National Taiwan University
Institute of Industrial Engineering
Jakey BLUE

Time Series Analytics

109-1 Homework #06

Due at 23h59, November 29 2020; files uploaded to NTU-COOL

1. (20%) Simulate a time series y_t of length $n = 100$ following an ARMA(1,1) model with $\phi = 0.8$ and $\theta = 0.4$.
   (a) Calculate and plot the **theoretical** autocorrelation function for this model. Plot sufficient lags until the correlations are negligible.
   (b) Calculate and plot the **sample** ACF for your simulated series. How well do the values and patterns match the theoretical ACF from part (a)?
   (c) Calculate and interpret the sample EACF for this series. Does the EACF help you specify the correct orders for the model?
   (d) Repeat parts (b) and (c) with a new simulation using the same parameter values but sample size $n = 48$.
   (e) Repeat parts (b) and (c) with a new simulation using the same parameter values but sample size $n = 200$.

2. (10%) Simulate an ARMA(1,1) series with $\phi = 0.7, \theta = -0.6, n = 48$ but with error terms from a t-distribution with degrees of freedom 6.
   (a) Display the sample EACF of the series. Is an ARMA(1,1) model suggested?
   (b) Estimate ϕ and θ from the series and comment on the results.

3. (20%) The data file named robot contains a time series obtained from an industrial robot. The robot was put through a sequence of maneuvers, and the distance from a desired ending point was recorded in inches.
   (a) Display the time series plot of the data. Based on this information, do these data appear to come from a stationary or nonstationary process?
   (b) Calculate and plot the sample ACF and PACF for these data. Based on this additional information, do these data appear to come from a stationary or nonstationary process?
   (c) Calculate and interpret the sample EACF.
   (d) Estimate the parameters of an AR(1) model and IMA(1, 1) for these data, respectively.
   (e) Compare the results from parts (d) in terms of AIC and discuss the residual tests.