Exam 1 **Resource Economics 702**
March 10, 2005 **Econometrics I**

There are 100 points on this exam. You should spend no more that 1 minute per point. Thus, you will finish within 100 minutes (1 hour 40 minutes). Allocate your time accordingly. If you spend more than 15 minutes on each of these first two problems, you'll be over-budgeting your time.

Part I: On numerous occasions, I've stated that the disturbance makes life interesting in econometrics. ***In the following two theoretical questions, illustrate why this is true.***

(15) 1. We experimented with a known population regression function (PRF) early in this course. We appended a disturbance drawn from a known distribution to that PRF. Write an essay explaining how the disturbance played a role in those experiments. What was the main lesson from those experiments?

a. Explain briefly how we modified the PRF to create a statistical relationship. How did this affect the results of individuals' estimations?

b. What important statistical concept was our experiment designed to illustrate? Explain clearly what we observed about the estimators b_0 and b_1. Your discussion should include the appropriate econometric jargon relating the population and its characteristics to samples, estimators and their characteristics.

(15) 2. Ordinary Least Squares is the method by which we derived the OLS vector **b**. Doesn't this vector of OLS estimators satisfy our quest in econometrics? Please explain clearly why we needed the Classical Regression Model (CRM). In particular, you should:

a. explain clearly why and where the **6** CRM assumptions were important in developing results for **b**; and

b. ***provide mathematical details*** for your answer by focusing on our derivations of the two most important ***desirable properties*** of the OLS vector **b**. (I think it's easiest to do this in matrix notation, but if you prefer summation notation, just select one OLS estimator, say b_1. You can illustrate nicely using the simple linear model if you wish.)

Part II: Use the SAS output to answer the following questions.

To estimate U.S. demand for oil, time-series data were gathered for the period 1959 – 1999. Included in the data set are oil demand (million barrels), the price of oil ($/barrel), the price of coal ($ per short-ton), and gross national product ($ billions). A research assistant was asked to estimate the following general linear model:

$$qoil_t = \beta_0 + \beta_1 poil_t + \beta_2 pcoal_t + \beta_4 GNP_t + u_t$$

Unfortunately, he headed off to Florida for spring break leaving only his SAS program and some printouts. Please use the printouts to answer the following questions.

(10) a. He has a big asterisk on one set of results with the note: "Use these." Are these results consistent with the model I asked him to estimate? What did he do to generate these results and why do you think he did what he did?

(6) b. How should the parameter estimates be interpreted for the set of results my research assistant favors? Please write a sentence or two for each estimate providing proper interpretations.

(10) c. Complete a hypothesis test for the effect of the price of oil on the U.S. demand for oil:

i. Specify both the null and alternative hypotheses;
ii. Choose the level of significance.
iii. Identify the critical value(s) and draw a picture of your test.
iv. Calculate the test statistic.
v. State your conclusion.

(6) d. Comment briefly on the statistical significance of the remaining parameter estimates. Justify your conclusion in each case.

(6) e. How well does the model "fit the data?" Explain.

(8) f. Does the model explain a statistically significant portion of the variation in U.S. oil demand? Complete a hypothesis test. State both the null and alternative hypothesis, illustrate the test, calculate the appropriate test statistic and provide your conclusion.

(8) g. Apparently, there is also some restriction that should be imposed for demand functions. What is the theoretical restriction? Explain briefly. Is the restriction supported by these data? Explain. How can you reach a conclusion?

(10) h. I really wanted a model that allows ***changing elasticities over the time series***. Did he provide a printout that will allow me to compute changing elasticities? Explain and then illustrate by calculating the income elasticity of U.S. oil demand for the first and final time period of the series.

(6) i. Is the income elasticity calculated from a parameter estimate that is statistically different from zero? Explain.

```
data newoil; set metrics.oil;
  lnoild=log(Oil_D); lnoilP=log(P_Oil); lncoalp=log(P_Coal); lnGnp=log(GNP);
run;
proc reg data=newoil;
  model Oil_D = P_oil P_Coal Gnp ;
    test P_oil + P_Coal + GNP = 0;
  model lnoild = lnoilp lncoalp lngnp ;
    test lnoilp + lncoalp + lngnp = 0;
run;
proc means data=metrics.oil;
run;
proc print data=newoil;
 var year Oil_D P_Oil P_Coal GNP;
run;
```

The REG Procedure
Model: MODEL1
Dependent Variable: Oil_D Oil D

Number of Observations Read	41
Number of Observations Used	41

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	243897272	81299091	50.22	<.0001
Error	37	59897053	1618839		
Corrected Total	40	303794326			

Root MSE	1272.33615	R-Square	0.8028
Dependent Mean	5905.63415	Adj R-Sq	0.7869
Coeff Var	21.54445		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	1522.87618	495.68419	3.07	0.0040
P_Oil	P Oil	1	-99.74630	49.18262	-2.03	0.0498
P_Coal	P Coal	1	220.55011	66.26276	3.33	0.0020
GNP	GNP	1	0.16911	0.02338	7.23	<.0001

The REG Procedure
Model: MODEL1

Test 1 Results for Dependent Variable Oil_D

Source	DF	Mean Square	F Value	Pr > F
Numerator	1	22994894	14.20	0.0006
Denominator	37	1618839		

The REG Procedure
Model: MODEL2
Dependent Variable: lnoild

Number of Observations Read	41
Number of Observations Used	41

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	11.05969	3.68656	83.17	<.0001
Error	37	1.64007	0.04433		
Corrected Total	40	12.69976			

Root MSE	0.21054	R-Square	0.8709
Dependent Mean	8.54826	Adj R-Sq	0.8604
Coeff Var	2.46293		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	3.53259	0.59256	5.96	<.0001
lnoilP		1	-0.36378	0.14981	-2.43	0.0202
lncoalp		1	0.81634	0.24090	3.39	0.0017
lnGnp		1	0.40567	0.06973	5.82	<.0001

The REG Procedure
Model: MODEL2

Test 1 Results for Dependent Variable lnoild

Source	DF	Mean Square	F Value	Pr > F
Numerator	1	3.15433	71.16	<.0001
Denominator	37	0.04433		

The MEANS Procedure

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
Year	Year	41	1979.00	11.9791486	1959.00	1999.00
P_Oil	P Oil	41	13.6431220	10.6561073	1.8000000	35.6900000
GNP	GNP	41	13562.88	10824.85	2041.20	37047.30
P_Coal	P Coal	41	15.6424390	8.2573860	4.5500000	27.2500000
Oil_D	Oil D	41	5905.63	2755.88	1780.00	10852.00
Pop	Pop	41	225.2732439	27.4928258	177.8290000	272.6900000

Obs	Year	Oil_D	P_Oil	P_Coal	GNP
1	1959	1780	2.080	4.95	2041.2
2	1960	1815	1.900	4.83	2122.4
3	1961	1917	1.800	4.73	2197.0
4	1962	2082	1.800	4.62	2362.9
5	1963	2123	1.800	4.55	2492.9
6	1964	2259	1.800	4.60	2677.5
7	1965	2468	1.800	4.55	2902.0
8	1966	2573	1.800	4.62	3177.9
9	1967	2537	1.800	4.69	3358.1
10	1968	2840	1.800	4.75	3670.4
11	1969	3166	1.800	5.08	3965.8
12	1970	3419	1.800	6.34	4184.3
13	1971	3926	2.240	7.15	4545.0
14	1972	4741	2.480	7.72	4996.4
15	1973	6256	3.290	8.59	5593.0
16	1974	6112	11.580	15.82	6066.9
17	1975	6056	11.530	19.35	6593.6
18	1976	7313	12.380	19.56	7364.2
19	1977	8807	13.300	19.95	8208.2
20	1978	8363	13.600	21.86	9272.0
21	1979	8456	30.030	23.75	10397.2
22	1980	6909	35.690	24.65	11323.3
23	1981	5996	34.280	26.40	12664.2
24	1982	5113	31.760	27.25	13182.5
25	1983	5051	28.770	25.98	14287.2
26	1984	5437	28.060	25.61	15872.3
27	1985	5067	27.530	25.20	16953.5
28	1986	6224	14.378	23.79	17873.4
29	1987	6678	18.423	23.07	19024.6
30	1988	7402	14.957	22.07	20507.0
31	1989	8061	18.196	21.82	22037.9
32	1990	8018	23.807	21.76	23328.9
33	1991	7627	20.047	21.49	24043.5
34	1992	7888	19.368	21.03	25369.4
35	1993	8620	17.067	19.85	26666.8
36	1994	8996	15.977	19.41	28284.6
37	1995	8835	17.179	18.83	29683.6
38	1996	9478	20.805	18.50	31325.0
39	1997	10162	19.301	18.14	33301.7
40	1998	10708	13.112	17.67	35112.3
41	1999	10852	18.251	16.76	37047.3