Project

RM-708/Bus-386
Due May 16 2017

Use 5% level in all tests.

1. The data set m-umcsent.txt contains the monthly series of Consumer Sentiment of the University of Michigan. The sample period is from January 1978 to August 2013.

   (i) Plot the monthly consumer sentiment series.

   (ii) Is there a unit root in the monthly sentiment series? Why?

   (iii) Consider the change series of the sentiment, i.e. the first differenced data. Test the hypothesis that the expected change of the sentiment is zero versus the alternative that the expected change is non-zero.

   (iv) Focus on the change series. Test the null hypothesis $H_0 : \rho 1 = \rho 2 = \cdots = \rho 12 = 0$ versus the alternative $H_1 : \rho i \neq 0$ for some i $\in$ [1, 12]. Draw your conclusion.

   (v) Use the command ar with method mle to find the order.

   (vi) Build an AR model based on the selected order for the change series. Perform model checking to validate the fitted model. Write down the model.

   (vii) Does the model imply the existence of business cycles in consumer sentiment? Why?

   (viii) Obtain 1-step to 4-step ahead point and 95% interval forecasts for the change series of consumer sentiment at the forecast origin August 1, 2013 (the last data point).

2. Following from Question 1:

   (i) Simplify the fitted AR model by removing parameter estimates with t-ratio less than 1.2 in absolute value. [Use the fixed subcommand.]

   (ii) Is the model adequate? Why?

   (iii) Compare the simplified model with the AR model built in Question 1. In terms of in-sample fitting, which model is preferred? Why?

   (iv) Use backtest to compare the two AR models. You may start the forecast origin at $t = 380$. Which model is preferred? Why?

3. The data set m-unempmean.txt contains the mean duration of unemployment is the U.S. from January 1948 to March 2014. The duration is measured in weeks.

   (i) Does the mean duration series have a unit root? Why?

   (ii) Focus on the change series of duration, i.e. the first differenced series. Denote the change series by rt and let $E(r_t) = \mu$. Test $H_0 : \mu = 0$ versus the alternative $H_1 : \mu \neq 1$. Draw your conclusion.

   (iii) Build an AR model for r_t series. Perform model checking using $gof = 24$. Is the model adequate? Why?

   (iv) Write down the fitted AR model.

   (v) Fit a seasonal model for the r_t series using the command $ms = arima(rt, order = c(2,0,1), seasonal = list(order = c(1,0,1), period = 12), include.mean = F)$ Perform model checking using $gof = 24$. Is the seasonal model adequate? Why?

   (vi) Based on the in-sample fitting, which model is preferred? Why?

   (vii) Consider out-of-sample predictions. Use $t = 750$ as the starting forecast origin. Which model is preferred based on the out-of-sample predictions?

4. The data set w-coilwtico.txt contains the weekly crude oil prices: West Texas Intermediate (WTI), Cushing, Oklahoma. The sample period is from January 3, 1986 to April 2, 2014.

   (i) Let r_t be the growth series, i.e. the first difference of log oil prices. Is there serial correlation in the rt series? You may use Q(10) to draw the conclusion.

   (ii) Build an AR model forr_t . Check the adequacy of the model, and write down the model.

   (iii) Fit another model to r_t using the following command $m5 = arima(rtn, order = c(3, 0, 2), include.mean = F)$ This is an ARIMA(3,0,2) model. Write down the model. Based on in-sample fitting, which model is preferred?

5. The data set m-PastorStambaugh.txt contains the monthly market liquidity measure of Professors Pastor and Stambaugh. Let x_t denote the variable PS level.

   (i) Build a time series model for x_t (the mean equation). Write down the fitted model.

   (ii) Is the model adequate? Why?

   (iii) Identify the largest outlier in the series. Refine the fitted model by using an indicator for the outlier. Write down the refined model.

   (iv) Further refine the model by fixing the least significant parameter to zero. Write down the revised model. 2.

6. The data set q-earn-msft.txt contains the quarterly earnings per share of Microsoft from the second quarter of 1986 to the third quarter of 2013. Let xt denote the logarithm of earnings.

   (i) Build a time series model for the log earnings series. Perform model checking and write down the fitted model. [For simplicity, you may ignore the outliers, if any.]

   (ii) Fit the following model to the log earnings series: m5=arima(xt,order=c(0,1,1),seasonal=list(order=c(0,0,1),period=4)), where xt denotes the log earnings series. Write down the fitted model.

   (iii) Compare the two time series models. Which model is preferred in terms of fitting? Why?

   (iv) Use backtest to compare the two models via 1-step ahead forecasts. You may use t = 81 as the starting forecast origin. Which model is preferred?

7. The data set m-FamaBlissdbndyields.txt contains monthly Fama-Bliss bond yields with maturities 1 and 3 years. Denote the yields by y_{1t} and y_{3t} , respectively.

   (i) Fit the linear regression model: $y_{3t} = \alpha + \beta y_{1t} + e_t$. Write down the fitted model. What is the R^2 ? Is the model adequate? Why?

   (ii) Let $d_{1t} = (1 - B)y_{1t}$ and $d_{2t} = (1 - B)y_{3t}$, where B is the back-shift operator and dit denotes the change in monthly bond yields. Consider the linear regression mode: $d_{3t} = \beta d_{1t} + e_t$. Write down the fitted model. What is the R2 ? Justify that it is appropriate to taking the first difference of the bond yields.

   (iii) Is the model in part (b) adequate? If not, refine the model and write down the refined model.

   (iv) Based on the refined model, describe the linear dependence between the bond yields.

   (v) Fit an AR(6) model to y_{3t} using y_{1t} as an explanatory variable. Write down the fitted model. You should include the intercept term in the model as the original data are used.

   (vi) Refine the model by letting the insignificant coefficients of lags 2 and 5 to zero. Write down the fitted model.

   (vii) Is the refined model adequate? Why?

8. The data set d-msft3dx0113.txt contains the daily returns of Microsoft (MSFT) stock from January 3, 2001 to December 31, 2013. Transform the simple returns (i.e., the column with heading msft to log returns).

   (i) Is the expected log return zero? Why? Are there any serial correlations in the log returns? Why?

   (ii) If there are serial correlations in the log return, build a mean equation for the log returns. Write down the fitted model. Is there ARCH effect in the log return series? Why?

   (iii) Fit a Gaussian ARMA-GARCH model to the log return series. Obtain the normal QQ-plot of the standardized residuals, and write down the fitted model. Is the model adequate? Why?

   (iv) Build an ARMA-GARCH model with Student-t innovations for the log return series (include option cond.dist = "std"). Perform model checking and write down the fitted model.

   (v) Obtain 1-step to 5-step ahead mean and volatility forecasts using the fitted ARMA-GARCH model with Student-t innovations (i.e., use predict()).