Economics 468

November 20, 2021 **R. Davidson**

Assignment 3

The file located at the URL

https://russell-davidson.arts.mcgill.ca/e468/e468.as3.21.dat

contains 100 observations on four variables, $\boldsymbol{y}$, $\boldsymbol{x}_1$, $\boldsymbol{x}_2$, and $\boldsymbol{x}_3$.

Consider the linear regression model

$$\boldsymbol{y} = \beta_0 + \beta_1\boldsymbol{x}_1 + \beta_2\boldsymbol{x}_2 + \beta_3\boldsymbol{x}_3 + \boldsymbol{u},$$

where the disturbance vector $\boldsymbol{u}$ may be heteroskedastic and/or serially correlated. You are asked to test the hypothesis

$$\mathrm{H}_0\ : \beta_2 = \beta_3 = 0$$

by use of a variety of tests. By "test", I mean obtain a P value.

First, compute an F statistic and obtain a P value using the F distribution with the appropriate degrees of freedom. Next, compute a Wald statistic, using the OLS covariance matrix estimate, and a P value based on the chi-squared distribution, again with the appropriate degrees of freedom.

Repeat the calculation of P values from Wald statistics, but using HAC covariance estimates, with lag truncation parameters $p = 0, 1, 2, 3, 4$. (**Note:** The HAC estimate with $p = 0$ is identical to the HC_0 estimate.)

Now obtain bootstrap P values, using two versions of the sieve bootstrap. Recall that the sieve bootstrap makes use of the parameter estimates from regressions of the form

$$\tilde{u}_t = \sum_{i=1}^{r} \rho_i \tilde{u}_{t-i} + v_t, \qquad (1)$$

where the $\tilde{u}_t$ are the residuals from the null-hypothesis regression

$$\boldsymbol{y} = \beta_0 + \beta_1\boldsymbol{x}_1 + \boldsymbol{u}.$$

For this assignment, I do not ask you actually to perform the sieve, but rather just to suppose that the best choice of r is $r = 2$, giving parameter estimates $\hat{\rho}_1$ and $\hat{\rho}_2$, and residuals $\hat{v}_t$ from (1). For both versions of the bootstrap, the bootstrap DGP takes the form

$$y_t^* = \tilde{\beta}_0 + \tilde{\beta}_1 x_{t1} + u_t^*,$$

with the u_t^* generated by the recurrence

$$u_t^* = \hat{\rho}_1 u_{t-1}^* + \hat{\rho}_2 u_{t-2}^* + v_t^*, \quad t = 1, \ldots, n,$$

initialised by setting $u_{-1}^* = u_0^* = 0$. For the first version, the bootstrap disturbances v_t^* are obtained by resampling the residuals $\hat{v}_t$. For the second, we use a wild bootstrap procedure, setting $v_t^* = s_t^* \hat{v}_t$, where the s_t^* follow the Rademacher distribution.

Choose a number of bootstrap repetitions suitable for your computing hardware and software, and obtain the bootstrap P values in the usual way.