Homework 2 (Due Sept 23, 2022)

The file labeled QUARTERLY.XLS contains the interest rates paid on U.S. three-month, three-year, and 10-year U.S. government securities. The data run from 1960Q1 to 2008Q1. The variables are labeled TBILL, R3, and R10, respectively.

a. Pretest the variables to show that the rates all act as unit root processes. Specifically, perform augmented Dickey-Fuller tests using the lag length selected by deleting lags until the t-statistic on the last lag is significant at the 5 percent level. If you include an intercept (but no time trend) you should obtain:

Series	Lags	Estimated a_1	*t*-statistic
TBILL	7	-0.04029	-1.99014
R3	7	-0.02468	-1.36935
R10	5	-0.02011	-1.40849

Choose one more unit root test to confirm that all three rates are unit root processes.

b. Estimate the cointegrating relationships using the Engle-Granger procedure. Perform augmented Dickey-Fuller tests on the residuals. Using TBILL as the "dependent" variable, you should find

$$TBILL_t = 0.291 + 1.85R3_t - 0.997R10_t$$

(2.26) (26.18) (-12.09)

where *t*-statistics are in parenthesis.

Perform the Engle-Granger test on the residuals from the equation above. Why is it appropriate to use eight lags in the augmented form of the test? If you use eight lags, you should find that the coefficient on the lagged residual (i.e., e_{t-1}) is -0.328 with a *t*-statistic of -4.02.

The 5 percent critical value is about -3.76. Based on these data, do you conclude that the variables are cointegrated?

c. Repeat part b using R10 as the dependent variable. If you use three lags in the augmented form of the Engle-Granger test (i.e., estimate $\Delta e_t = \alpha_1 e_{t-1} + \cdots$), you should find $\alpha_1 = -0.167$ and the *t*-statistic is -3.74.

Using R10 as the dependent variable, are the three interest rates cointegrated?

d. Estimate an error-correcting model using seven lagged changes of each variable. Use the residuals from part b as the error-correction term and do not include intercepts. You should find that the error-corrections are such that:

$\Delta TBILL_t = 0.070e_{t-1} + \cdots$ *t*-statistic for the error-correction term: 0.427

$\Delta R3_t = -0.272e_{t-1} + \cdots$ *t*-statistic for the error-correction term: -1.83

$\Delta R10_t = -0.271e_{t-1} + \cdots$ *t*-statistic for the error-correction term: -2.41

where e_{t-1} is the lagged residual from your estimate in part b.

i. Perform the appropriate diagnostic tests on the system. In particular, determine whether the three residual series appear to be white noise. Are the lag lengths unnecessarily long?

ii. Discuss the nature of the adjustment. In response to a deviation from the long-run relationship, how are the three rates predicted to change?