BOSTON COLLEGE
Department of Economics

EC 228 01
Econometric Methods
Fall 2005
Prof. Baum

Midterm Exam
27 October 2005

Exam ends at 2:45 P.M. sharp. Answer all questions. Total of 110 points. Partial credit given for partial answers.

1. (35 pts) Briefly explain each term. Use examples to illustrate your explanation.

a. constant elasticity model
b. *ceteris paribus* in the context of multiple regression
c. zero conditional mean
d. perfect collinearity
e. omitted variable bias
f. adjusted R-squared
g. interaction term

2. (15 pts) Which of the following circumstances can cause OLS estimators to be biased? Explain your answers.

a. Heteroskedasticity in the error process
b. Omitting an important variable from the regression.
c. A sample correlation coefficient of -0.95 between two of the regressors in the model.

> The only circumstance that will cause the OLS point estimates to be biased is b, omission of a relevant variable. Heteroskedasticity biases the standard errors, but not the point estimates. High (but not unitary) correlations among regressors do not cause any sort of bias.

3. (20 pts) Suppose our model of y is $y_i = \gamma + v_i$, and we have a sample of size N.

a. Write out the least squares (OLS) criterion for the estimation of this model.

b. Using this criterion, derive the least squares estimator of $\hat{\gamma}$ as that value minimizing the criterion. First order conditions are sufficient.

$$min_g \; S = \sum_{i=1}^{N} (y_i - g)^2$$

$$\begin{aligned} \partial S/\partial g &= -2 \sum (y_i - g) = 0 \\ g &= \sum y_i / N \end{aligned}$$

4. (15 pts) Consider the estimated equation, derived from 141 observations on college students:

$$\begin{aligned} colGPA &= 1.39 + 0.412 hsGPA + 0.015 ACT - 0.083 skip + e \\ &\quad (0.33)\ (0.094) \qquad\quad (0.011) \qquad (0.026) \end{aligned}$$

where the estimated standard errors are given in parentheses. $colGPA$ is the college GPA, $hsGPA$ the corresponding high school GPA, ACT is a standardized test score, and $skip$ measures the number of times the student skipped classes last term.

a. Which of the slope coefficients are significantly different from zero (using the standard Normal approximation, and a 95% level of significance)?

b. Find a 95% confidence interval for the coefficient of $hsGPA$ using a standard Normal approximation.

c. Can you reject the hypothesis $H_0 : \beta_{hsGPA} = 1$ against the two-sided alternative at the 5% level?

a. The coefficients on *hsGPA* and *skip*.

b. $0.412 \pm 1.96 \times 0.094 = (0.22776, 0.59624)$

c. Yes, since 1.0 lies outside the confidence interval. The test statistic would be $\frac{(0.412-1.0)}{0.094} = -6.2553191$.

5. (25 pts) The following regression results were obtained from models explaining U.S. corporations' CEO salaries. The dependent variable is log(salary), and 177 observations are available. Standard errors are given in parentheses.

Table 1: default

Regressor	(1)	(2)	(3)
log(sales)	0.224	0.158	0.188
	(0.027)	(0.040)	(0.040)
log(mktval)		0.112	0.100
		(0.050)	0.049)
profmarg		-0.0023	-0.0022
		(0.0022)	(0.0021)
ceoTen			0.0171
			(0.0055)
comTen			-0.0092
			(0.0033)
constant	4.94	4.62	4.57
	(0.20)	(0.25)	(0.025)
R^2	0.281	0.304	0.353

mktval is market value of the company. profmarg is profit as a percentage of sales. ceoTen is the number of years the CEO has held that position, while comTen is the number of years s/he has been with the company.

a. Comment on the effect of profmarg on CEO salary.

b. Does market value of the firm have a significant effect? Explain.

c. Interpret the coefficients on ceoTen and comTen. Are the variables statistically significant?

d. How do you interpret the result that longer tenure with the company, *ceteris paribus*, is associated with a lower salary?

e. Show how you would predict the salary, in dollars, for a hypothetical CEO. (That is, one for whom I specify a value for each of the regressors).

a. Its effect is not distinguishable from zero in either model. The negative sign could make sense if it indicated that lower-margin (less profitable) firms had to pay more to attract management talent.

b. Yes, in both models its coefficient has a t over 2. Firms with larger valuations pay more.

c. The CEO's tenure as CEO increases salary; her number of years with the firm, *cet.par.* decrease salary. Both coefficients are statistically significant.

d. This might indicate that in a cross-section of CEOs those who have risen within the firm are not paid as well as outsiders brought in to run the company, who might demand a bonus to take the job.

e. Plug in values for the X's, generate $\hat{y}$ and exponentiate it. We did not discuss the correct method for making such a prediction from a log dependent variable. That is discussed in the textbook on pp. 218–220. A simple approach is to generate the predictions of the original model and regress y in levels on those predictions without an intercept. The sole coefficient in that regression is α_0 in Wooldridge's terminology, and may then be used to generate

$$\hat{y} = \hat{\alpha}_0 \; exp(\widehat{logy})$$

where $\widehat{logy}$ is the standard prediction from the model (for a given set of X values).