In-Class Assignment 10

1. Define an exponential random variable with parameter λ = 1/3. Generate 2 sets of simulations of the random variable (call them exp_1 and exp_2) of 10,000 simulations each. Create a third variable su which is the sum of exp_1 and exp_2. Verify that

    i. val = 1/3

    ii. exp_1 <- rexp(10000, val)

    iii. exp_2 <- rexp(10000, val)

    iv. su <- exp_1 + exp_2

    b. E(su) = E(exp_1) + E(exp_2)

        i. print(mean(exp_1) + mean(exp_2)) = 6.075177

        ii. print(mean(su)) = 6.075177

    c. Var(su) = Var(exp_1) + Var(exp_2)

        i. print(var(exp_1) + var(exp_2) = 18.3664

        ii. print(var(su))) =18.65352

2. Create 1,000,000 simulations of a multivariate normal random variable similar to the one you worked with in ICA 9 (set var(X) = var(Y) = 1.5, and cor(X,Y) = -0.8), and call it mvn. x will be the first column of mvn and y will be the second column (for example, x = mvn[,1]). Create a new variable z which is the sum of the two outputs from the simulation. Verify from the experimental data that

    a. min <- -4

    b. max <- 5

    c. var_x <- 1.5

    d. var_y <- 1.5

    e. cor_xy <- -0.8

    f. mvn <- cbind(c(var_x,cor_xy*sqrt(var_x)*sqrt(var_y)),c(cor_xy*sqrt(var_x)*sqrt(var_y),var_y))

    g. x <- mvn[,1]

    h. y <- mvn[,2]

    i. z <- sum(x,y)

j. Cov(x, y) = -1.2

   i. cov(x,y)

   ii. [1] -1.2

k. E(z) = E(x) + E(y)

   i. print(mean(z)) = 0.3

   ii. print(mean(x) + mean(y)) = 0.3

l. Var(z) = Var(x) + Var(y) + 2Cov(x, y)

   i. print(var(x) + var(y) + 2*cov(x,y)) = 1.87653

   ii. print(var(z)) = 1.81346

3. For this problem we will look at sample means of an exponential distribution with mean value 3 (parameter is 1/3). Create 20,000 simulation sets of 10,000 simulations each for this distribution. Calculate the means of the 20,000 sets and plot a histogram. Does the histogram look approximately like a normal distribution?

   a. param <- 1/3

   b. um<-rexp(10000, param)

   c. round(mean(um))

   d. largev<- replicate(20000,um)

   e. mean(largev)

   f. hist(largev)

3

[1] 3.038718