**A&AE 624, Laminar-Turbulent Transition**
**Fall 2016, Professor Steve Schneider**
**Project 1**
**Handed Out: Friday, 26 August**
**Due: Friday, 9 September**

For the following functions, compute and plot (a) a sample of the time series, (b) the probability density function, (c) the autocorrelation, (d) the power spectrum. If time allows, examine the effect of various methods of computing each of these. Present your results in the form of a brief report.

1. A sine wave with random length segments. The segments are of random lengths, distributed with equal probability over durations of $(0, T)$. The sine waves always have frequency $\omega$, but the phase of each sine-wave segment as it begins after a break is random. Examine the effect of the relation between $T$ and $\omega$. What is the effect of the sampling rate and the length of your record?

2. A function similar to (1), but each segment is windowed with a $\cos^2$ taper to remove the edge effects.

3. A function similar to (2), but each segment has a randomly distributed frequency $\omega$, distributed with equal probability over the interval $(\omega_1, \omega_2)$.

If time allows, also carry out the following exercises.

1. Create some pure periodic waves of varying record lengths, made up by adding sine waves of different frequencies. If the frequencies are very low or high, what kind of parameters do you need to use in your computations of power spectra to obtain good spectra? If the frequencies are very close to each other, what kind of parameters do you need to choose to resolve the differences?

2. Compute spectra of some plain pure sine waves, using the various mathematical techniques and also computational techniques. What limits do you find in the normal processes? Where do they break down?