Professor R.L. Oaxaca | Assignment #1
Econ 522a | Spring 2005

Due Thursday, February 3

This assignment is on estimation with the standard linear regression model. The necessary data are in the Excel file dats105.xls available at http://uaeller.eller.arizona.edu/~rlo under econ 522a. Be sure to attach the supporting computer print out to the completed assignment and make clear where your answers are shown.

The aggregate demand for money is given by

$$\ell n\,(M_{1t}) = \beta_0 + \beta_1 \ell n(r_t) + \beta_2 \ell n(P_t\,) + \beta_3 \ell n(Q_t\,) + u_t, \quad t = 1959, ..., 1989,$$

where M_1 is a measure of the money stock (billions of \$'s), r is the 6 month Treasury bill rate, P is the GNP implicit price deflator, Q is real GNP (billions of constant 1982 \$'s), and u is the disturbance term

1. Estimate the model by OLS and empirically verify the conditions given below.
   a. $|\ M\ | = 0$, trace $(M) = 27$, where $M = \mathrm{I}_{31} - X\,(X'X)^{-1}\,X'$, and X is the observation matrix for the money demand model.
   b. $\sum_t \ell n\,(r_t) \cdot \hat{u}_t = 0, \sum_t \ell n\,(P_t) \cdot \hat{u}_t = 0, \sum_t \ell n(Q_t) \cdot \hat{u}_t = 0,\ \sum_t \hat{u}_t = 0.$
   c. $\hat{\beta}_0 = \overline{\ell n\,(M_1)} - \hat{\beta}_1 \overline{\ell n\,(r)} - \hat{\beta}_2\,\overline{\ell n\,(P)} - \hat{\beta}_3 \overline{\ell n\,(Q)}$

2. Estimate the model by OLS in *deviation* form, and empirically verify the conditions given below.
   a. $(x'x)^{-1}x'm_1^* = \begin{pmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ \hat{\beta}_3 \end{pmatrix}$, where x is the observation matrix on the regressors in deviation form, and m_1^* is the observation vector on $\ell n\,(M_{1t})$ in deviation form.
   b. The estimated variances of $\hat{\beta}_1, \hat{\beta}_2$ and $\hat{\beta}_3$ from the regression output are given by the diagonal elements of $\hat{\sigma}_u^2\,(x'x)^{-1}$.
   c. $R^2 = 1 - \left(\frac{\hat{u}'\hat{u}}{m_1^{*\prime} m_1^*}\right) = \left(\frac{\underline{\hat{\beta}}'\,x'x\,\underline{\hat{\beta}}}{m_1^{*\prime} m_1^*}\right)$, where $\underline{\hat{\beta}} = \begin{pmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ \hat{\beta}_3 \end{pmatrix}$.
   d. The separate regressions of $\ell n\,(M_{1t})$ on $\hat{v}_{1t}$, $\ell n\,(M_{1t})$ on $\hat{v}_{2t}$, and $\ell n\,(M_{1t})$ on $\hat{v}_{3t}$ yield the multiple regression estimates of β_1, β_2 and β_3 where $\hat{v}_{1t}$, $\hat{v}_{2t}$ and $\hat{v}_{3t}$ are the residuals from the auxiliary regressions of (1) $\ell n\,(r_t)$ on $\ell n\,(P_t)$ and $\ell n(Q_t)$,(2) $\ell n\,(P_t)$ on $\ell n\,(r_t)$ and $\ell n(Q_t)$, and (3) $\ell n(Q_t)$ on $\ell n\,(r_t)$ and $\ell n\,(P_t)$. Be sure that the constant term is included in all of these auxiliary regressions.

3. Empirically demonstrate that OLS estimation of $\ell n\,(M_{1t}) = \alpha + u_t$ yields $\hat{\alpha} = \overline{\ell n\,(M_1)}$.