Homework 5

Problem 14 b

```
sim.a <- function(n=100,a=-2,b=1,c=pi/4)
{
  Zt <- rnorm(n+2)
  a + b*Zt[3:(n+2)] + c*Zt[1:n]
}

sim.b <- function(n=100,a=-3,b=1,c=pi/4)
{
  Zt <- rnorm(n+2,sd = sqrt(0.25))
  a + b*Zt[3:(n+2)] + c*Zt[1:n]
}

set.seed(42)
```

Problem 14 b

```
df <- data.frame()

for (k in 1:1000){

  row_i <-  as.vector(acf(sim.a(), lag.max=4, plot=FALSE)$acf[2:5])
  df <- rbind(df,row_i)
}

acf.tss.mat.1000 <- as.matrix(df)
colnames(acf.tss.mat.1000) <- c('rho_1','rho_2','rho_3', 'rho_4')

df_corr <- data.frame()

for (i in 1:4){
 b <- c()

 for (j in 1:4)
 {
   b <- c(b, cor(acf.tss.mat.1000[,i],acf.tss.mat.1000[,j]))
 }
 df_corr <- rbind(df_corr,b)
}

df_cov <- data.frame()

for (i in 1:4){
 b <- c()

 for (j in 1:4)
 {
```

```
  b <- c(b, cov(acf.tss.mat.1000[,i],acf.tss.mat.1000[,j]))
 }
 df_cov <- rbind(df_cov,b)
}
 colnames(df_corr) <-  c('cor_1','cor_2','cor_3', 'cor_4')
 colnames(df_cov) <-  c('cov_1','cov_2','cov_3', 'cov_4')
```

Sample mean

```
colMeans(acf.tss.mat.1000)
```

```
##       rho_1       rho_2       rho_3       rho_4
## -0.02600225  0.45860763 -0.02268161 -0.02475111
```

Correlation Matrix

```
knitr::kable(df_corr)
```

cor_1	cor_2	cor_3	cor_4
1.0000000	-0.0396955	0.6217270	-0.0538426
-0.0396955	1.0000000	-0.0525408	0.8285797
0.6217270	-0.0525408	1.0000000	-0.0680291
-0.0538426	0.8285797	-0.0680291	1.0000000

Covariance Matrix

```
knitr::kable(df_cov)
```

cov_1	cov_2	cov_3	cov_4
0.0233988	-0.0004535	0.0112017	-0.0009680
-0.0004535	0.0055768	-0.0004621	0.0072725
0.0112017	-0.0004621	0.0138732	-0.0009418
-0.0009680	0.0072725	-0.0009418	0.0138139

It is very much in sync with what large sample theory suggests, have done some spot checking below

Lets calculate W(4,4) (Same as W(3,3)) using the Bartlett matrix

```
((2*(pi^2))/(16 * (1+pi/4)^2) + 1 )/100 =  0.01387026
```

Also, lets calculate W(1,1) using the Bartlett matrix

```
((2*pi^2)/(16 * (1+pi/4)^2) + 1 + (2*pi/(4*(1+(pi/4)^2))) )/100 = 0.02358542
```

Also, lets calculate W(3,1) using the Bartlett matrix

```
(((pi^2))/(16 * (1+pi/4)^2) + ( (2*pi/(4*(1+(pi/4)^2))))) /100 = 0.01165029
```

Once in negative, can be taken as tending towards 0, so W(1,2),W(1,4), W(2,3) & W(3,4) are all zeros.

Changing the value , a = -2, sd =4

```
#create matrix from vectors
set.seed(42)
df2 <- data.frame()

for (k in 1:1000){

  row_i <-  as.vector(acf(sim.b(), lag.max=4, plot=FALSE)$acf[2:5])
  df2<- rbind(df2,row_i)
}

acf.tss.mat.1000.v2 <- as.matrix(df2)
colnames(acf.tss.mat.1000.v2) <- c('rho_1_2','rho_2_2','rho_3_2', 'rho_4_2')

df_corr_2 <- data.frame()

for (i in 1:4){
 b <- c()

 for (j in 1:4)
 {
   b <- c(b, cor(acf.tss.mat.1000.v2[,i],acf.tss.mat.1000.v2[,j]))
 }
 df_corr_2 <- rbind(df_corr_2,b)
}

df_cov_2 <- data.frame()

for (i in 1:4){
 b <- c()

 for (j in 1:4)
 {
   b <- c(b, cov(acf.tss.mat.1000.v2[,i],acf.tss.mat.1000.v2[,j]))
 }
 df_cov_2 <- rbind(df_cov_2,b)
}
 colnames(df_corr_2) <-  c('cor_1_2','cor_2_2','cor_3_2', 'cor_4_2')
 colnames(df_cov_2) <-  c('cov_1_2','cov_2_2','cov_3_2', 'cov_4_2')
```

Sample mean 2

```
colMeans(acf.tss.mat.1000.v2)
```

```
##      rho_1_2      rho_2_2      rho_3_2      rho_4_2
## -0.02600225  0.45860763 -0.02268161 -0.02475111
```

Covariance Matrix 2

```
knitr::kable(df_cov_2)
```

cov_1_2	cov_2_2	cov_3_2	cov_4_2
0.0233988	-0.0004535	0.0112017	-0.0009680
-0.0004535	0.0055768	-0.0004621	0.0072725
0.0112017	-0.0004621	0.0138732	-0.0009418
-0.0009680	0.0072725	-0.0009418	0.0138139
## Correlatio	n Matrix 2		

```
knitr::kable(df_corr_2)
```

cor_1_2	cor_2_2	cor_3_2	cor_4_2
1.0000000	-0.0396955	0.6217270	-0.0538426
-0.0396955	1.0000000	-0.0525408	0.8285797
0.6217270	-0.0525408	1.0000000	-0.0680291
-0.0538426	0.8285797	-0.0680291	1.0000000

Changing the variance (sqrt(0.25)) and 'a'(-3) does not seem to change the Mean,Correlation or Covariance matrix. I would say ecause of large sample, it would still be normally distributed.