

CSC425 – Time series analysis and forecasting

Homework 3

Due on February 15th, 2013 before midnight

Total points: 30

Reading assignment

- Chapter 2 sections 2.4, 2.5, and 2.6 on AR/MA/ARMA models
- Chapter 2 sections 2.6, 2.7, 2.8, 2.9 on ARIMA
- Review course documents posted under week 4 and 5

PROBLEMS

Problem 1 [16 points] (review week 4 notes)

You are asked to analyze the daily conventional gasoline spot prices (in dollars per gallon) (Gallon). Gasoline price have impact on daily life. High prices results in high transportation and heating costs, and hence, higher prices for food and services. The data file oilprice.csv contains two variables: date and price, and they are obtained from the US Energy Information Administration website at <http://www.eia.gov>.

- a. Create a time plot of gasoline spot prices and discuss the trends over time.
- b. Compute the new time series for price changes: $rate = (p_t - p_{t-1}) / p_{t-1}$.
- c. Analyze the dynamic behavior of the price changes using the time plot of RATE, and its autocorrelation values (ACFs) (20 lags).
- d. Analyze the ACF and the PACF functions and determine which model is more appropriate to model this time series. Does the process show AR effects or MA effects?
- e. Fit an AR(6) model: run model diagnostics to examine the significance of model coefficients and analyze the residuals. If model contains non-significant parameters, remove the parameters and fit the model again. Stop when you reach a satisfactory model.
- f. Fit an MA(6) model run model diagnostics to examine the significance of model coefficients and analyze the residuals. If model contains non-significant parameters, remove the parameters and fit the model again. Stop when you reach a satisfactory model.
- g. Use backtesting procedure to compare the performance of the two models for forecasting.
- h. Identify the best model based on the results of your analysis. Write down the formula for the selected model.
- i. Using the selected final model, compute the 5 step-ahead forecasts with origin in the last observation.
- j. Discuss possible weaknesses of your model and analyses.

Problem 2 [12 points] (to be covered in Week 5)

Global temperatures are rising. Analyze the time series of Land-Ocean Temperature Index in degrees Celsius published at the NASA-GISS (Goddard Institute for Space Studies). The temperature index measures temperature anomalies that are computed relative to the base period 1951-1980. The reason to work with anomalies, rather than absolute temperature

is that absolute temperature varies markedly in short distances, while monthly or annual temperature anomalies are representative of a much larger region (from GISS website).

1. Plot the temperature index time series and its ACFs (20 lags). Analyze trends and patterns shown by the data.
2. Analyze if the series is stationary using both the ACF function and the Dickey Fuller test to check if TS is unit-root non-stationary.
3. Test if TS is white noise using the Ljung - Box test
4. Use order selection methods such as EACF or BIC to identify the order of the “best” AR/MA/ARMA model for the temperature index TS. Note that if you determine that the TS is non-stationary, you should use an ARIMA model on the first differenced time series.
5. Fit the selected ARIMA model, and write down the result.
6. Use residual analysis to check the model.
7. Compute up to 4-step ahead forecasts of the fitted model with origin at the end of the data, i.e. 2012. Write down the forecasts and their standard errors.

“Reflection” Problem [2 pts]

Post a message on the discussion board reflecting on the topics in week 5. Indicate the assignment in this module you found to be the easiest, the one you found to be the hardest, and why. I created a new Thread called “Week 5 Comments”.

Submission instructions

Submit the homework at the Course Web page <http://d2l.depaul.edu>. Keep a copy of all your submissions! If you have questions about the homework, email me BEFORE the deadline. The assignment will lose 10% of the points per day, after the due date. Assignments submitted five days after the deadline will not be accepted.