Project 2

August 8, 2019

```
In [1]: #PROBLEM 1

        p1 = c(4,6,4,4,1,6,4,6,3,5,5,6,7,7,1)

In [2]: mean(p1)
```

4.6

```
In [99]: #PROBLEM 2

         p2 = c(5.3,5.6,7.6,6.8,4.8,5.7,9.0,6.0,4.9,8.4,6.5,7.9,6.8,4.3,8.5,3.6,6.1,5.8,6.4,4.

         p2_sampleMean = mean(p2)
         p2_length = length(p2)
         p2_t_value = qt(0.03/2, p2_length-1, lower.tail = FALSE, log.p = FALSE)
         p2_sd = sd(p2)

         p2_E = p2_t_value*p2_sd/sqrt(p2_length)

         p2_sd
```

1.52453616759846

```
In [4]: p2_sampleMean-(p2_t_value*p2_sd/sqrt(p2_length))
        p2_sampleMean+(p2_t_value*p2_sd/sqrt(p2_length))
```

5.40037661257665
6.99962338742335

```
In [9]: #PROBLEM 3(A)

        p3_xbar_1 = 53.8
        p3_n_1 = 400
        p3_s_1 = 2.4

        p3_xbar_2 = 54.5
        p3_n_2 = 500
        p3_s_2 = 2.5
```

```
p3_z = ((p3_xbar_1-p3_xbar_2)-(-0.3))/sqrt((2.4^2/400)+(2.5^2/500))

p3_z

qnorm(0.02,mean=0,sd=1)
```

-2.43884304339879
-2.05374891063182

```
In [10]: #PROBLEM 3(B)

         p3_z_partb = ((p3_xbar_1-p3_xbar_2)-(-0.4))/sqrt((2.4^2/400)+(2.5^2/500))

         p3_z_partb

         qnorm(0.02,mean=0,sd=1)
```

-1.82913228254909
-2.05374891063182

```
In [120]: #PROBLEM 3(C)

          p3_p_score = pnorm(p3_z_partb, mean = 0, sd = 1, lower.tail = TRUE, log.p = FALSE)
          p3_p_score
```

0.0336898969384112

```
In [118]: #PROBLEM 3(D)(1)

          p3_zalpha_partd1 = qnorm(0.02,mean=0,sd=1)
          p3_k_partd1 = -0.30+p3_zalpha_partd*sqrt((2.4^2/400)+(2.5^2/500))
          p3_K_partd1 = (p3_k_partd-(-0.28))/sqrt((2.4^2/400)+(2.5^2/500))
          P3_beta_partd1 = 1-pnorm(p3_K_partd1, mean = 0, sd = 1, lower.tail = TRUE, log.p = FA

          sigma = sqrt((2.4^2/400)+(2.5^2/500))
          intersection = -0.29
          k = p3_k_partd1
          integrand0 <- function(x) {(1/(sigma*sqrt(2*pi)))*exp(-1/2*((x+0.3)/sigma)^2)}
          integrand1 <- function(x) {(1/(sigma*sqrt(2*pi)))*exp(-1/2*((x+0.28)/sigma)^2)}

          a=integrate(integrand0, lower = intersection, upper = Inf, subdivisions = 200L)
          b=integrate(integrand1, lower = k, upper = intersection, subdivisions = 200L)
          beta1 = a$value+b$value

          beta1
```

0.936593059663156

In [119]: #PROBLEM 3(D)(2)

```
p3_zalpha_partd2 = qnorm(0.02,mean=0,sd=1)
p3_k_partd2 = -0.30+p3_zalpha_partd*sqrt((2.4^2/400)+(2.5^2/500))
p3_K_partd2 = (p3_k_partd-(-0.31))/sqrt((2.4^2/400)+(2.5^2/500))
P3_beta_partd2 = 1-pnorm(p3_K_partd2, mean = 0, sd = 1, lower.tail = TRUE, log.p = F

sigma = sqrt((2.4^2/400)+(2.5^2/500))
intersection1 = -0.305
k = p3_k_partd1
integrand00 <- function(x) {(1/(sigma*sqrt(2*pi)))*exp(-1/2*((x+0.3)/sigma)^2)}
integrand11 <- function(x) {(1/(sigma*sqrt(2*pi)))*exp(-1/2*((x+0.31)/sigma)^2)}

a1=integrate(integrand00, lower = k, upper = intersection1, subdivisions = 200L)
b1=integrate(integrand11, lower = intersection1, upper = Inf, subdivisions = 200L)
beta2 = a1$value+b1$value

beta2
```

0.955679826991673

In [112]: # PROBLEM 4

```
vector1 <- c(45,52,60)
vector2 <- c(42,55,43)
vector3 <- c(15,28,25)

column.names <- c("1","2","3+")
row.names <- c("Poor","Adequate","Good")

p4_array = array(c(vector1,vector2,vector3), c(3,3),dimnames = list(row.names,column

e <- function(i,j,array) {
    Fidot = sum(array[i,])
    Fjdot = sum(array[,j])
    F = sum(array)
    return(Fidot*Fjdot/F)
}

p4_chiSquared_testStat <- function(array1){
    rows = dim(array1)[1]
    cols = dim(array1)[2]
    sum = 0
    for(i in 1:rows){
        for(j in 1:cols){
            term = ((array1[i,j]-e(i,j,array1))^2)/(e(i,j,array1))
            sum = sum + term
        }
```

```
        }
        return(sum)
    }

    p4_chiSquared_testStat = p4_chiSquared_testStat(p4_array)

    cat('Question 4: ',"\n")
    cat('Chi-squared test stat: ',p4_chiSquared_testStat,"\n")
    cat('Critical region bound: ',qchisq(1-0.05, df=3+3-2),"\n")
    cat('Conclusion is that we fail to reject the null hypothesis because our test statis
```

```
Question 4:
Chi-squared test stat:  3.497039
Critical region bound:  9.487729
Conclusion is that we fail to reject the null hypothesis because our test statistic is less tha
```

In [113]:

```
# PROBLEM 5
library(tidyverse)

poisson_pdf <- function(rate,calls) {
    poisson_pdf = (rate^calls * exp(-1*rate)) / factorial(calls)
    return(poisson_pdf)
}

array1 = c(0,1,2,3,4,5,6,7,8)
array2 = c(28,52,60,70,50,45,32,18,5)

p4_array = array(c(array1,array2), c(9,2))


data_frame = data.frame(p4_array)

data_frame = data_frame %>% mutate(`Probability` = poisson_pdf(3.24,`X1`), `Expected

p4_chiSquared_testStat <- function(df){
    k = dim(df)[1]
    sum = 0
    for(i in 1:k){
        value = ((data_frame[i,2]-data_frame[i,4])^2)/(data_frame[i,4])
        sum = sum + value
    }
    return(sum)
}

cat('Question 5: ',"\n")
cat('Chi-squared test stat: ',p4_chiSquared_testStat(data_frame),"\n")
cat('Critical region bound: ',qchisq(1-0.05, df=8-1-1),"\n")
cat('Conclusion is that we reject the null hypothesis because our test score is great
```

```
Question 5:
Chi-squared test stat:  31.41491
Critical region bound:  12.59159
Conclusion is that we reject the null hypothesis because our test score is greater then our cri
```