P1.

1. According to Formula,

$$\mu_n = \int_{-\infty}^{\infty} (x - c)^n f(x) dx = E[(x - c)^n]$$

We set c = 0, we can get moment 1 is mean, moment 2 is variance, moment 3 is skewness, moment 4 is Kurtosis.

Therefore, based on the data, I have

Mean = 1.04897039

Variance = 5.42722068

Skewness = 0.88060864

Kurtosis = 23.12220079

2. I will use pandas package to calculate moment value directly

Mean = 1.0489703904839582

Variance = 5.427220681881727

Skewness = 0.8819320922598395

Kurtosis = 23.2442534696162

3. I think package is biased because its value is different from what I calculated in question 1.

P2.

1.

For OLS, Beta0 = -0.087384, Beta1 = 0.775274, Sigma = 1.003756319417732

For MLE, Beta0 = -0.08738422 Beta1 = 0.77527366, Sigma = 1.0037567839833497

All values are very close

2.

For MLE, Beta0 = -0.08738422 Beta1 = 0.77527366, Sigma = 1.0037567839833497

For MLE_T, Beta0 = -0.09619478 Beta1 = 0.72657001, Sigma = 1.0

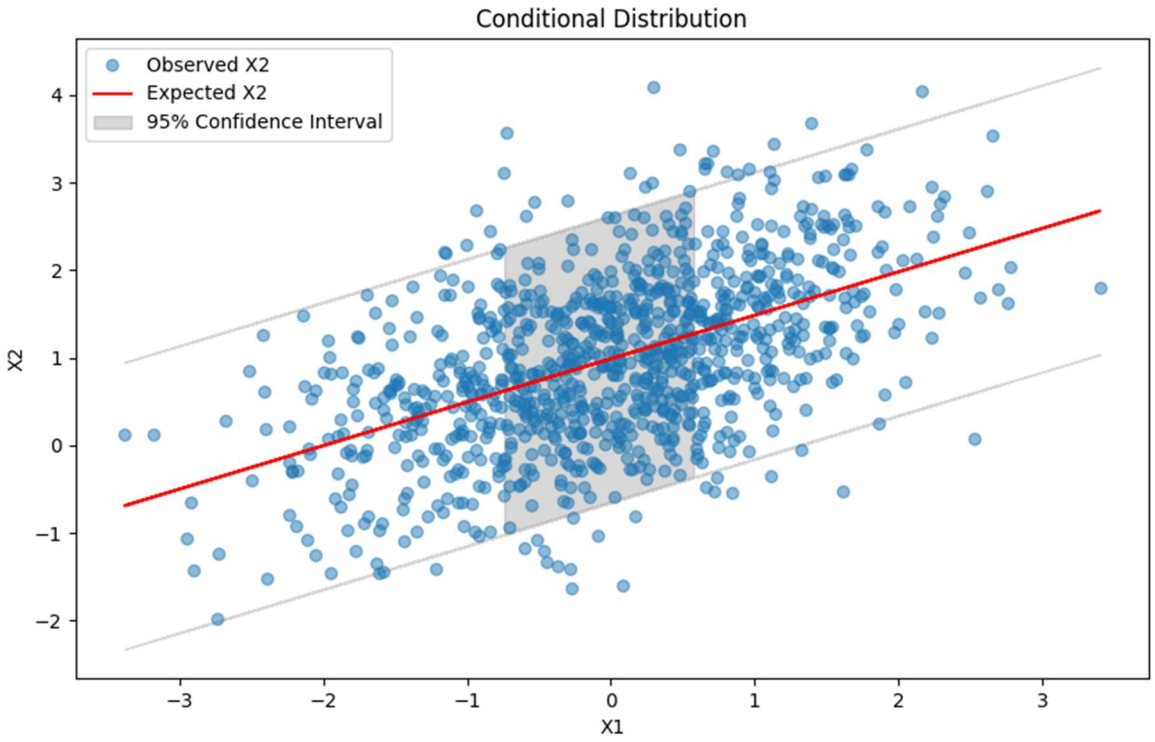
I search online and try to use AIC to judge which model is the best.

AIC: 573.0751261089839

AIC(T-distribution): 572.1664483328211

The AIC value for different models is shown above, and the smallest AIC value means the best mode, thus, the MLE_T distribution model is the best fit

3.



P3.

After fit the data in csv file using AR(1) through AR(3) and MA(1) through MA(3) respectively, I search online and try to use AIC to judge which model is the best.

AR(1): 1644.6555047688475

AR(2): 1581.0792659049775

AR(3): 1436.6598066945853

MA(1): 1567.4036263707862

MA(2): 1537.9412063807385

MA(3): 1536.867708735029

The AIC value for different models is shown above, and the smallest AIC value means the best mode, thus, the AR(3) is the best fit.