

MIDTERM EXAMINATION #3 ANSWER KEY
“Multiple Regression With Cross-Sectional Data”
March 30, 2006

VERSION A

I. MULTIPLE CHOICE: [2 pts each—28 pts total]

(1)a. (2)d. (3)b. (4)b. (5)b. (6)c. (7)b. (8)e. (9)e. (10)e. (11)c. (12)a. (13)e. (14)c.

II. PROBLEMS

(1) [Analysis of variance table, R^2 , F-test: 20 pts] a. 25. b. 5. c. 10.
 d. $2/3 = 0.667$. e. 0.6.

f. degrees of freedom in numerator = 4, degrees of freedom in denominator = 20,
 value of test statistic=10, critical point = 2.87, reject null hypothesis=YES.

(2) [LS tests: 6 pts] (Note: There was a typographical error in the exam as given. The standard error of the coefficient of *yearsjc* should have been 0.008.)

Value of test statistic=1.5, critical point= ± 1.96 , reject null hypothesis=CANNOT REJECT.

(3) [Dummy variables and structural change: 22 pts] a. perfect multicollinearity.
 b. 0.021. c. -0.0066. d. -0.0068. e. [1]. f. [2].

g. degrees of freedom in numerator = 3, degrees of freedom in denominator = 45,
 value of test statistic= $((360-270)/3) / (270/45) = 5$,
 critical point = between 2.76 and 2.84, reject null hypothesis=YES.

(4) [Heteroskedasticity: 18 pts] (Note: There was a typographical error in the exam as given. The number of low-population countries should be 12.)

a. estimated error variance small countries = 4.0, estimated error variance large countries = 5.0.

b. Small countries appear to lie closer to true regression line. The variance of the error term measures the dispersion of observations around the true regression line. Lower estimated variance of error term suggests that observations are closer to the true population regression line.

c. value of test statistic=1.25, critical point=2.98, reject null hypothesis=CANNOT REJECT.

d.

Obs.	Raw data			Transformed data		
	y	x	pop	y	intercept	x
#1	40	35	25	8	1/5 = 0.2	5
#2	20	12	16	5	1/4 = 0.25	3

III. CRITICAL THINKING [4 pts]

Least-squares is unbiased and consistent only if $E(\varepsilon | x_2, x_3) = 0$, that is, if the x variables are uncorrelated with the error term. Therefore, we should choose the left-hand-side "y" variable so that the remaining variables (the right-hand-side "x" variables) are likely to be uncorrelated with the error term.

According to the theory of demand, the quantity demanded of a good like electricity depends on its price, consumer income, the prices of related goods (including substitutes like natural gas and complements like electric appliances), and consumer tastes and preferences for electricity. Because we have no data on the prices of substitutes and complements or on consumer tastes and preferences, these variables form the error term.

Which observed variables are least likely to be correlated with this error term? In a sample of households, it is quite likely that income is uncorrelated with prices of related goods and tastes for electricity. It is also likely that the price of electricity, which is set by the electric utility company serving the region, is uncorrelated with prices of related goods and tastes for electricity. Therefore income and the price of electricity should be "x" variables.

On the other hand, it is hard to believe that electricity consumption could be uncorrelated with prices of related goods and household tastes for electricity. *So to insure that least-squares is consistent and unbiased, electricity consumption should be the left-hand-side "y" variable.*

VERSION B

I. MULTIPLE CHOICE: [2 pts each—28 pts total]

(1)b. (2)a. (3)c. (4)d. (5)d. (6)e. (7)c. (8)b. (9)c. (10)c. (11)d. (12)b. (13)d. (14)b.

II. PROBLEMS

(1) [Analysis of variance table, R^2 , F-test: 20 pts] a. 126. b. 6. c. 2.
d. 0.52. e. 0.5.

f. degrees of freedom in numerator = 5, degrees of freedom in denominator = 120,
value of test statistic = 26, critical point = 2.29, reject null hypothesis = YES.

(2) [LS tests: 6 pts] (Note: There was a typographical error in the exam as given. The standard error of the coefficient of *yearsjc* should have been 0.005.)

Value of test statistic = 2.4, critical point = ± 1.96 , reject null hypothesis = REJECT.

(3) [Dummy variables and structural change: 22 pts] a. perfect multicollinearity.
b. 0.019. c. 0.016. d. -0.0067. e. [1]. f. [4].

g. degrees of freedom in numerator = 6, degrees of freedom in denominator = 42,
value of test statistic = $((360 - 168) / 6) / (168 / 42) = 8$,
critical point = between 2.25 and 2.34, reject null hypothesis = YES.

(4) [Heteroskedasticity: 18 pts]

- a. estimated error variance small countries = 2.5, estimated error variance large countries = 12.5.
- b. Small countries appear to lie closer to true regression line. The variance of the error term measures the dispersion of observations around the true regression line. Lower estimated variance of error term suggests that observations are closer to the true population regression line.
- c. value of test statistic=5, critical point=2.98, reject null hypothesis=REJECT.
- d.

Obs.	Raw data			Transformed data		
	y	x	pop	y	intercept	x
#1	77	42	49	11	1/7 ≈ 0.143	6
#2	54	24	9	9	1/6 ≈ 0.167	4

III. CRITICAL THINKING [4 pts]

Same as Version A.

[end of answer key]