

Exam No. 1 on Topics from Chapters 2 through 8 (1 hour)

I.

The attached partial computer printout relates to the model $EXPTRAV_t = a + b INCOME + u_t$ that was used as an example in the chapter on heteroscedasticity (HSK). EXPTRAV is the expenditure on travel and INCOME is the total income, both measured in billions of dollars for the 50 states and the District of Columbia (51 observations).

OLS ESTIMATES USING THE 51 OBSERVATIONS 1-51
Dependent variable - exptrav

VARIABLE	COEFFICIENT	STDERROR	T STAT	PROB t > T
0) constant	0.26649	0.32944	0.809	0.4225
2) income	0.06754	0.00350	19.288	0.0000 ***
Error Sum of Sq (ESS)	157.90707	Std Err of Resid. (sgmahat)		1.79516
Unadjusted R-squared	0.884	Adjusted R-squared		0.881

Generate usq = uhat*uhat
Create sq_pop = pop squared

OLS ESTIMATES USING THE 51 OBSERVATIONS 1-51
Dependent variable - usq

VARIABLE	COEFFICIENT	STDERROR	T STAT	PROB t > T
0) constant	-1.37791	2.24070	-0.615	0.5415
1) pop	1.37239	0.67147	2.044	0.0465 **
5) sq_pop	-0.04124	0.03086	-1.337	0.1877
Error Sum of Sq (ESS)	3684.47761	Std Err of Resid. (sgmahat)		8.76128
Unadjusted R-squared	0.119	Adjusted R-squared		0.082

1. (2 points) Write down the auxiliary equation for the error variance implicit in the print out.
2. (2 points) Next state the null hypothesis that there is no HSK.
3. (2 points) Calculate the numerical value of the test statistic (show your work).
4. (2 points) Write down the distribution and its d.f.
5. (7 points) Actually carry out the test (at 5 percent) and state whether HSK is present or not.

6. (10 points)

Regardless of your answer to (5) above, suppose you want to use the weighted least squares procedure to estimate the parameters. Your research assistant is a good programmer, but does not know any econometrics. Describe step by step how your R.A. should proceed to estimate the

model by weighted least squares. Note that your description must be specific to the model and estimated auxiliary equation (with numerical values from the computer printout wherever available). First assume that there is no negative or zero variance problem. How would you modify your answer if the negative or zero variance problem arose?

II

Consider the model $S_t = \mathbf{a} + \mathbf{b} A_t + u_t$, in which S_t is the average sales and A_t is the average advertising budget for industry t ($t = 1, 2, \dots, n$) at a point in time (that is, it is cross section). The average is computed for all the firms in the industry. This makes the variance of u_t not constant but equal to σ^2 / N_t , where N_t is the known number of firms in the industry. You have data on S_t , A_t , and N_t .

1. (17 points)

Carefully describe, step by step, how you would obtain weighted least squares (WLS) estimates of \mathbf{a} and \mathbf{b} . Your instructions should be clear and specific as though to a research assistant. In particular, describe what variables to generate and how the OLS method can be used to obtain estimates.

2. (2 points) Are the WLS estimators biased or unbiased?

3. (2 points) Are they consistent?

4. (2 points) Are they BLUE?

5. (2 points) Are the tests of hypotheses on WLS estimates valid?