Problem 1

In problem 1, I proved that the kurtosis function is biased, and the skewness function is not biased. Here are the steps

Steps

1. Sample 100,000 standardized random normal values.
2. Calculate the kurtosis
3. Sample the kurtosis by repeating steps 1 and 2 100 times.
4. Calculate the mean kurtosis $\overline{k}$ and standard deviation S_k
5. Calculate the T statistic ($\mu_0 = 0$).
6. Use the CDF function to find the p-value of the absolute value of the statistic and subtract from 1. Multiply the value by 2 because this is a 2 sided test.
7. If the value is lower than your threshold (typically 5%), then you reject the hypothesis that the kurtosis function is unbiased.

The result shows that

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Reject the null hypothesis that the kurtosis function is unbiased.
Fail to reject the null hypothesis that the skewness function is unbiased
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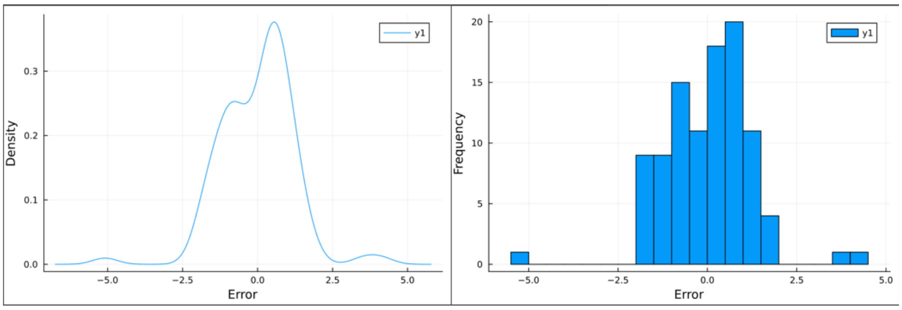
Problem 2

OLS fit:



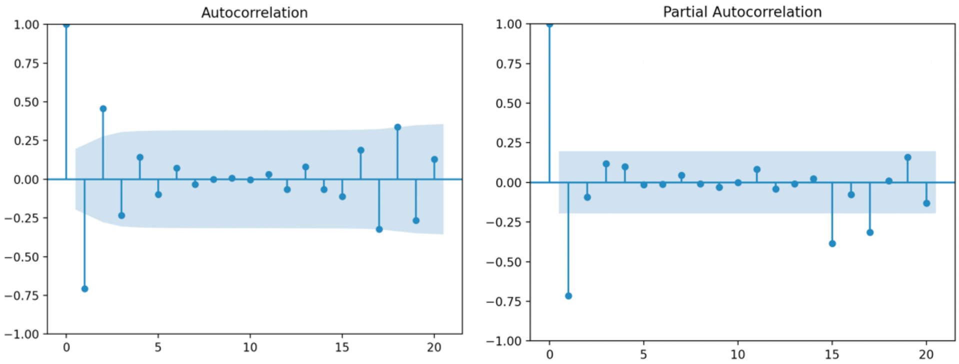
Error Vector = 0.6052048166519023

This Distribution is not a very well fit for a normal distribution and it is a left skew distribution.

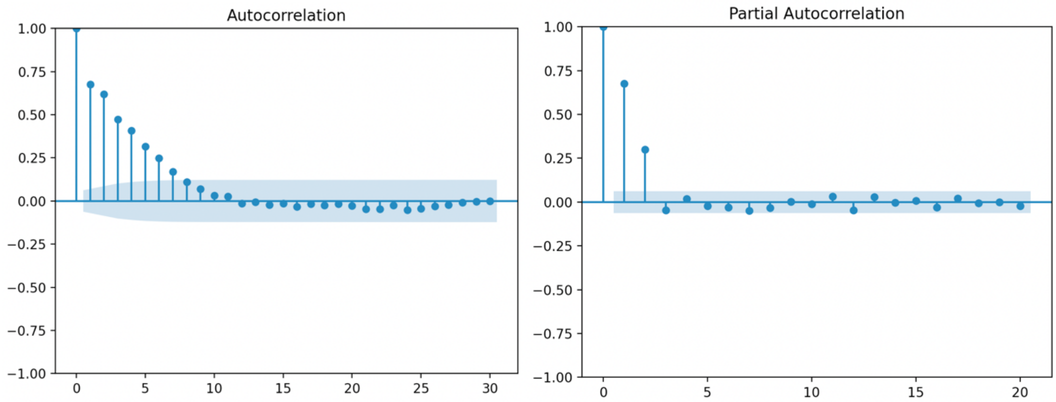
After applying the MLE given the assumption of normality, it shows that MLE is the better fit. Because the error of MLE is smaller than the OLS fit. Since the normality assumption is broken, it affects the estimation of the coefficient and the fitted parameters. So we should check the assumption and make sure we have a close distribution before the estimation.

Problem 3

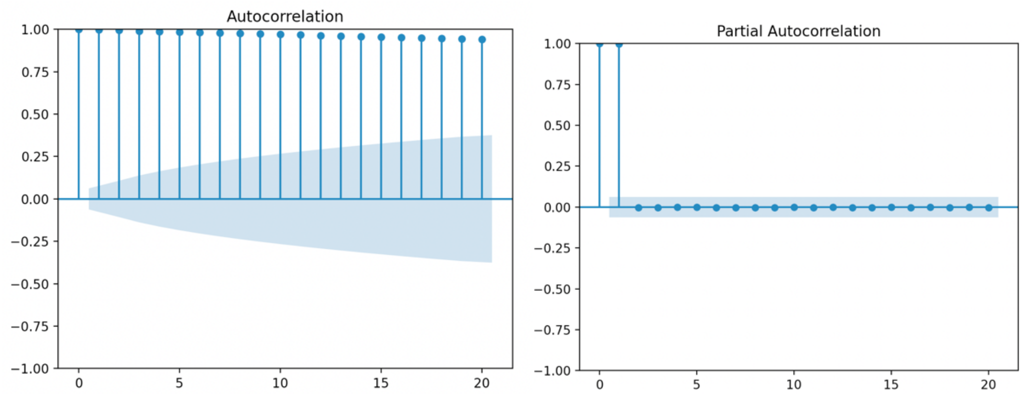
AR(1)



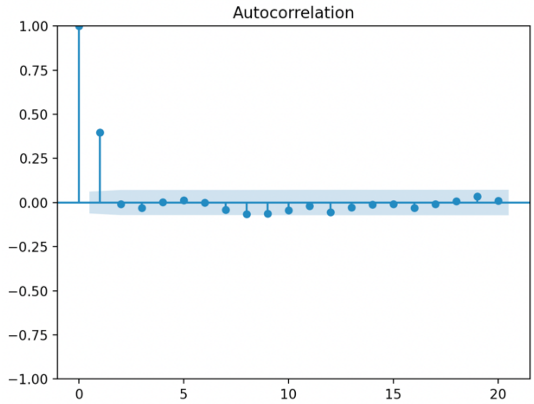
AR(2)

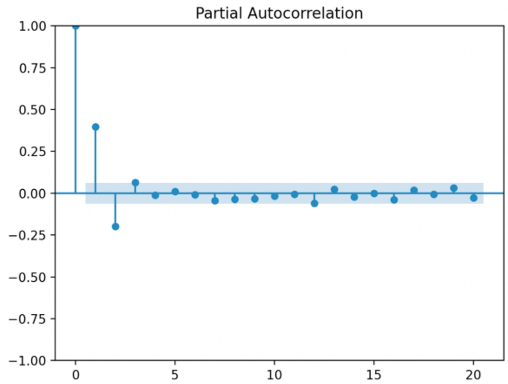


AR(3)

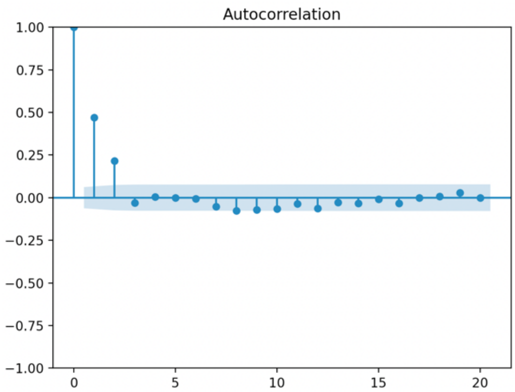


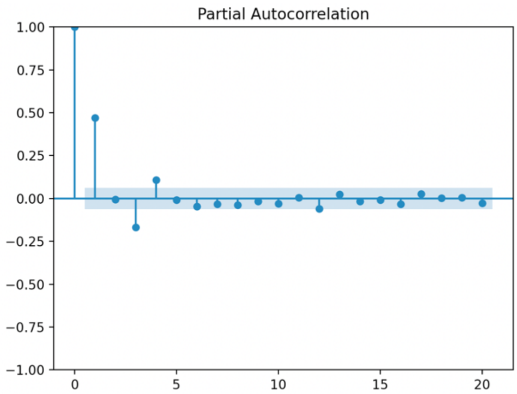
MA(1)


Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20

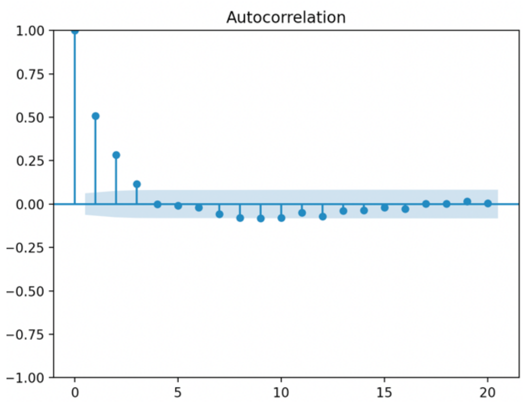

Partial Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20

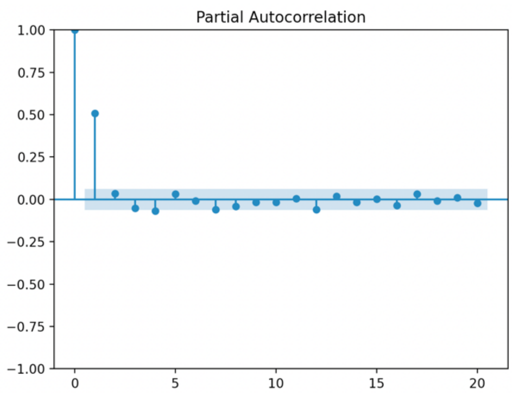
MA(2)


Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20


Partial Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20

MA(3)


Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20


Partial Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20

AR(1) through AR(3): both ACF and PACF have relatively high value at the beginning, but the PACF graphs shrinks to 0 way faster than ACF. And as the order increases, the ACF goes to 0 slower and slower. As the order increases, the PACF decrease more rapidly

MA(1) through MA(3): both ACF and PACF have relatively high value at the beginning, but the PACF graphs shrinks to 0 way faster than ACF. Compare to AR(p), MA(p) has more similar ACF and PACF graph