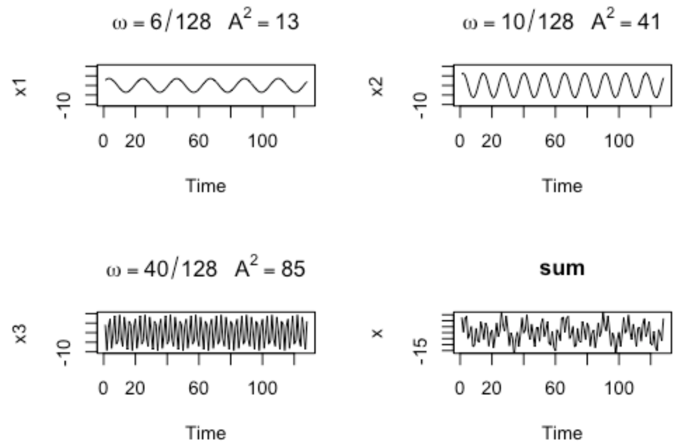
4.2

A)

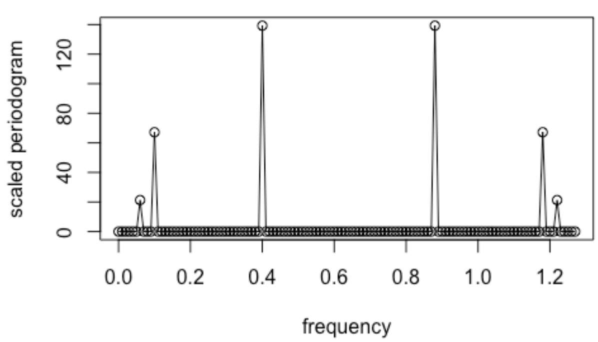



```
x1 = 2*cos(2*pi*1:128*6/128) + 3*sin(2*pi*1:128*6/128)
x2 = 4*cos(2*pi*1:128*10/128) + 5*sin(2*pi*1:128*10/128)
x3 = 6*cos(2*pi*1:128*40/128) + 7*sin(2*pi*1:128*40/128)
x = x1 + x2 + x3
par(mfrow=c(2,2))
plot.ts(x1, ylim=c(-10,10), main=expression(omega==6/128~~~A^2==13))
plot.ts(x2, ylim=c(-10,10), main=expression(omega==10/128~~~A^2==41))
plot.ts(x3, ylim=c(-10,10), main=expression(omega==40/128~~~A^2==85))
plot.ts(x, ylim=c(-16,16), main="sum")

P = Mod(2*fft(x)/100)^2; Fr = 0:127/100
plot(Fr, P, type="o", xlab="frequency", ylab="scaled periodogram")
```

The series for this sample size is longer since the sample size is increasing.

B)



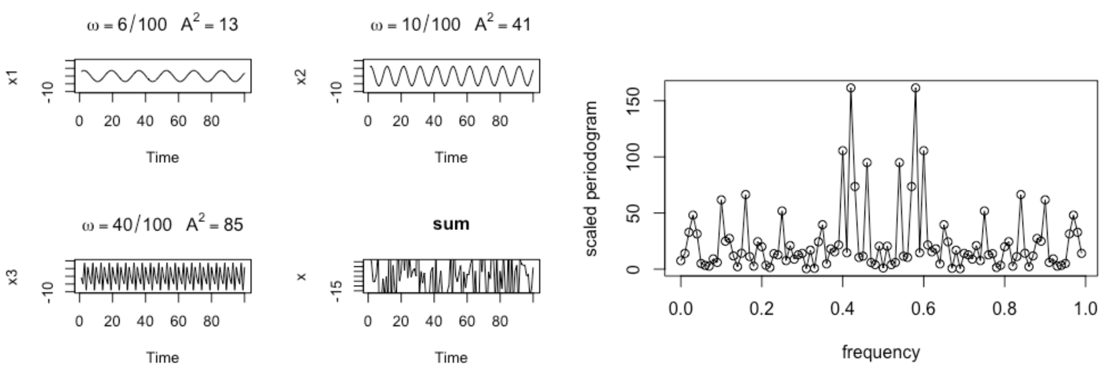

```
wt= rnorm(100,0,25)
```

```
x1 = 2*cos(2*pi*1:100*6/100) + 3*sin(2*pi*1:100*6/100)
x2 = 4*cos(2*pi*1:100*10/100) + 5*sin(2*pi*1:100*10/100)
x3 = 6*cos(2*pi*1:100*40/100) + 7*sin(2*pi*1:100*40/100)
x = x1 + x2 + x3 + wt

P = Mod(2*fft(x)/100)^2; Fr = 0:99/100
plot(Fr, P, type="o", xlab="frequency", ylab="scaled periodogram")
```

The scaled periodogram has 5 predominant peaks since there is no white noise in the data.

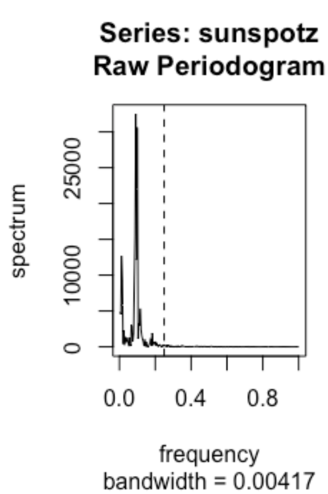
C)



With the white noise, it is harder to interpret the peaks in the scaled periodogram since the data is much nosier. But there are still predominant peaks at the frequency .4 and .6.

4.9

```
par(mfrow=c(1,2))
sunspotz.per = mvspec(sunspotz, log="no")
abline(v=1/4, lty=2)
```



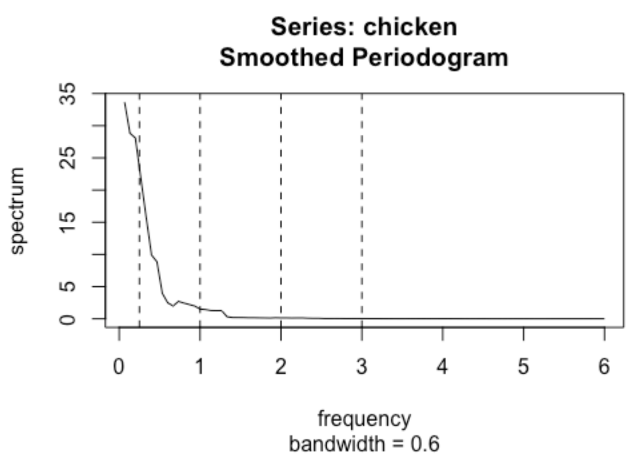
The two spikes occur in the periodogram occur at the frequency .012 = 1/.012= 83 period and 0.0916 = 1/.0916= 10.9 period. The spectrum values for these frequencies are 32477.87 and 12645.8 respectively. The periods are 83 and 10.9

```
> 2*sunspotz.per$spec[22]/L
[1] 8804.265
> 2*sunspotz.per$spec[22]/U
[1] 1282807
> 2*sunspotz.per$spec[3]/L
[1] 3428.087
> 2*sunspotz.per$spec[3]/U
[1] 499482.4
```

The confidence intervals for the predominant period 83 are (8804.26, 1282807) and 11 period is (3428.087, 499482.4).

4.13

```
#Non Parametric Spectral Density
k = kernel("daniell", 4)
soi.ave = mvspec(chicken, k, log="no")
abline(v=c(.25,1,2,3), lty=2)
soi.ave$bandwidth # = 0.225
```

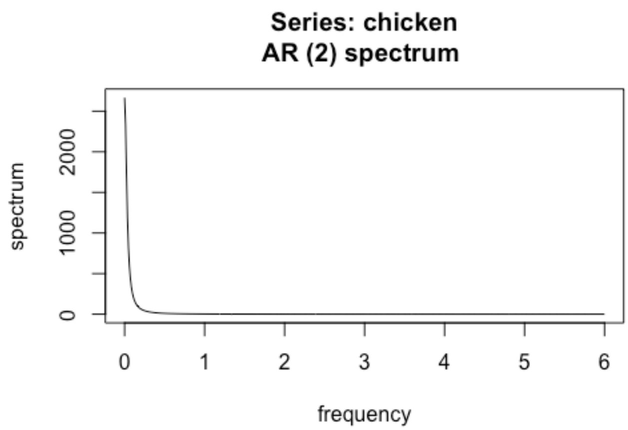


The smoothed periodogram tapers of at the frequency 1 and the peak occurs early at .5 and 1/.5= 2 So the cycle occurs every 2 months.

4.20

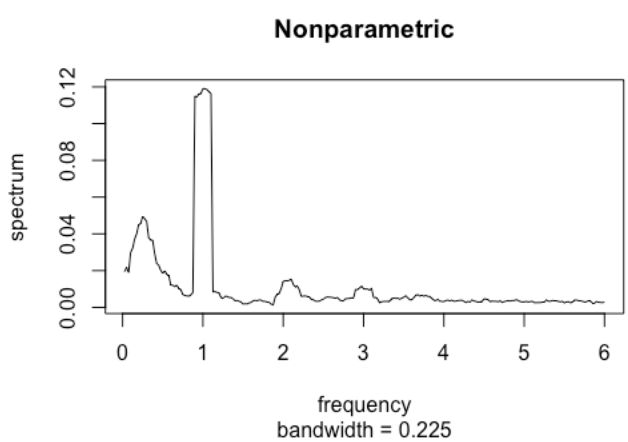
#Parametric Spectral Density

```
spec.ar(chicken, log="no")
specvalues=spec.ar(chicken, log ="no")
chicken.ar = ar(chicken, order.max=30) # estimates and AICs
```



The Periodogram tapers of at .2 which is much lower than the non parametric spectral density. And the peak is not visible in this periodogram.

```
#Comparing Nonparametric and Parametric Spectral Density
k = kernel("daniell",4)
soi.ave = mvspec(soi, k, log="no",main="Nonparametric")
```



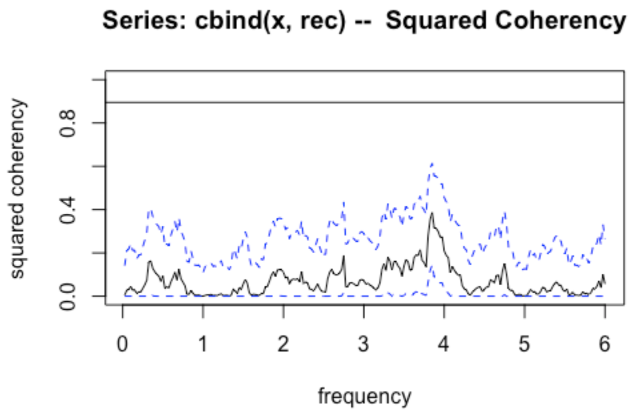
When comparing the nonparametric and parametric spectral density, the peak occurs at the frequency 1.So the cycle occurs every 1 month.

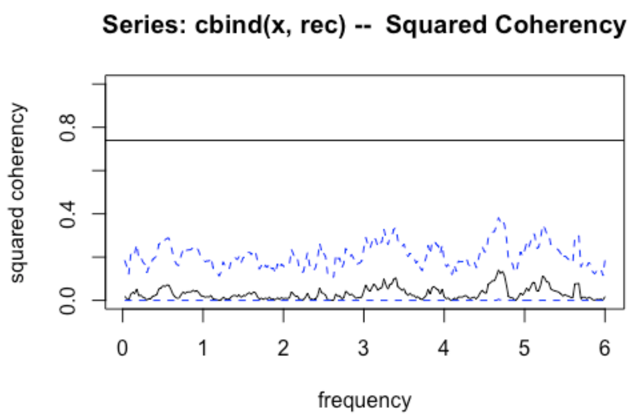
4.23

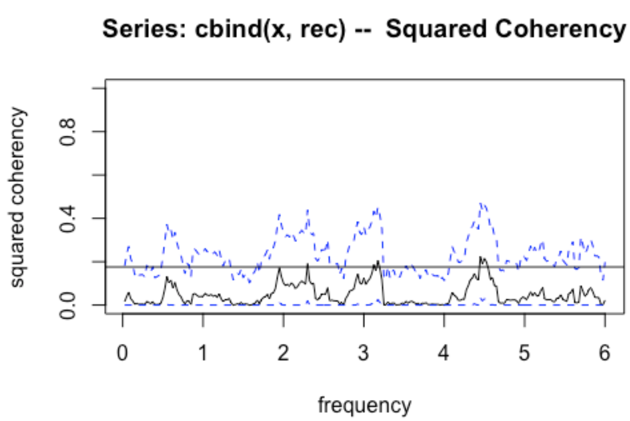
A)

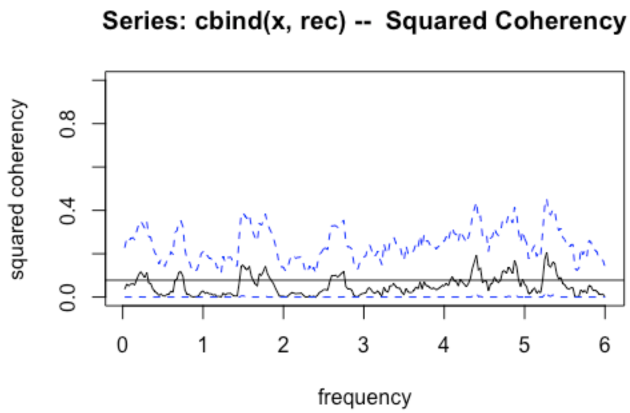
The coherence between x and y is zero.

B)
The L is in order from 1,3,41,101









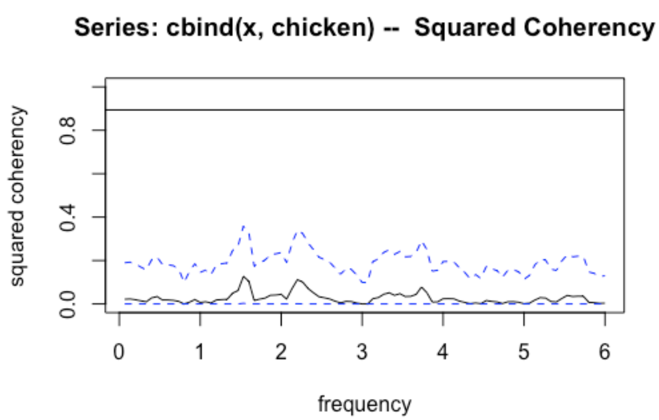
As L decreases, the constant squared coherences decreases and the squared coherence for the frequencies are consistent.

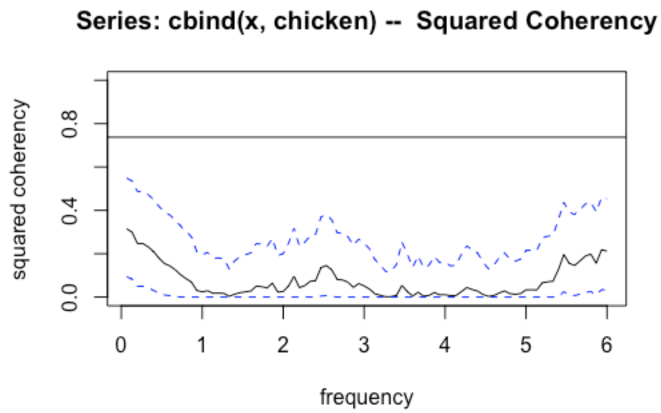
4.25

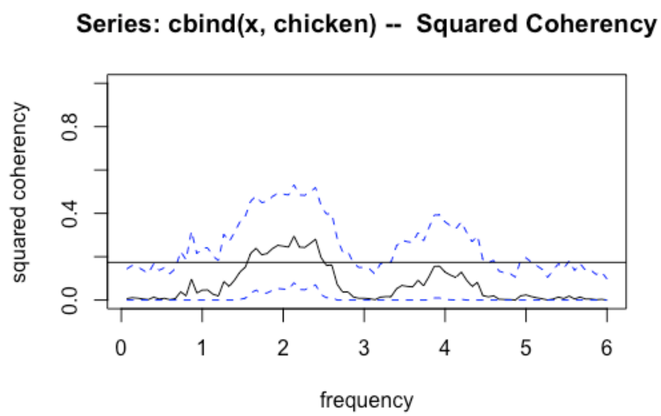
A) The phase between x and y is 1.

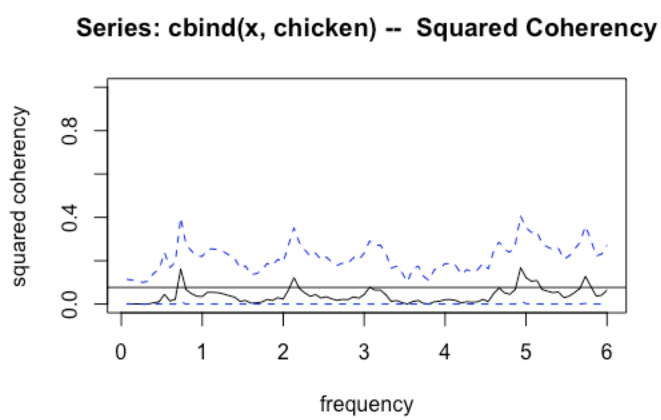
B)

The L is in order from 1,3,41,101









As L decreases, the constant squared coherences decreases and the squared coherence for the frequencies are consistent. For the squared coherence where L=3, the plot seems to going off near the end points.