

# ASSIGNMENT 4

STAT 485/685 E100/G100: Applied Time Series Analysis

Fall 2020

Simon Fraser University

This week's assignment will be based on moving average (MA), autoregressive (AR) and autoregressive moving average (ARMA) models. The topics here have been covered in the Week 5 & 6 videos, as well as Chapter 4 of the textbook *Time Series Analysis with Applications in R (2nd ed.)* by Cryer & Chan.<sup>1</sup>

Due date: **Friday, Oct. 23rd at 11:59 pm (end of day)** (Pacific Time).

Marks: 10.

Important policies on assignment submissions:

- Please write each question on a **separate page!** This is important for the purposes of Crowdmark.
- Please **show all your work**, in order to get full marks.
- Upload your complete answers as PDF files or high-resolution images.
- If you're hand-writing answers, please make sure they are **neat and clearly readable**, and that the photo is high resolution. There may be penalties if the marker cannot clearly read your answers.
- Please **clearly label the question numbers**.

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<sup>1</sup>Cryer, J. D., & Chan, K. S. (2008). *Time series analysis: with applications in R*. Springer Science and Business Media.

1. (4 marks) Consider the following AR model:

$$Y_t = 0.8Y_{t-1} + e_t$$

Suppose that the variance of the white noise process terms is  $\sigma_e^2 = 1$ .

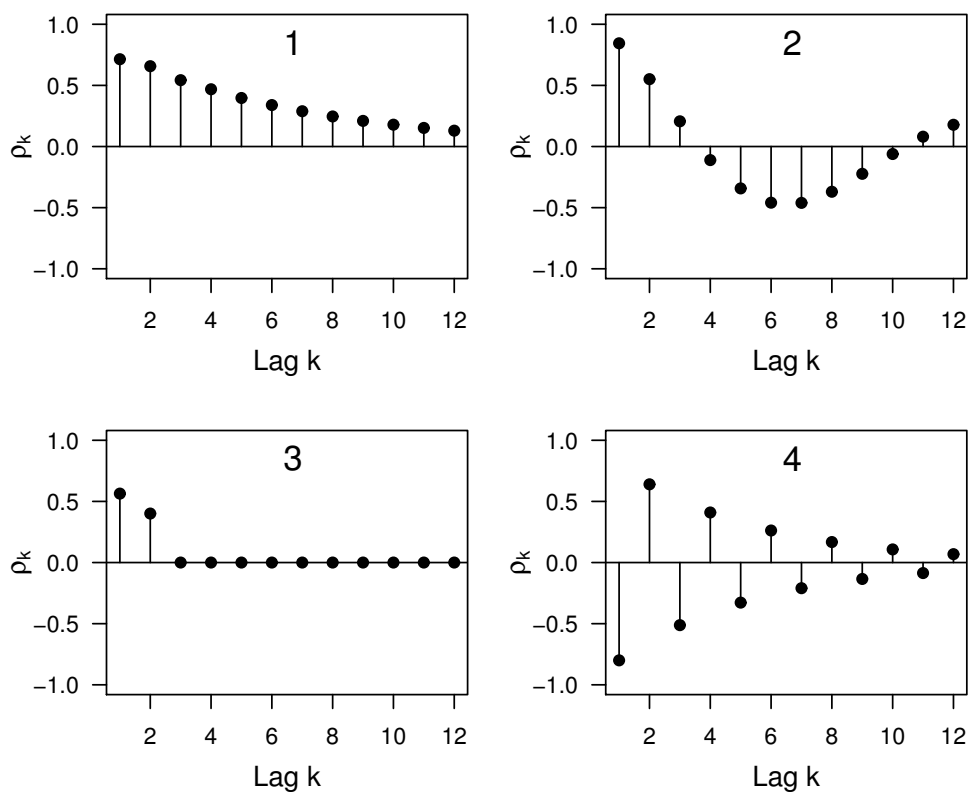
- (a) What is the order  $p$  of this model? Give the values of each of its  $\phi$ -parameters.
- (b) Using the results we have obtained in this week's videos, give the values of the mean function, autocovariance function and autocorrelation function for this model.
- (c) Sketch what you think each of the following plots might look like:
  - (i)  $Y_t$  vs.  $Y_{t-1}$
  - (ii)  $Y_t$  vs.  $Y_{t-2}$
- (d) Sketch the autocorrelation function for this model (i.e.,  $\rho_k$  vs.  $k$ ).

2. (1 mark) Consider the following AR(2) model:

$$Y_t = 0.9Y_{t-1} - 0.1Y_{t-2} + e_t$$

Is this model stationary? Show all your work.

3. (4 marks) Consider the following four autocorrelation plots:



For each of the models below, choose one of the four plots, 1-4, that best represents what you think  $\rho_k$  will look like. Explain your reasoning.

- (a) AR(2), with  $\phi_1 = 1.6$  and  $\phi_2 = -0.8$
- (b) MA(2), with  $\theta_1 = -0.7$  and  $\theta_2 = -0.99$
- (c) AR(2), with  $\phi_1 = 0.5$  and  $\phi_2 = 0.3$
- (d) AR(1), with  $\phi = -0.8$

4. (1 mark) Consider the following model:

$$Y_t = 0.2Y_{t-1} - 0.4Y_{t-2} + e_t - 0.8e_{t-1}$$

State the name of this model (MA, AR or ARMA), give its order(s)  $p$  and/or  $q$ , and give all values of the  $\theta$ - and/or  $\phi$ -parameters. (Hint: Be very careful about the signs of the parameters!)