ASSIGNMENT 3

STAT 485/685 E100/G100: Applied Time Series Analysis
Fall 2020
Simon Fraser University

This week's assignment will be based on general linear models and moving average (MA) models. The topics here have been covered in the Week 5 videos, as well as Sections 4.1 - 4.2 of the textbook *Time Series Analysis with Applications in R (2nd ed.)* by Cryer & Chan.[1]

Due date: **Saturday, Oct. 17th at 11:59 pm (end of day)** (Pacific Time). (Due date is on a Saturday instead of a Friday for this assignment, due to the instructor uploading the questions late.)

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

1. *(1 mark) (Exercise 4.4 in Cryer & Chan.)* Show that, for the MA(1) process $Y_t = e_t - \theta e_{t-1}$, the autocorrelation function does not change when θ is replaced by $1/\theta$.

2. *(5 marks)* Consider the following MA model:

$$Y_t = e_t + 0.8e_{t-1} + 0.9e_{t-2}$$

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

   (a) What is the order q of this model? Give the values of each of its θ 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. *(Hint: Remember to include each possible case: all the different values that k might take on.)*

   (c) Sketch what you think each of the following plots might look like, and explain your reasoning for each:

      (i) Y_t vs. Y_{t-1}

      (ii) Y_t vs. Y_{t-2}

      (iii) Y_t vs. Y_{t-3}

3. *(1 mark)* Consider an MA model that results in the following plots of Y_t vs. Y_{t-1}, Y_t vs. Y_{t-2} and Y_t vs. Y_{t-3}:
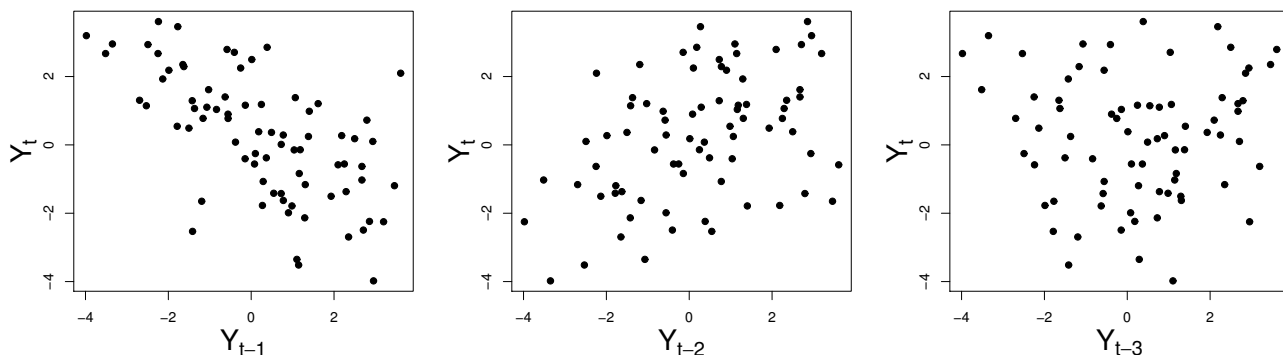
   Based on the above plots, what do you believe to be the order q of this model? Explain your reasoning.

4. *(3 marks)* Consider an MA(1) model that results in the following plots of Y_t vs. Y_{t-1} and Y_t vs. Y_{t-2}:
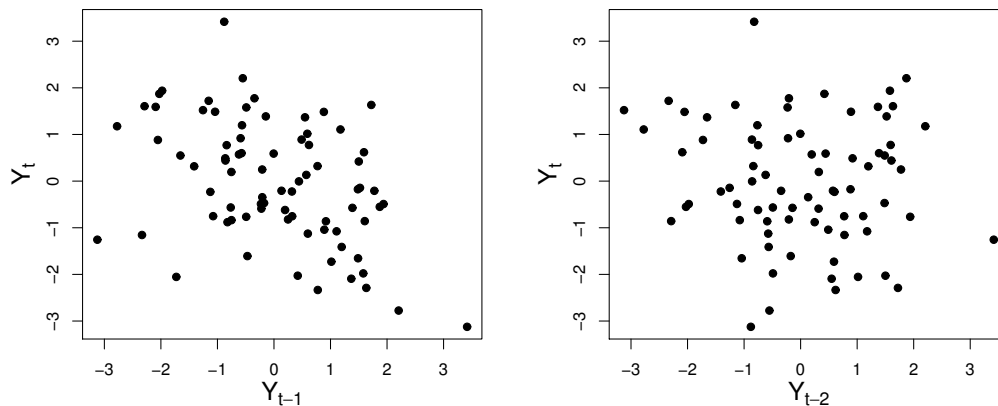
(a) Based on the above plots, give an estimate of the lag-1 autocorrelation ρ_1 for this model.

(b) Use your estimate in (a) to obtain two possible estimates of the parameter θ. *(Hint: You will need the equation for the solution of a quadratic function: if $ax^2 + bx + c = 0$, then $x = (-b \pm \sqrt{b^2 - 4ac})/(2a)$.) (Hint #2: There will be no real solution if your estimate in part (a) is > 0.5 or < -0.5, so change the estimate if needed.)*

(c) If we knew that the value of θ was restricted to be $-1 < \theta < 1$, which estimate from (b) would you choose?

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