

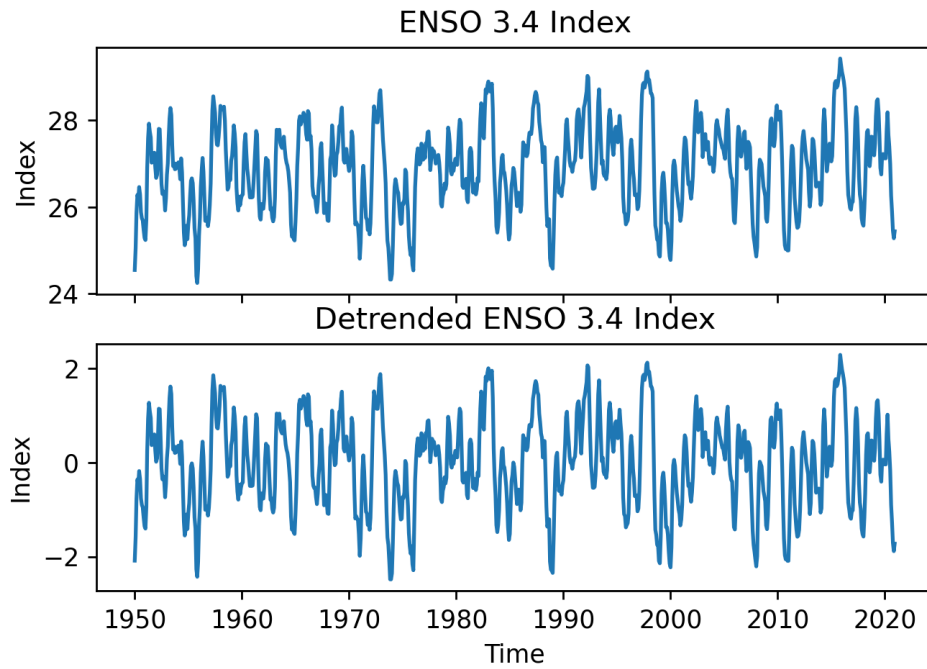
Elliott Foust

Code available at https://github.com/wefoust/Meteo515_AtmosStats

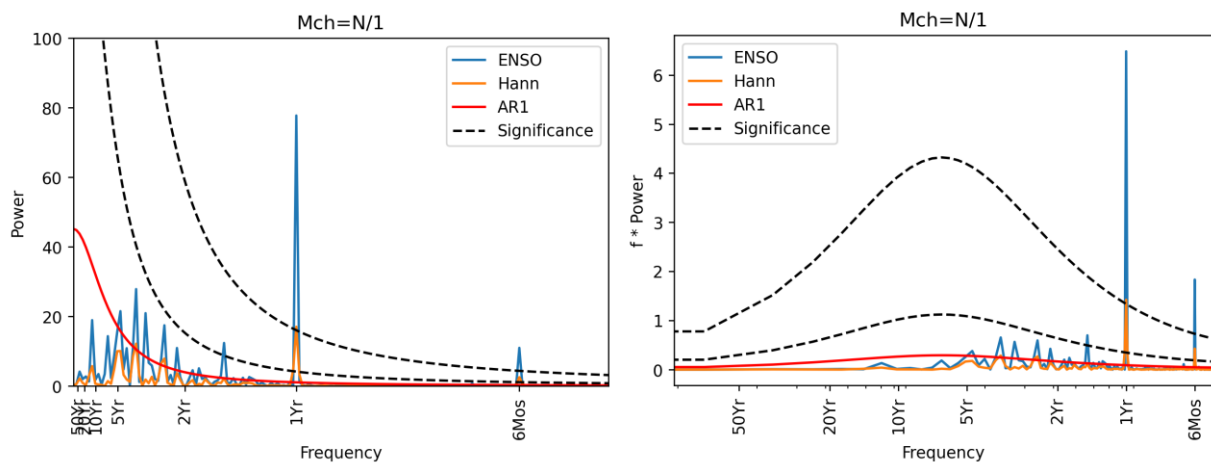
REVISED HW4

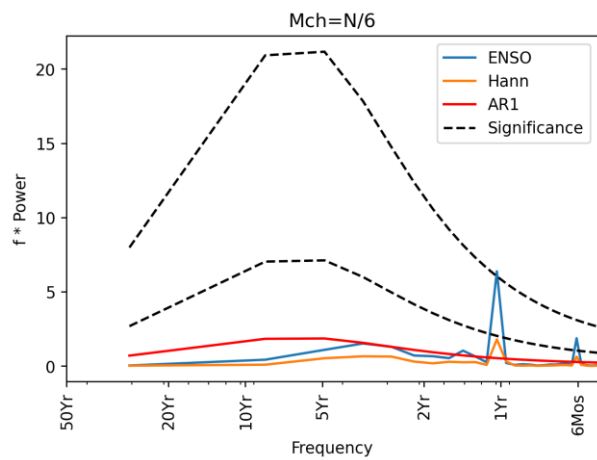
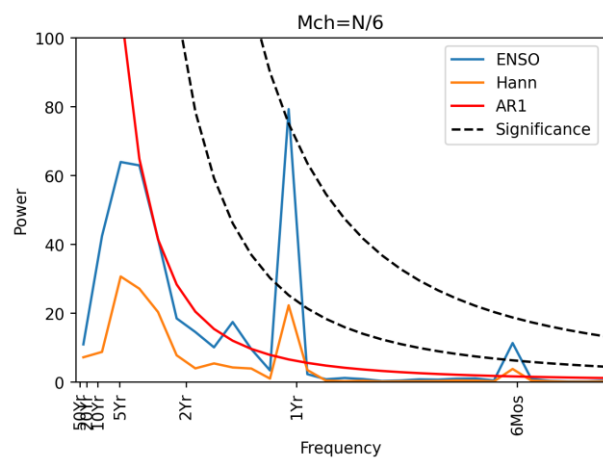
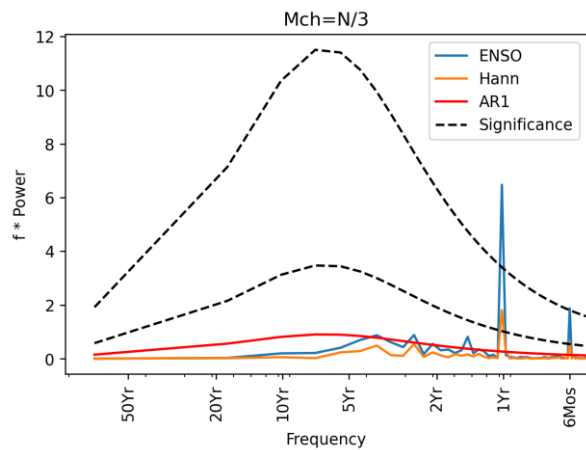
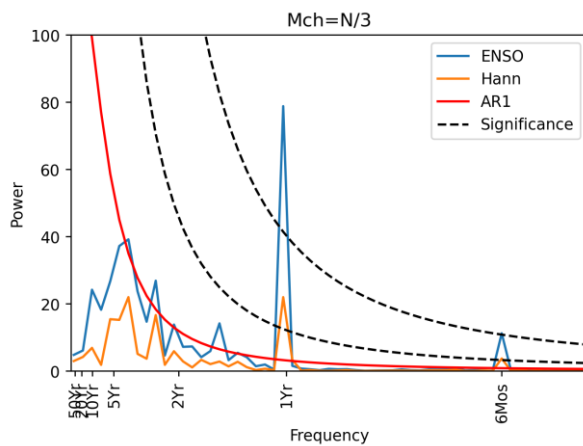
This assignment is resubmitted as I did not have enough time to successfully complete the assignment.

Question 1)



Figures for Question 2 & 3





3a) After squaring each element of the detrended ENSO time data and summing over the whole time series, the result is 803.94. When summing the power of ENSO, the result is also 803.94. This is consistent with Parseval's theorem and demonstrates how the total power can be evaluated equally in the time and frequency domains.

3b) Due to the shape and weight of the Hanning window, the overall power spectrum of ENSO is reduced. This is because the magnitude of the ENSO index is reduced as the month (t) deviates from the center of the sample (1985). While the Hanning window defends against spurious power at lower frequencies, the manipulation of the ENSO power spectrum eliminates the ability to discern significance of spectral peaks.

3c) Chunking essentially smooths the power spectrum. As chunking is increased, details of the ENSO power spectrum are removed. As more smoothing is applied, the ENSO power spectrum begins to resemble the theoretical AR1 curve. This suggests that ENSO retains some memory and can be considered a red noise process.

The amount of chunking to use for publication will depend on what I would like to highlight. If I would like to emphasize the power spectrum of ENSO, I would refrain from chunking. Despite some noise towards lower frequencies, the spectral bands of interest are still clearly seen, and "paper space" will be saved by not explaining chunking. If the goal was to highlight the nature of the ENSO index, then $N/3$ chunking seems appropriate because it resembles the AR1 fit but maintains some detail in the power spectrum.

3d) Using a priori estimates, SST variability is important on yearly and 2-7 year timescales. On yearly timescales the seasonal cycle is likely to be a large source of variability. The 2-7 year timescale is well documented (<https://www.climate.gov/enso>) and numerous spectral peaks are shown within these corresponding frequencies. Ironically, these peaks are not significant. A possible reason for this is that the temporal record is relatively short for a phenomenon that varies between 2-7 years. Additionally, the range of 2-7 years implies that ENSO is not stationary. This suppresses the power within the spectral bands and hinders significance.