Homework 5. Due Wednesday March 1.

1. Show, under the standard assumptions of the linear model (normality is not needed), that if you estimate a parameter $\tilde{\beta}$ under a set of linear restrictions, $R\beta = q$, the restricted estimator $\tilde{\beta}$ has lower variance that the unrestricted estimator $\hat{\beta}$. (Hint: Find the variance of $\hat{\beta} = \tilde{\beta} + (\hat{\beta} - \tilde{\beta})$— the key is that the covariance of $\tilde{\beta}$ and $\hat{\beta} - \tilde{\beta}$ is 0 [a matrix of zero's].)

2. Formulating restrictions. What is R and q if you have a regression with 4 regressors and test:

   (a) $\beta_1 = 2$ and $\beta_2 = 0$. (The word "and" indicates that you test the joint hypothesis.)

   (b) $2\beta_1 - \beta_2 = 0$.

   (c) $\beta_1 = \beta_2$ and $\beta_3 = 4$.

d) Assuming you know the variance matrix for $\hat{\beta}$, how can you do the test of $2\beta_1 = \beta_2$ as a normally distributed test?

3. Computer question (continuation of previous homeworks). In Matlab, regress real per capita U.S. data consumption growth on income growth and the interest rate using the posted dataset. (This is the what you did in homework 1.) Calculate the residuals and examine if they are approximately normally distributed. [I forgot to stress in class: there is a difference between the residuals being normally distributed and the errors of the model—which is what we would really like to know—are normally distribued. But if the the degrees of freedom are not too small, you will likely get the right answer by examining the residuals.]

a) Construct a normal probability plot and comment on it.

b) Calculate the skewness and the kurtosis and comment.

c) Perform the test that I outlined in class assuming that the data is large enough to use the asymptotic ξ-square distribution.

4. Computer question (continuation of previous homeworks). In Matlab, regress real per capita U.S. data consumption growth on income growth and the interest rate using the posted dataset. (This is the what you did in homework 1.) Perform the following Chow tests (assuming the data are normally distributed—even if you rejected this in the previous question).

a) Examine if the coefficients are the same before and after year 2008. (Use the appropriate test).

b) Examine if the coefficient to the interest rate is the same before and after year 2008 (assuming that the coefficient to income is not changing).

c) Examine if the coefficients are different in the last period.