Question 1:

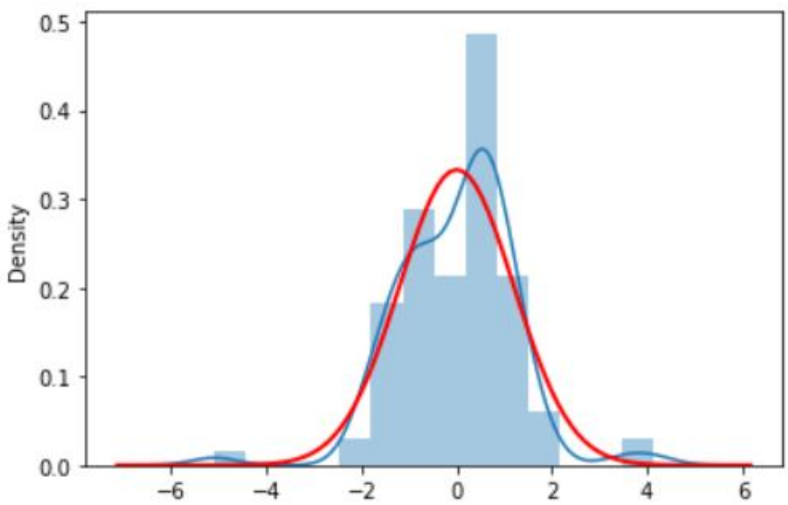
My function is unbiased when the sample size is large while biased when it is really small. Here is the skweness and kurtosis caculated by my function and function in python respectively with a large sample size.

```
skewness based on my function: 0.2353731049770189 skewness based on python: 0.23537310497701916
kurtosis based on my function: -0.251705164369591l kurtosis based on python: -0.25170516436959023
```

Question 2:

a)

The distribution of the error vector fits the assumption of normally distributed errors pretty well. In the graph, the blue line represents the distribution of the error vector, and the red line represents the normal distribution. Except for some outliers, the blue line fits the red line mainly.



b)

Error terms have similar log likelihood under normality and t distribution which are -159.99 and -161.78 respectively. However, T distribution fits better since it has both a smaller AIC and BIC compared with the normal distribution.

```
Normal AIC:   163.9946134818374
Normal BIC:   169.20495385381358
t AIC:   167.78162891109736
t BIC:   175.59713946906163
```

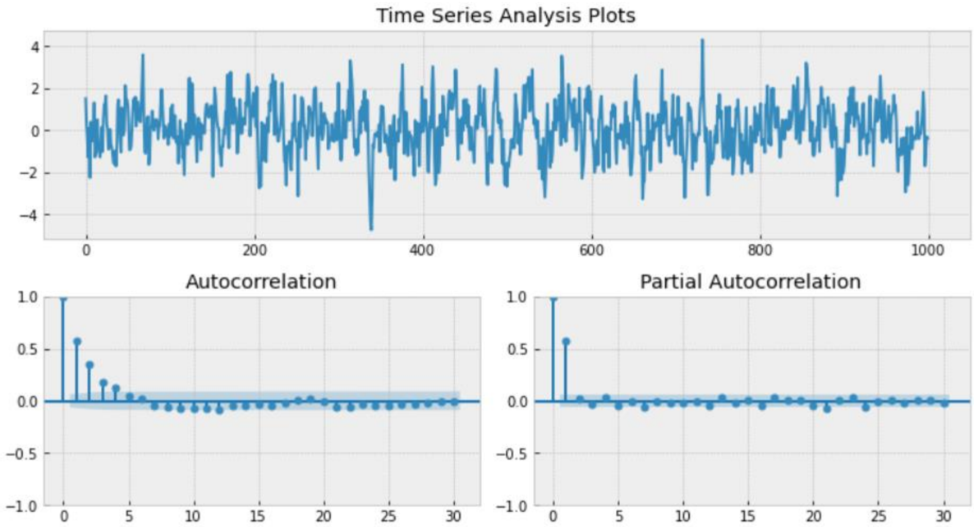
c)

The fitted parameters for normal distribution should be mean and standard deviation, while for t distribution, they should be mean, standard deviation, and degree of freedom. The t distribution has a fatter tail than the normal distribution, so if more data deviated from the mean, the t distribution would be a better choice. We do not need to stick to normal distribution but should be more flexible and use different distributions based on different kinds of data.

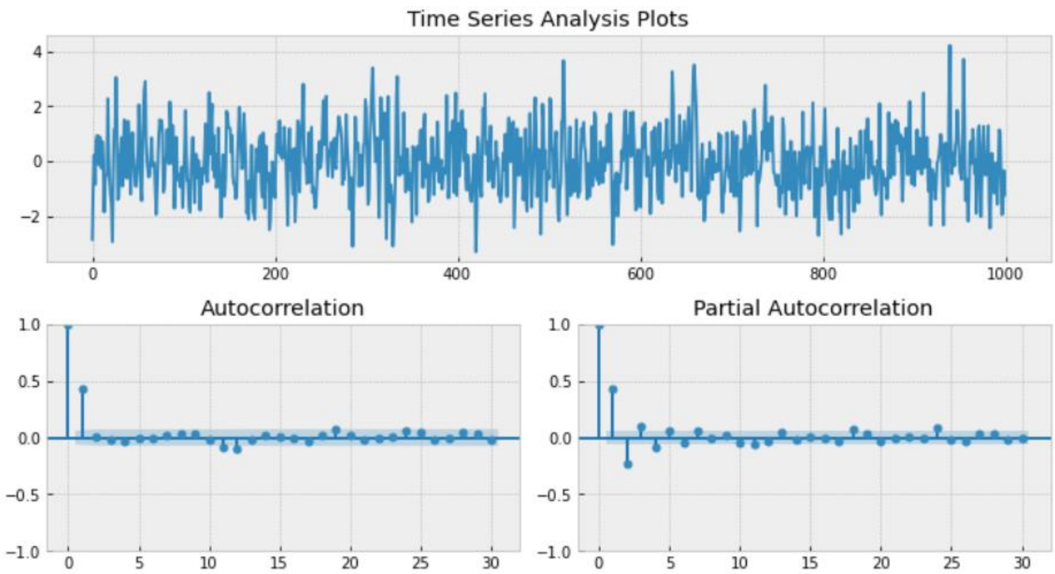
Question 3:

Comparing the graphs of ACF of AR(1) and PACF of AR(1), it is evident that there is a steady and kind smooth decrease in autocorrelation while a dramatic decrease in partial autocorrelation. However, comparing graphs of ACF of MA(1) and PACF of MA(1), such a difference becomes not apparent, and the PACF even shows a more steady decrease than ACF. The reason behind it is that AR is mainly determined by the previous value, which has a relatively strong correlation with the present value. In contrast, the MA is mainly determined by the error term, which has nearly no correlation with each other, so it will decrease dramatically.

AR(1)



MA(1)



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