Assignment 4

Due: Thursday, July 17 by 11:59 pm

Data sets are on Canvas.

[This is a Bonus Assignment. Weight: 5%]

1.

The file entitled MONEYDEM.XLS contains quarterly values of seasonally adjusted U.S.3-month ($TB3mo$) and 1-year ($TB1yr$) treasury bill rates. Each series is measured over the period 1959:Q3 to 2001:Q1.

(a) Plot the time series of each series separately. Does each series appear to have a constant mean and variance over time?

(b) Plot each time series on the same figure. What can you say about the relationship between the two series?

(c) Use Ordinary Least Squares (OLS) to estimate the relationship between long-term and short-term interest rates as

$$TB1yr_t = \alpha + \beta TB3mo_t + \varepsilon_t$$

(d) What does the estimate of β tell you about the relationship between long-run and short-run interest rates?

(e) Test the null that $\beta = 1$. Is this result in accordance with macroeconomic theory?

(f) Plot the residuals from the regression in part (c) versus $TB3mo$. Do you observe any pattern?

(g) Use the White Test to test for the presence of heteroskedasticity.

(h) Estimate the model again, but calculate the robust (White) standard errors.

(i) What happens to the coefficients of the model in part (h) relative to part (c)? What happens to the standard errors of the model in part (h) relative to part (c)? Why?

(j) Create a dummy variable that is equal to 1 when $TB3mo$ is in excess of 10.00 and zero otherwise. Include this variable in the regression model as

$$TB1yr_t = \alpha + \beta TB3mo_t + \delta D_t + \varepsilon_t$$

and run OLS.

(k) Test the null that the dummy variable is relevant in part (j).

(l) What happens to the fit of the model in part (j) relative to part (c)?

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2.

The file entitled SIM_2.XLS contains simulated data sets. The series Y1, contains ($T =$) 100 values of a simulated AR(1) process. Use this series to perform the following tasks.

(a) Plot the sequence against time. Does the series appear to be stationary?

(b) Plot the ACF and PACF.

(c) Estimate the AR(1), AR(2), ARMA(1,1), ARMA(1,4), and ARMA(2,1) models with intercepts.

(d) Estimate the series as both an AR(2) and ARMA(1,1) process without an intercept.

(e) Use $\overline{R}^2$, AIC and SC to choose the best single model over parts (c) and (d).

(f) Are you surprised by the result from part (e)? Why or why not?

(g) Using your ideal model, plot the ACF and PACF of the residuals. Do they appear to be white noise?

3.

The file QUARTERLY.XLS contains the quarterly values of the Consumer Price Index (excluding food and fuel) that have not been seasonally adjusted ($CPINSA$). The series is over the period 1960:Q1 to 2008:Q1.

(a) Plot the $CPINSA$ sequence against time. Does the series appear to be stationary?

(b) Plot the ACF and PACF of $CPINSA$.

(c) Create the growth rate series $\log(CPINSA_t/CPINSA_{t-1})$ and plot this series against time. Does the series appear to be stationary?

(d) Plot the ACF and PACF of $\log(CPINSA_t/CPINSA_{t-1})$.

(e) Seasonally difference CPI using $\log(CPINSA_t/CPINSA_{t-4})$. Does this series appear to be stationary?

(f) Plot the ACF and PACF of $\log(CPINSA_t/CPINSA_{t-4})$

(g) Use the ACF and PACF from part (f) and estimate a tentative model. Try several other alternative models.

(h) Use $\overline{R}^2$, AIC and SC to choose the best model from part (g).

(i) Instead of seasonally differing the series, regress $\log(CPINSA_t/CPINSA_{t-1})$ on (three) dummy variables to control for seasonality.

(j) Plot the residuals in part (i) versus time. Does this series appear to be stationary?

(k) Plot the ACF and PACF for the residuals in part (i). What do you conclude here?

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4.

The file QUARTERLY.XLS contains U.S. interest rate data over the period 1960:Q1 to 2008:Q1. Our goal here is to estimate a quarterly model of spread between a long-term and a short-term interest rate. Specifically, the interest rate spread (s) can be formed as the difference between the interest rate on a 10-year U.S. government bonds ($r10$) and the rate on a three-month treasury bills ($Tbill$) as

$$s_t = r10_t - Tbill_t$$

(a) Plot s_t against time. Does the series appear to be stationary?

(b) Plot the ACF and PACF of the time series. What do you conclude?

(c) Estimate an AR(2) model for s_t.

(d) Look at the ACF and PACF of the residuals from the regression in part (c). What do the Ljung-Box Q-statistics say about autocorrelation in the residuals?

(e) Estimate an AR(7) model for s_t.

(f) Look at the ACF and PACF of the residuals from the regression in part (e). What do the Ljung-Box Q-statistics say about autocorrelation in the residuals?

(g) Which model appears to perform better in terms of goodness-of-fit measures and diagnostic checks?

(h) Estimate both the AR(2) and AR(7) models over the period 1960:Q1 to 2005:Q3. Obtain the one-step-ahead forecast and the one-step-ahead forecast error

$$\widehat{e}_{t+1} = y_{t+1} - \widehat{y}_{t+1|t}$$

for 2005:Q4. In other words, estimate the model from 1960:Q1 to 2005:Q3, create a forecast for 2005:Q4 ($\widehat{y}_{t+1|t}$) and compare that to the true value of s_t in 2005:Q4 (y_{t+1}). Which model has the smaller forecast error? Hint: this may be easier to compute in Excel (after estimation).

(i) Estimate a ten-step-ahead forecast for each model as in part (h). Which model has the smallest mean square forecast error

$$\begin{aligned} MSE &= \frac{1}{10}\sum_{i=1}^{10} \widehat{e}_{t+i}^2 \\ &= \frac{1}{10}\sum_{i=1}^{10} \left(y_{t+i} - \widehat{y}_{t+i|t}\right)^2 \end{aligned}$$

Which model performs better? Is this surprising? Hint: this may be easier to compute in Excel (after estimation).