Economics 421/521
Winter 2011
Midterm

Answer FIVE of the following questions (if you answer all six, the *third highest* score will be dropped):

1. Explain the following terms: (a) unbiased, (b) consistent, (c) efficient, (d) AR(3) errors, (e) Durbin-Watson statistic (give the definition).

2. (a) In the model $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$, describe in detail how to test the hypothesis that $\beta_2 + \beta_3 = 1$.

(b) Given the following estimated model (standard errors in parentheses):

$$Y_i = \underset{}{-2.46} + \underset{(0.94)}{6.11} X_{2i} - \underset{(2.80)}{1.78} X_{3i} \qquad (1.47)$$

N=40, R^2 = .43, RSS = 287.2

And the regression for the White Test:

$$\hat{u}_i^2 = \underset{}{4.2} + \underset{(0.44)}{1.24} X_{2i} + \underset{(0.31)}{.862} X_{3i} + \underset{(0.55)}{.743} X_{2i}^2 + \underset{(0.71)}{3.86} X_{3i}^2 + \underset{(1.23)}{.065} X_{2i} X_{3i},$$

N=40, R^2 = .25, RSS = 127.2

Test the hypothesis that the errors are homoskedastic (tables with critical values are attached to the exam) at the 5% level.

(c) Explain two ways that heteroskedasticity can occur in a regression model.

3. (a) What are the consequences of using OLS to estimate a model that has heteroskedastic errors? (b) Describe the Goldfeld-Quant test for heteroskedasticity.

4. (a) Given the model $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$, where $var(u_i) = \sigma_i^2$, explain how to correct for heteroskedasticity when the variance is known. Show that the variance is a constant in the corrected model. (b) When the variance is unknown, why do we need to use a model to parameterize the variance in order to estimate and correct for heteroskedasticity? (c) Write down the three models of the variance we used in the LM test for heteroskedasticity, and briefly explain how they differ.

5. (a) What are the consequences of estimating the time-series model $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 Y_{t-1} + u_t$ using OLS? (b) Suppose that the errors in part (a) follow the process $u_t = \rho_1 u_{t-1} + e_t$. How do the consequences change? (c) Given the model $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + u_t$, where $u_t = \rho_1 u_{t-1} + e_t$, explain how to transform the model so that the errors are no longer serially correlated (note that there is no lagged dependent variable on the right-hand side as in parts (a) and (b)).

6. (a) For the model $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + u_t$, where $u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \ldots \rho_p u_{t-p} + e_t$ give a step-by-step account of how to perform the Breusch-Godfrey test for higher order serial correlation. (b) Explain why this test is better than the Durbin-Watson test when there is higher order serial correlation. (c) Explain how serially correlated errors might arise in a regression model.

Table A.4 χ^2 (chi-squared) distribution: critical values of χ^2

Degrees of freedom	Significance level		
	5%	1%	0.1%
1	3.841	6.635	10.828
2	5.991	9.210	13.816
3	7.815	11.345	16.266
4	9.488	13.277	18.467
5	11.070	15.086	20.515
6	12.592	16.812	22.458
7	14.067	18.475	24.322
8	15.507	20.090	26.124
9	16.919	21.666	27.877
10	18.307	23.209	29.588
12	21.026	26.217	32.909
15	24.996	30.578	37.697
20	31.410	37.566	45.315
30	43.773	50.892	59.703

Table A.2 t distribution: critical values of t

Degrees of freedom	Two-tailed test:	Significance level					
	One-tailed test:	10% 5%	5% 2.5%	2% 1%	1% 0.5%	0.2% 0.1%	0.1% 0.05%
1		6.314	12.706	31.821	63.657	318.309	636.619
2		2.920	4.303	6.965	9.925	22.327	31.599
3		2.353	3.182	4.541	5.841	10.215	12.924
4		2.132	2.776	3.747	4.604	7.173	8.610
5		2.015	2.571	3.365	4.032	5.893	6.869
6		1.943	2.447	3.143	3.707	5.208	5.959
7		1.894	2.365	2.998	3.499	4.785	5.408
8		1.860	2.306	2.896	3.355	4.501	5.041
9		1.833	2.262	2.821	3.250	4.297	4.781
10		1.812	2.228	2.764	3.169	4.144	4.587
11		1.796	2.201	2.718	3.106	4.025	4.437
12		1.782	2.179	2.681	3.055	3.930	4.318
13		1.771	2.160	2.650	3.012	3.852	4.221
14		1.761	2.145	2.624	2.977	3.787	4.140
15		1.753	2.131	2.602	2.947	3.733	4.073
16		1.746	2.120	2.583	2.921	3.686	4.015
17		1.740	2.110	2.567	2.898	3.646	3.965
18		1.734	2.101	2.552	2.878	3.610	3.922
19		1.729	2.093	2.539	2.861	3.579	3.883
20		1.725	2.086	2.528	2.845	3.552	3.850
21		1.721	2.080	2.518	2.831	3.527	3.819
22		1.717	2.074	2.508	2.819	3.505	3.792
23		1.714	2.069	2.500	2.807	3.485	3.768
24		1.711	2.064	2.492	2.797		