequence

Equation 1
============

Method of estimation = Ordinary Least Squares

Dependent variable: PRICE
Current sample: 1 to 88
Number of observations: 88

Mean of dep. var. = 293.546 LM het. test = 4.10974 [.043]
Std. dev. of dep. var. = 102.713 Durbin-Watson = 2.13267 [>.884]
Sum of squared residuals = 279973. Jarque-Bera test = 67.7966 [.000]
Variance of residuals = 3414.31 Ramsey’s RESET2 = 13.7906 [.000]
Std. error of regression = 58.4321 F (zero slopes) = 37.3652 [.000]
R-squared = .694970 Schwarz B.I.C. = 493.164
Adjusted R-squared = .676370 Log likelihood = -479.732

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P-value</th>
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Partial Effects
===============

Univariate statistics
======================

Number of Observations: 88

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Prediction
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<td>502.97299</td>
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Heteroscedasticity
==================

Equation 2
==========

Method of estimation = Ordinary Least Squares

Dependent variable: RES2
Current sample: 1 to 88
Number of observations: 88

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<tr>
<th>Estimated</th>
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Test Statistic and P-Value
---------------------------

CHISQ(2) Test Statistic: 6.203160, Upper tail area: .04498
Equation 3

Method of estimation = Ordinary Least Squares

Dependent variable: PRICE
Current sample: 1 to 88
Number of observations: 88

Mean of dep. var. = 293.546  LM het. test = 4.10974 [.043]
Std. dev. of dep. var. = 102.713  Durbin-Watson = 2.13267 [<.884]
Sum of squared residuals = 279973  Jarque-Bera test = 67.7966 [.000]
Variance of residuals = 3414.31  Ramsey’s RESET2 = 13.7906 [.000]
Std. error of regression = 58.4321  F (zero slopes) = 37.3652 [.000]
R-squared = .694970  Schwarz B.I.C. = 493.164
Adjusted R-squared = .676370  Log likelihood = -479.732

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P-value</th>
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Standard Errors are heteroskedastic-consistent (HCTYPE=2).

Results of Parameter Analysis

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<th>Parameter</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P-value</th>
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</tbody>
</table>

Wald Test for the Hypothesis that the given set of Parameters are jointly zero:

CHISQ(2) = 3.0082361  ; P-value = 0.22221

F Test for the Hypothesis that the given set of Parameters are jointly zero:

F(2,82) = 1.5041180  ; P-value = 0.22828
Estimation in logs
==================

Equation 4
============

Method of estimation = Ordinary Least Squares

Dependent variable: LPRICE
Current sample: 1 to 88
Number of observations: 88

Mean of dep. var. = 5.63318   LM het. test = 1.01119 [.315]
Std. dev. of dep. var. = .303573  Durbin-Watson = 2.11226 [<.864]
Sum of squared residuals = 2.77267  Jarque-Bera test = 47.3100 [.000]
Variance of residuals = .033813  Ramsey’s RESET2 = 5.72059 [.019]
Std. error of regression = .183883  F (zero slopes) = 31.0231 [.000]
R-squared = .654177  Schwarz B.I.C. = -13.8325
Adjusted R-squared = .633090  Log likelihood = 27.2645

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<th>P-value</th>
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Heteroscedasticity
==================

Equation 5
============

Method of estimation = Ordinary Least Squares

Dependent variable: RES2
Current sample: 1 to 88
Number of observations: 88

Mean of dep. var. = .031508  
Std. dev. of dep. var. = .074897
Sum of squared residuals = .462401  
Variance of residuals = .544001E-02
Std. error of regression = .073756
R-squared = .052510
Adj. R-squared = .030216
LM het. test = 2.74285 [.098]
Durbin-Watson = 2.06474 [<.694]
Jarque-Bera test = 1971.97 [.000]
Ramsey’s RESET2 = .520431 [.473]
F (zero slopes) = 2.35534 [.101]
Schwarz B.I.C. = -99.3584
Log likelihood = 106.074

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<td>.193122</td>
<td>.102195</td>
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Test Statistic and P-Value
==========================

CHISQ(2) Test Statistic: 4.620844, Upper tail area: .09922
Reset Test
==========

Equation 6
==========

Method of estimation = Ordinary Least Squares

Dependent variable: LPRICE
Current sample: 1 to 88
Number of observations: 88

Mean of dep. var. = 5.63318
Std. dev. of dep. var. = .303573
Sum of squared residuals = 2.58977
Variance of residuals = .031972
Std. error of regression = .178808
R-squared = .676990
Adjusted R-squared = .653063

LM het. test = .895239 [>.344]
Durbin-Watson = 2.00358 [>.762]
Jarque-Bera test = 74.8085 [>.000]
Ramsey’s RESET2 = .064189 [>.801]
F (zero slopes) = 28.2943 [>.000]
Schwarz B.I.C. = -14.5965
Log likelihood = 30.2672

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Correct assessment?
===============

Equation 7
===========

Method of estimation = Ordinary Least Squares

Dependent variable: LPRICE
Current sample: 1 to 88
Number of observations: 88

<table>
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<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-statistic</th>
<th>P-value</th>
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Results of Parameter Analysis
==================================

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<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t-statistic</th>
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<td>-.370409</td>
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</table>

Wald Test for the Hypothesis that the given set of Parameters are jointly zero:
CHISQ(4) = 28.710407 ; P-value = 0.00001

F Test for the Hypothesis that the given set of Parameters are jointly zero:
F(4,84) = 7.1776016 ; P-value = 0.00005

14
Appendix for Problem 3

freq q;
smpl 69:1 94:4;

? Generate variables for the empirical analysis
? =====================================
trend t;
dot conr ydr r;
genr l. = log(.);
genr g. = l. - l.(-1);
enddot;

msd(byvar,terse) @all;

? a)
? =====================================
olsq conr c ydr r t;

? c)
? =====================================
olsq gconr c gconr(-1)-gconr(-4) gydr gydr(-1)-gydr(-4) gr;

frml lpr (gydr + gydr(-1) + gydr(-2) + gydr(-3) + gydr(-4)) ;
analyz(nocons) lpr;
TSP output based on the above program sequence

Univariate statistics

<table>
<thead>
<tr>
<th></th>
<th>Num.Obs</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>CONR</td>
<td>104</td>
<td>280.87471</td>
<td>52.90497</td>
<td>181.62000</td>
<td>376.44000</td>
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<tr>
<td>YDR</td>
<td>104</td>
<td>322.17944</td>
<td>59.31023</td>
<td>208.59160</td>
<td>427.68259</td>
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<tr>
<td>R</td>
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<td>7.81987</td>
<td>1.35963</td>
<td>5.46667</td>
<td>11.33333</td>
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<tr>
<td>T</td>
<td>104</td>
<td>52.50000</td>
<td>30.16621</td>
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<tr>
<td>LCONR</td>
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<td>5.62012</td>
<td>0.19057</td>
<td>5.20192</td>
<td>5.93076</td>
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<tr>
<td>GCONR</td>
<td>103</td>
<td>0.0069408</td>
<td>0.0083219</td>
<td>-0.019083</td>
<td>0.029510</td>
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<td>LYDR</td>
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<td>GYDR</td>
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<td>0.0088385</td>
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<td>0.027283</td>
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<td>0.17432</td>
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<tr>
<td>GR</td>
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<td>0.060252</td>
<td>-0.13992</td>
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</tbody>
</table>

Equation 1

Method of estimation = Ordinary Least Squares

Dependent variable: CONR
Current sample: 1969:1 to 1994:4
Number of observations: 104

Mean of dep. var. = 280.875   LM het. test = .702854 [.402]
Std. dev. of dep. var. = 52.9050   Durbin-Watson = .447784 [.000,.000]
Sum of squared residuals = 501.678   Jarque-Bera test = 4.15483 [.125]
Variance of residuals = 5.01678   Ramsey’s RESET2 = .015855 [.900]
Std. error of regression = 2.23982   F (zero slopes) = 19121.8 [.000]
R-squared = .99826   Schwarz B.I.C. = 238.684
Adjusted R-squared = .998208   Log likelihood = -229.395

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P-value</th>
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<tr>
<td>C</td>
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<td>6.91171</td>
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<td>R</td>
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</tbody>
</table>
Equation 2

Method of estimation = Ordinary Least Squares

Dependent variable: GCONR
Current sample: 1970:2 to 1994:4
Number of observations: 99

| Mean of dep. var. | .651103E-02 | LM het. test | .035247 [.851] |
| Std. dev. of dep. var. | .819270E-02 | Durbin-Watson | 2.00806 [.137,.880] |
| Sum of squared residuals | .187162E-02 | Jarque-Bera test | 5.57629 [.062] |
| Variance of residuals | .212684E-04 | Ramsey's RESET2 | .043433 [.835] |
| Std. error of regression | .461177E-02 | F (zero slopes) | 22.1275 [.000] |
| R-squared | .715463 | Schwarz B.I.C. | -372.617 |

| Estimated Standard Parameter Coefficient Error t-statistic P-value |
|--------------------------|----------|----------------|-----------------|
| C | .117645E-02 | .785120E-03 | 1.49843 [.138] |
| GCONR(-1) | -.097059 | .098769 | -.982686 [.328] |
| GCONR(-2) | .160560 | .092800 | 1.73017 [.087] |
| GCONR(-3) | .174408 | .092871 | 1.87796 [.064] |
| GCONR(-4) | -.381187 | .097054 | -3.92758 [.000] |
| GYDR | .679287 | .069437 | 9.78283 [.000] |
| GYDR(-1) | .071293 | .089316 | .798210 [.427] |
| GYDR(-2) | -.086678 | .087700 | -.988348 [.326] |
| GYDR(-3) | .038408 | .089580 | .428758 [.669] |
| GYDR(-4) | .274190 | .095183 | 2.88065 [.005] |
| GR | -.013433 | .776543E-02 | -1.72983 [.087] |

Results of Parameter Analysis

| Standard Parameter Estimate Error t-statistic P-value |
|--------------------------|----------|----------------|-----------------|
| LPR | .976500 | .171324 | 5.69974 [.000] |

Wald Test for the Hypothesis that the given set of Parameters are jointly zero:

CHISQ(1) = 32.487031 ; P-value = 0.00000

F Test for the Hypothesis that the given set of Parameters are jointly zero:

F(1,88) = 32.487031 ; P-value = 0.00000

END OF EXAM