



## Time Series Analytics

109-1 Homework #07

**Due at 23h59, December 06 2020; files uploaded to NTU-COOL**

1. (10%) Given the model  $y_t = a + bt + c_t + x_t$ , where  $a, b$  are constants,  $c_t$  is deterministic and periodic with period  $s$  and  $x_t$  is a  $\text{SARIMA}(p, 0, q) \times (P, 1, Q)_s$ . What is the model for  $w_t = y_t - y_{t-s}$ ?
2. (10%) Identify the following as certain multiplicative SARIMA models:
  - (a)  $y_t = 0.5y_{t-1} + y_{t-4} - 0.5y_{t-5} + a_t - 0.3a_{t-1}$
  - (b)  $y_t = y_{t-1} + y_{t-12} - y_{t-13} + a_t - 0.5a_{t-1} - 0.5a_{t-12} + 0.25a_{t-13}$
3. (10%) If the characteristic function of an AR time series model is
$$(1 - 1.6B + 0.7B^2)(1 - 0.8B^{12})$$
  - (a) Is the model stationary?
  - (b) Identify the model as a certain SARIMA model.
4. (15%) Suppose  $y_t = y_{t-4} + a_t$  with  $y_t = a_t$ , for  $t = 1, 2, 3, 4$ .
  - (a) Find the variance function for  $y_t$ .
  - (b) Find the autocorrelation function for  $y_t$ .
  - (c) Identify the model for  $y_t$  as a certain SARIMA model.
5. (15%) Consider the famous time series data “co2” (monthly carbon dioxide through 11 years in Alert, Canada).
  - (a) Fit a deterministic regression model in terms of months and time. Are the regression coefficients significant? What is the adjusted R-squared? (Note that the month variable should be treated as categorical and transformed into 11 dummy variables.)
  - (b) Identify, estimate the SARIMA model for the co2 level.
  - (c) Compare the two models above, what do you observe?