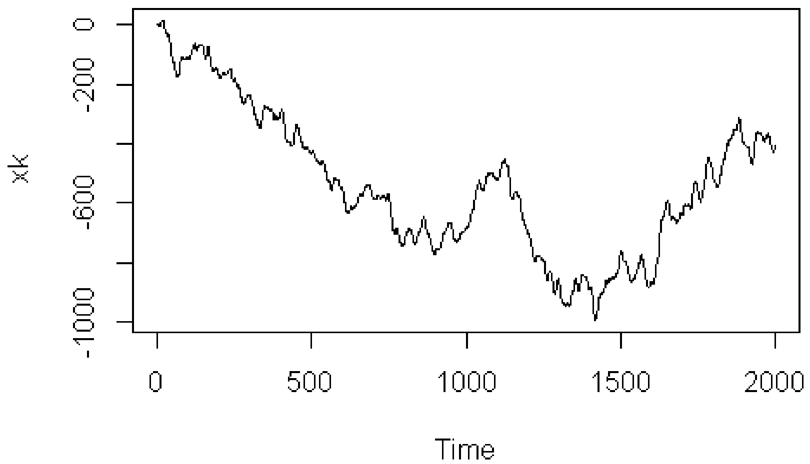
1a)

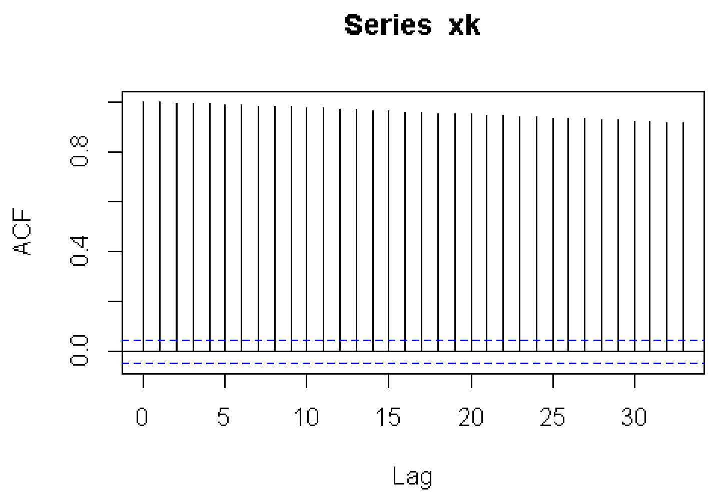
```
PAC_theory_e=ARMAacf(ma=0,lag.max=20,pacf=TRUE)# white noise
PAC_theory_arma=ARMAacf(ma=0.6,ar=0.5,lag.max=20,pacf=TRUE)#arma(1,1)

e=rnorm(1000,0,1)
vk<-arima.sim(n=1000,list(order(1,0,1),ar=0.5,ma=0.6))

rho_o=acf(vk)
rho_f=1:30
A=matrix(data=NA,ncol=25,nrow=25)
for(i in 1:30)
{
  rho_f[i]=rho_o$acf[i+1]
}
phi_i <-function(t,j,rho_f)
{
  p=t-1
  #return(1)

  if(p==j)
  {
    if(p==1)
    {
      return(1)
    }
    else
    {
      sum=0
      for(j in 1:p)
      {
        q=p
        sum=sum+phi_i[q,j,rho_f]*rho_f[p+1-j]
      }
      numer=rho_f[p+1]-sum
      sum1=0
      for(j in 1:p)
      {
        q=p
        sum1=sum1+phi_i[q,j,rho_f]*rho_f[j]
      }
      denom=1-sum1
      final=numer/denom
      return(final)
    }
  }

  else
  {k=p-j+1
   q=p
   t=p+1
    s=phi_i[q,j,rho_f]-phi_i[t,t,rho_f]*phi_i[q,k,rho_f]
```

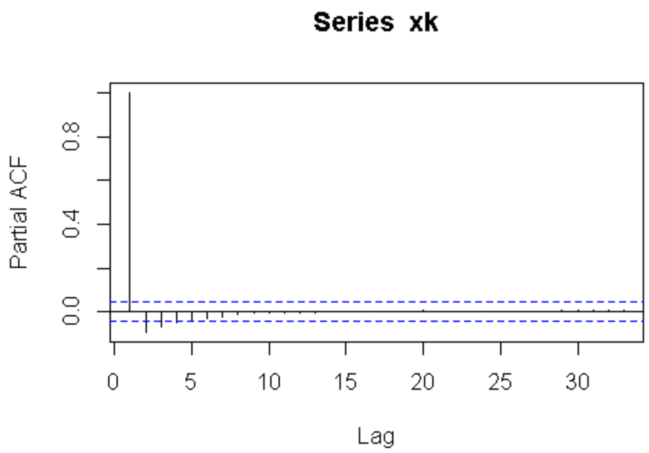
```
    return(s)

  }
}
for (p in 1:25)
{
  for (j in 1:p+1)
    {
    A[1,1]=1
    t=p+1
    A[t,j]=phi_i(t,j,rho_f)
  }
}
pac=1:25
for (i in 1:25)
{
  pac[i]=A[i,i]
}
```

1c)

```
load('C:/Users/Toshiba/Desktop/vishal iit/5th sem/Applied time series analysis/assignments/assignment 3/a3_q1.Rdata')

plot(xk)
acf(xk)
pacf(xk)
t=arima(xk,order=(c(1,0,0)))# AR(1)
```

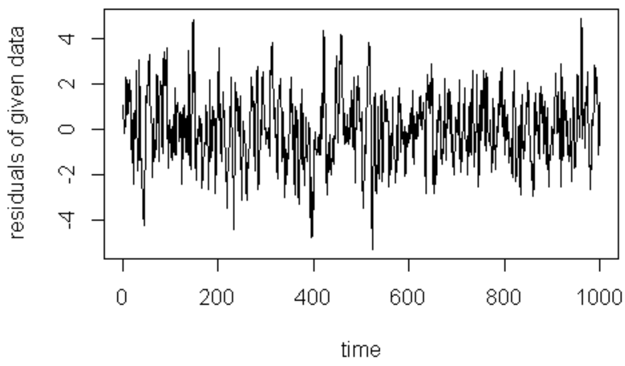




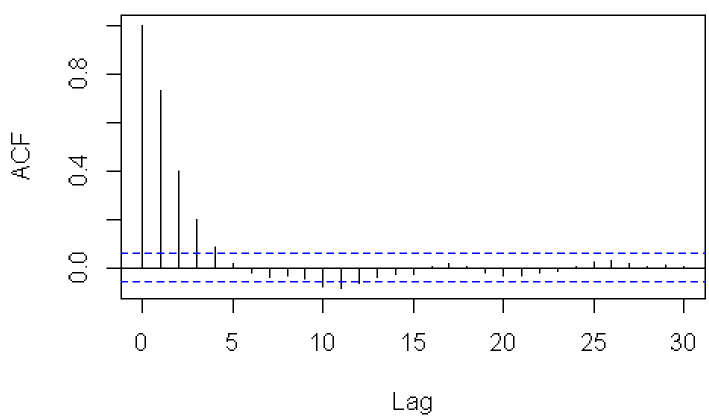


2)

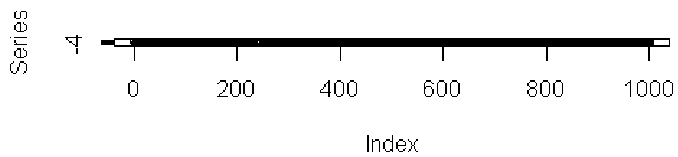
```
load('C:/Users/Toshiba/Desktop/vishal iit/5th sem/Applied time series analysis/assignments/assignment 3/a3_q2.Rdata')
#a
t=1:1000
tr_fit<-lm(xk~t)
b=tr_fit$coefficients
plot(tr_fit$residuals,type='l',xlab='time',ylab='residuals of given data')
s_a=acf(tr_fit$residuals)
plot(s_a,type='h',xlab='lag',ylab='acf of residuals')
arma_a<-arma(tr_fit$residuals,order=(c(0,3)))
```



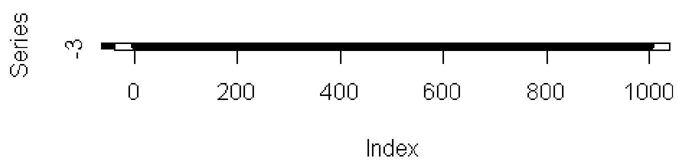
Series tr_fit$residuals

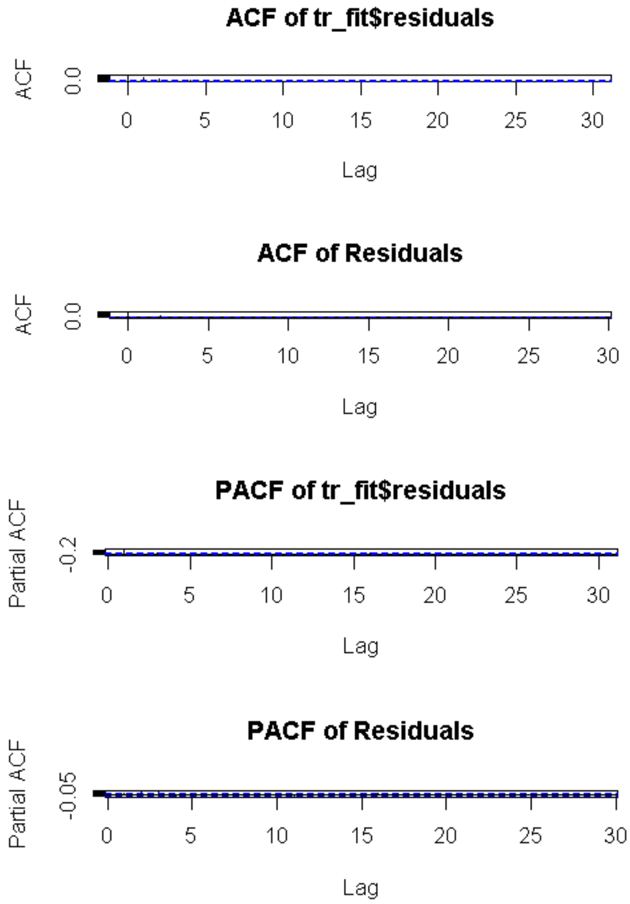


tr_fit$residuals

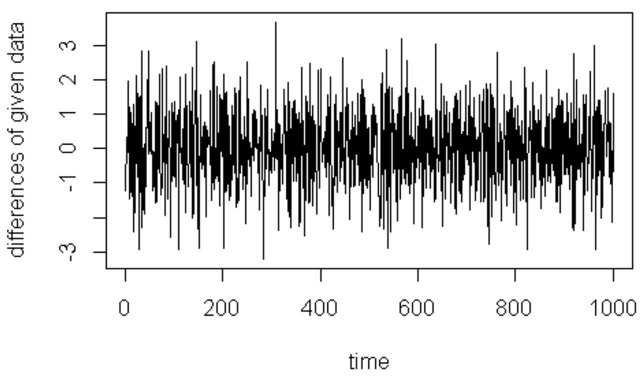


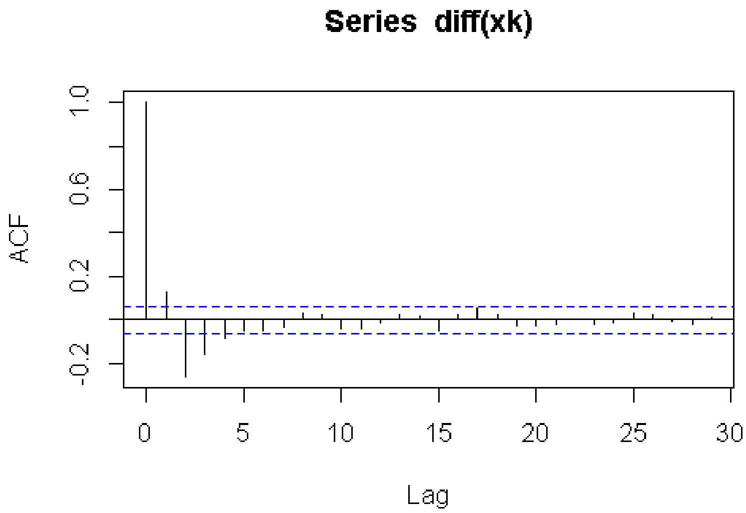
Residuals

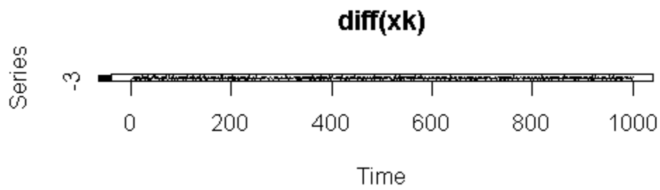


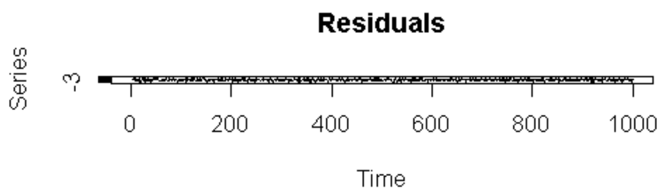


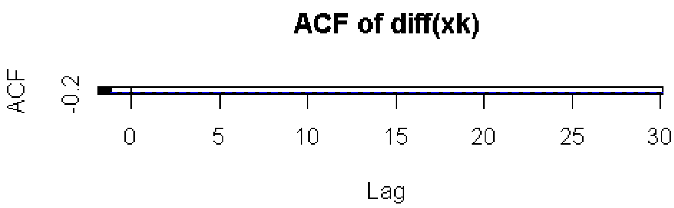

```
#b
plot(diff(xk),type='l',xlab='time',ylab='differences of given data')
s_b=acf(diff(xk))
plot(s_b,type='h',xlab='lag',ylab='acf of differences of given data')
s_b=arma_b<-arma(diff(xk),order=(c(0,3)))
plot(arma_a)
plot(arma_b)
```

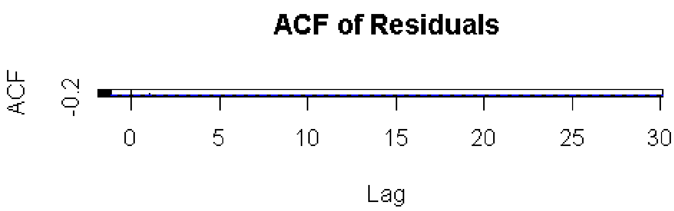


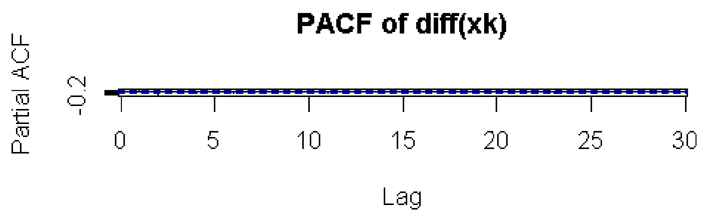

Series diff(xk)
ACF
1.0
0.6
0.2
-0.2
0
5
10
15
20
25
30
Lag

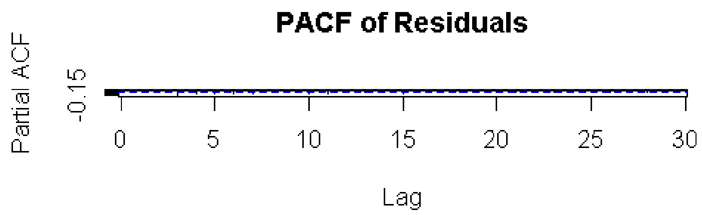

diff(xk)
Series
-3
0
200
400
600
800
1000
Time


Residuals
Series
-3
0
200
400
600
800
1000
Time


ACF of diff(xk)
ACF
-0.2
0
5
10
15
20
25
30
Lag

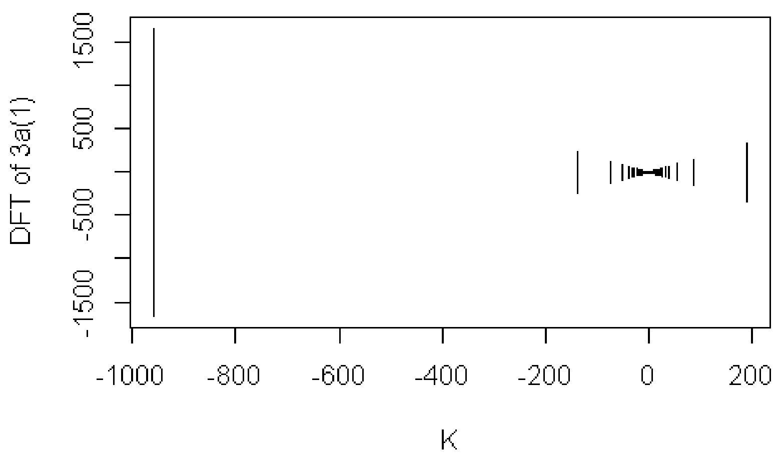

ACF of Residuals
ACF
-0.2
0
5
10
15
20
25
30
Lag

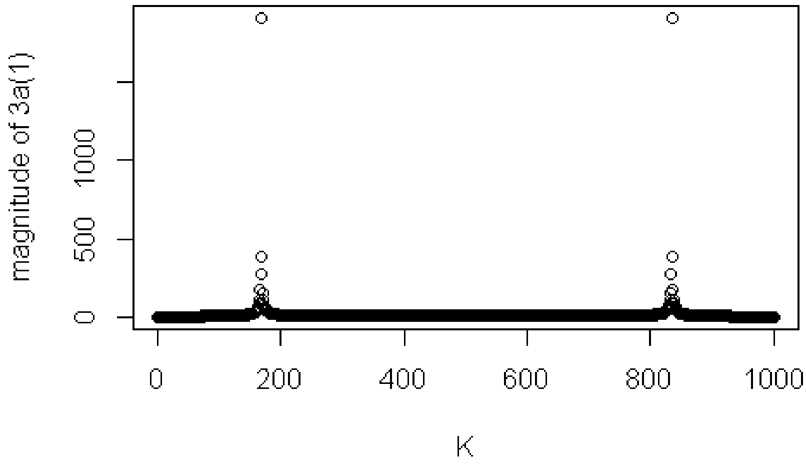


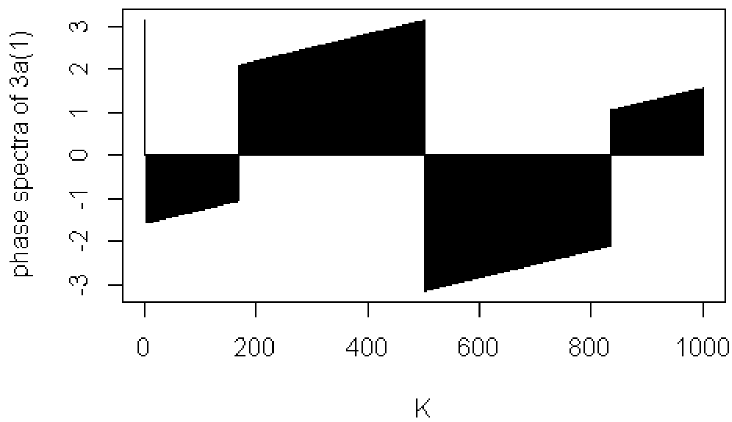


3a)

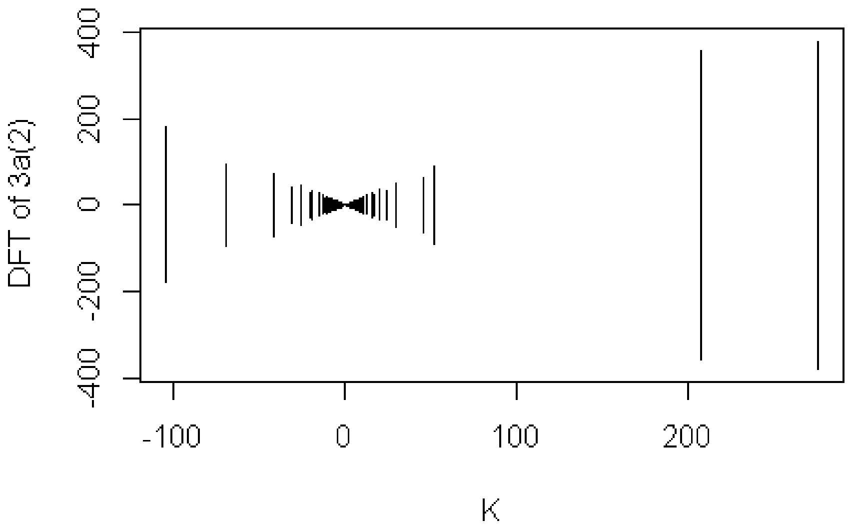
```
k=0:1000
xk1<-4*sin((pi*(k-2))/3.0)
t1<-fft(xk1)
plot(t1,type="h",xlab="K",ylab="DFT of 3a(1)")
mag1=abs(t1)
arg1=Arg(t1)
plot(arg1,type="h",xlab="K",ylab="phase spectra of 3a(1)")
plot(mag1,tpye="h",xlab="K",ylab="magnitude of 3a(1)")
```



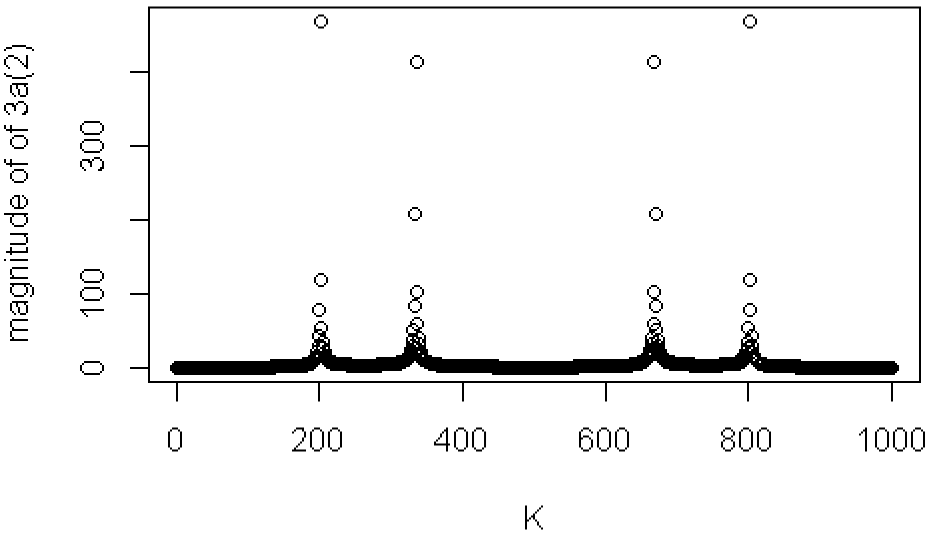




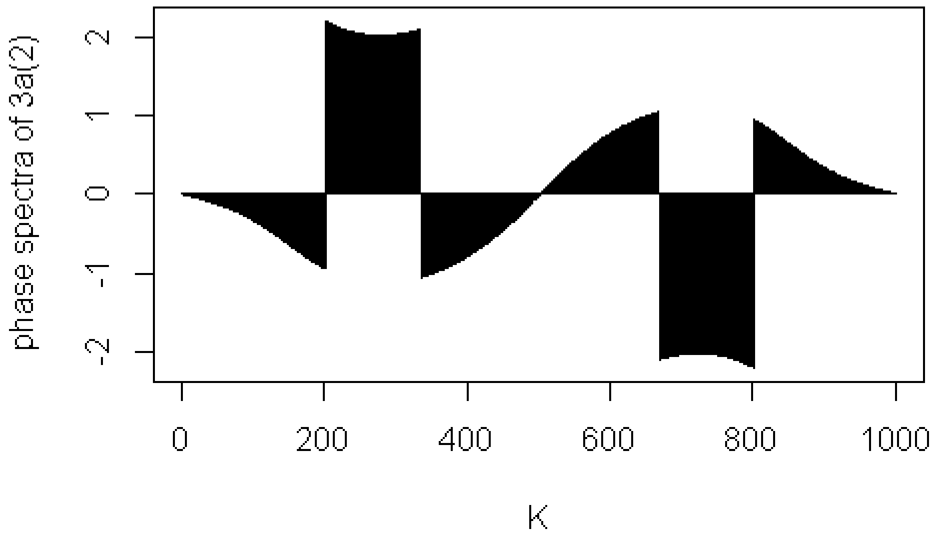

```
xk2<-cos((2*pi*k)/3.0)+sin((2*pi*k)/5.0)
t2<-fft(xk2)
plot(t2,type="h",xlab="K",ylab="DFT of 3a(2)")
mag2=abs(t2)
arg2=Arg(t2)
plot(arg2,type="h",xlab="K",ylab="phase spectra of 3a(2)")
plot(mag2,tpye="h",,xlab="K",ylab="magnitude of of 3a(2)")
```



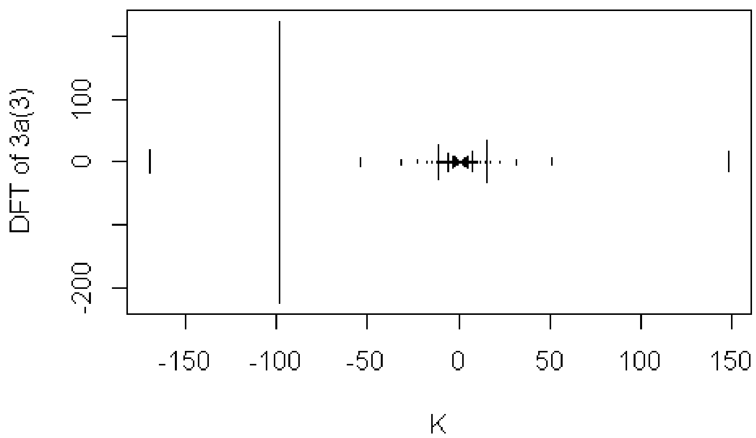
DFT of 3a(2)
400
200
0
-200
-400
-100
0
100
200
K

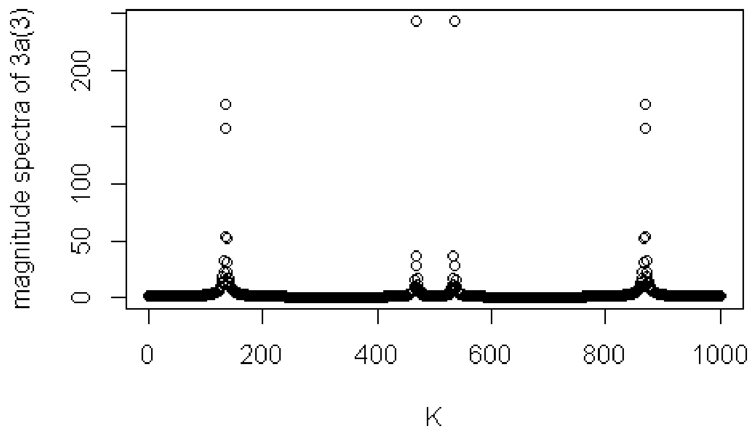


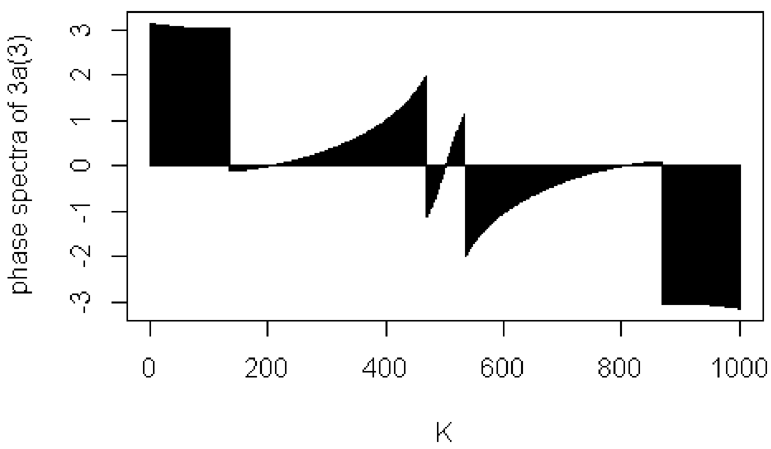
magnitude of of 3a(2)
0
100
300
0
200
400
600
800
1000
K




```
xk3<-cos((2*pi*k)/3.0)*sin((2*pi*k)/5.0)
t3<-fft(xk3)
plot(t3,type="h",xlab="K",ylab="DFT of 3a(3)")
mag3=abs(t3)
arg3=Arg(t3)
plot(arg3,type="h",xlab="K",ylab="phase spectra of 3a(3)")
plot(mag3,tpye="h",xlab="K",ylab="magnitude spectra of 3a(3)")
```







3c)

```
xk=c(1,0,1,2,3,2)#N=6
N=6
tk=fft(xk)
sum1=sum(xk*xk)#19
sum2=(sum(abs(tk)*abs(tk)))/N#114/6=19
#sum1 is equal to sum2 Hence we verified Parseval's theorem
```