

Economics 466
Introduction to Econometrics
Fall 2006, Midterm Exam I
Total points - 100, Time - 1 hr. 15 min.

Note: Answer all questions clearly. Do not write anything irrelevant. Show your work for full credit.

1. (51 points) You are given the following data to estimate regression coefficients in several models.

$$n = 15, \bar{X} = 5, \bar{Y} = 4, \sum_i X_i^2 = 430, \sum_i Y_i^2 = 350, \sum_i X_i Y_i = 265. \quad (1)$$

- (a) (5 points each) Estimate the **intercept and slope coefficients** for the following models.
- (i) $Y_i = \beta_0 + \beta_1 X_i + u_i$
 - (ii) $Y_i = \beta_0 + \beta_1 (X_i - \bar{X}) + u_i$
 - (iii) $Y_i - \bar{Y} = \beta_0 + \beta_1 X_i + u_i$
 - (iv) $Y_i - \bar{Y} = \beta_0 + \beta_1 (X_i - \bar{X}) + u_i$
- (b) (3 points each) Explain why the estimates of the slope coefficients above (cases (i)-(iv)) are the same. Find R^2 in each of the cases (i)-(iv) above. Explain why they are identical.
- (c) (10 points) Compute the standard error and the t -value for testing the null hypothesis $H_0 : \beta_1 = -.5$ for the model in (i). Do you think that the t -values for the models in (ii)-(iv) will be the same? Explain.
- (d) (9 points) If all the Y values are multiplied by 10, i.e., $Y_i^* = 10Y_i$, show that $\bar{Y}^* = 4(10)$, $\sum Y_i^{*2} = 350(100)$, $\sum X_i Y_i^* = 265(10)$. Use these results to show that the slope coefficient of the regression Y^* on X is 10 times bigger.

Critical values you may find useful:

5% Critical Values for the F-distribution

$$F(2, 504) = 3.0136, F(2, 503) = 3.0137, F(2, 502) = 3.0138, F(2, 501) = 3.0139, \\ F(3, 504) = 2.6225, F(3, 503) = 2.6226, F(3, 502) = 2.6227, F(3, 501) = 2.6228$$

5% Critical Values for the t-distribution (2-sided)

$$t(504) = 1.9646, t(503) = 1.9647, t(502) = 1.9648, t(501) = 1.9649, t(15) = 2.131, \\ t(14) = 2.145, t(13) = 2.160$$

5% Critical Values for the t-distribution (1-sided)

$$t(504) = 1.6478, t(503) = 1.6479, t(502) = 1.6480, t(501) = 1.6481, t(15) = 1.753, \\ t(14) = 1.761, t(13) = 1.771$$

2. (49 points) An influential study in the late 1970 tried to determine the impact of pollution on home prices. The regressand (LMDEV) is the logarithm of the median value of owner occupied homes for a given community, where the median value is measured in \$1,000s. The regressors are: the per capita crime rate for the community (CRIME), the level of nitric oxides (NOX²) in the air in the community (measured in parts per 10 million) and the ratio of students to teachers in the community (PTRATIO). Some regression results are reported below. Standard errors are reported in parentheses beneath each estimate.
- (3 points each) Interpret the slope coefficients for Model (3).
 - (4 points each) Test the individual significance of each of the variables impact on LMDEV from Model (3) at the 5% level. Be sure to set up your alternative hypotheses correctly.
 - (8) Suppose my main interest was in the effect of NOX². Using Model (3) test the hypothesis (at the 5% level) that NOX² is the only variable that impacts LMDEV.
 - (2 points each) Suppose I were to measure median home values in \$100s. What would the intercepts be in models (1) through (3) if I did that?
 - (7 points) Many would argue that crime is similar to pollution. Write down the null hypothesis that crime rates and air pollution have the same impact on housing price. If you were to use a *t-test* what model would you use? (The model might not be in the table below).
 - (7 points) If you were to use a *F-test* to test the above hypothesis what would be the restricted and unrestricted regressions? Explain in details how you would perform the test. (If you need to run a new model, write it down).

| Dependent Variable: <i>LMDEV</i> | | | |
|----------------------------------|-----------------|------------------|------------------|
| Regressors | (1) | (2) | (3) |
| <i>intercept</i> | 10.41 (0.04) | 10.33 (0.04) | 11.60 (0.12) |
| <i>NOX²</i> | -1.46 (0.11) | -1.00 (0.11) | -0.96 (0.10) |
| <i>CRIME</i> | | -0.02 (0.002) | -0.01 (0.002) |
| <i>PTRATIO</i> | | | 0.07 (0.006) |
| Observations | 506 | 506 | 506 |
| <i>R²</i> | 0.25 | 0.38 | 0.50 |