Econ 120C **Ramu Ramanathan**
Fall 1998 **Second exam (30%)**

Your name _____

Your Id No. (NOT Soc. Sec. no.) _____

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD THAT YOU CAN DO SO.

Read the questions carefully and answer all points. For each part, confine your answers to the specific question. Marks will be taken off for irrelevant or redundant answers. Also, if you write the answers to one part in another part, you wouldn't get credit. Answers must be specific to the model in the problem. Simply copying down formulas from the index card without applying them to the problem will get you zero points. Don't use general terms such as "estimate basic model", "compute nRsquare statistic", "use weighted least squares", "compute p-value", etc. Clearly state exactly what they are FOR THE SPECIFIC QUESTION. Think of your answers as explaining to a Research Assistant exactly how to proceed.

CHECK AND MAKE SURE THAT ALL 5 PAGES ARE LEGIBLE. IF ANY OF THEM IS MISSING, GET A NEW COPY.

ANYONE CHEATING IN THIS EXAM WILL GET AN F IN THE COURSE AND BE REFERRED TO THE PROVOST FOR DISCIPLINARY ACTION.

MAXIMUM NUMBER OF POINTS 40 + 20 = 60

I. Consider the relationship between expenditures on travel (E_t) and total income (Y_t) given by

$$E_t = \beta_1 + \beta_2 Y_t + u_t$$

I believe that the error term is heteroscedastic (HSK) with $Var(u_t) = \sigma_t^2$ that depends on the population (P_t). To test this hunch, I used cross-section data for the States in the U.S. and D.C. (51 observations), and obtained the following auxiliary regression.

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

  VARIABLE            COEFFICIENT          STDERROR       T STAT   2Prob(t > |T|)

  0) constant            -1.93858          0.507782     -3.81774 0.000378991 ***
  4) lnpop                1.21804          0.334229      3.64433 0.000647169 ***

Error Sum of Sq (ESS)       291.971     Std Err of Resid. (sgmahat)     2.44102
Unadjusted R-squared          0.213     Adjusted R-squared                0.197
F-statistic (1, 49)         13.2811     pvalue = Prob(F > 13.281) is 0.000647169
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where lnusq = $\ln(\hat{u}_t^2)$, $\hat{u}_t$ is the residual from the model specified at the top, and lnpop = $\ln(P_t)$.

I.1 (5 points)
Write down in symbolic terms, that is, in terms of Greek symbols, what the above table implies with regards to the error variance. Your answer should be of the form $\sigma_t^2 = f(..)$, where you have to derive explicitly the function f(..) and should not include any numerical values.

I.2 (3 points) In the expression in I.1, state the null hypothesis for no HSK.

I.3 (5 points) Describe exactly how lnusq was obtained. You can either give ESL commands or describe the steps to obtain lnusq.

I.4 (3+3+3+3+3 points)
Next carry out the test. That is, compute the test statistic, state its distribution including d.f., the critical value for a 1 percent level, the decision, and the conclusion whether HSK is present or not.

I.5 (10 points)
Regardless of your answer to I.4, describe how I can obtain the weighted least squares estimates of the original model. Again be very specific about the steps for the procedure. In particular, it should be relevant to the model at the top of Page 2 and include numerical values where available. Copying the index card with general statements will not be adequate. (Use the next page for your answers). Also ESL commands are NOT ACCEPTABLE.

I.6 (2 points) Would you run into the negative variance problem here? Explain.

II.
Consider the double-log model

$$LHARVEST_t = \beta_1 + \beta_2\, LHOUSING_t + \beta_3\, LINDPRO_t + \beta_4\, LTIMBERPR_t + u_t$$

where L refers to the logarithm, HARVEST is total softwood timber harvest in Oregon (billion board feet), HOUSING is total housing starts in the U.S. in millions, INDPRO is the index of industrial production for paper and wood products, and TIMBERPR is the price of timber per 1000 board feet in dollars. Using annual data for the years 1959 through 1989 (31 observations), the above model was estimated by OLS and it was found that the Durbin-Watson statistic was 0.411.

II.1 (3+3 points)
Write down the equation for the error term (u_t) when it follows the AR(1) process, that is, first-order autocorrelation. Define the variables and indicate the null hypothesis of no serial correlation.

II.2 (4 points) Now carry out the test and state whether your test indicates significant autocorrelation or not. Show all your work.

II.3 (10 points) Describe step by step how you would use the Cochrane-Orcutt procedure for obtaining the estimates of the β´s. Again describe as you would to a Research Assistant (ESL commands are not acceptable here).