Fintech 545
HW1

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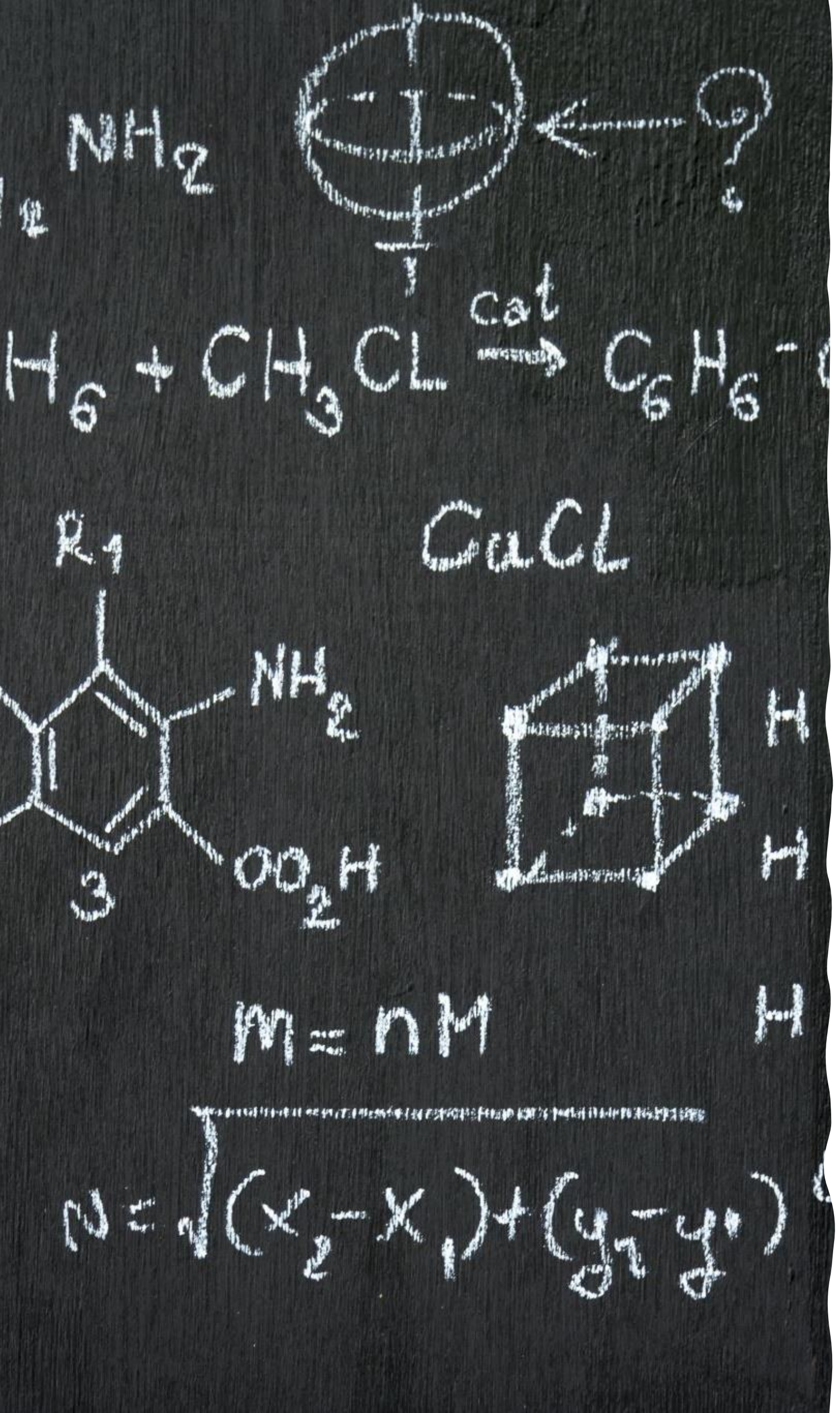


Problem 1

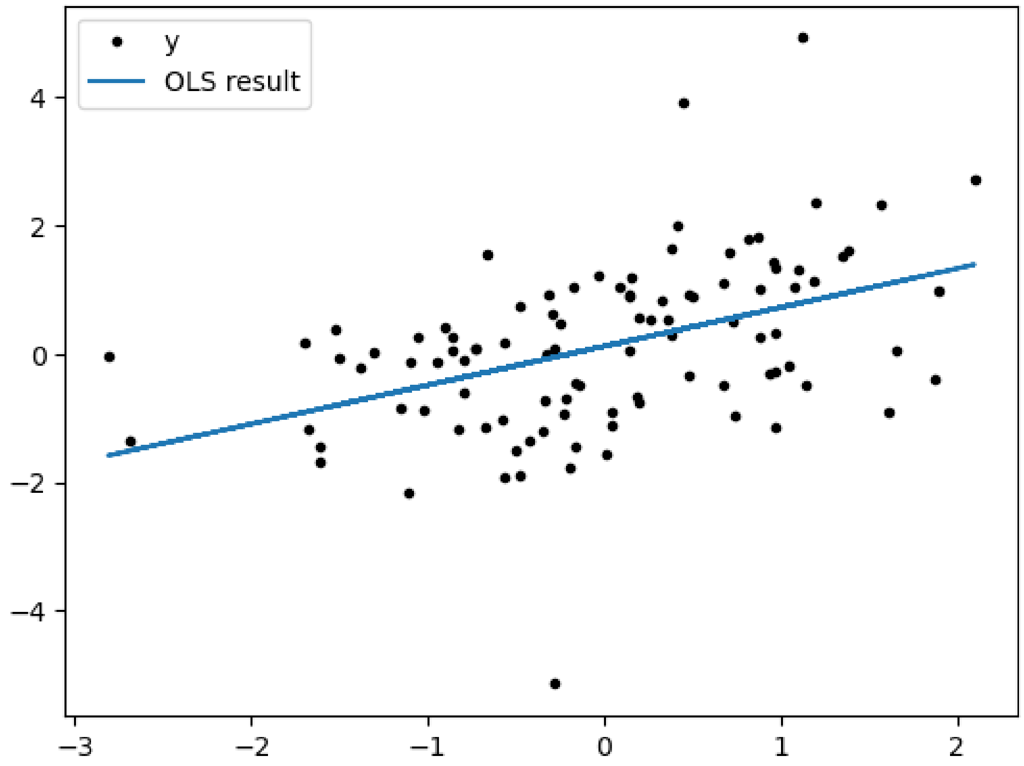
- Question : Remember from last week we discussed that skewness and kurtosis functions in statistical packages are often biased. Is your function biased? Prove or disprove your hypothesis.

- **Ans: My function and packages are biased.**
- Reason:
- The skewness calculated from my function: 0.002496781058375659,
- The excess kurtosis calculated from my function: -0.0027746871508631797.
- These two numbers are smaller than the threshold(0.05) so that we can reject the null hypothesis that they are unbiased.

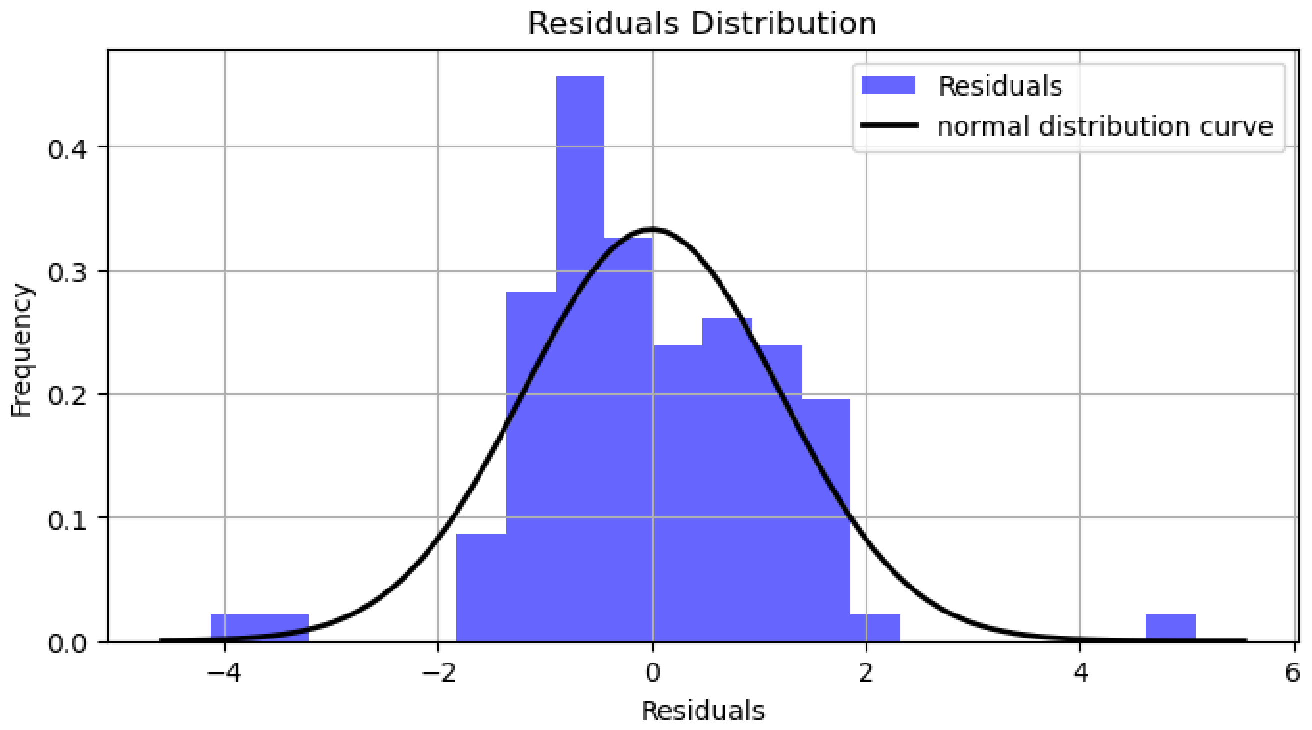
Problem2

- Question:
- (a). Fit the data in problem2.csv using OLS and calculate the error vector. Look at its distribution. How well does it fit the assumption of normally distributed errors?
- (b). Fit the data using MLE given the assumption of normality. Then fit the MLE using the assumption of a T distribution of the errors. Which is the best fit?
- (c). What are the fitted parameters of each and how do they compare? What does this tell us about the breaking of the normality assumption in regard to expected values in this case?

Problem 2(A)



y
OLS result
4
2
0
−2
−4
−3
−2
−1
0
1
2



Residuals Distribution
Residuals
normal distribution curve
Frequency
0.4
0.3
0.2
0.1
0.0
−4
−2
0
2
4
6
Residuals

Problem 2(A)

- Ans: Based on these two graphs, we can see that error factor does fit normal distribution a little bit. However, it is still not a good fit. Thus, I don’t think error vector is following the normal distribution.

Problem 2(B)

- Question: Fit the data using MLE given the assumption of normality. Then fit the MLE using the assumption of a T distribution of the errors. Which is the best fit?

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SSE for normal distribution: 143.61484854062613, AIC: 325.9841933783248, BIC: 333.79970393628906
SSE for t-distribution: 144.06627090325546, AIC: 319.030574551578, BIC: 329.45125529553036
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Problem 2(B)

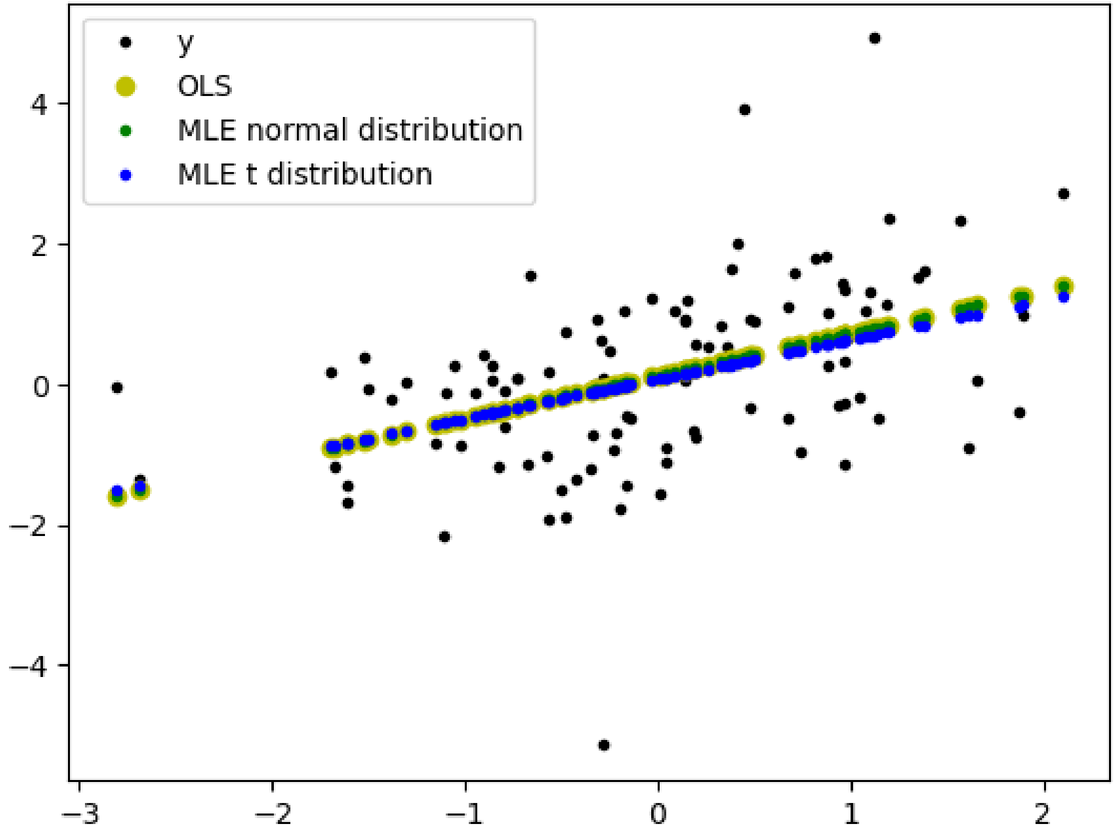
- Ans: We can see that SSE, AIC, BIC of t-distribution are all lower than normal-distribution so that we can make a conclusion that t-distribution fits better than normal-distribution.

Problem 2(C)

- Question: What are the fitted parameters of each and how do they compare? What does this tell us about the breaking of the normality assumption regarding expected values in this case?

Problem 2(C)

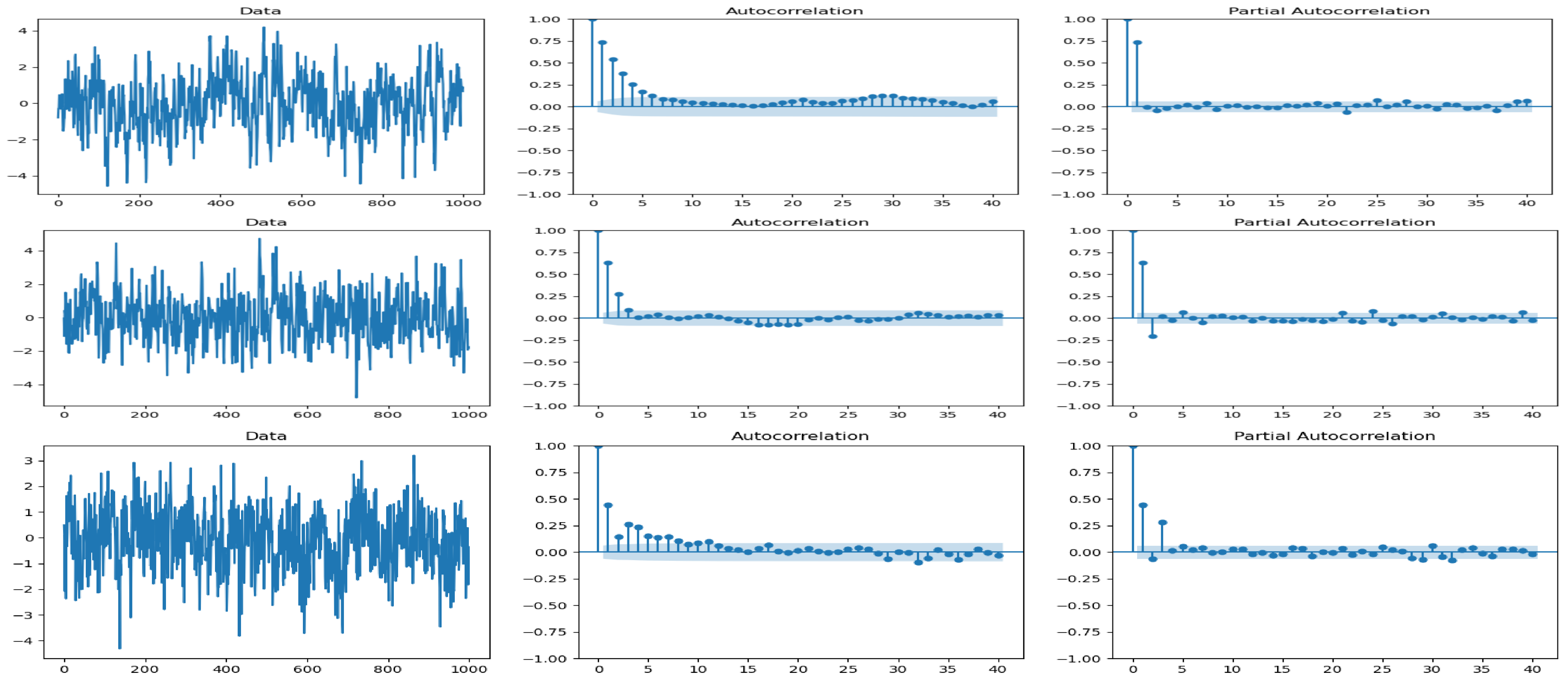
- Ans: As we can see, these two parameters(OLS & MLE) are very close, but they are not the same, which means that if we break the assumption of normality, we may get an unreliable model fitting.



Problem 3

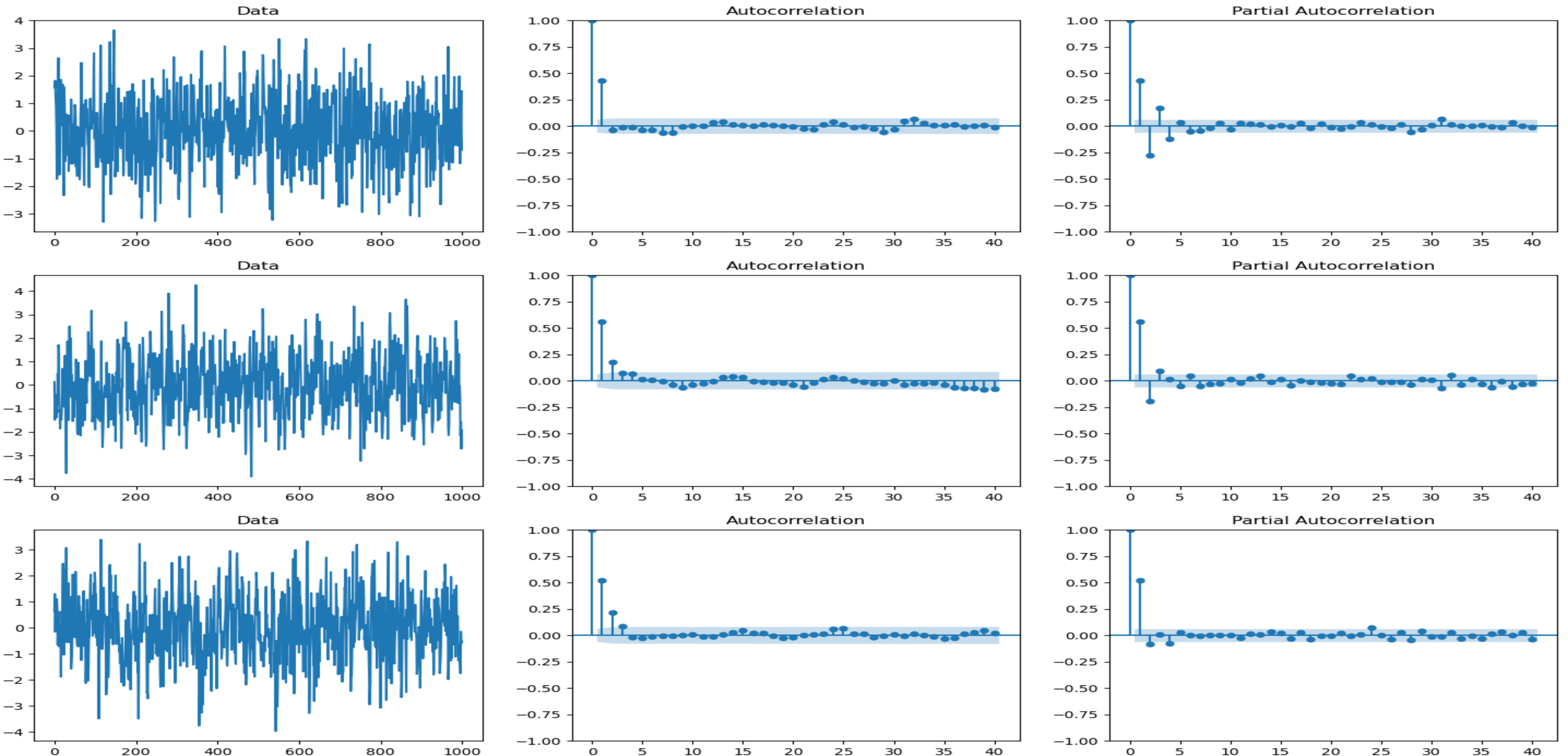
- Question: Simulate AR(1) through AR(3) and MA(1) through MA(3) processes. Compare their ACF and PACF graphs. How do the graphs help us to identify the type and order of each process?

AR(1) to AR(3)



Data
Autocorrelation
Partial Autocorrelation
Data
Autocorrelation
Partial Autocorrelation
Data
Autocorrelation
Partial Autocorrelation

MA(1) to MA(3)



Data
Autocorrelation
Partial Autocorrelation
Data
Autocorrelation
Partial Autocorrelation
Data
Autocorrelation
Partial Autocorrelation

Problem 3

- Ans: For AR, ACF decays more slowly than PACF, meaning that the autocorrelation pattern can be explained more easily by adding AR terms than by adding MA terms. And it looks the same for MA.