STA642 hw3

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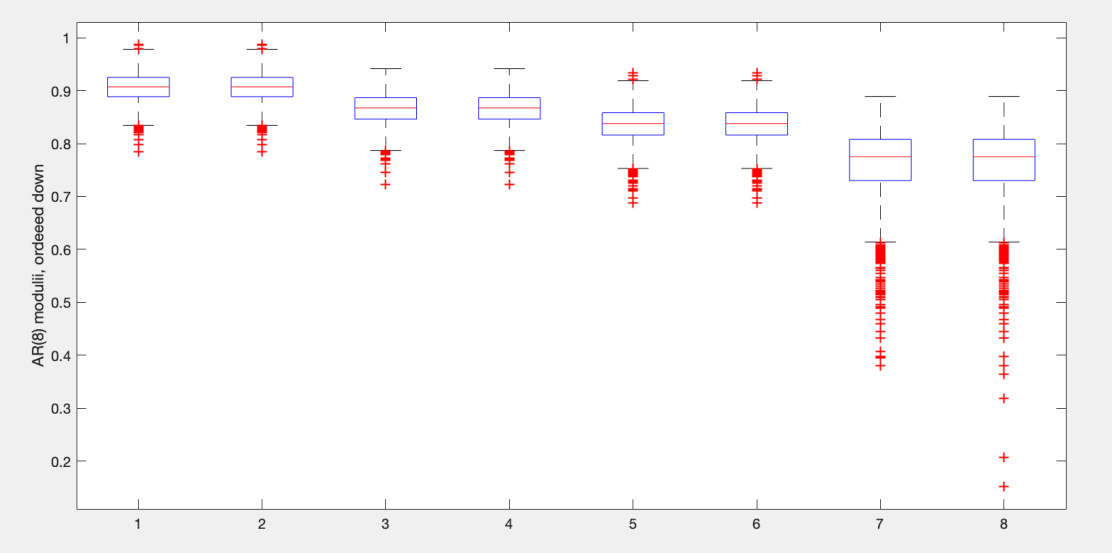
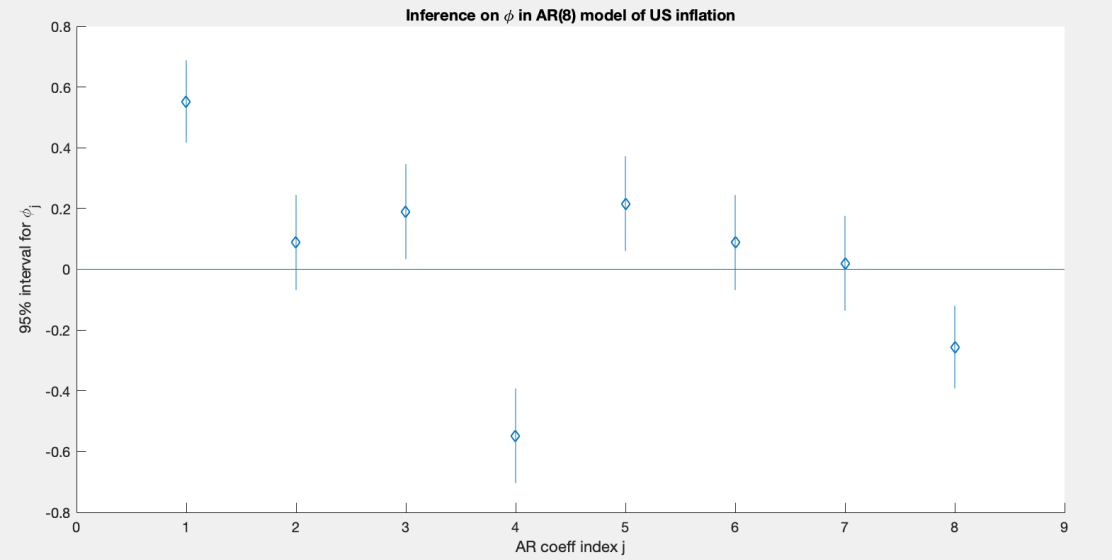
# Q3

## (a)

I do think that the data-model match supports stationarity. Based on the plots of the modulus of eigenvalues of transition matrix G, each of them is smaller than 1, which implies stationarity. On the other hand, the probability of non-stationarity based on the posterior sample is 0. This is another indication of stationarity.

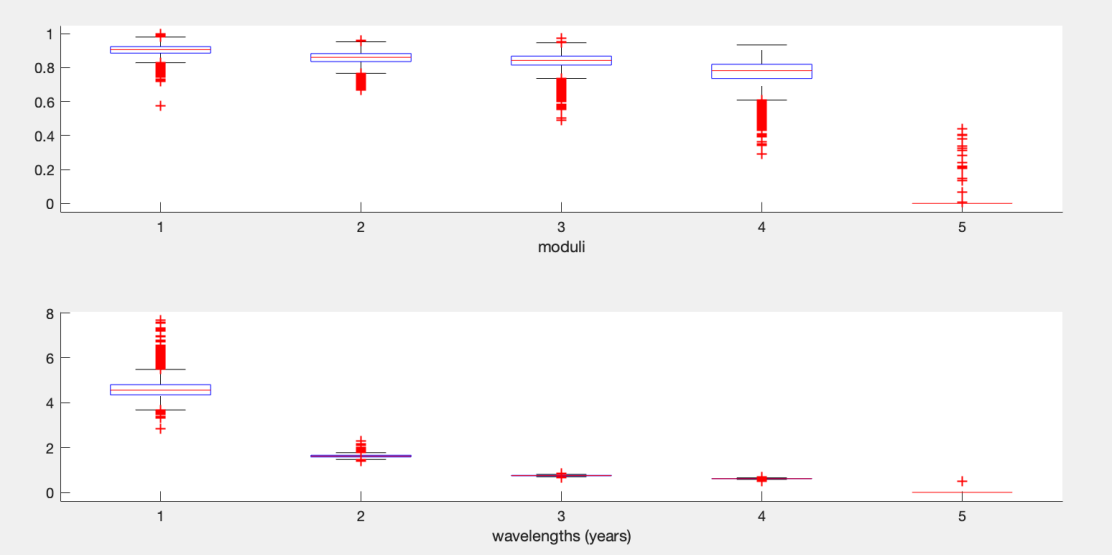
Numerically, The modulus of 4 pairs of complex conjugates are 0.9051, 0.8590, 0.8354, 0.7791 based on the $\phi$ computed from posterior.

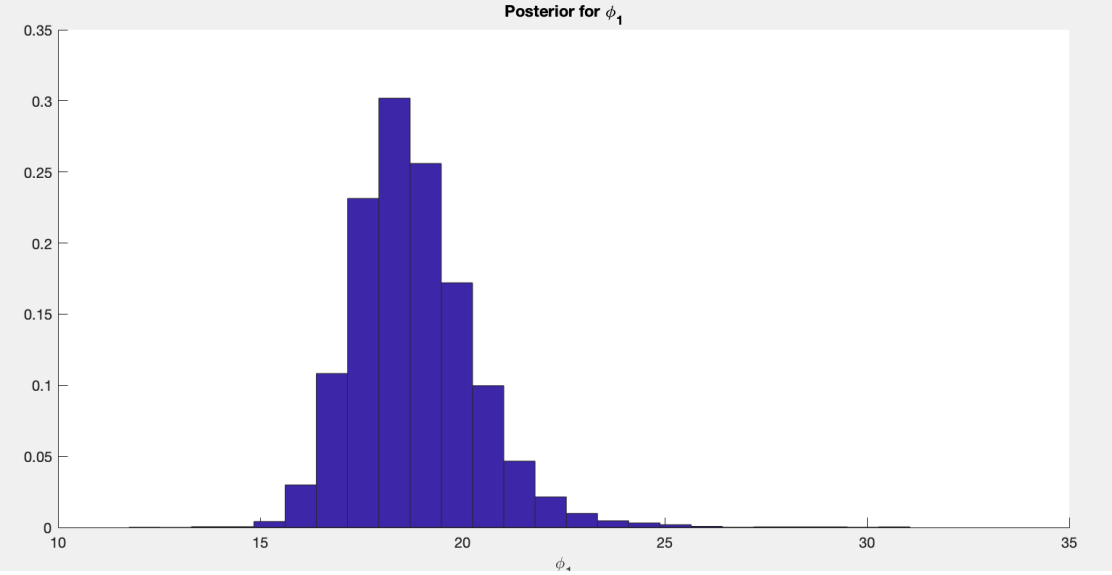





## (b)

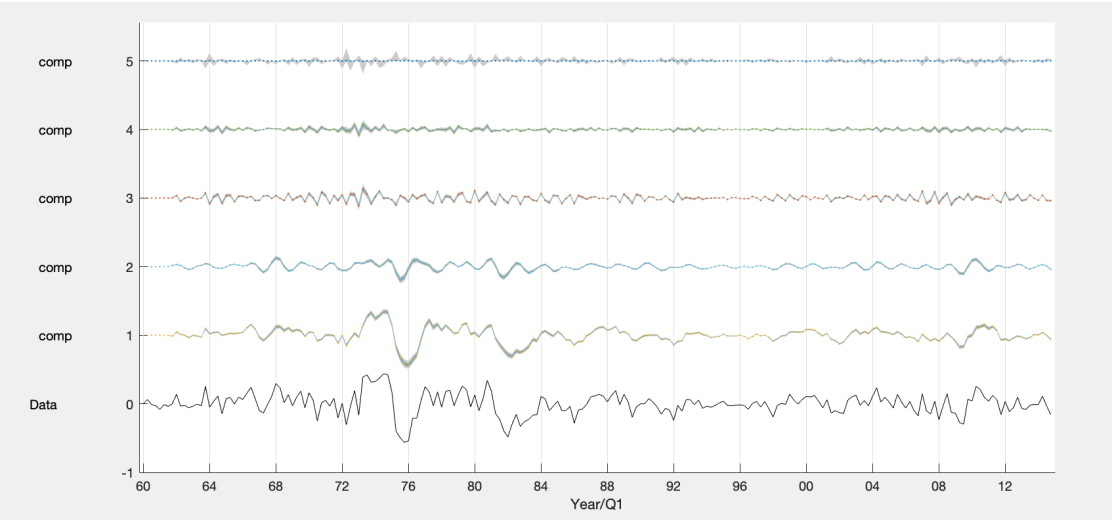
There are 4 quasi-periodic components since there are four pairs of complex eigenvalues. The maximum wavelength of the periodic components is about about 4.5 years (18 quarters). The mean of maximum wavelength is 18.4102 and the variance is 2.2598.



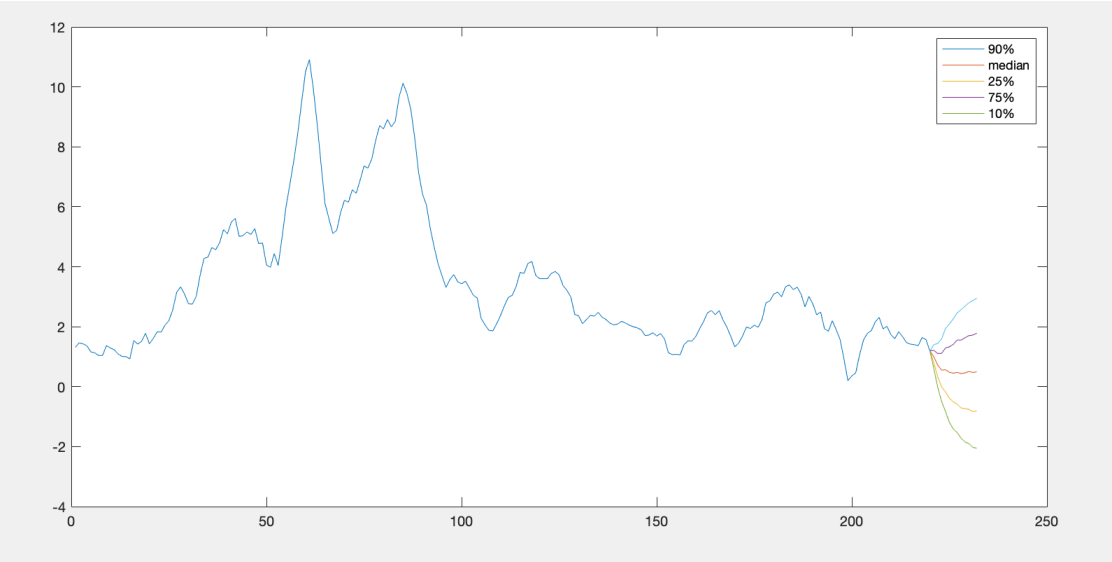



## (c)

By observing the plot, we find that the time series is decomposed into 3 components. It is evident that the lowest decomposed component contributes the most to the time series and the upper most one contributes the least. The eigenstructure of the AR model (most specifically, of the evolution matrix G), determines the contributions of the decomposed components. The larger the eigenvalue, the more the corresponding component contributes.

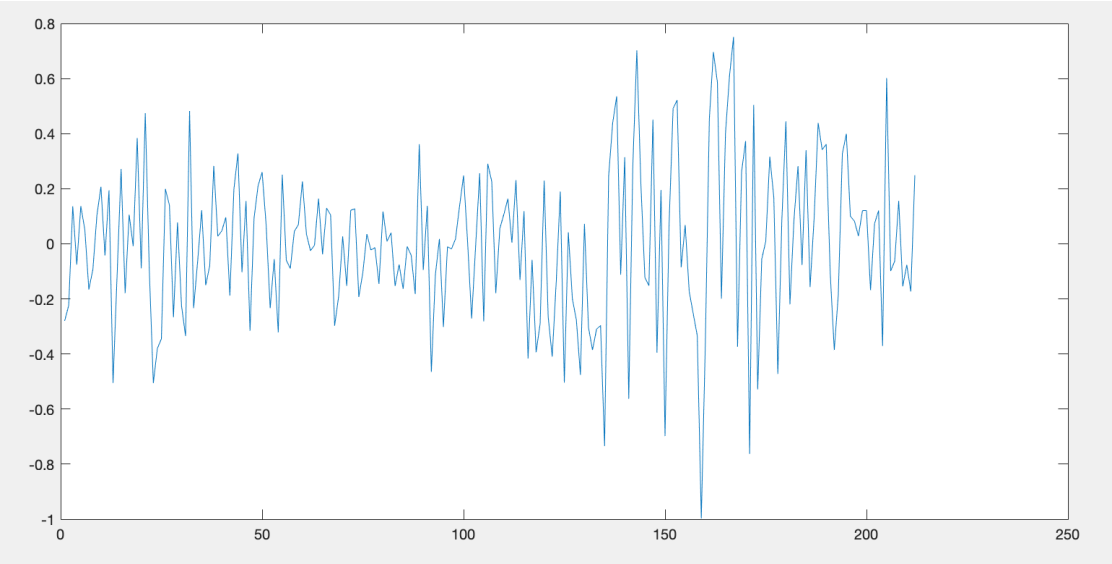


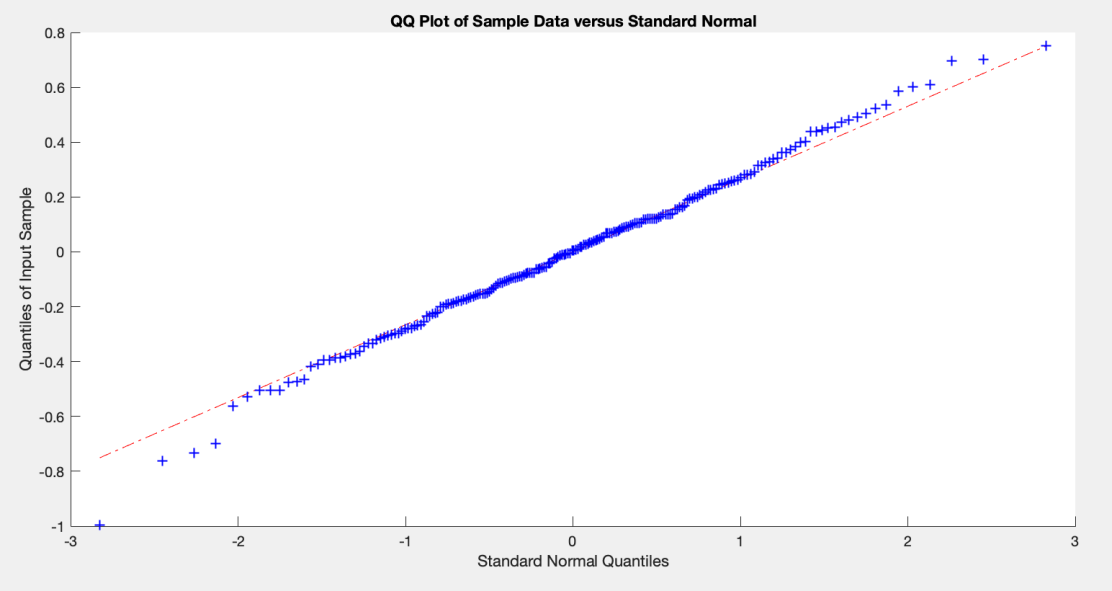
## (d)




## (e)

The first plot is the residual vs. fitted plot. It has a mean of 0 which satisfies the assumption of zero mean residuals. The second plot is the Q-Q plot of the residual, I find that the tail is a bit heavier than normal distribution but the majority of the residuals follows normality.






Based on the plot of arpcompare.m function, p = 8 has the highest log reference marginal likelihood and highest AIC. Its BIC is also high but BIC peaks at p = 4.