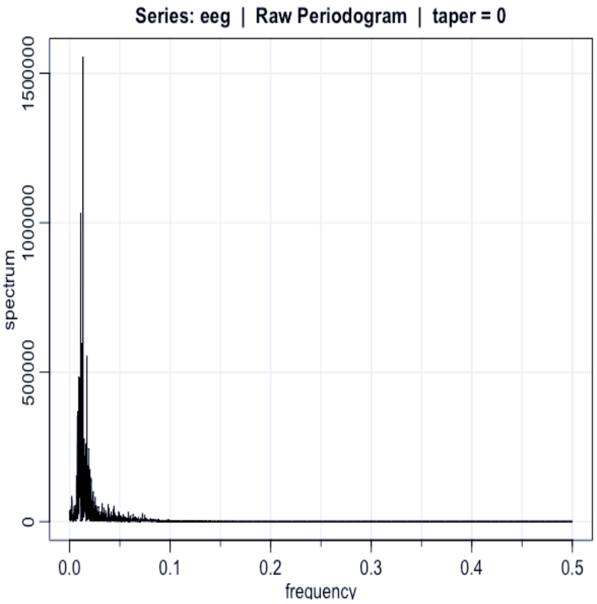
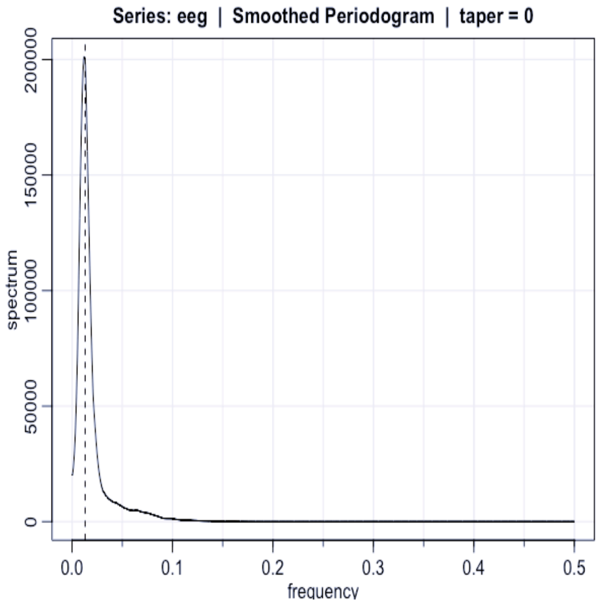
STA 137 - Project 3

Introduction. In signal processing, a periodogram is an estimate of the spectral density of a signal. One problem with the raw periodogram is that it is not a consistent estimator of the the energy associated with a given frequency. In this project, we smoothed electroencephalogram time series model, index at 13000 seconds, projecting EEG activity readings from patient having a seizure. The Daniell kernel with parameter m = 51 produces a more extensive smoothing by averaging over a wider time interval.

Methods and Materials: We have 13000 observations in our model, and the Raw Periodogram shows us the rough sample estimate of the population spectral density. One possible improvement to the periodogram estimate of the spectral density is to smooth it using centered moving averages, in this case m = 51. We will determine the max peak in the spectrum for eeg and its corresponding frequency, and after that determine in 95% Confidence Interval for the specified frequency.

Results.





A bandwidth of B = 0.01166092 means we are averaging over frequencies in a band of this width, so we are treating the spectral density as approximately constant over this bandwidth. With a broader band, we have smoothed out valid peaks.
Our degrees of freedom for this sample is df = 303.184. The peak spectrum is 201109.3, with a corresponding frequency of 0.0121 at t = 159. The 95% Confidence Interval for the specified frequency is [237395.4, 172575.5], which is too wide to be of much use. Most of the variation in the time series is due to the frequency component of the frequency.

Code.

```
library(TSA)
data(eeg)
kernel(”modified.daniell”, c(51,51))
plot(kernel(”modified.daniell”, c(51,51)))
eeg.smo = mvspec(eeg, kernel = k)
abline(v = c(.01166,1), lty = 2)
df = eeg.smo$df
L = qchisq(.95, df)
max(eeg.smo$spec)
df*eeg.smo$spec[159]/L
```