Exploratory Data Analysis Assignment2

FNU Anirudh

September 16, 2015

Solution 1:-

a. E [Xi]= ?? and Var[Xi]= ??2

   _ d ????? (X- ??)——-> N (0, ??^2)

Given ??2 = 1/??2 We can write _ d ???n (X- 1/??) –>??? N (0, 1/??2)

b. We know that the asymptotic distribution of the sample median is

   _ d ???n (X- X0.5) –???> N (0, 1/4 {f(X0.5) }2) f (X0.5)= f (log2/ ??) = ?? e (-?? log 2/??) = ??/2 We have , 1/ 4 { {f(X0.5) }2 = 1 /4 (??2/4d)—>??? N (0,5) -

c. Var (T2)= Var (X/log2) _ = (1/ln2)^2 Var (X) = 2.081 ??^2
d. ARE(T1,T2)= ??^2/n/2.081 ??^2/n = 0.481= 48.1%

e. Comparing the two statistics T1 and T2, T1 is the better because when we compare the variance of these two methods T1 has a lesser variance, so this would be the preferred statistic method of the given two

f.

source(lvalprogs.r) x <- rexp(1000, 1) lval(x)

Depth Lower Upper Mid Spread pseudo-s M 500.5 0.6932 0.6932 0.6932 0.0000 0.0000 F 250.5 0.2929 1.3877 0.8403 1.0948 0.8116 E 125.5 0.1291 2.0037 1.0664 1.8746 0.8148 D 63.0 0.0617 2.6406 1.3511 2.5790 0.8405 C 32.0 0.0289 3.3680 1.6985 3.3391 0.8963 B 16.5 0.0149 4.3889 2.2019 4.3741 1.0154 A 8.5 0.0083 4.6239 2.3161 4.6157 0.9546 Z 4.5 0.0050 5.2925 2.6488 5.2874 0.9938 Y 2.5 0.0009 5.6520 2.8264 5.6511 0.9792 X 1.5 0.0006 5.8699 2.9352 5.8692 0.9475 W 1.0 0.0004 5.9646 2.9825 5.9642 0.9044

Data is skewed to the right.

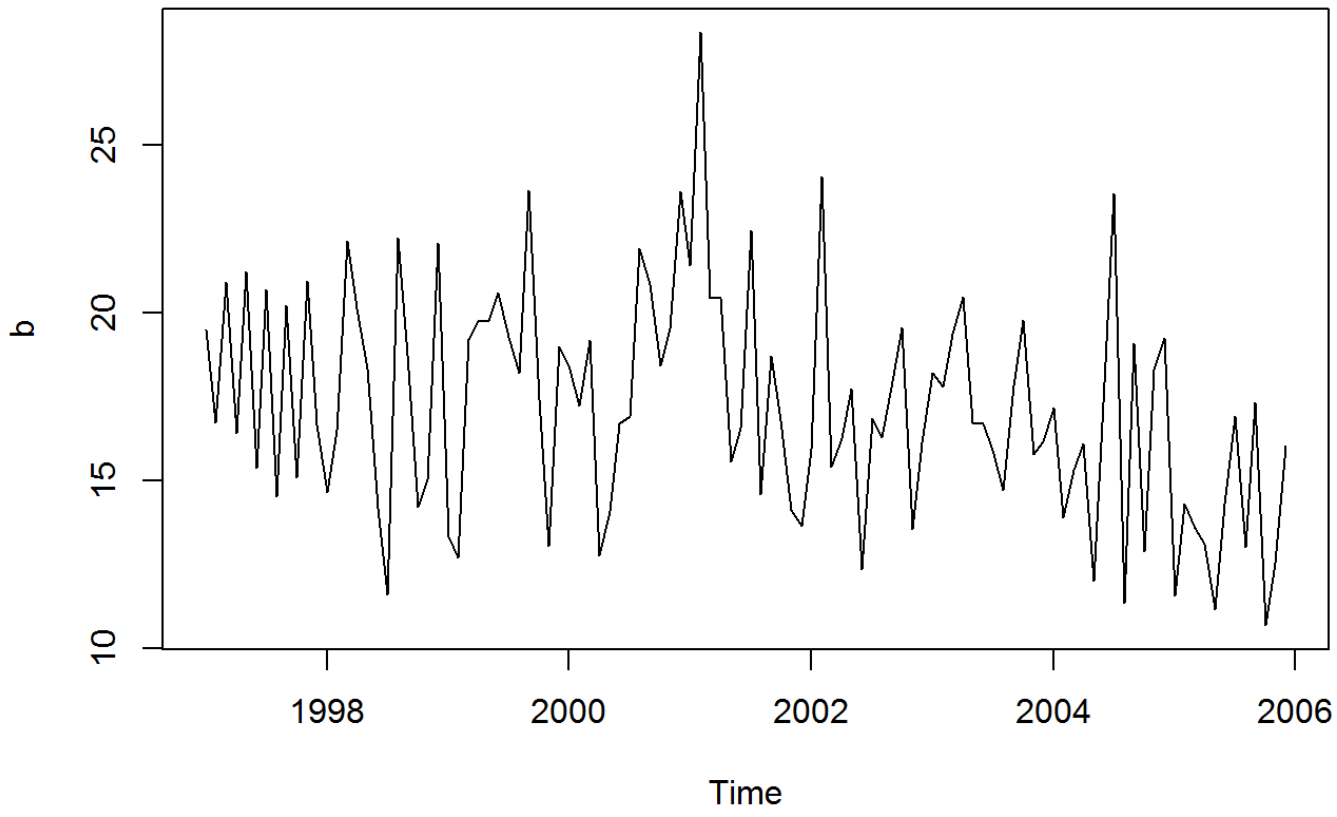
Solution 2:-

```
library(aplpack)
```

```
## Loading required package: tcltk
```

```
# Letter Value
lval <- function(x) {
 #tag <- c("M ","F ","E ","D ","C ","B ","A ","Z ","Y ","X ","W ","V","U","T",
 # "S","R","Q","P","O","N")
 # gau <- abs(qnorm(c(.25,.125,1/16,1/32,1/64,1/128,1/256,1/512,1/1024,1/2048,
 #   1/4096, 1/8192, 1/16384, 1/32768, 1/65536)))
 tag <- c("M",LETTERS[6:1],LETTERS[26:14])

 gau <- abs(qnorm(1/2^(2:20)))

 # col 1 = depth; 2 = lower; 3 = upper; 4 = mid; 5 = spread; 6 = pseudo-s

 y <- sort(x[!is.na(x)])
 n <- length(y)
 m <- ceiling(log(n)/log(2)) + 1
 depth   <- rep(0,m)
 depth[1] <- (1 + n)/2

 for (j in 2:m) {depth[j] <- (1 + floor(depth[j-1]))/2 }

 ndepth <- n+1 - depth
 out <- matrix(0, m, 6)
 dimnames(out) <- list(tag[1:m],
                 c("Depth", "Lower","Upper", "Mid", "Spread","pseudo-s"))
 out[1,2:3] <- median(y)
 out[,1] <- depth


 for (k in 2:m) {
  out[k,2] <- ifelse(depth[k] - round(depth[k]) == 0,
                y[depth[k]], (y[depth[k]-.5]+y[depth[k]+.5])/2 )
  out[k,3] <- ifelse(ndepth[k] - round(ndepth[k]) == 0,
                y[ndepth[k]], (y[ndepth[k]-.5]+y[ndepth[k]+.5])/2 )
 }

 out[1:m,4] <- (out[1:m,2] + out[1:m,3])/2
 out[2:m,5] <- out[2:m,3] - out[2:m,2]
 out[2:m,6] <- out[2:m,5]/(2*gau[1:(m-1)])
 round(out,4)
}



A = c(19.50, 16.72, 20.92, 16.42, 21.22, 15.40, 20.68, 14.55, 20.23
    , 15.11, 20.95, 16.68, 14.67, 16.50, 22.15 , 20.14, 18.33, 14.20
    ,11.61,22.24,18.75,14.22,15.03,22.07,13.34,12.73,19.23
    ,19.74,19.74,20.60,19.29,18.22,23.65,17.44,13.07,19.00
    ,18.44, 17.25, 19.19, 12.77,14.10,16.69,16.92,21.92,20.84
    ,18.43, 19.54, 23.61, 21.40, 28.34, 20.43, 20.43, 15.58,16.58
    , 22.44, 14.59, 18.70, 16.79, 14.12, 13.67, 15.94, 24.04 , 15.42
```

```
, 16.26, 17.74, 12.37 , 16.87, 16.28, 17.97, 19.56, 13.56, 16.13
, 18.20, 17.79, 19.38, 20.47, 16.75, 16.69, 15.93, 14.73, 17.83
, 19.78, 15.78, 16.17, 17.18, 13.90, 15.33, 16.10, 12.03,17.92
, 23.56, 11.35, 19.10, 12.91, 18.32, 19.24, 11.57, 14.33, 13.60
, 13.12, 11.19, 14.33, 16.91, 13.03, 17.32, 10.70, 12.56, 16.04)

# Plot Time series
b= ts(A, frequency = 12, start = c(1997, 1))
plot(b)
```



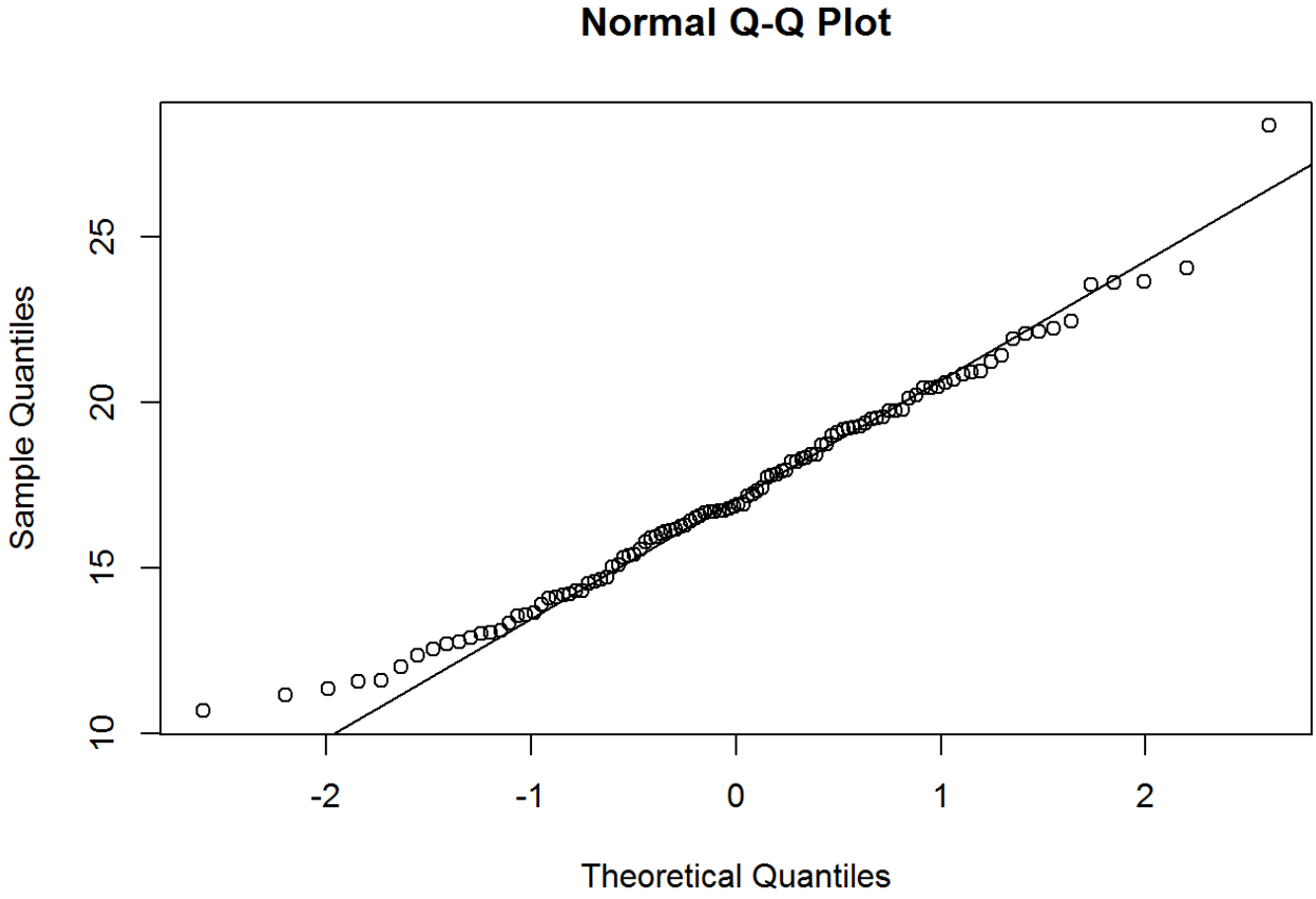

```
# Stem and Leaf
stem.leaf(b)
```

```
## 1 | 2: represents 1.2
##  leaf unit: 0.1
##            n: 108
##    1    10 | 7
##    5    11 | 1356
##   11    12 | 035779
##   19    13 | 00135669
##   29    14 | 1122335567
##   38    15 | 013445799
##   56    16 | 011122455666777899
##  (9)    17 | 123477899
##   43    18 | 22334477
##   35    19 | 0112223555777
##   22    20 | 1244466899
##   12    21 | 249
##    9    22 | 0124
##    5    23 | 566
##    2    24 | 0
## HI: 28.34
```

```
lval(b)
```

```
##   Depth  Lower  Upper    Mid Spread pseudo-s
## M  54.5 16.890 16.890 16.8900  0.000   0.0000
## F  27.5 14.630 19.520 17.0750  4.890   3.6250
## E  14.0 13.120 20.920 17.0200  7.800   3.3903
## D   7.5 12.465 22.195 17.3300  9.730   3.1712
## C   4.0 11.570 23.610 17.5900 12.040   3.2318
## B   2.5 11.270 23.845 17.5575 12.575   2.9192
## A   1.5 10.945 26.190 18.5675 15.245   3.1530
## Z   1.0 10.700 28.340 19.5200 17.640   3.3157
```

```
# QQ Plot
qqnorm(b)
qqline(b)
```



From stem and leaf we can see that data is skewed to the left. d) NotNormally distributed e) Yes, there is outlier.

Solution 3:-

a. Single Batch n=120

0.4 + 0.007* n= 0.4+ 0.007 * 120= 1.24

b. Two batches n=60

a= 0.4+0.007*n= 0.4+0.42=0.82

Similarly,b= 0.82

Total outside values= a+b= 0.82+0.82= 1.64

c. n=40

a= 0.4+ 0.007* 40= 0.68

n=30

b= 0.4+ 0.007* 30= 0.61

n=20

c= 0.4+0.007* 20= 0.54

n=10

c= 0.4+0.007* 10= 0.47

n=5

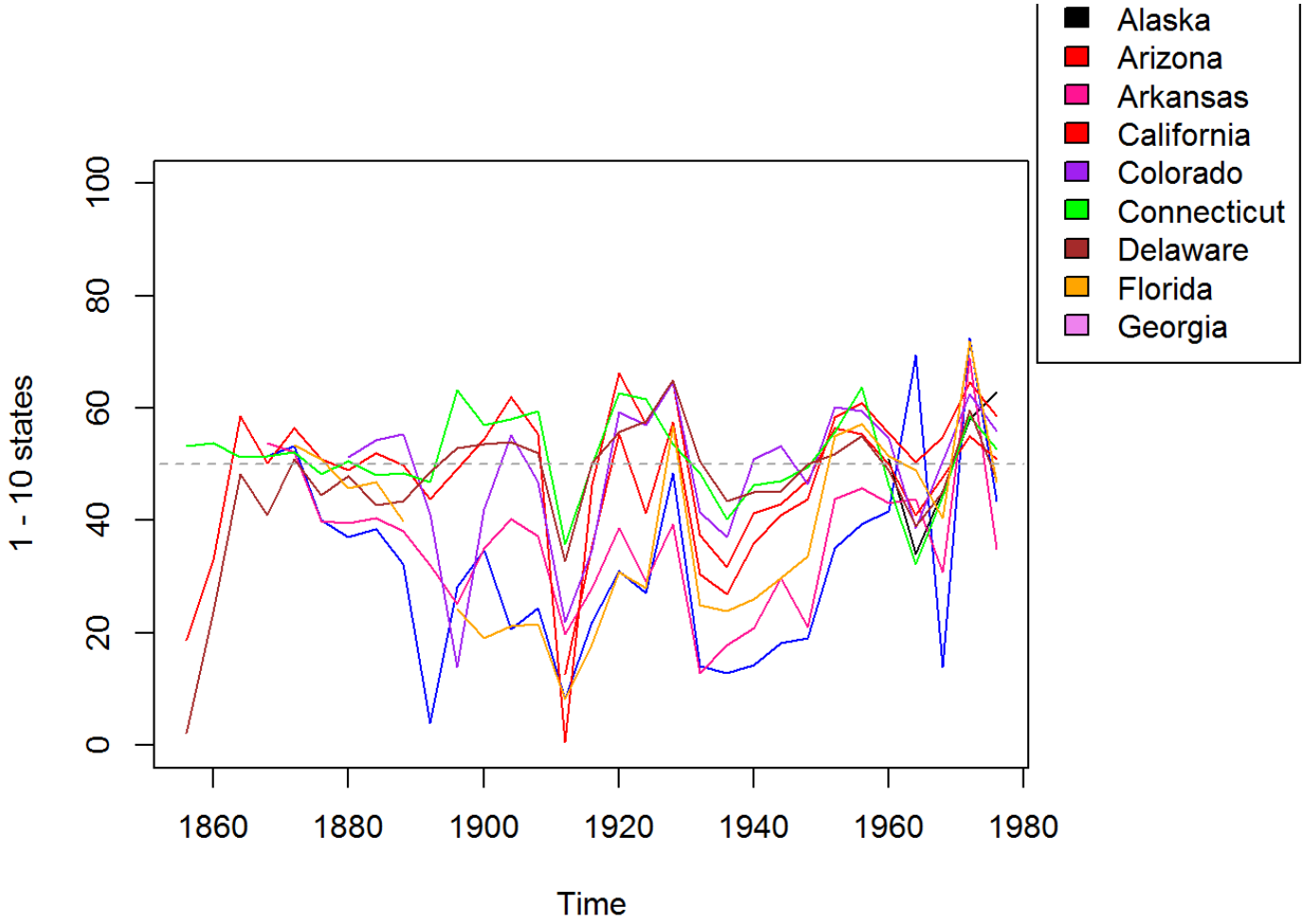
c= 0.4+ 0.007*5= 0.435

Total outside value= 0.68 + 0.61 + 0.54 + 0.47 + 4* 0.435 = 4.04

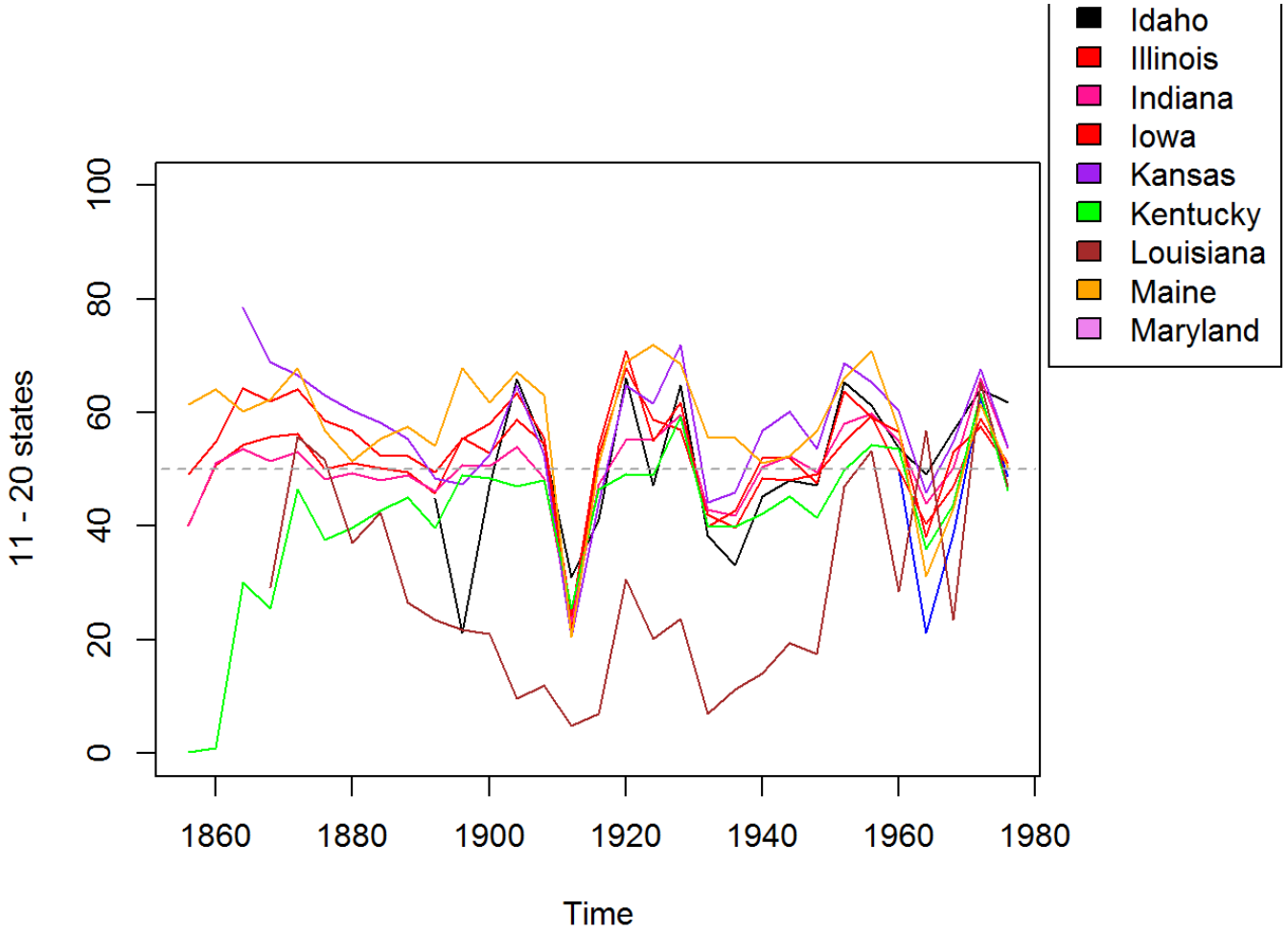
Solution 4

1.

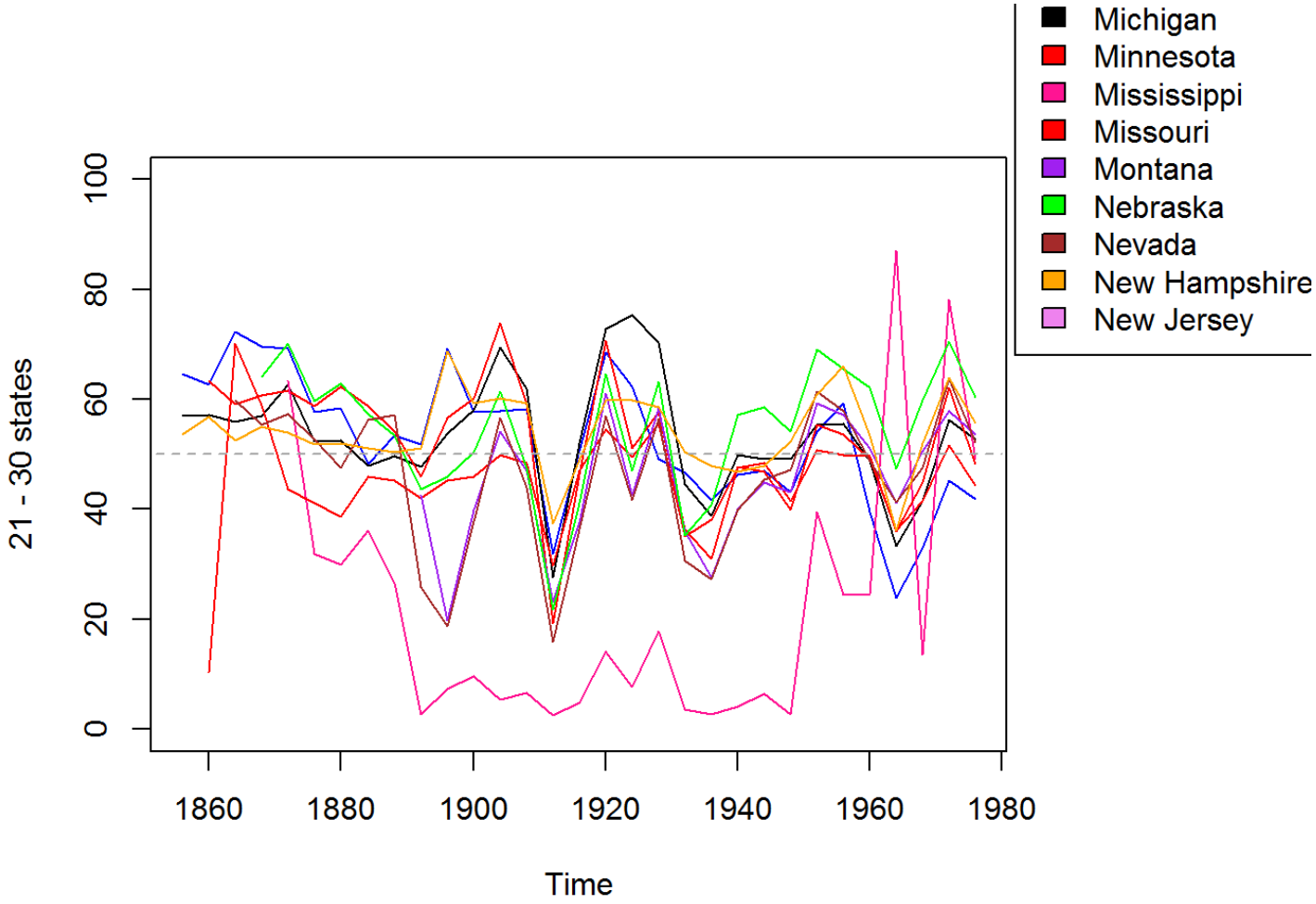
```
library(cluster)
vote=votes.repub
vote_calc= function(vote,lower,upper)
{
 colours=c("blue","black","red","deeppink","red","purple","green","brown",
         "orange","violet")
 par(xpd=NA,oma=c(0,0,0,6))
 for(i in lower:upper)
 {
  vote_t=vote[i,]
  vote_t=as.data.frame(t(vote_t))
  vote_ts=ts(vote_t,frequency=0.25,start=1856)
  if(i==lower)
  {
   plot(vote_ts,col=colours[1],ylim=range(0,100),xlim=range(1856,1976),
       ylab=paste(lower,"-",upper,"states"))
  }
  else
   lines(vote_ts,col=colours[i%%10])
 }
 legend(1982,150,legend=row.names(vote[lower:upper,]),
       fill=colours,title="States")
 segments(1852,50,1980,50,col="grey65",lty=2)
}
vote_calc(vote,1,10)
```



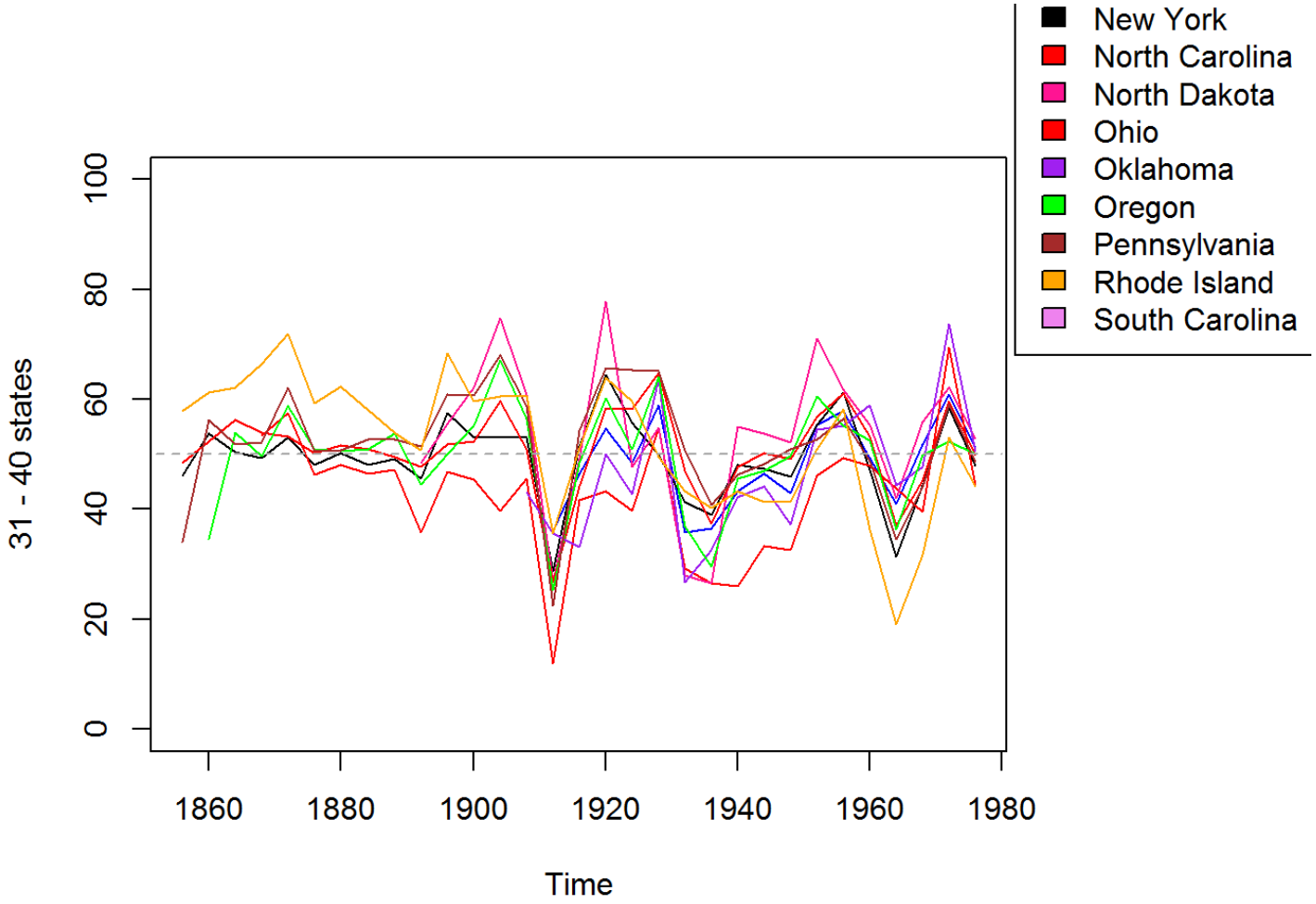

```
vote_calc(vote,11,20)
```



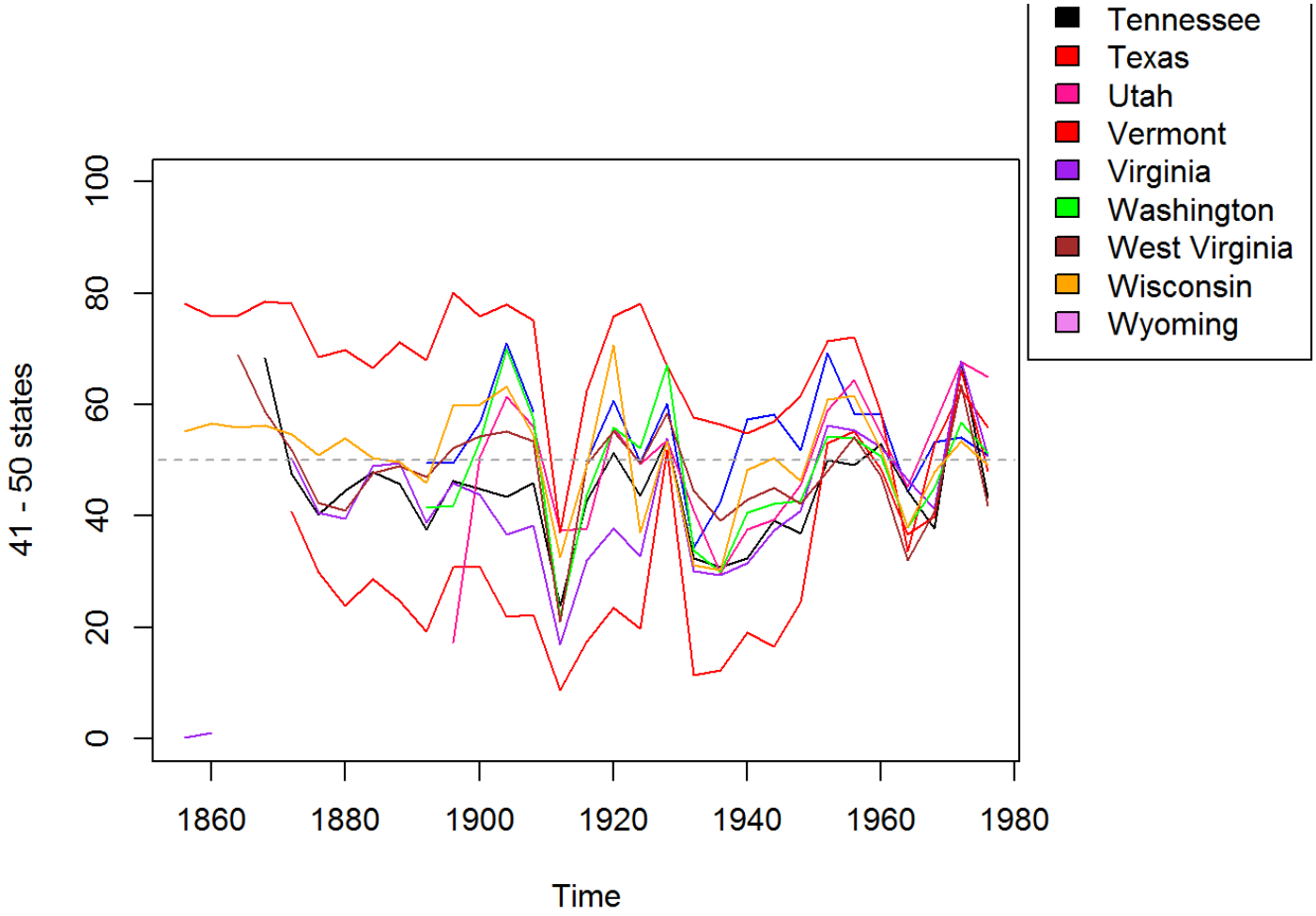

```
vote_calc(vote,21,30)
```




```
vote_calc(vote,31,40)
```

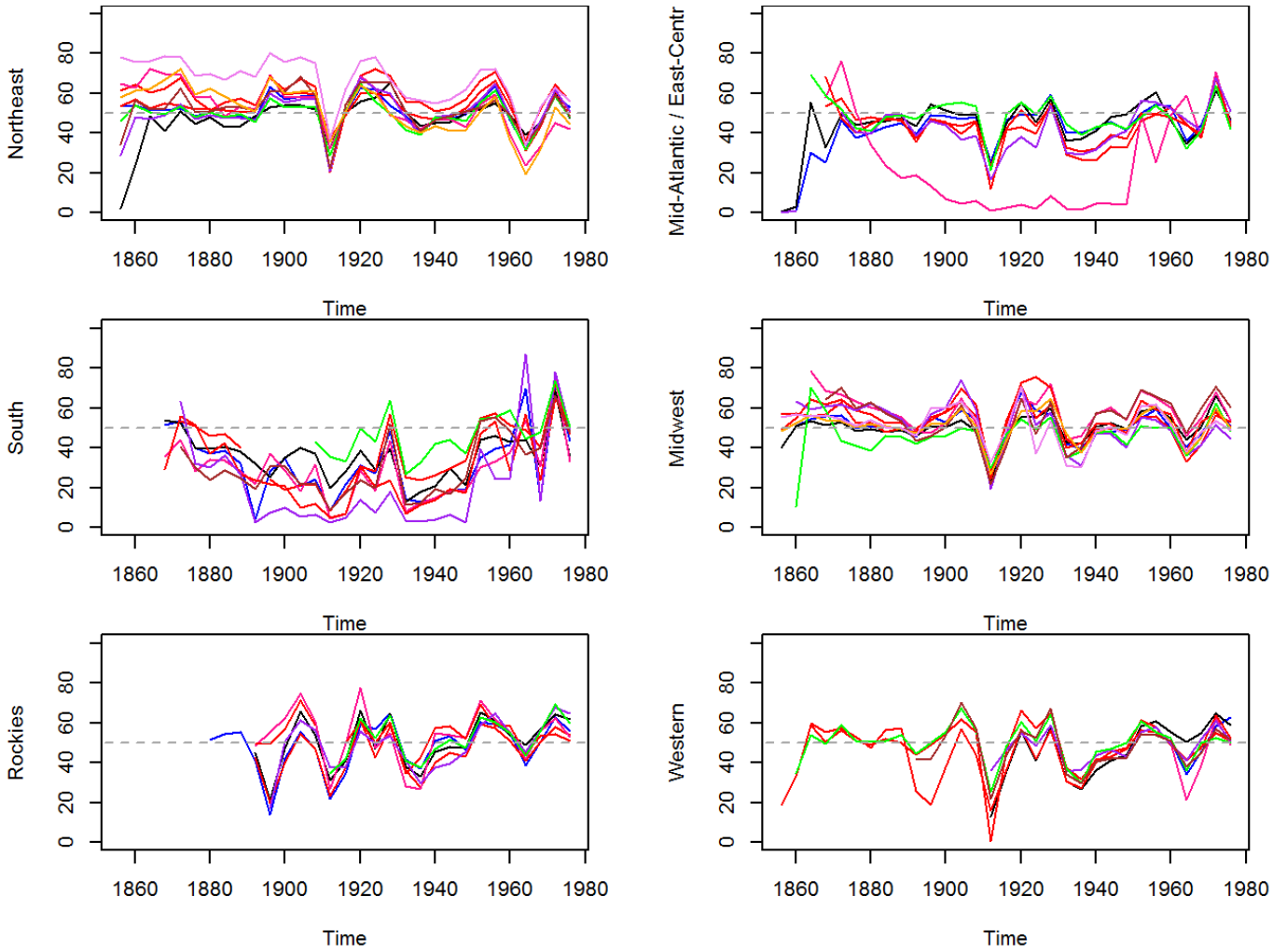



```
vote_calc(vote,41,50)
```


Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
Wisconsin
Wyoming
41 - 50 states
0
20
40
60
80
100
1860
1880
1900
1920
1940
1960
1980
Time

2.

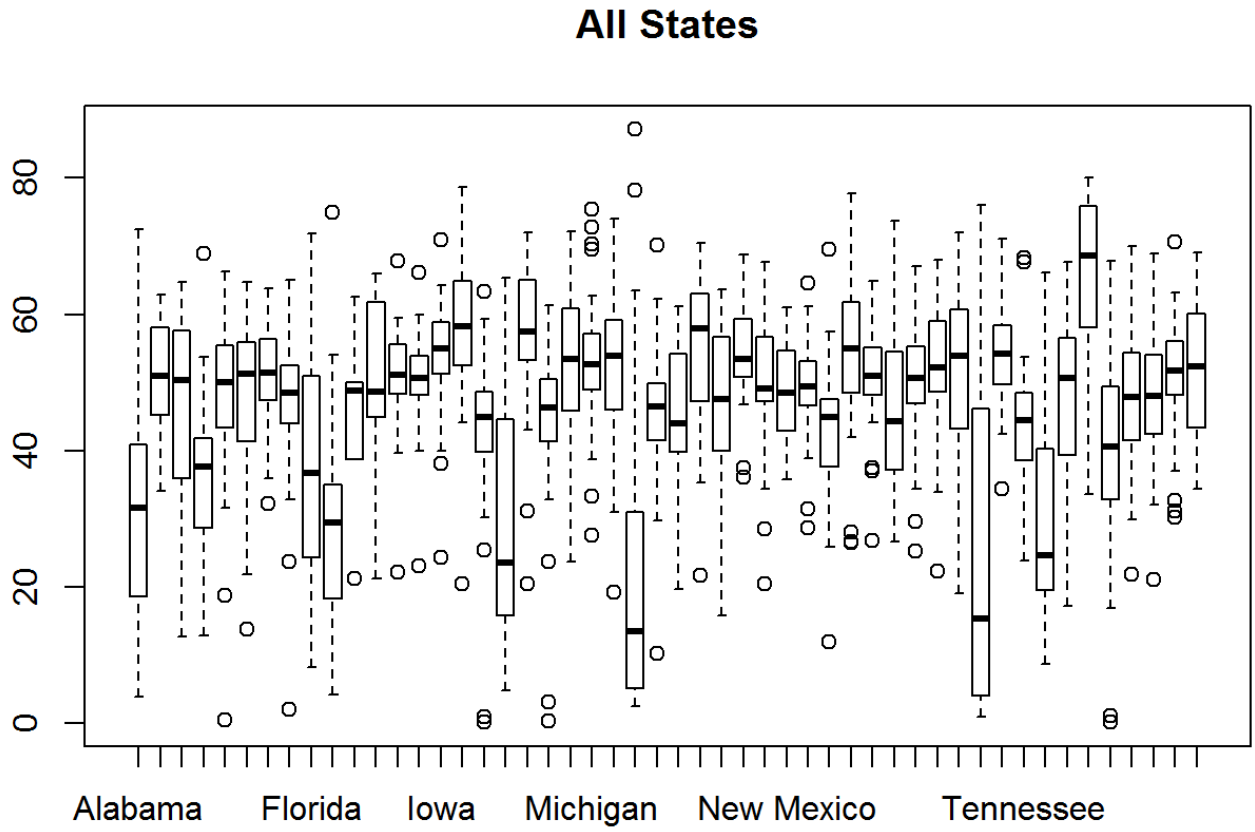
```
library(cluster)
vote = votes.repub
par(mfrow = c(3, 2))
vote_calc = function(vote, reg, name)
{

 colours=c("blue","black","red","deeppink","red","purple","green","brown",
         "orange","violet")
 par(mar=c(4,5,0,2))
 j = 1
 for(i in reg)
 {
  vote_t = vote[i,]
  vote_t = as.data.frame(t(vote_t))
  vote_ts = ts(vote_t, frequency = 0.25, start = 1856)
  if(i==reg[1])
  {
   plot(vote_ts, col = colours[1], ylim = range(0,100),
       ylab = name)
  }
  else
   j = j + 1
  lines(vote_ts, col = colours[j])
 }
 segments(1852,50,1980,50, col = "grey65", lty = 2)
}

northeast = c("Connecticut","Delaware","Maine", "Massachusetts","New Hampshire","New Jersey",
           "New York","Pennsylvania","Rhode Island","Vermont")
east_central = c("Kentucky","Maryland","North Carolina","South Carolina","Tennessee",
              "Virginia","West Virginia")
south = c("Alabama", "Arkansas", "Florida", "Georgia","Louisiana","Mississippi","Oklahoma","Texas")
midwest = c("Illinois","Indiana","Iowa","Kansas","Michigan","Minnesota","Missouri","Nebraska",
          "Ohio","Wisconsin")
rockies = c("Colorado","Idaho","Montana","North Dakota","South Dakota","Utah","Wyoming")
west = c("Alaska","Arizona","California","Hawaii","Nevada","New Mexico","Oregon","Washington")

vote_calc(vote, northeast, "Northeast")
vote_calc(vote, east_central, "Mid-Atlantic / East-Central")
vote_calc(vote, south, "South")
vote_calc(vote, midwest, "Midwest")
vote_calc(vote, rockies, "Rockies")
vote_calc(vote, west, "Western")
```



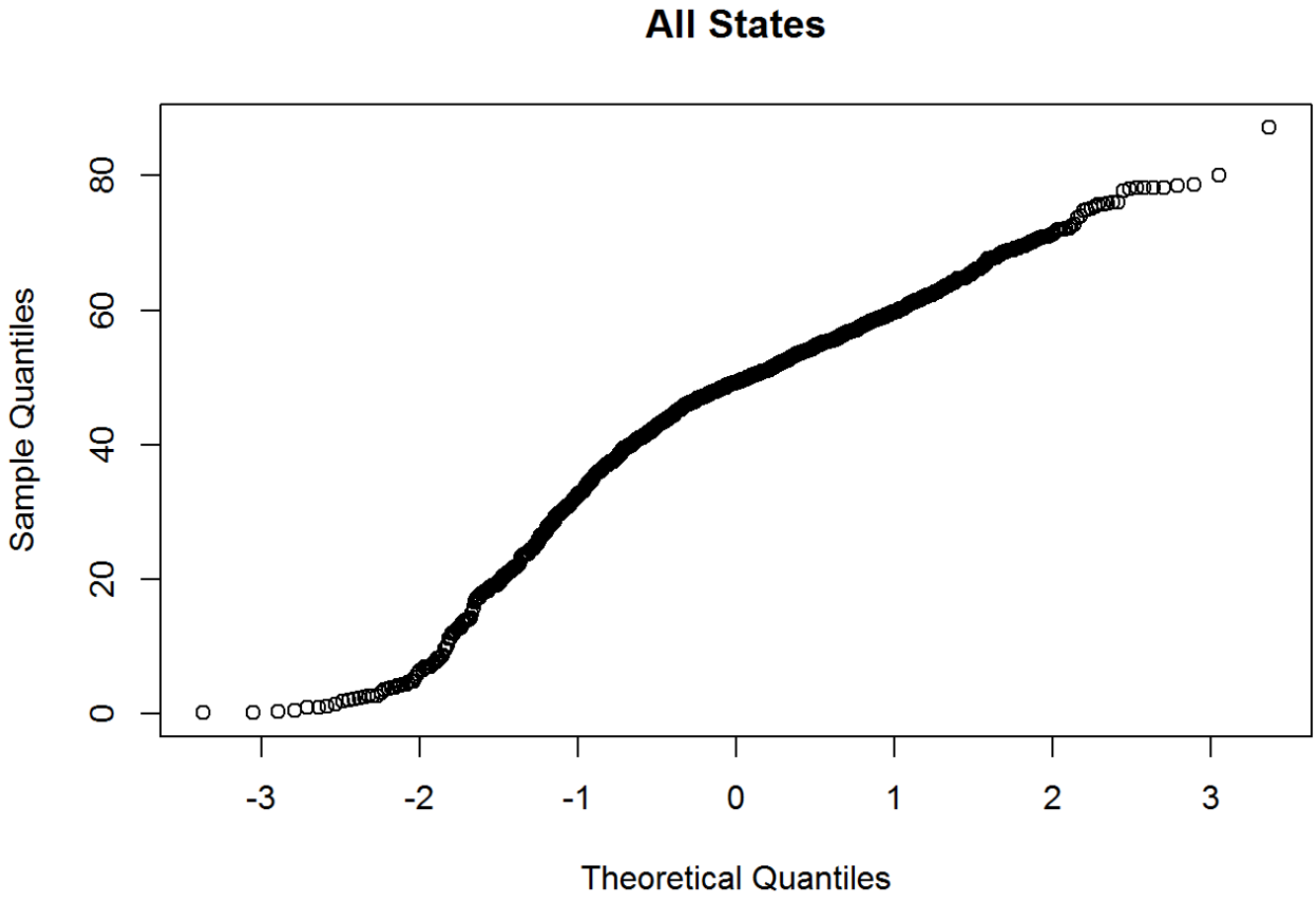
Republicans recieved less votes from South.

3).

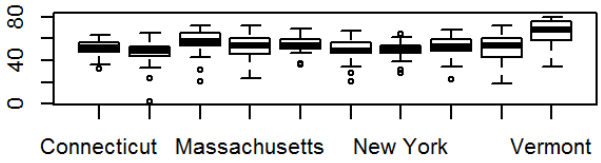
```
library(cluster)
vote = votes.repub
par(mfrow = c(3, 2))
vote_calc = function(vote, reg, name)
{

 colours=c("blue","black","red","deeppink","red","purple","green","brown",
         "orange","violet")
 par(mar=c(4,5,0,2))
 j = 1
 for(i in reg)
 {
  vote_t = vote[i,]
  vote_t = as.data.frame(t(vote_t))
  vote_ts = ts(vote_t, frequency = 0.25, start = 1856)
  if(i==reg[1])
  {
   plot(vote_ts, col = colours[1], ylim = range(0,100),
        ylab = name)
  }
  else
   j = j + 1
  lines(vote_ts, col = colours[j])
 }
 segments(1852,50,1980,50, col = "grey65", lty = 2)
}

northeast = c("Connecticut","Delaware","Maine", "Massachusetts","New Hampshire","New Jersey",
           "New York","Pennsylvania","Rhode Island","Vermont")
east_central = c("Kentucky","Maryland","North Carolina","South Carolina","Tennessee",
              "Virginia","West Virginia")
south = c("Alabama", "Arkansas", "Florida", "Georgia","Louisiana","Mississippi","Oklahoma","Texas")
midwest = c("Illinois","Indiana","Iowa","Kansas","Michigan","Minnesota","Missouri","Nebraska",
          "Ohio","Wisconsin")
rockies = c("Colorado","Idaho","Montana","North Dakota","South Dakota","Utah","Wyoming")
west = c("Alaska","Arizona","California","Hawaii","Nevada","New Mexico","Oregon","Washington")

# Box Plot for All States
par(mfrow=c(1,1))
boxplot(t(votes.repub), main ="All States")
```

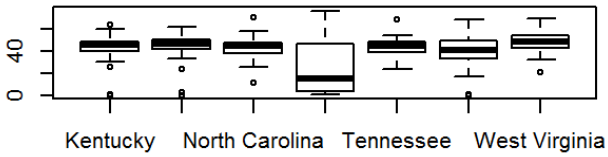


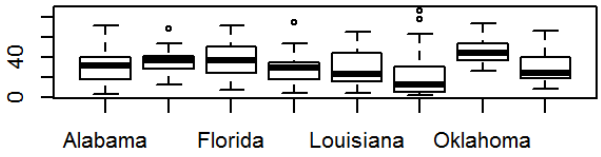

```
qqnorm(t(votes.repub), main ="All States")
```

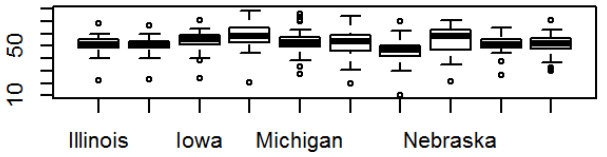


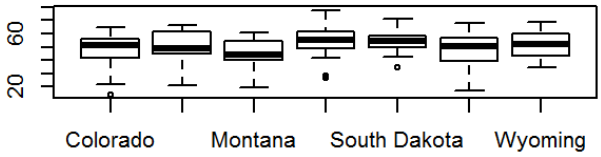

```
par(mfrow=c(3,2))
# Box Plot for Northwest
boxplot(t(votes.repub[northeast,]))

# Box Plot for East central
boxplot(t(votes.repub[east_central,]))

#Box Plot for South
boxplot(t(votes.repub[south,]))

#Box Plot for Midwest
boxplot(t(votes.repub[midwest,]))

# Box Plot for Rockies
boxplot(t(votes.repub[rockies,]))

# Box Plot for West
boxplot(t(votes.repub[west,]))
```

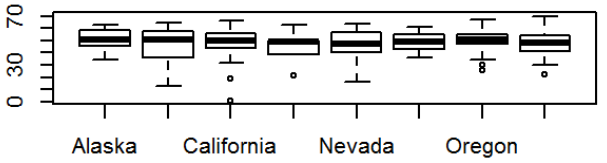




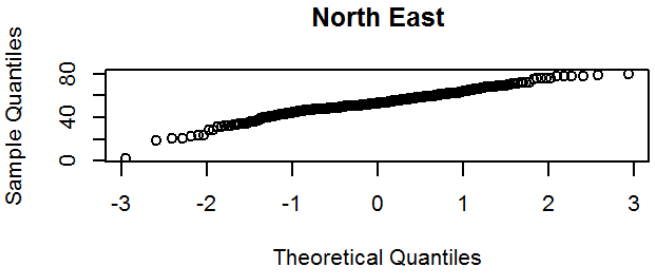


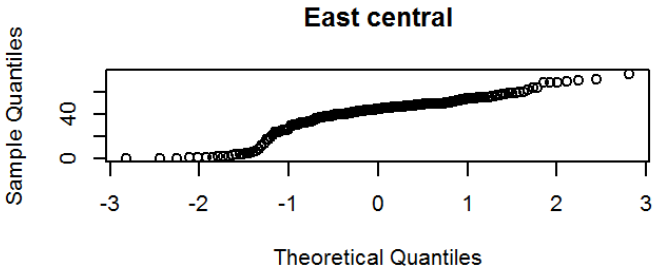


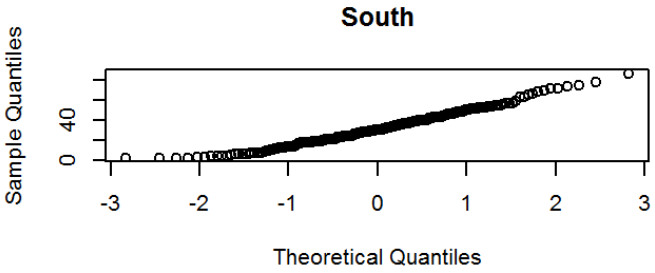


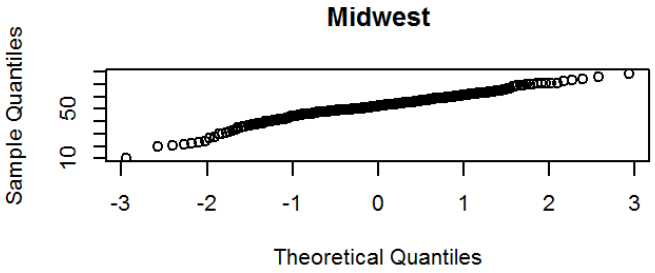


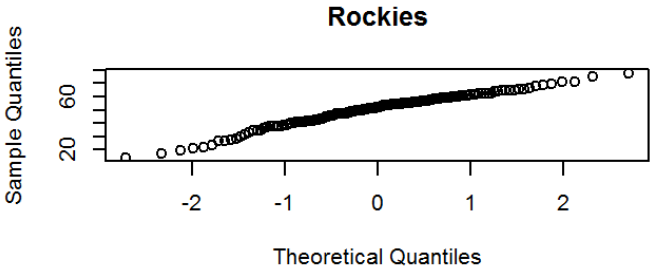

```
par(mfrow=c(3,2))
qqnorm(t(votes.repub[northeast,]), main ="North East")
qqnorm(t(votes.repub[east_central,]), main = "East central")
qqnorm(t(votes.repub[south,]), main="South")
qqnorm(t(votes.repub[midwest,]), main="Midwest")
qqnorm(t(votes.repub[rockies,]), main="Rockies")
qqnorm(t(votes.repub[west,]), main="West")
```

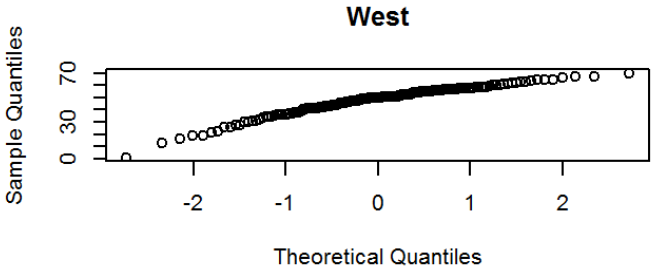

North East
Sample Quantiles
0 40 80
-3 -2 -1 0 1 2 3
Theoretical Quantiles


East central
Sample Quantiles
0 40
-3 -2 -1 0 1 2 3
Theoretical Quantiles


South
Sample Quantiles
0 40
-3 -2 -1 0 1 2 3
Theoretical Quantiles


Midwest
Sample Quantiles
10 50
-3 -2 -1 0 1 2 3
Theoretical Quantiles


Rockies
Sample Quantiles
20 60
-2 -1 0 1 2
Theoretical Quantiles


West
Sample Quantiles
0 30 70
-2 -1 0 1 2
Theoretical Quantiles