Econ 120B **Ramu Ramanathan**
Fall 2003 **Second Exam answers**

I. Using annual data for 31 years, the following model of timber harvest in Oregon was estimated:

$$\text{HARVEST} = b_1 + b_2\text{EXPORTS} + b_3\text{HOUSTART} + b_4\text{INDPROD} + b_5\text{TIMBPRIC} + b_6\text{PRODPRIC} + u$$

HARVEST = Total timber harvested in billion board feet
EXPORTS = Volume of timber exports to foreign countries in 100 million board feet
HOUSTART = Total housing starts in the United States in millions
INDPROD = Index of industrial production for paper and wood products
TIMBPRIC = Price of timber measured in dollars per 1,000 board feet
PRODPRIC = Producer price index for all commodities

The following is the unrestricted model results with standard errors in parentheses.

$$\text{(U)} \quad \widehat{\text{HARVEST}} = \underset{(0.574)}{3.913} + \underset{(0.082)}{0.108}\ \text{EXPORTS} + \underset{(0.355)}{0.524}\ \text{HOUSESTART} + \underset{(0.127)}{0.525}\ \text{INDPROD} - \underset{(0.011)}{0.018}\ \text{TIMBPRIC} - \underset{(0.087)}{0.456}\ \text{PRODPRIC}$$

ESS = 6.22273

Ia (3 points) To test whether individual coefficients are zero or different from zero, write down the degrees of freedom (d.f.) for this model, the critical value for a 10 percent level of significance, and the statistical distribution of the test statistic (don't ask whether the test is one-tailed or two-tailed; you decide what it is based on the information given).

d.f. *25* **Critical value** *1.708* **Distribution under null** t_{25}

Ib (15 points) Test each regression coefficient (except the constant term) for whether it is significantly different from zero or not, and whether or not the variable is a candidate for omission by making appropriate entries in the following table.

	Calculate test statistic	Significant/ Insignificant	Omit variable/ Retain variable
b_2)	*0.108/0.082 = 1.317*	*Insignificant*	*Omit*
b_3)	*0.524/0.355 = 1.476*	*Insignificant*	*Drop*
b_4)	*0.525/0.127= 4.134*	*Significant*	*Retain*

	Calculate test statistic	Significant/ Insignificant	Omit variable/ Retain variable
b_5)	*- 0.018/0.011 = -1.636*	*Insignificant*	*Omit*
b_6)	*0.456/0.087 = 5.241*	*Significant*	*Retain*

Ic (2 points) Which of the variables should be dropped first? Fully explain why.

Because b_2 has the smallest t-statistic in absolute value, EXPORTS should be dropped first.

A second model was estimated and the relation is given below (again standard errors are in parentheses).

$$\textbf{(R)} \quad \widehat{\text{HARVEST}} = \underset{(0.533)}{3.602} + \underset{(0.360)}{0.618}\ \text{HOUSTART} + \underset{(0.091)}{0.612}\ \text{INDPROD} - \underset{(0.089)}{0.481}\ \text{PRODPRIC}$$

ESS = 7.1265

Id (12 points) State the joint null hypothesis on the b s of Model U that will make Model R the restricted model. Then compute the test statistics, state its distribution under the null including d.f., and carry out the test at the 10% level. What is your conclusion in terms of the joint significance of the parameters in your H_0?

H_0: $b_2 = b_5 = 0$.

$$F_c = \frac{(ESS_R - ESS_U)/2}{ESS_U/25} = \frac{(7.1265 - 6.22273)/2}{6.22273} = \frac{0.452}{0.248} = 1.815$$

$F^* = 2.53$ Since $F_c < F^*$, we cannot reject H_0 and conclude that b_2 and b_5 are jointly insignificant.

II (9 points)
Indicate whether each of the following statements is valid and <u>explain your reasons</u>. In particular, state relevant assumptions and properties, if appropriate.

a. **"Although multicollinearity lowers *t*-statistics, all the variables with insignificant regression coefficients should not be dropped from the model in one swoop."**

If we drop the variable with the least significant coefficient, it is possible that a variable it was correlated with might become significant whereas the latter was previously insignificant. If we drop both, we will miss this. The statement is therefore TRUE.

b. **"Even though multicollinearity raises the standard errors of regression coefficients, the *t*- and *F*-tests are still valid."**

t- and F- tests depend only on the normality of u_t. *Multicollinearity does not violate that. Therefore, the tests are still valid and the statement is TRUE.*

c. **"High multicollinearity affects standard errors of estimated coefficients, but estimates are still efficient."**

Efficiency requires that $E(u_t) = 0$, X_t *is given and hence non-random,* u_t *has a constant variance, and zero covariance with all other errors. Multicollinearity does not violate these assumptions and hence estimators are still efficient. Statement is TRUE.*

III (9 points) State three reasons why it is sensible to omit the variable with an insignificant coefficient. Justify your answers.

1) *A simpler model is easier to interpret than a more complicated model.*
2) *Omitting the variable increases the d.f. and improves the precision of the remaining coefficients, that is, reduces standard errors.*
3) *Omitting the variable increases the power of tests.*
4) *Omitting the variable reduces the width of a confidence interval.*
5) *Omitting the variable reduces any multicollinearity caused by it and hence improves precision of the remaining coefficients.*