STAT 455 Homework 02 - R Code

Martha Eichlersmith
2019-10-17

Problem 1.b

```
SampleSize <- c(rep(75, 4), rep(rep(250, 5)))
l.b <- length(SampleSize)
pi.T1 <- c(1/3, 1/4, 1/6, 0.2, 1/3, 0.3, 0.22  , 0.250, 0.22)
pi.T2 <- c(1/3, 1/4, 3/6, 0.3, 1/3, 0.3, 0.4467, 0.300, 0.40)
pi.T3 <- c(1/3, 2/4, 2/6, 0.5, 1/3, 0.4, 0.3333, 0.450, 0.38)
P.R <- c(rep("N/A", l.b))
aP.R <- c(rep("N/A", l.b))
P.U <- c(rep("N/A", l.b))
aP.U <- c(rep("N/A", l.b))
q.R <- qchisq(0.95, df=1) #3.8415
q.U <- qchisq(0.95, df=2) #5.9915
it <- 10000

#function for restricted lambda
func_lambda.R <- function(n, pib){
lambda.R <- ((n*pib[1]+n*pib[2]- (2/3)*n))^2 / ((2/9)*n)
return(lambda.R)}

#function for unrestricted lambda
func_lambda.U <- function(n, pib){
lambda.U <- 3*n*(sum( (pib - (1/3))*(pib-(1/3)) ) )
return(lambda.U)}

#function for approximate restricted p-value
func_aP.R <- function(n, pib, q.R){
lambda.R <- func_lambda.R(n, pib)
return(1-pchisq(q.R, df=1, lambda.R))}

#function for approximate unrestricted p-value
func_aP.U <- function(n, pib, q.U){
lambda.U <- func_lambda.U(n, pib)
return(1-pchisq(q.U, df=2, lambda.U))}

#function for estimating exact  restricted p-value
func_P.R <- function(it, n, pib, q.R){
S.2.R <- c()
for (j in 1:it){
y <- rmultinom(1, n, pib)
score.R <- ((y[1]+y[2]- (2/3)*n))^2 / ((2/9)*n)
S.2.R <- c(score.R, S.2.R)
count <- length(S.2.R[S.2.R >= q.R])
total <- length(S.2.R)
P.R <- count/total}
return(P.R)}
```

```r
#function for estimating exact  unrestricted p-value
func_P.U <- function(it, n, pib, q.U){
S.2.U <- c()
for (j in 1:it){
y <- rmultinom(1, n, pib)
score.U <- (y[1] - n/3)^2/(n/3) + (y[2] - n/3)^2/(n/3) + (y[3] - n/3)^2/(n/3)
S.2.U <- c(score.U, S.2.U)
count <- length(S.2.U[S.2.U >= q.U])
total <- length(S.2.U)
P.U <- count/total
paste(P.U)}
return(P.U)}
```

```r
#for loop to calculate approximate p-values for restricted and unrestricted
set.seed(1017)
l <- length(pi.T1)
for (i in 1:l.b){
  n <- SampleSize[i]
  pib <- c(pi.T1[i], pi.T2[i], pi.T3[i])
  aP.R[i] <- format(round(func_aP.R(n, pib, q.R), 4), nsmall=4)
  aP.U[i] <- format(round(func_aP.U(n, pib, q.U), 4), nsmall=4)
  P.R[i] <-  format(round(func_P.R(it, n, pib, q.R), 4), nsmall=4)
  P.U[i] <-  format(round(func_P.U(it, n, pib, q.U), 4), nsmall=4)
  }

Table1b <- data.frame(
   "Sample.Size" = format(SampleSize, 0)
  ,"pi.T1" = format(pi.T1, 4)
  ,"pi.T2" = format(pi.T2, 4)
  ,"pi.T3" = format(pi.T3, 4)
  ,"P.R" = P.R
  ,"aP.R" = aP.R
  ,"P.U" = P.U
  ,"aP.U" = aP.U)

kable(Table1b)
```

Sample.Size	pi.T1	pi.T2	pi.T3	P.R	aP.R	P.U	aP.U
75	0.3333333	0.3333333	0.3333333	0.0373	0.0500	0.0508	0.0500
75	0.2500000	0.2500000	0.5000000	0.8242	0.8647	0.7795	0.7884
75	0.1666667	0.5000000	0.3333333	0.0378	0.0500	0.9216	0.8962
75	0.2000000	0.3000000	0.5000000	0.8238	0.8647	0.8397	0.8349
250	0.3333333	0.3333333	0.3333333	0.0519	0.0500	0.0467	0.0500
250	0.3000000	0.3000000	0.4000000	0.6256	0.6088	0.4902	0.5037
250	0.2200000	0.4467000	0.3333000	0.0542	0.0500	0.9868	0.9819
250	0.2500000	0.3000000	0.4500000	0.9727	0.9746	0.9543	0.9594
250	0.2200000	0.4000000	0.3800000	0.3721	0.3467	0.9598	0.9381

Problem 1.c

```
pi.T1 <- c(1/3, 1/4, 1/6, 0.2, 0.3, 0.22  , 0.250, 0.22)
pi.T2 <- c(1/3, 1/4, 3/6, 0.3, 0.3, 0.4467, 0.300, 0.40)
pi.T3 <- c(1/3, 2/4, 2/6, 0.5, 0.4, 0.3333, 0.450, 0.38)
l.c <- length(pi.T1)
n.R <- c(rep("N/A", l.c))
n.U <- c(rep("N/A", l.c))
```

```
lambda.R80 <- 7.84886
lambda.U80 <- 9.63469

1-pchisq(q.R, df=1, lambda.R80)
```

```
## [1] 0.8
```

```
1-pchisq(q.U, df=2, lambda.U80)
```

```
## [1] 0.8
```

```
func_n.R <- function(pib, lambdaRU80){
n.R <- lambda.R80 / func_lambda.R(1, pib)
return(n.R)}

func_n.U <- function(pib, lambda.U80){
n.U <- lambda.U80 / func_lambda.U(1, pib)
return(n.U)}
```

```
#for loop to calculate approximate p-values for restricted and unrestricted
set.seed(1017)
for (i in 1:l.c){
  pib <- c(pi.T1[i], pi.T2[i], pi.T3[i])
  n.R[i] <- format(ceiling(func_n.R(pib, lambda.R80)), 0)
  n.U[i] <- format(ceiling(func_n.U(pib, lambda.U80)), 0)}

Table1c <- data.frame(
   "pi.T1" = format(pi.T1, 4)
  ,"pi.T2" = format(pi.T2, 4)
  ,"pi.T3" = format(pi.T3, 4)
  ,"n.R" = n.R
  ,"n.U" = n.U
  )
kable(Table1c)
```

pi.T1	pi.T2	pi.T3	n.R	n.U
0.3333333	0.3333333	0.3333333	Inf	Inf
0.2500000	0.2500000	0.5000000	63	78
0.1666667	0.5000000	0.3333333	Inf	58
0.2000000	0.3000000	0.5000000	63	69
0.3000000	0.3000000	0.4000000	393	482
0.2200000	0.4467000	0.3333000	1569772001	125
0.2500000	0.3000000	0.4500000	129	149
0.2200000	0.4000000	0.3800000	801	165