Fin Time Series Homework 3

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Question 1

(a)

In [5]:
```
install.packages("fpp")
library(fpp)
data(plastics)
```

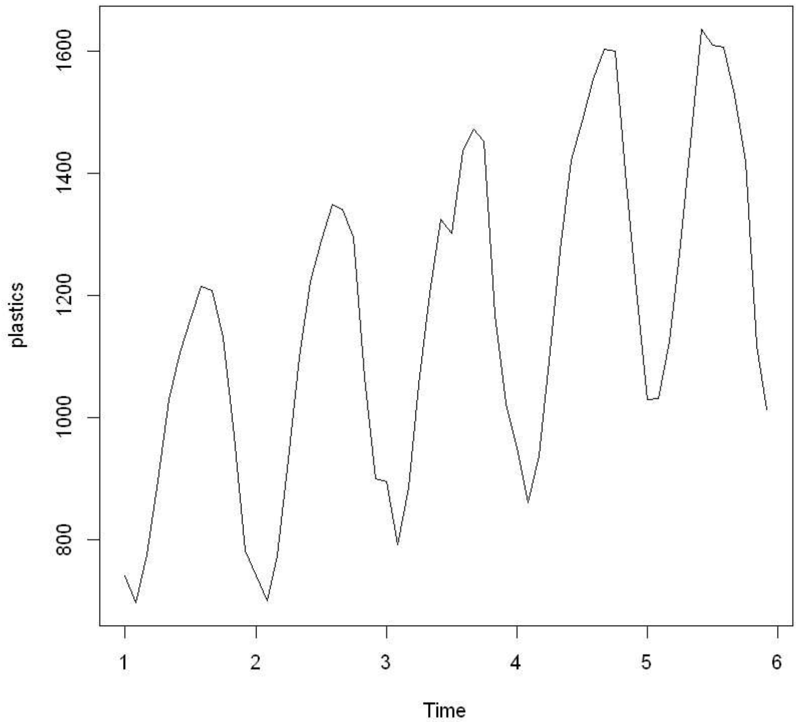
```
Installing package into 'C:/Users/zzzha/Documents/R/win-library/3.6'
(as 'lib' is unspecified)

Warning message:
"package 'fpp' is in use and will not be installed"
Warning message in data(plastics):
"data set 'plastics' not found"
```

In [6]:
```
plastics
```

A Time Series: 5 × 12

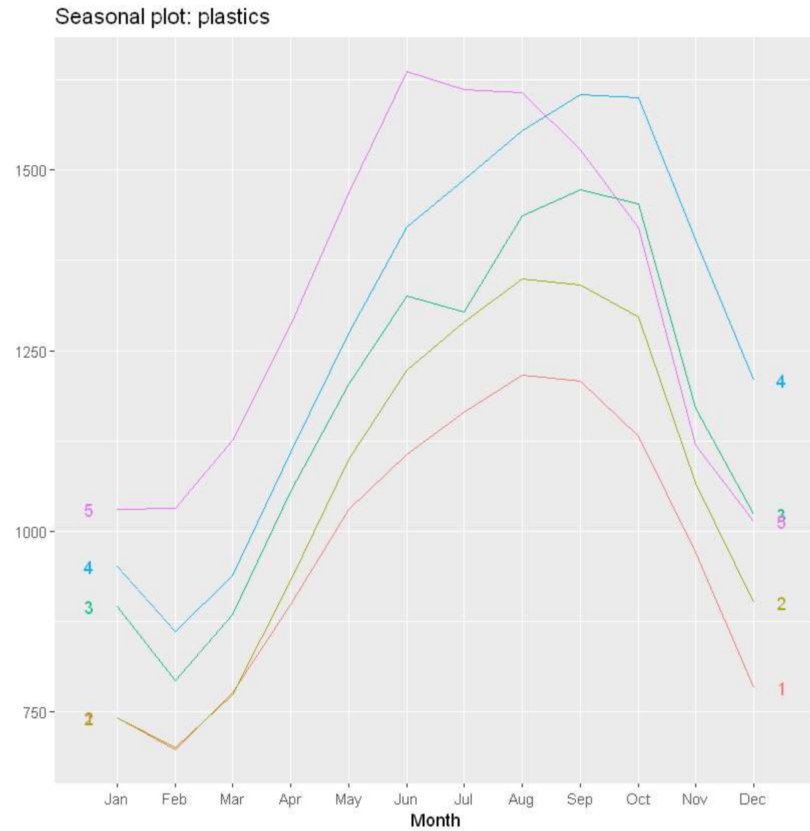
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
742	697	776	898	1030	1107	1165	1216	1208	1131	971	783
741	700	774	932	1099	1223	1290	1349	1341	1296	1066	901
896	793	885	1055	1204	1326	1303	1436	1473	1453	1170	1023
951	861	938	1109	1274	1422	1486	1555	1604	1600	1403	1209
1030	1032	1126	1285	1468	1637	1611	1608	1528	1420	1119	1013

In [8]:
```
plot(plastics)
```



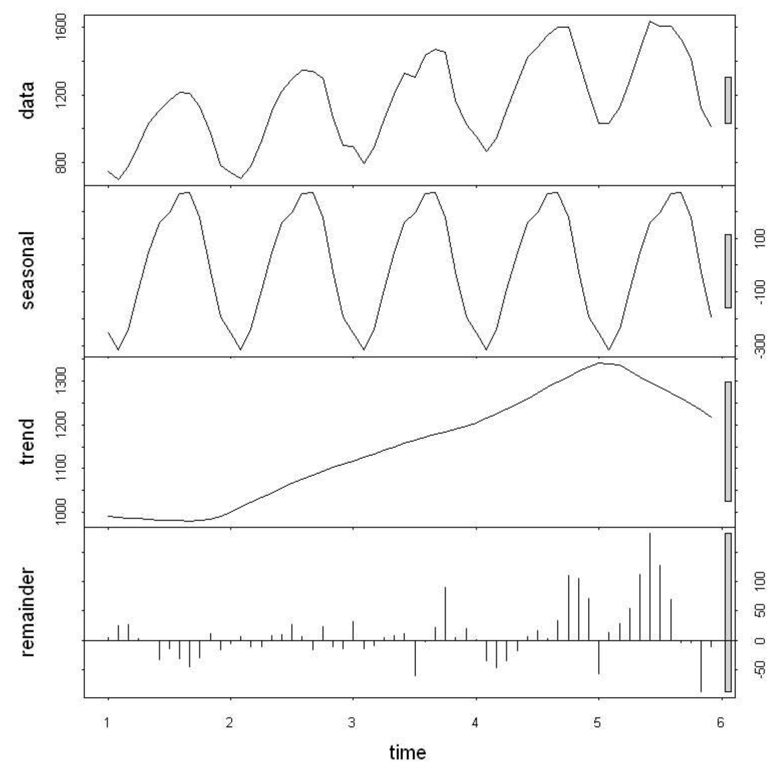
The plot shows that there is a seasonal pattern and positive trend.There are seasonal fluctuation with sales peaking in summer and reaching troughs in winter. Also, we can use seasonal plot to see it.

In [22]:
```
ggseasonplot(plastics, year.labels=TRUE, year.labels.left=TRUE)#seasonal plot
```

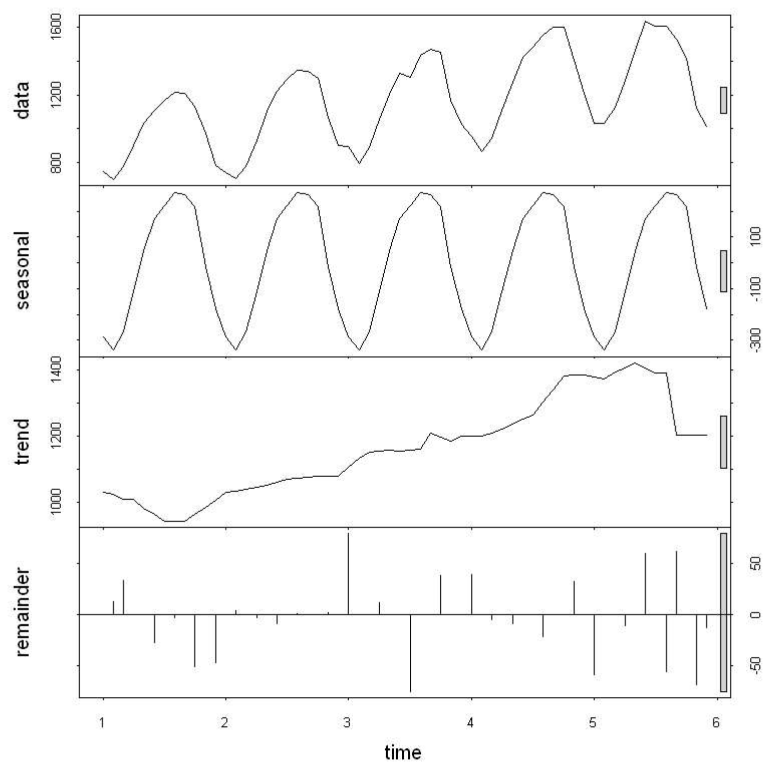


(b)

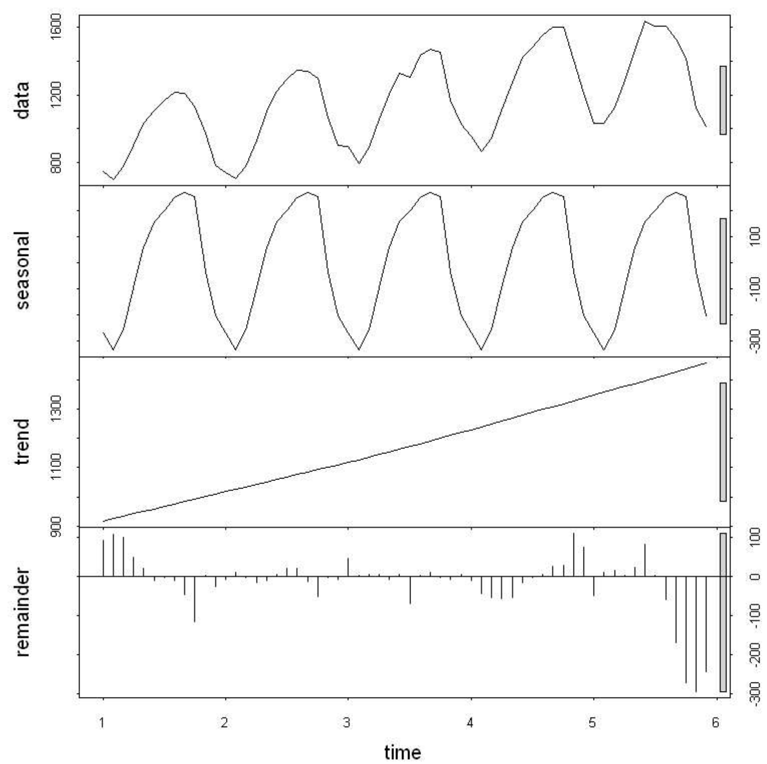
In [41]:
```
fit1 <- stl(plastics, t.window=NULL, s.window="periodic", robust=TRUE)
plot(fit1)
```



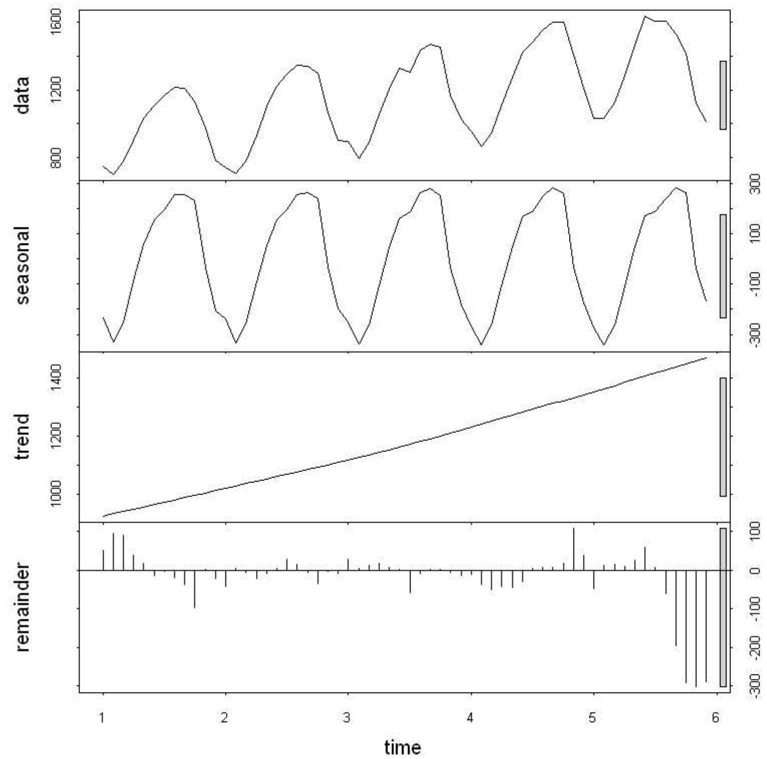
In [43]:
```
fit2 <- stl(plastics, t.window=5, s.window="periodic", robust=TRUE)
plot(fit2)
```



In [44]:
```
fit3 <- stl(plastics, t.window=50, s.window="periodic", robust=TRUE)
plot(fit3)
```



In [45]:
```
fit4 <- stl(plastics, t.window=50, s.window=5, robust=TRUE)
plot(fit4)
```

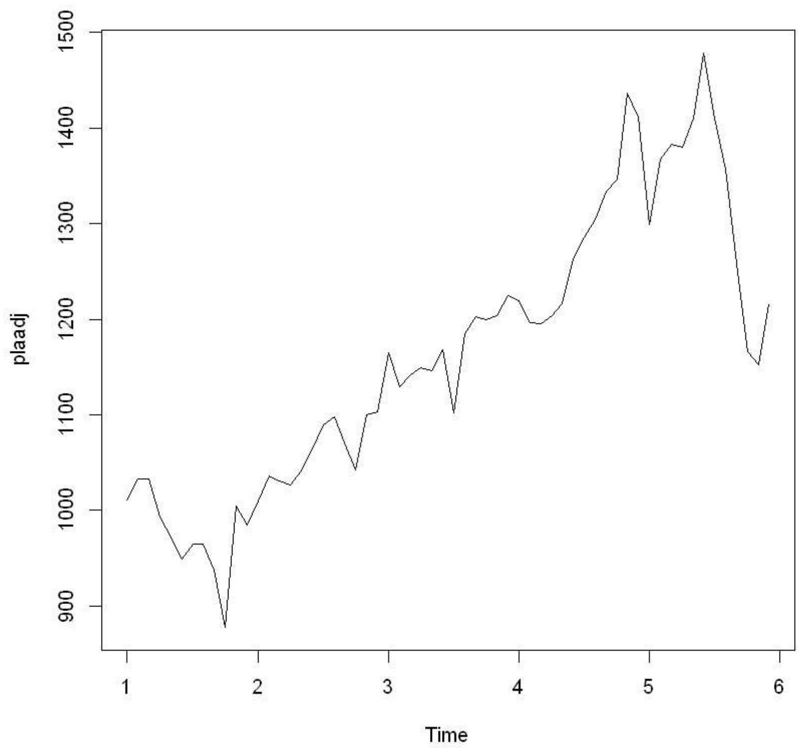


1. it seems that if the t.window is bigger, the trend will be more smooth and less fluctuated.
2. s.window controls how rapidly the seasonal component can change. Small values allow more rapid change. So it seems that 5 is very close to the value of periodic

(c)

In [48]:
```
plaadj <- seasadj(fit3)
```

In [50]:
```
plot(plaadj)
```

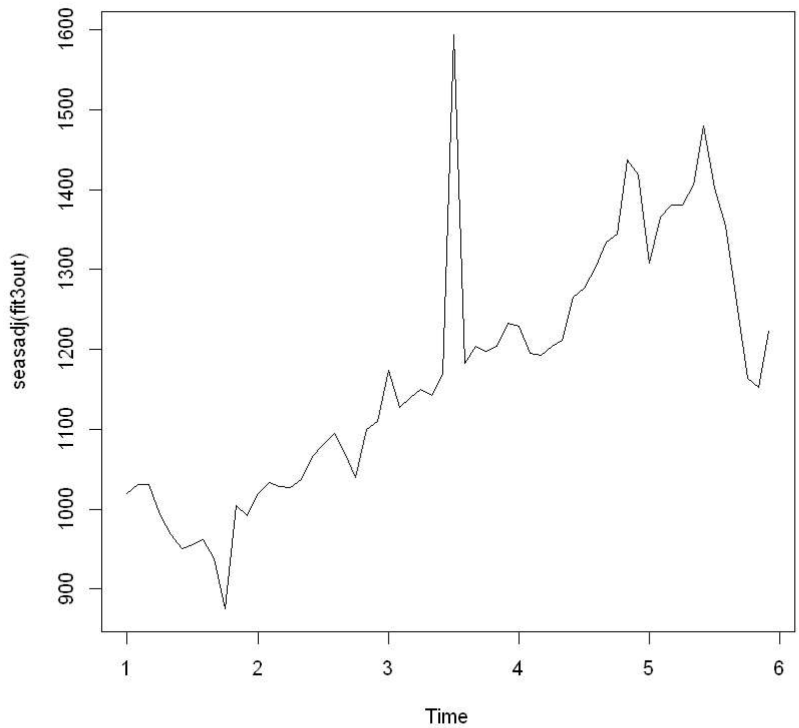


(d)

In [37]:
```
plastics2<-plastics
```

In [39]:
```
#add 500 to July of the third year
plastics2[31] = plastics2[31] + 500
```

In [57]:
```
fit3mid<-stl(plastics2, t.window=50, s.window="periodic", robust=TRUE)
plot(seasadj(fit3out))
```

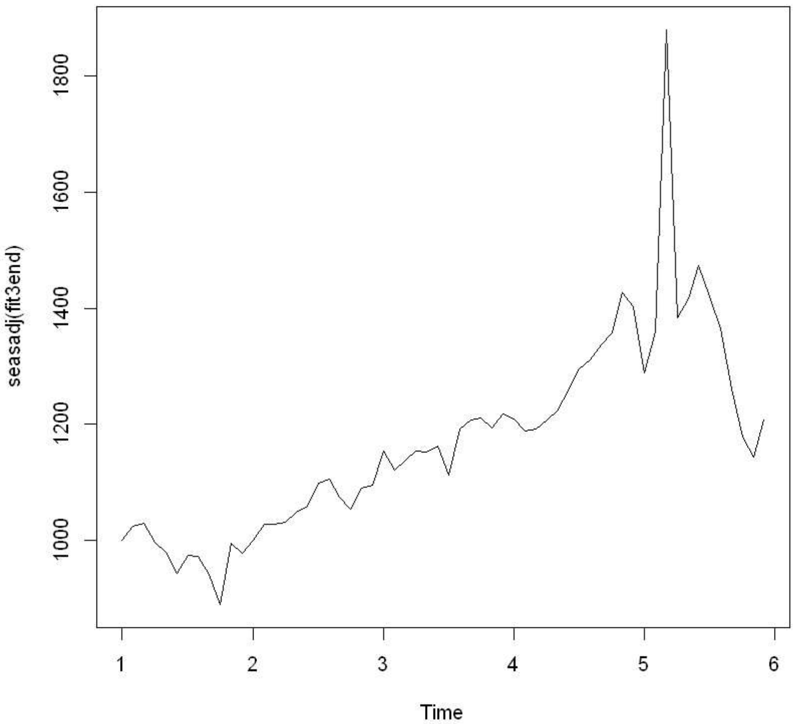


The outlier causes a spike in the graph at the month it appears.

In [52]:
```
plastics3<-plastics
```

In [53]:
```
plastics3[51]=plastics3[51]+500
```

In [58]:
```
fit3end<-stl(plastics3, t.window=50, s.window="periodic", robust=TRUE)
plot(seasadj(fit3end))
```



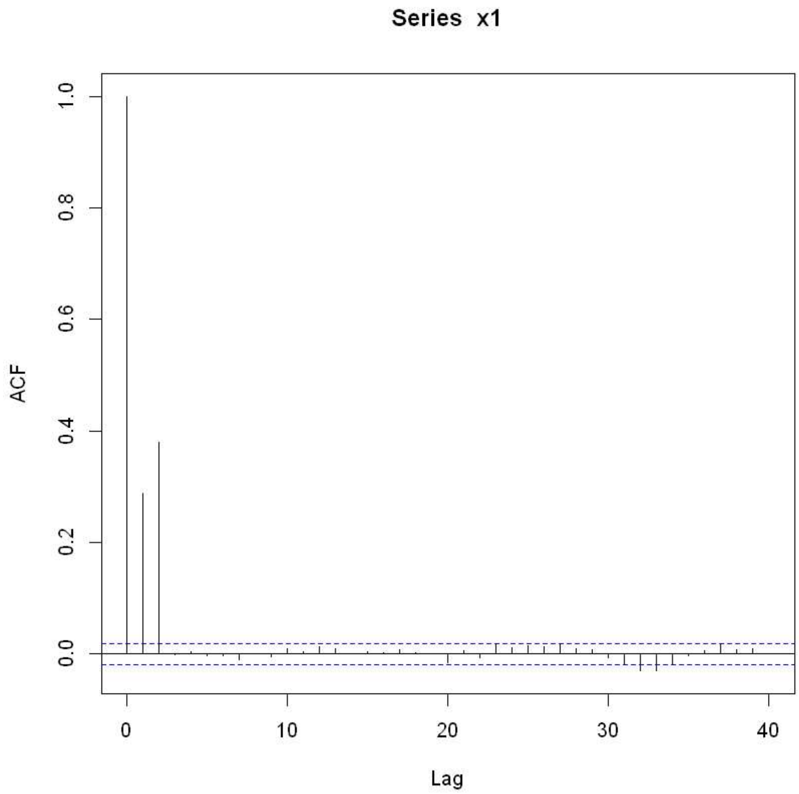
It appears that it doesn't matter where the outlier occurs, we get a similar sized spike. Although the spike appears in different area of the plot.

Question 2

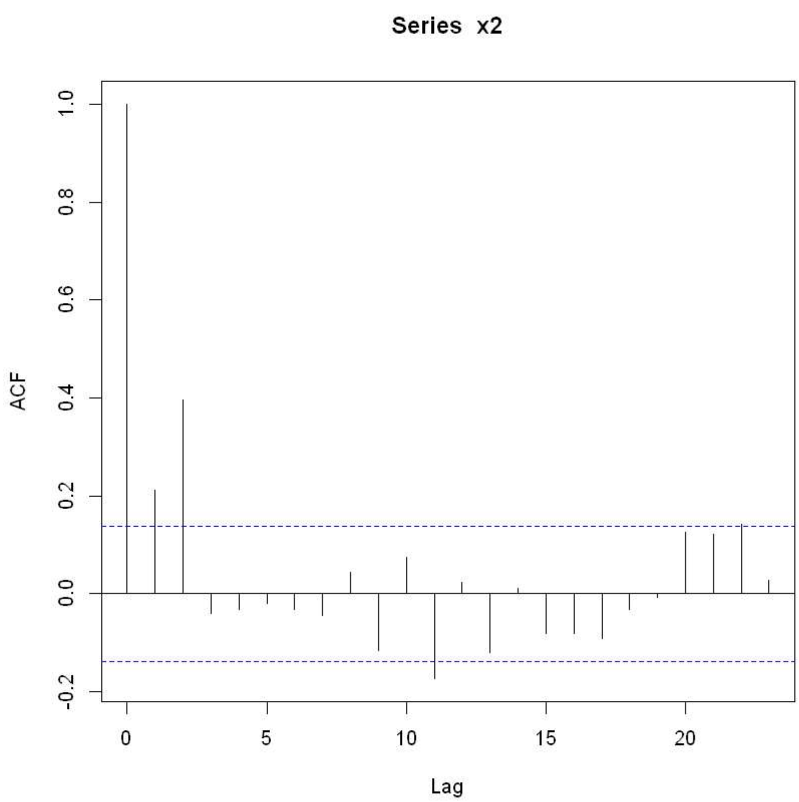
In [59]:
```
masim=function(the, sigsq, T){
    q=length(the)
    noise=rnorm(T+q,sd=sqrt(sigsq))#generate the white noise plus a few to get started
    x=c(noise[1:q],rep(0,T))#put the initial noise terms in and set the rest to zero
    for (i in (q+1):(T+q)){
        x[i]=the %*% noise[i-(1:q)]+noise[i]
    }
    x=x[(q+1):(T+q)]
    x
}
```

In [60]:
```
x1<-mas(c(0.5,2),1,10000)
```

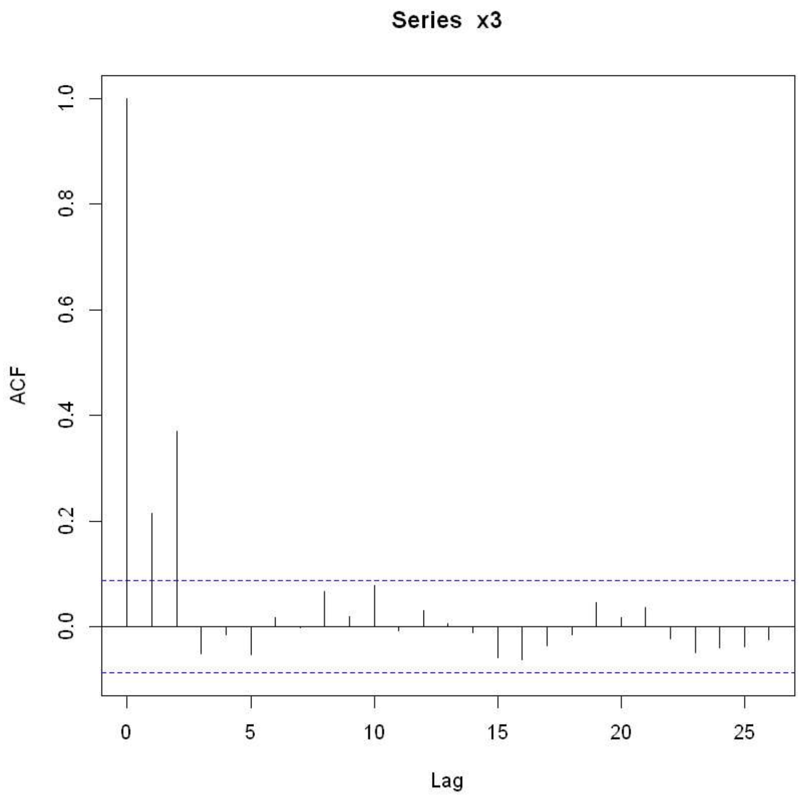
In [61]:
```
acf(x1)
```



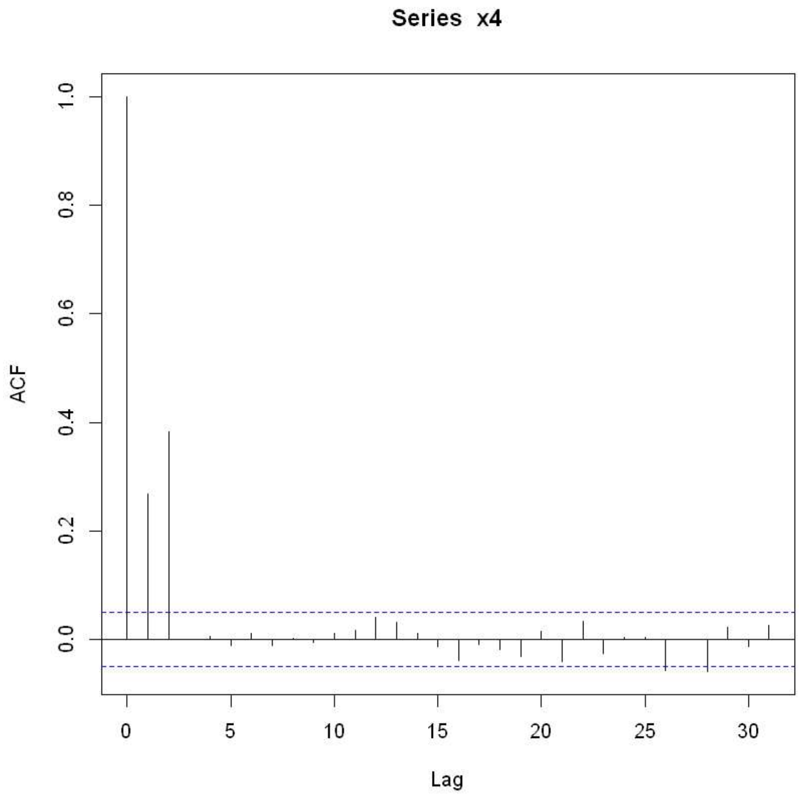
In [67]:
```
x2=masim(c(0.5,2),1,200)
acf(x2)
```



In [69]:
```
#observation = 500
x3=masim(c(0.5,2),1,500)
acf(x3)
```



In [68]:
```
#observation = 1500
x4=masim(c(0.5,2),1,1500)
acf(x4)
```



We can see from above plots that when the sample size get smaller, the blue line get wider and the many of the correlations that should be 0 are outside the blue line.

Question 3

(a)

Xt is not stationary because its mean=5+6t, which depends on time t. E(Xt)=E(5+6t+Wt)=5+6t+E(Wt)=5+6t

(b)

Yt is stationary because

1. its mean is consistant as E (Yt)=E(Xt -Xt-1)

```
=E(Xt )-E(Xt-1 )
=E(5+6t+Wt )-E(5+6(t-1)+Wt-1 )
=5+6t+E(Wt )-5-6(t-1)-E(Wt-1 )
=6
```

2. its correlation is 0 as
   Cor=E(Yt -E(Yt))(Yt+h -E(Yt+h))
   =E(Xt -Xt-1 -6)*(Xt+h -Xt+h-1 -6)*
   Because Xt =5+6t+Wt , we have Wt =Xt -5-6t
   Xt-1 =5+6(t-1)+Wt-1, we have Wt-1=Xt-1 -5-6(t-1)
   Then we get
   Wt-Wt-1=Xt-Xt-1-6
   Cor=E(Wt-Wt-1) (Wt+h-Wt+h-1)
   =E(WtWt+h – WtWt+h-1-Wt-1Wt+h+WtWt+h-1)
   =0