Assignment 6: Power Spectra

1.   In this assignment you will be creating a power spectra of the AMO index that you used in Assignment 1. This data has already been detrended (unlike the data used in Assignment 4). We already know that this data has variability at a timescale between 60-80 years and we would also expect there to be annual variability.

- For this assignment will only be looking at data over the period of 1900-2017. The data is organized in a format of years by months. Convert this into a single monthly time series in order to compute your power spectra using all available information (no annual averaging for this assignment).

- Include in your report a list of the following values for your data: period T, number of time steps N, time interval length Δt, fundamental frequency ω_0, and Nyquist frequency ω_N.

- Calculate the fast Fourier transform (FFT) of the data

- Compute the theoretical AR(1) power spectra, the apriori significance level based on this AR(1) power spectra, and the aposteriori significance level based on this AR(1) power spectra.

- Plot the power spectra with power on the y axis and frequency on the x axis. Include on this plot the AR(1) power spectra and associated apriori and aposterior significance tests. Feel free to limit your x-axis so that we can better see frequencies that have higher power.

- Plot the power spectra with frequency times power on the y axis and natural logarithm of frequency on the x-axis. Replace your frequency labels with time labels so that we can see at what time scale we have power. These may be in expressed in months or years, depending on how you have defined your parameters. Remember you have a very good sense of what these should be. Include on this plot the AR(1) power spectra and associated apriori and aposterior significance tests.

- Briefly describe your two power spectra including at what frequencies / periods there is significant power.