AAEC 6312: Applied Econometrics III
Homework 3: Due 12/14/2017

November 30, 2017

Your submission should be as professional as possible. Your grade will be proportional to the way you present your results. Just copying and pasting the software output will not earn you full credit.

1. The file CPIdata.xlsx contains quarterly data on U.S. CPI from 1960Q1 to 2012Q4.

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

   (b) Plot and examine the autocorrelation and partial autocorrelation functions (ACF and PACF).

   (c) Is the CPI series stationary? Formally test the stationarity of the series

   (d) Based on questions (b) and (c) propose at least three ARIMA models to study the CPI series and use all data in the sample to estimate them.

   (e) Use AIC and BIC to pick the best of the three models.

   (f) Compare the forecasting power of the three models by leaving out the last 50 observations. A graph showing the actual and the forecasted observed may help in this task.

2. In the previous problem, we assumed the CPI series has a constant variance. This assumption might not be appropriate.

   (a) Plot the squared residuals from your best model from problem 1. Can we assume the series is a constant variance one?

   (b) Formally test for ARCH or GARCH.

   (c) Estimate and ARCH(4) for the CPI series and interpret the results.

   (d) Estimate a GARCH(1,1) for the CPI series and interpret the results.

3. The number of customer arrivals per unit time at a supermarket checkout counter follows a Poisson distribution. Consider a random sample of the following 10 observations from this Poisson distribution $y_i = 5, 0, 1, 1, 0, 3, 2, 3, 4, 1$. The density of each observation is given by

$$f(y_i) = \frac{e^{-\theta}\theta^{y_i}}{y_i!}$$

(a) What is the likelihood function of this process?

(b) Using the sample, find the maximum likelihood estimate of θ.

(c) You consider to estimate θ using Bayesian procedure. To this end, you use Gamma distribution as a prior for θ. Derive the posterior distribution for θ.

(d) Using this posterior distribution, generate 10,000 draws and do the following

    i. Plot the cumulative density function (CDF).

    ii. What is the mean of θ?

    iii. What is the variance of θ?

    iv. Construct a confidence interval for θ.

    v. What is the probability that we observe less than 4 customers per minute?