HW1 STT810 Tiancheng Liu

Tiancheng Liu

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Question 1

a

```
samp <- sample(c(1:6),100,replace = TRUE)
samp
```

```
##   [1] 2 5 2 1 5 6 6 5 1 3 5 6 4 5 3 1 6 4 3 5 5 1 2 2 5 4 3 4 3 1 1
3 4 6 3 4 3
##  [38] 1 2 4 5 4 2 5 3 6 1 5 1 4 6 1 3 1 2 1 2 4 6 2 3 6 5 1 5 4 2 3
3 4 5 6 6 3
##  [75] 2 5 2 1 4 6 4 1 6 4 5 4 1 4 4 3 4 1 3 2 2 4 5 4 5 1
```

b

```
mean(samp)
```

```
## [1] 3.46
```

c

```
samp1000 <- sample(c(1:6),1000,replace = TRUE)
mean(samp1000)
```

```
## [1] 3.623
```

```
samp10000 <- sample(c(1:6),10000,replace = TRUE)
mean(samp10000)
```

```
## [1] 3.504
```

```
samp100000 <- sample(c(1:6),100000,replace = TRUE)
mean(samp100000)
```

```
## [1] 3.49897
```

```
samp1000000 <- sample(c(1:6),1000000,replace = TRUE)
mean(samp1000000)
```

```
## [1] 3.499426
```

Yes, the mean is approaching the true value.

d

```
samp1000 <- sample(c(0,1),1000,replace = TRUE)
mean(samp1000)
```

```
## [1] 0.498
```

```
samp10000 <- sample(c(0,1),10000,replace = TRUE)
mean(samp10000)
```

```
## [1] 0.4989
```

```
samp100000 <- sample(c(0,1),100000,replace = TRUE)
mean(samp100000)
```

```
## [1] 0.50018

samp1000000 <- sample(c(0,1),1000000,replace = TRUE)
mean(samp1000000)

## [1] 0.500358
```

Yes,same convergence.

e

```
samp1000 <- sample(c(0,1,1),1000,replace = TRUE)
mean(samp1000)

## [1] 0.664

samp10000 <- sample(c(0,1,1),10000,replace = TRUE)
mean(samp10000)

## [1] 0.6627

samp100000 <- sample(c(0,1,1),100000,replace = TRUE)
mean(samp100000)

## [1] 0.66757

samp1000000 <- sample(c(0,1,1),1000000,replace = TRUE)
mean(samp1000000)

## [1] 0.666797
```

Yes, the result is converging to 0.667.

Question 2

a

The sample space is {0,1,2,3,4,5}.

b

6*6 there are a total of 36 possible outcomes, and if the difference is 1 then it has to be 12,23,34,45,56,65,54,43,32,21, a total of 10 outcomes. Then the probability is 10/36 = 0.278

c

```
fir <- sample(c(1:6),10000,replace = TRUE)
sec <- sample(c(1:6),10000,replace = TRUE)
dif <- abs(fir-sec)
sum(dif == 1)/length(dif)

## [1] 0.2763
```

We can see the result agrees on what we have in b.

Qustion 3

a

Dice 1, coin 1 head*2 Dice 2, coin 2 head.

(1+2)/4*6 = 0.125 chance to win the game.

b

```
count <- 0

for (i in 1:10000){
  dice <- sample(c(1:6),1,replace = T)
  coin <- sample(c(0,1),2,replace = T)
  if (dice == sum(coin)){
    count = count + 1
  }
}
count/10000

## [1] 0.1198
```

The probability to win the game is about 0.125.

Question 4

Let

A : a viewer watched gymnastics B : a viewer watched baseball C : a viewer watched soccer

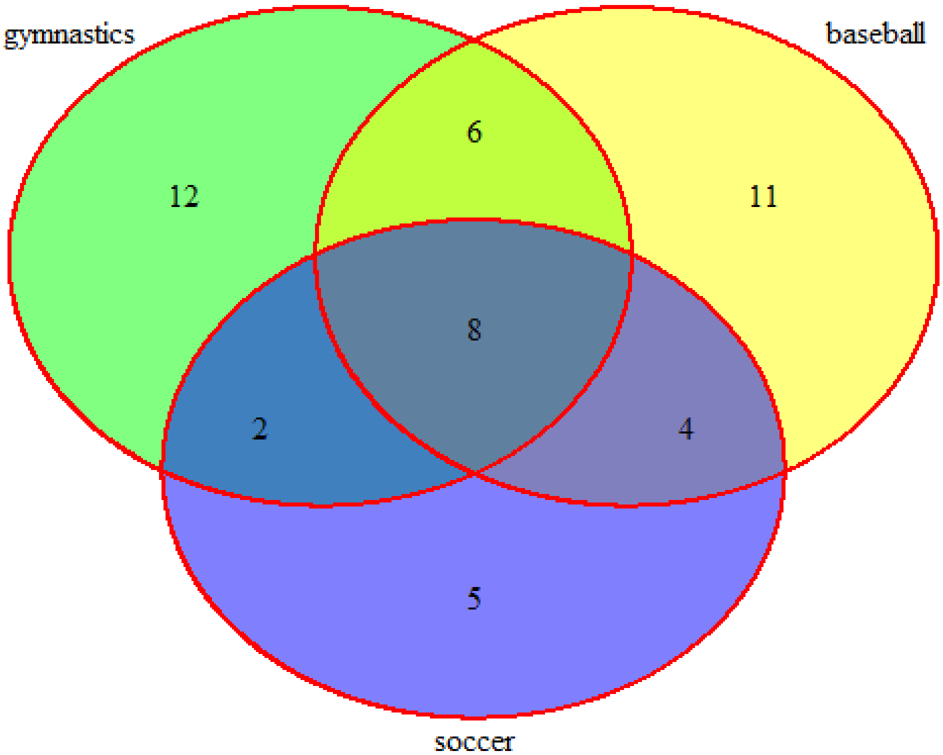
We have

```
library(VennDiagram)

## 载入需要的程辑包：grid

## 载入需要的程辑包：futile.logger

draw.triple.venn(area1=28, area2=29, area3=19,
                 n12=14, n23=12, n13=10, n123=8,
                 category=c("gymnastics","baseball","soccer"),
                 col="Red",fill=c("Green","Yellow","Blue"))
```




```
## (polygon[GRID.polygon.1], polygon[GRID.polygon.2], polygon[GRID.poly
gon.3], polygon[GRID.polygon.4], polygon[GRID.polygon.5], polygon[GRID.
polygon.6], text[GRID.text.7], text[GRID.text.8], text[GRID.text.9], te
xt[GRID.text.10], text[GRID.text.11], text[GRID.text.12], text[GRID.tex
t.13], text[GRID.text.14], text[GRID.text.15], text[GRID.text.16])
```

Thus the result should be (100-28-29-19+14+12+10+8)/100 = 0.68.

68 percent of the group watched none of the three sports during the last year.

Question 5 Matloff 1.9

Skipped for the question is incorrect.

Question 6 Matloff 1.10

a

```
Pn3n4 <- 2/4
Pn3n4

## [1] 0.5
```

Thus the answer for a is 0.5.

b

```
pn43 <- (1/2)*(1/4)+(1/2)*(1/4) #p(n3=1 and n4=3) +  p(n3=2 and n4=3)
pn43
```

```
## [1] 0.25
```

Thus the answer is 0.25.

Question 7 Matloff 2.1

```
minpiece <- function(k) {
  breakpts <- sort(runif(k-1))
  lengths <- diff(c(0,breakpts ,1))
  min(lengths)
}
# returns the approximate probability
# that the smallest of k pieces will
# have length less than q
bkrod <- function(nreps ,k,q) {
  minpieces <- replicate(nreps ,minpiece(k))
  mean(minpieces < q)
}
bkrod(10000,5,0.02)

## [1] 0.3352

#here is the modified function
bkrod(10000,sample(c(2,3,4),1,replace = T,prob = c(0.3,0.3,0.4)),0.02)

## [1] 0.2126
```

The probability is shown above.

question 8 Matloff 2.6

```
nreps <- 10000
nstops <- 9 # because the 10th arrival is the same as 9th departure
count <- 0
pas_tt <- rep(0,10000)
for (i in 1:nreps){
  pas_lis <- 0
  passengers <- 1
  for (j in 1:nstops) {
    if (passengers > 0){
      for (k in 1:passengers){
        if (runif(1) < 0.2)
          passengers <- passengers - 1
      }
    }
    newpass <- sample(0:2,1,prob=c(0.5,0.4,0.1))
    passengers <- passengers + newpass
    if (passengers == 0){
      pas_lis <- 1
    }
  }
  pas_tt[i] <- pas_lis
}
```

```
sum(pas_tt)/10000

## [1] 0.3021
```

Thus we can see that, it about 30% chance the bus will be empty for at least one stop.