Spectral Estimation Time Series

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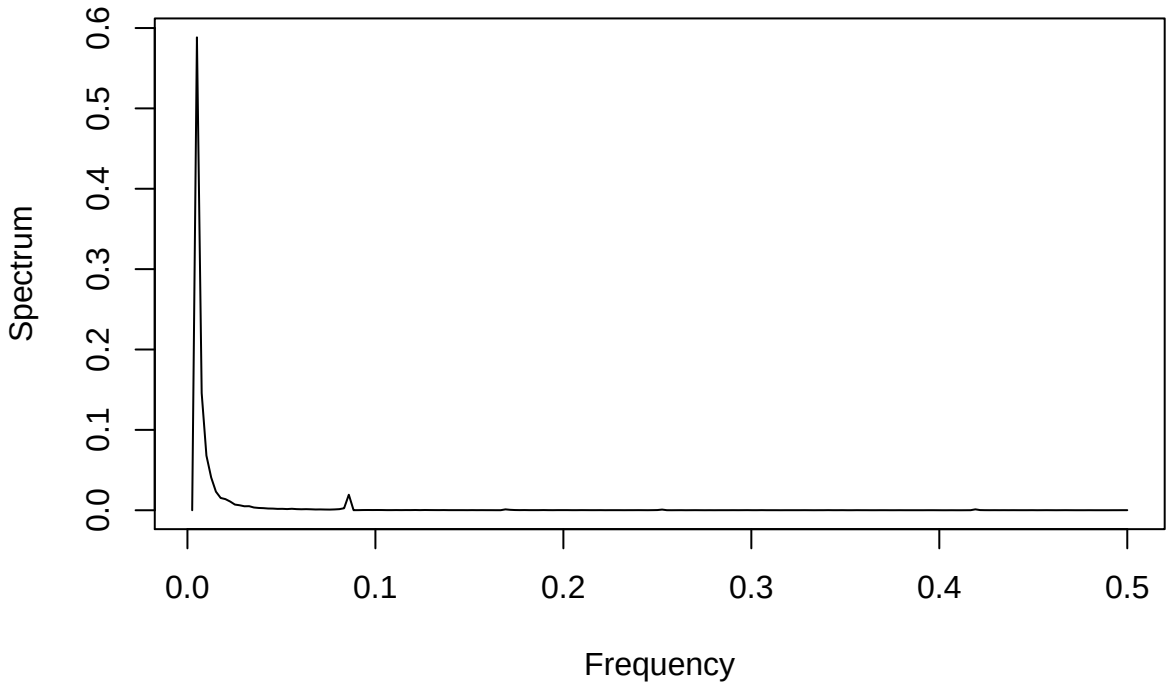
Question 2

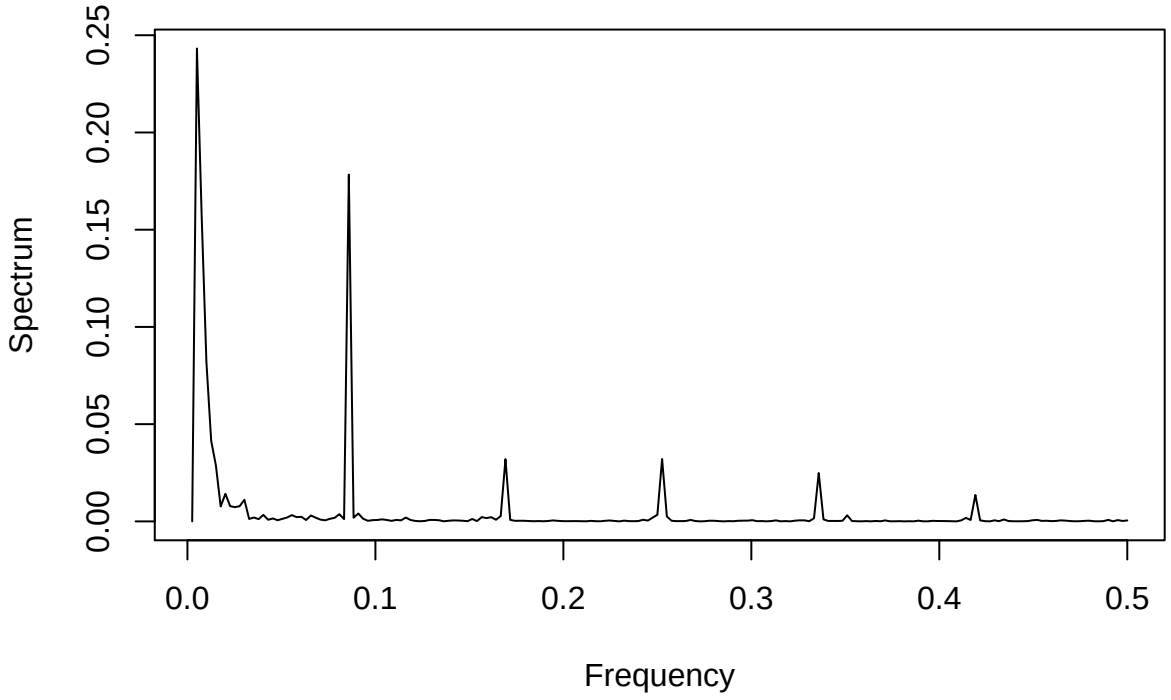
```
CBEData= read.table("~/gdrive/IUBCourseWork/TimeSeries/Introductory Time Series with R-Paul S.P. Cowper

# using only a sample of the total data -- Electricity
attach(CBEData)

elec = CBEData$elec - mean(CBEData$elec)
choc = CBEData$choc - mean(CBEData$choc)
ec = cbind(elec, choc)
N = 396

# FFT
PlotFFT <- function(values){
  values_fft = fft(values)
  n2 = 1:(N/2)
  values_fft = values_fft[n2]
  values_fft = abs(values_fft)^2
  values_fft = values_fft/sum(values_fft)
  values_fft = values_fft/sum(values_fft)
  plot(n2/N,values_fft,type="l",xlab="Frequency", ylab = "Spectrum")
  # print(which(values_fft==max(values_fft)))
}

# Dtrend
DT<- function(values,f)  {
  time <- 1:length(values)
  s1 = cos(2*pi*time*(f))
  s2 = sin(2*pi*time*(f))
  T2 = time*time
  reg <- lm(values ~ time+T2+s1+s2)
  return (reg)
}
```

Before detrending the 2 measures electricity and chocolate

```
PlotFFT(elec)
```



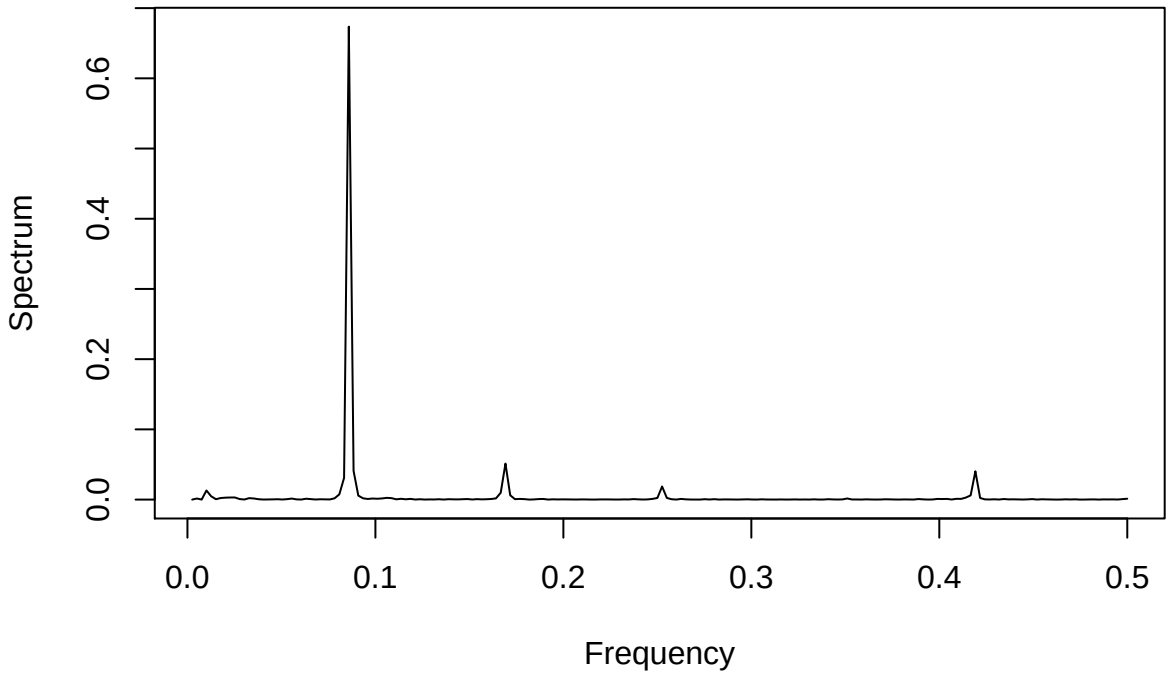

```
PlotFFT(choc)
```



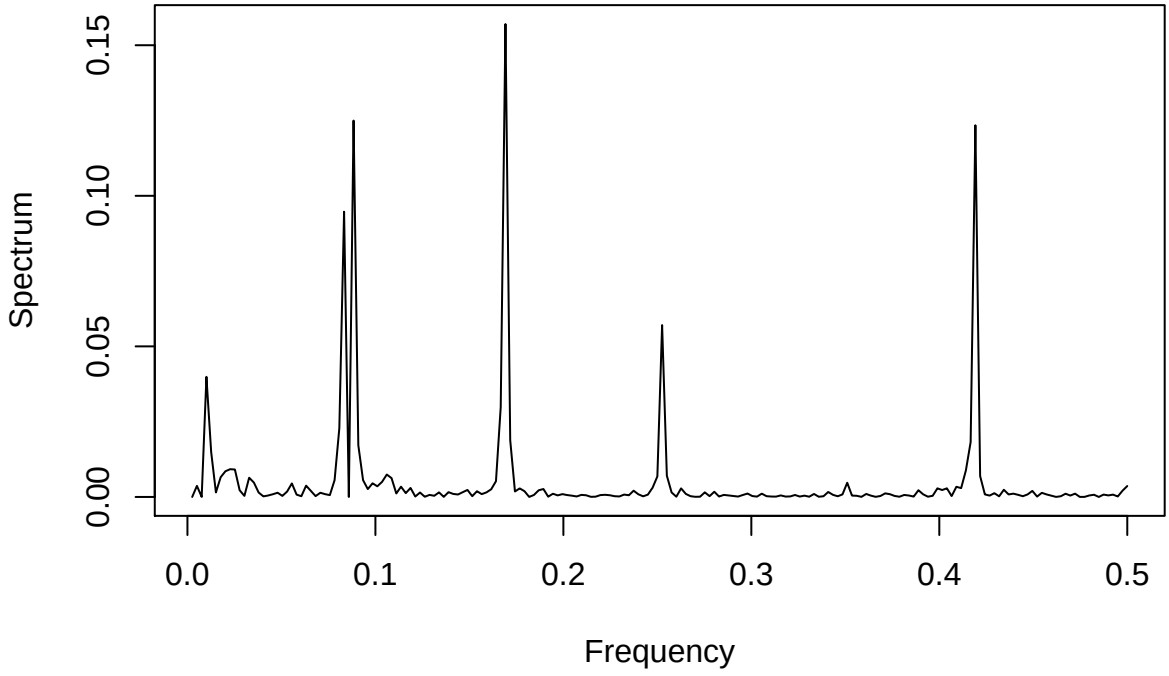
Electricity

After detrending electricity for frequencies = {2/396, 33/396}. We can notice the magnitudes falling in spectrum

```
elec_reg <- DT(elec, f=(2/N))
PlotFFT(elec_reg$residuals)
```



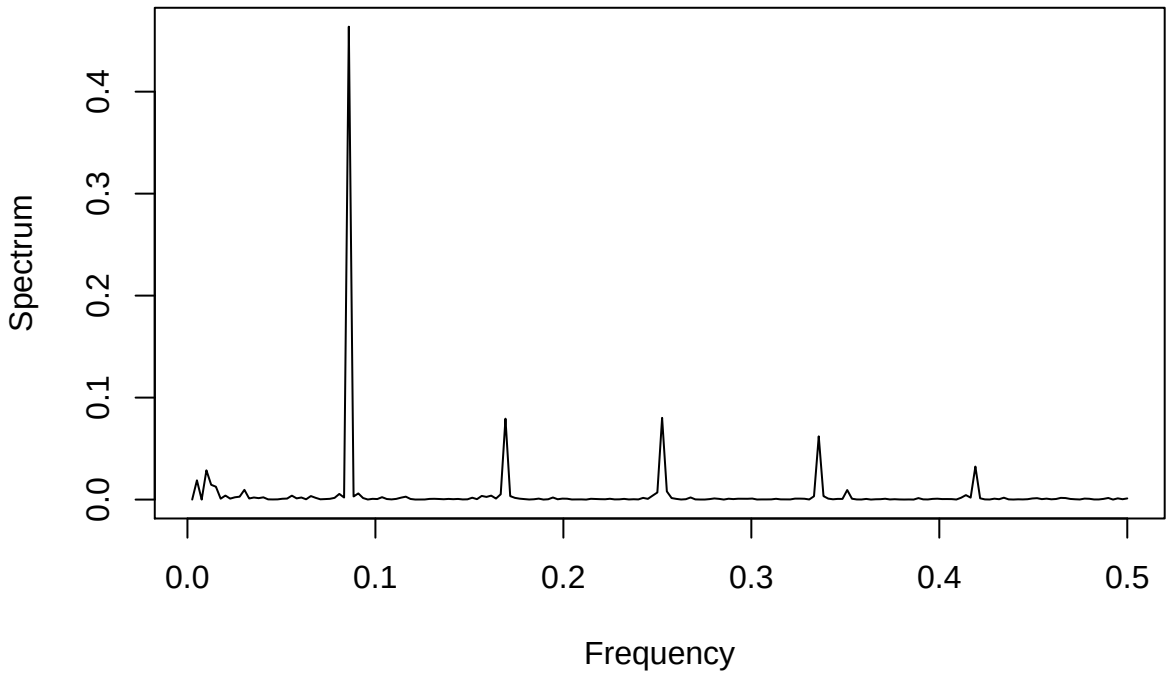

```
elec_reg <- DT(elec_reg$residuals, f=(33/N))
PlotFFT(elec_reg$residuals)
```



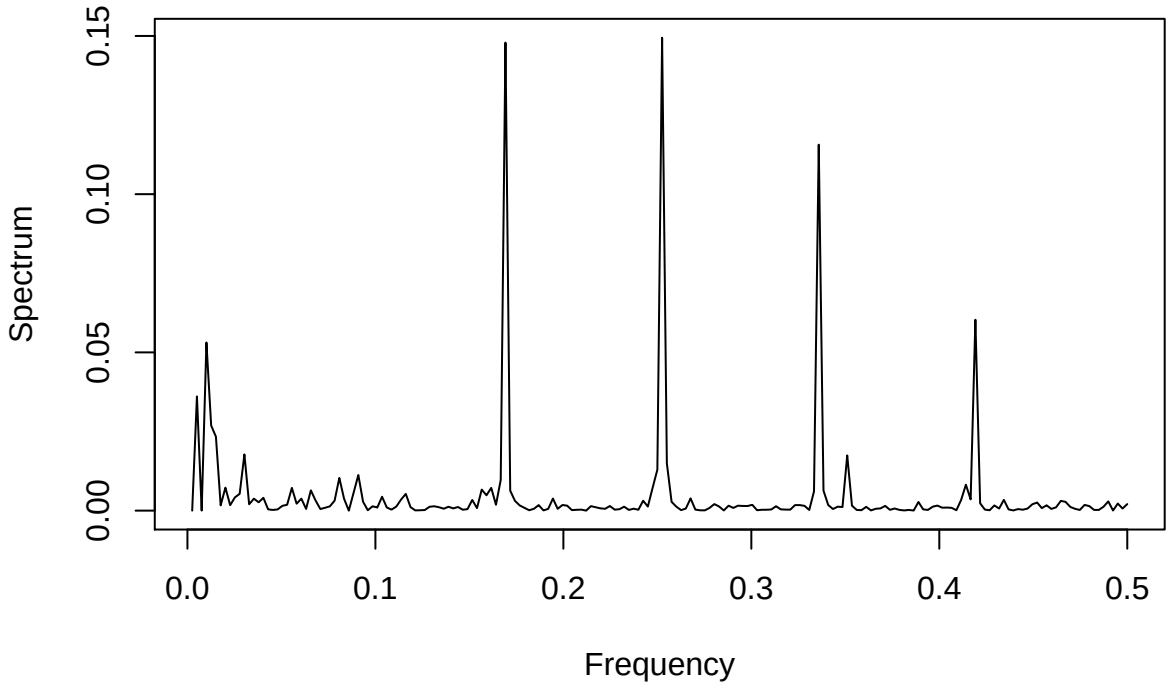
Chocolate

After detrending chocolate for frequencies = {2/396, 33/396}. We can notice the magnitudes falling in spectrum

```
choc_reg <- DT(choc, f=(2/N))
PlotFFT(choc_reg$residuals)
```




```
choc_reg <- DT(choc_reg$residuals, f=(33/N))
PlotFFT(choc_reg$residuals)
```

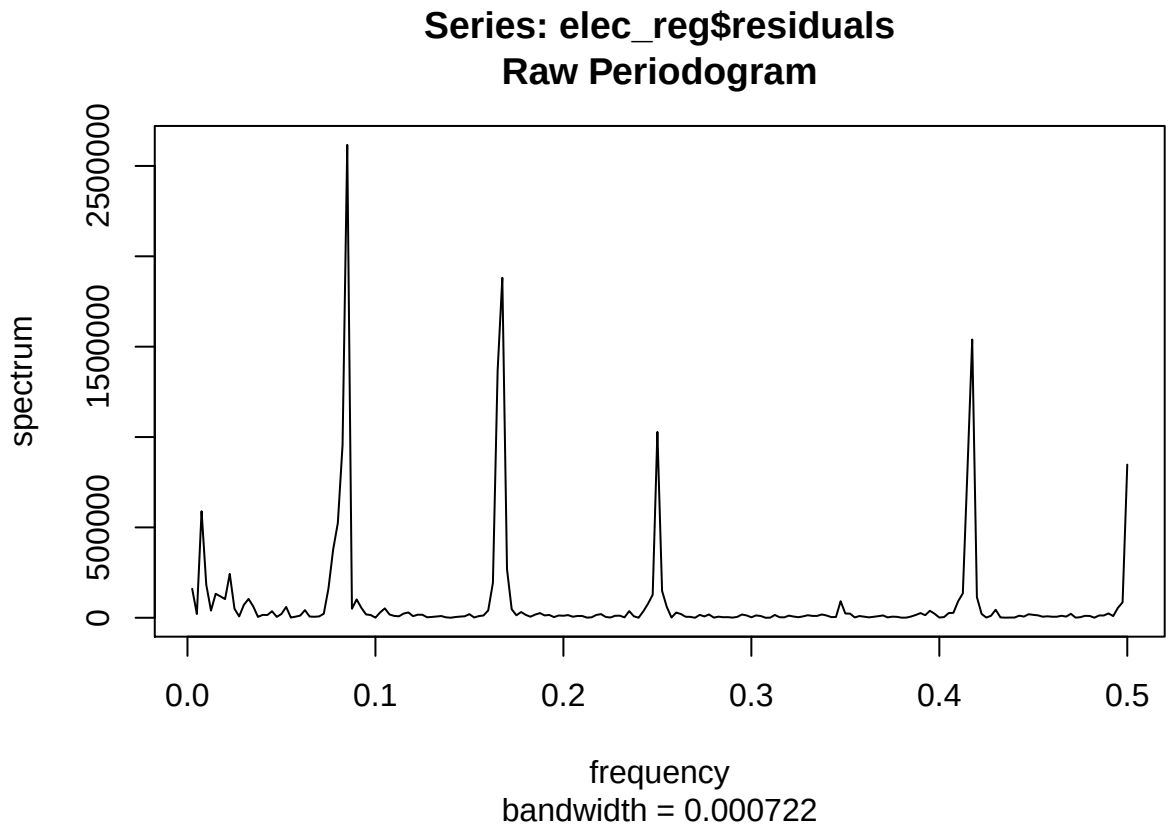


Question 3

Electricity

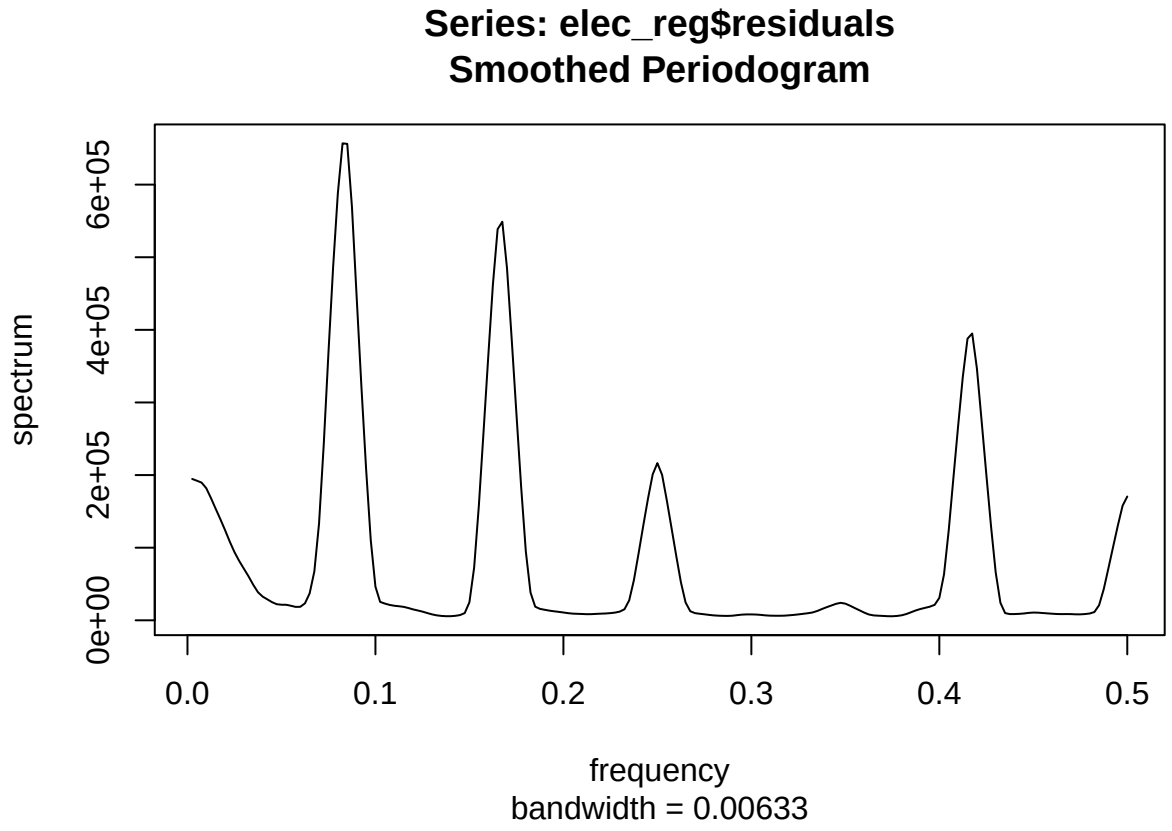
without window

```
spec.pgram(elec_reg$residuals,log="no")
```



with window size = 7 :Reason: I choose 7 as window size as it removes the the noise(power of unwanted frequencies) and still retains the power of important frequencies in the plot

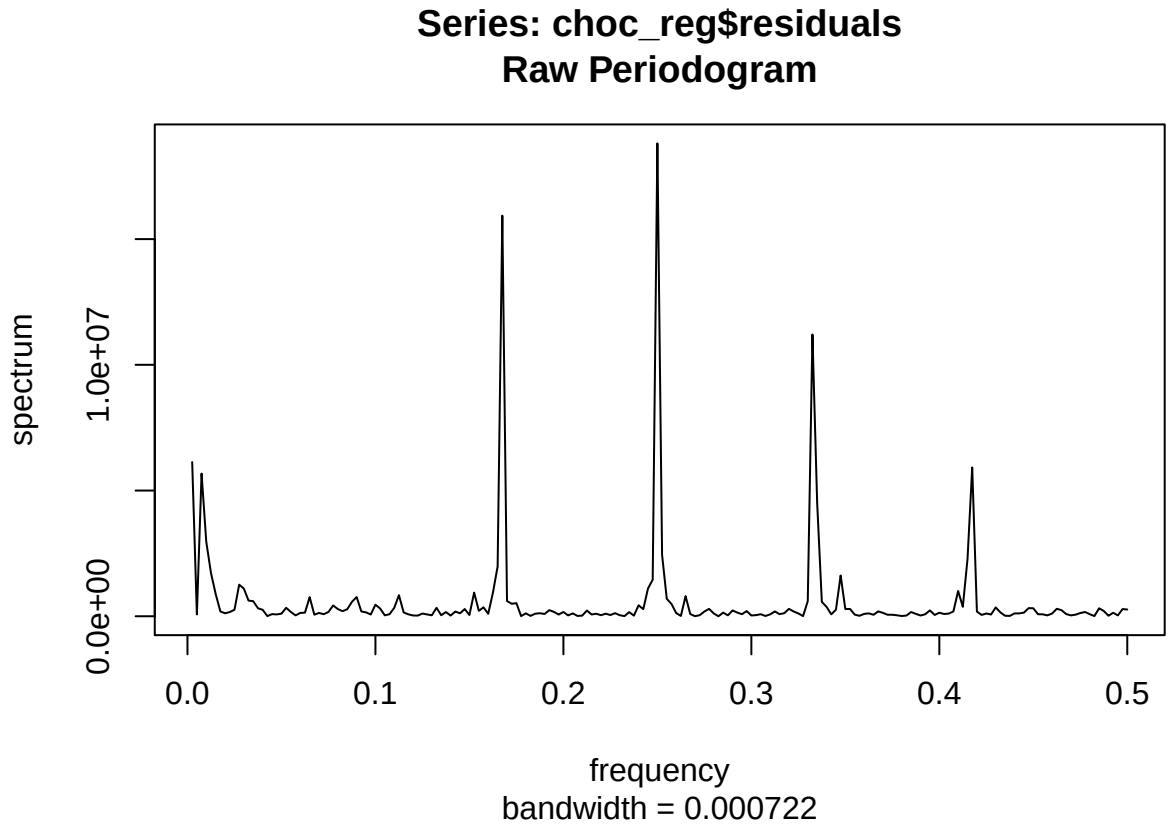
```
spec.pgram(elec_reg$residuals,spans=c(7,7),log="no")
```



Chocolate

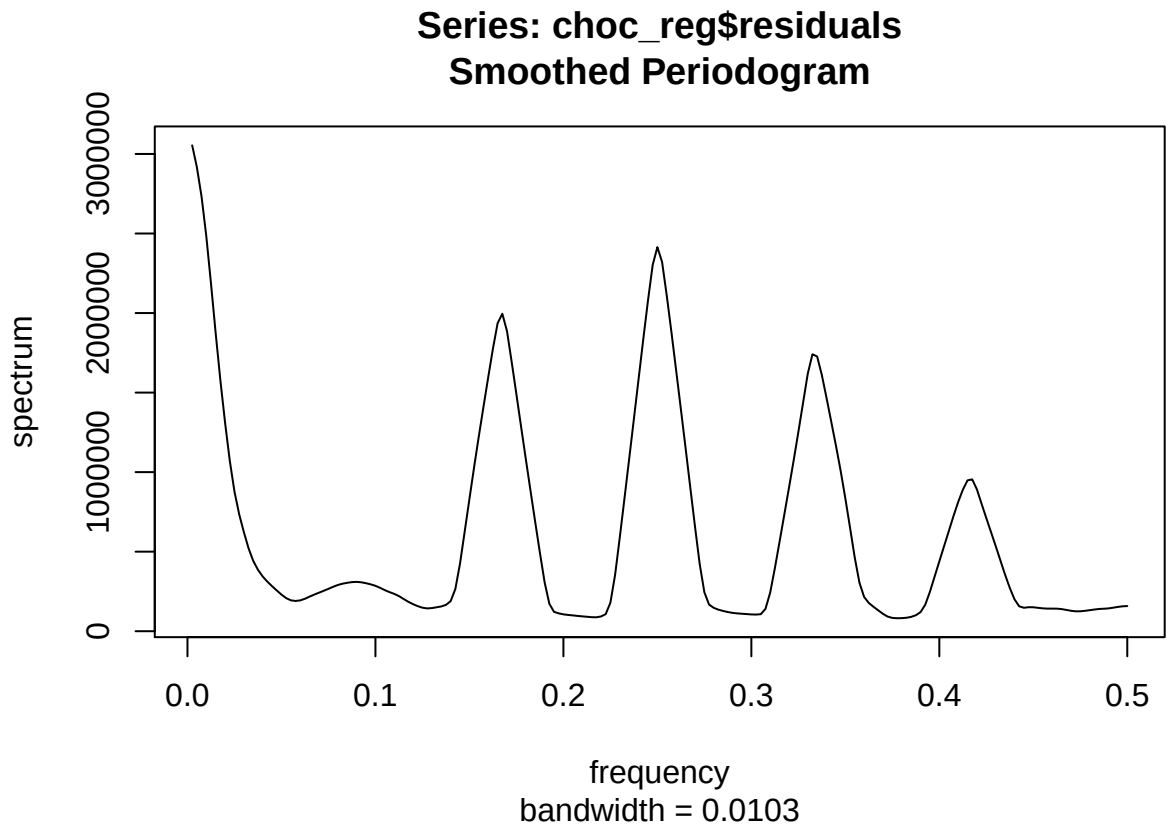
without window

```
spec.pgram(choc_reg$residuals,log="no")
```



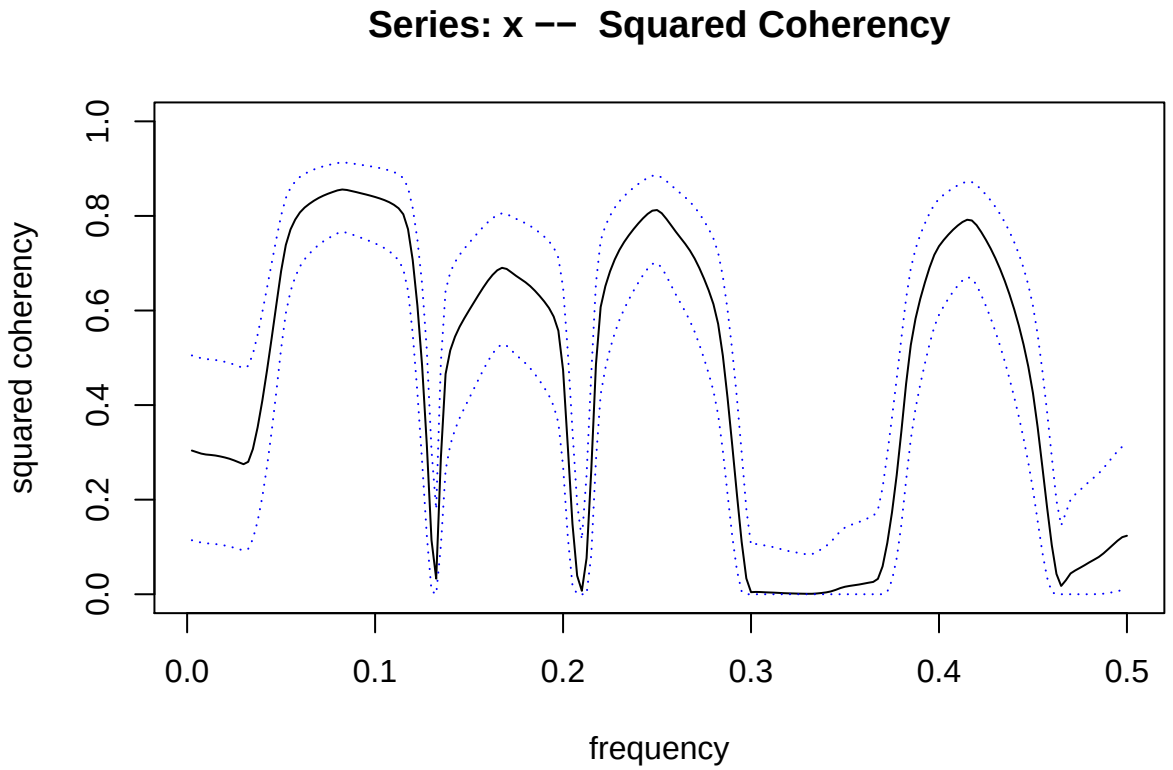
with window size = 10 :Reason: I choose 10 as window size as it removes the the noise(power of unwanted frequencies) and still retains the power of important frequencies in the plot

```
spec.pgram(choc_reg$residuals,spans=c(10,10),log="no")
```



Question 4

```
X=cbind(elec, choc)
H = spectrum(X,spans=c(20,20),plot.type="coherency")
```



In the above graph, the coherence varies with various frequencies. The blue lines show the standard deviation of coherence. Coherence is high at various frequencies which means that there are varoius sinusoids that built this signal. The standard deviation seems to be similar atmost of the frequencies.