

**Stat ST485/685, Project 6**  
**Due: Monday, December 6**

**(182 points)** In this project, you are asked to carry out time series modeling and analysis of **two** data sets. The models for each data set are specified in the instructions.

For each analysis, you should carry out the following steps. Your solution should be numbered accordingly.

1. Read in the data.
  - (a) Plot the data.
  - (b) Use the plot to make a preliminary assessment of stationarity.
  - (c) Plot the sample acf/pacf.
  - (d) Use the plot to make observations about possible orders of dependency.
2. Estimate the parameters in the specified model using the specified method.
  - (a) Give the estimated coefficients.
  - (b) Give the value of the AIC or AICC.
  - (c) Plot the model and sample acf/pacf.
  - (d) Use the plot from (c) **to assess** the quality of the model fit.
3. Analyze the standardized residuals.
  - (a) Plot the standardized residuals.
  - (b) Plot the sample acf/pacf for the standardized residuals.
  - (c) Assess the plots for the hypothesis that the residuals are iid.
  - (d) Evaluate the Ljung-Box and McLeod-Li statistics and indicate if they support rejection of the iid hypothesis.
  - (e) Give a final assessment on the validity of the iid hypothesis.
4. Use the results to give a summary evaluation about the quality of the fitted model.

*Be sure to label all plots and include your code after your answers.*

1. You will treat the data in gnp-47-02D.txt. This is the quarterly US GNP from 1947 (first quarter) to 2002 (third quarter) in billions of 1996 US dollars seasonally adjusted. The data has been differenced with lag 1. From P. Brockwell and R. Davis, Time Series: Theory and Methods, Springer-Verlag, 1991.
  - (a) Use the MLE to fit an MA(2) model. Perform the analysis steps listed above.
  - (b) Use the MLE to fit an AR(2) model. Perform the analysis steps listed above.
  - (c) Use MLE to fit an ARMA(1, 1) model. Perform the analysis step listed above.
  - (d) Use the results from (a) - (c) to decide which model is best and provide a reason for your choice.

2. You will treat the data in `apc.txt`. This is the monthly private housing units started in the U.S.A. From P. Brockwell and R. Davis, Time Series: Theory and Methods, Springer-Verlag, 1991.
- (a) Use MLE to fit an ARMA(3, 2) model to the data. Perform the analysis steps listed above. *Do not difference the data.*
  - (b) Use the MLE to fit an ARMA(1, 1) model to the **differenced** data  $\{\nabla x_t\}$ . *Difference the data, then center the differenced data by subtracting the sample mean of the differenced data. Perform the analysis steps listed above on the centered, differenced data. Perform a single difference on the data.*
  - (c) Use the results from (a) and (b) to decide which model is best and give a reason for your choice.

Some general comments:

Subtract the sample mean from the data sets.  
Repeat all four steps for each model.  
Plot the acv/pacf values for 40 lags.  
Use lag 20 for the L-B and M-L statistical tests.