

Homework 7

Problem 25 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
## Correlation 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 because of large sample, it would still be normally distributed.