Tutorial 11

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Part A

Question 1

- Seasonality is usually defined as patterns which occur within a year
- With yearly data, seasonality by this definition is not observable
- If you use a broader definition to include cycles which occur over a longer period of time, then seasonality could exist wit yearly data

Question 2

Covariance stationary process

1. $E(y_t) = \mu_y$
2. $Var(y_t) = \sigma_y^2$
3. $Cov(y_t, y_{t+j}) = \gamma_j$

Correlogram will decay exponentially for each lag

Question 2

White noise process

1. $E(y_t) = 0$
2. $Var(y_t) = \sigma_y^2$
3. $Cov(y_t, y_{t+j}) = 0$

ACF should be close to zero at all lags

Question 2

Mean reverting process

Another name for a covariance stationary process

- If y_t is above μ_y, it will over time revert back to μ_y
- Effect of a large 'shock' on y_t will decay exponentially

Question 2

Trend stationary process

Stationary process with added trend

- Full process is non-stationary
- When trend is removed, process is stationary

e.g.

$$y_t = \phi_0 + \delta t + \phi_1 y_{t-1} + u_t$$

- Is non-stationary
- Correlogram will be very persistent

Question 2

Trend stationary process

$$y_t - \delta t = \phi_0 + \phi_1 y_{t-1} + u_t$$

- If this detrended process is stationary, we call it trend stationary
- Correlogram will decay exponentially

Question 2

Random Walk

$$y_t = y_{t-1} + u_t$$

- Non-stationary
- Correlogram will start at 1 and decay very slowly (if at all)
- Finance theories sometimes assume that stock prices follow a modified form of a Random Walk. e.g. Black-Scholes Option Pricing Formula, Efficient Markets Hypothesis

Part B

Question 1a: Models with lagged dependent variables and serialy correlated errors

Let

$$y_t = c + \phi_1 y_{t-1} + u_t, \quad |\phi_1| < 1$$
$$u_t = \rho u_{t-1} + e_t, \quad |\rho| < 1$$
$$e_t \sim i.i.d.(0, \sigma^2)$$

Show that

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + e_t$$

where

$$\alpha_0 = (1-\rho)c, \alpha_1 = \phi_1 + \rho, \alpha = -\rho\phi_1$$

Question 1b: What are the implications of this result?

- If AR model has serial correlation, try adding more lags
- Used to check whether model is correctly specified

Question 2

Open up "US_gdp.wf1". Variables included are

- gdp: Real GDP for the US
- ir_3m: 3-Month Treasury bill interest rates
- ir_20y: 20-year government bond yields

Reported on a quarterly basis from 1954Q1 to 2017Q2

Question 2a

Generate a new series $dlgdp = 400 \times dlog(gdp)$

- GDP is a non-stationary process
- Growth rates however are stationary
- Multiplied by 100 to convert to percentage point
- Mulptlied by 4 to annualise from quarterly data

Question 2b

Generate a variable to calculate the spread between interest rates on 3 month treasury bills and 20 year bonds

- Is the spread white noise?
- Is it mean reverting?
- Is it stationary?

Question 2c

Change the sample period to 1955Q1-2017Q2 and estimate

$$dlgdp_t = \beta_0 + \beta_1 dlgdp_{t-1} + \beta_2 dlgdp_{t-2} + \beta_3 spread_{t-1} + \beta_4 spread_{t-2} + u_t$$

- This is an ARDL(2,2) model with $y_t = dlgdp_t$ and $x_t = spread_t$ - Test the null hypothesis that there is no serial correlation vs the alternative that there is serial correlations in the errors up to the fourth lag

Question 2d

Test for the joint significance of $spread_{t-1}$ and $spread_{t-2}$.

Question 2e

Drop the lag of spread that is least statistically significant and re-estimate the equation.

What is the effect of a one percentage point *decrease* in the spread on the GDP growth rate:

- this period?
- next period?
- two periods later?
- in the long run?

Question 2e

Long run effect is the effect this period, plus next period, plus two periods later ad infinitum.

Formula is

$$= \frac{\text{sum of coefficients for } x_t}{\text{1-sum of coefficients for lags of } y_t}$$

Question 2f

Some economists believe that the informativeness of the interest spread has declined since the 1980s.

Create a dummy variable which is 1 before 1986Q1, and is 0 on and after 1986Q1. Test whether or not this is the case.