Topic 1: Exercise 2

Daniel Alonso

November 21th, 2020

Creating function(s)

Function to compute mean vector

```
mean_vector <- function(pis, means) {
    mv <- c()
    for (i in 1:length(pis)) {
        mv <- c(mv, pis[i]*means[,i])
    }
    return(matrix(rowSums(matrix(mv, nrow=2)),nrow=2))
}
```

Testing mean vector

```
pis <- c(0.5, 0.5)
means <- matrix(c(0,0,3,3), nrow=length(pis))
meanvector <- mean_vector(pis,means)
meanvector
```

```
##      [,1]
## [1,]  1.5
## [2,]  1.5
```

Function to compute covariance matrix

```
covariance_matrix <- function(pis, means, sigmas, meanvector) {
    result <- 0
    for (i in 1:length(pis)) {
        result <- result + pis[i]*(sigmas[[i]] + means[,i]%*%t(means[,i]))
    }
    return(result - meanvector%*%t(meanvector))
}
```

Testing covariance matrix

```
pis <- c(0.5, 0.5)
means <- matrix(c(0,0,3,3), nrow=length(pis))
sigmas <- list()
sigmas[[1]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
sigmas[[2]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
```

```
covmatrix <- covariance_matrix(pis,means, sigmas, mean_vector(pis,means))
covmatrix
```

```
##      [,1] [,2]
## [1,] 3.25 2.95
## [2,] 2.95 3.25
```

Function to compute correlation matrix

```
correlation_matrix <- function(covmatrix) {
    delta <- diag(diag(covmatrix)^(-1/2))
    return(delta%*%covmatrix%*%delta)
}
```

Testing correlation matrix

```
corrmatrix <- correlation_matrix(covmatrix)
corrmatrix
```

```
##           [,1]      [,2]
## [1,] 1.0000000 0.9076923
## [2,] 0.9076923 1.0000000
```

Putting it all together

```
final_function <- function(pis, means, sigmas) {
    meanvector <- mean_vector(pis,means)
    print('Mean Vector:')
    print(meanvector)
    covmatrix <- covariance_matrix(pis,means, sigmas, meanvector)
    print('Covariance Matrix:')
    print(covmatrix)
    corrmatrix <- correlation_matrix(covmatrix)
    print('Correlation Matrix:')
    print(corrmatrix)
}
```

Exercises

Exercise 1

```
pis <- c(0.5, 0.5)
means <- matrix(c(0,0,3,3), nrow=length(pis))
sigmas <- list()
sigmas[[1]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
sigmas[[2]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
```

```
final_function(pis,means,sigmas)
```

```
## [1] "Mean Vector:"
##      [,1]
## [1,]  1.5
## [2,]  1.5
## [1] "Covariance Matrix:"
##      [,1] [,2]
## [1,] 3.25 2.95
## [2,] 2.95 3.25
## [1] "Correlation Matrix:"
##           [,1]      [,2]
## [1,] 1.0000000 0.9076923
## [2,] 0.9076923 1.0000000
```

Exercise 2

```
pis <- c(0.5, 0.5)
means <- matrix(c(0,0,0,0), nrow=length(pis))
sigmas <- list()
sigmas[[1]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
sigmas[[2]] <- matrix(c(1,-0.7,-0.7,1), nrow=length(pis))
```

```
final_function(pis,means,sigmas)
```

```
## [1] "Mean Vector:"
##      [,1]
## [1,]    0
## [2,]    0
## [1] "Covariance Matrix:"
##      [,1] [,2]
## [1,]    1    0
## [2,]    0    1
## [1] "Correlation Matrix:"
##      [,1] [,2]
## [1,]    1    0
## [2,]    0    1
```

Exercise 3

```
pis <- c(0.5, 0.5)
means <- matrix(c(-3,3,3,-3), nrow=length(pis))
sigmas <- list()
sigmas[[1]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
```

```
sigmas[[2]] <- matrix(c(1,0.7,0.7,1), nrow=length(pis))
```

```
final_function(pis,means,sigmas)
```

```
## [1] "Mean Vector:"
##      [,1]
## [1,]    0
## [2,]    0
## [1] "Covariance Matrix:"
##      [,1] [,2]
## [1,] 10.0 -8.3
## [2,] -8.3 10.0
## [1] "Correlation Matrix:"
##       [,1]  [,2]
## [1,]  1.00 -0.83
## [2,] -0.83  1.00
```

Exercise 4

```
pis <- c(0.5, 0.5)
means <- matrix(c(-3,-3,3,3), nrow=length(pis))
sigmas <- list()
sigmas[[1]] <- matrix(c(1,-0.7,-0.7,1), nrow=length(pis))
sigmas[[2]] <- matrix(c(1,-0.7,-0.7,1), nrow=length(pis))
```

```
final_function(pis,means,sigmas)
```

```
## [1] "Mean Vector:"
##      [,1]
## [1,]    0
## [2,]    0
## [1] "Covariance Matrix:"
##      [,1] [,2]
## [1,] 10.0  8.3
## [2,]  8.3 10.0
## [1] "Correlation Matrix:"
##      [,1] [,2]
## [1,] 1.00 0.83
## [2,] 0.83 1.00
```