Homework#2

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R Markdown

Lab #1

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Possible Protocol 1 (PP1): roll once; if get 6 then conclude the dice is not fair; if roll any other nu

-Once we rolled the dice and ran the code, we "rolled" a "1". This would indicate that the dice is fair

```
dice = c("1", "2", "3", "4", "5", "6")
sample(x = dice, size = 1, replace = TRUE)
a<-sample(1:6,size=1,replace = T)
print(a)
table(a)
[1] "1"
```

Then, we rolled the tampered dice to see if the roll is consistent with the code.

We rolled a "5" initially with the tampered dice, which makes this consistent with the fair dice portio
As the dice is fair, the probability of it being judged as unfair is 1/6 or 16.67%. Rolling a six is th

Depending on if the dice was unfair, the probability of them being deemed as fair is still 5/6 or 83.3%

PP2: roll the dice 30 times. Group can specify a decision rule to judge that dice is fair or unfair. Co
-As we rolled the tampered dice, we had a range of different outcomes. The format for the distribution

As seen in the tampered dice with the outcome of 2:6, two rolls cannot equal a six which will prove its

When we run code in R, the values follow rule for judging fairness. If a fair die is rolled 30 times, t

```
dice = c("1", "2", "3", "4", "5", "6")
sample(x = dice, size = 30, replace = TRUE)
a<-sample(1:6,size=30,replace = T)
print(a)
table(a)
1 2 3 4 5 6
1 6 7 5 9 2
[1] "5" "3" "3" "4" "3" "1" "4" "2" "3" "4" "3" "5" "5" "2" "3" "2" "6" "4" "4"
[20] "5" "5" "5" "2" "5" "5" "2" "2" "5" "6" "3"
outcomes <- c(5,3,3,4,3,1,4,2,3,4,3,5,5,2,3,2,6,4,4,5,5,5,2,5,5,2,2,5,6,3)
count1 <- length(which(outcomes == 1))
1
count2 <- length(which(outcomes == 2))
6
```

```
count3 <- length(which(outcomes == 3))
7
count4 <- length(which(outcomes == 4))
5
count5 <- length(which(outcomes == 5))
9
count6 <- length(which(outcomes == 6))
2
```

If the dice is being judged unfairly,it must be because any value appears at an alarmingly higher rate t

PP3: roll 100 times and specify decision rules. Some cases are easy: if every roll comes to 6 then migh
-From what we believe,our sample size is now much greater from 30, so we can expect the number of 6's i

```
sample(x = dice, size = 100, replace = TRUE)
a<-sample(1:6,size=100,replace = T)
print(a)
table(a)
 1  2  3  4  5  6
12 17 23 16 15 17
  [1] "3" "4" "3" "4" "3" "6" "6" "4" "1" "2" "3" "3" "4" "5" "4" "3" "4" "3" "6"
 [20] "4" "5" "2" "2" "4" "2" "1" "3" "6" "1" "6" "4" "1" "6" "5" "5" "3" "3" "5"
 [39] "1" "4" "5" "2" "4" "1" "1" "5" "5" "2" "2" "4" "6" "3" "3" "3" "4" "6" "6"
 [58] "4" "2" "6" "6" "2" "6" "3" "3" "3" "6" "1" "5" "5" "3" "6" "1" "3" "3" "1"
 [77] "6" "5" "1" "1" "2" "5" "2" "2" "5" "2" "3" "6" "4" "5" "2" "2" "3" "4" "6"
 [96] "3" "5" "2" "3" "2"
 outcomes <- c(5,3,3,4,3,1,4,2,3,4,3,5,5,2,3,2,6,4,4,5,5,5,2,5,5,2,2,5,6,3)
count1 <- length(which(outcomes == 1))
12
count2 <- length(which(outcomes == 2))
17
count3 <- length(which(outcomes == 3))
23
count4 <- length(which(outcomes == 4))
16
count5 <- length(which(outcomes == 5))
15
count6 <- length(which(outcomes == 6))
17
```

Ultimately, this proves the fairness of the dice where not one single number is appearing at a rate sig

EP1: What is a reasonable number of times to roll your experiment dice? (given time available in class,
-"Rolling" a single 100 times for 5 rounds, (500 times) with replacements as the rolls are independent

We will then take the average of the experimental probability of the 5 separate trials. For the average

```
sample(x = dice, size = 500, replace = TRUE)
a<-sample(1:6,size=500,replace = T)
print(a)
  [1] 3 5 1 5 5 1 2 1 5 6 4 1 3 2 5 3 1 2 2 5 3 4 5 3 6 6 4 6 5 2 6 6 3 2 3 4 4 3 5
 [40] 5 6 6 5 3 5 2 1 3 2 4 5 3 6 3 4 3 3 1 2 1 5 5 2 5 5 3 2 1 4 1 1 5 1 5 6 3 4 3
 [79] 1 4 3 5 1 4 4 1 5 5 3 3 4 6 2 5 4 5 6 4 1 2 5 4 6 2 1 6 4 1 1 3 4 1 6 4 5 5 3
[118] 4 3 2 5 4 2 3 4 2 5 6 6 3 3 4 1 5 2 3 3 3 4 5 5 1 5 5 5 5 4 2 3 2 3 6 2 6 2 3
[157] 4 6 3 3 2 3 4 4 2 2 2 1 1 5 2 4 3 5 5 4 6 2 2 5 2 2 2 4 5 5 5 3 5 2 1 1 3 4 6
[196] 2 3 5 2 6 6 4 2 1 5 2 2 1 4 3 3 2 5 2 6 3 6 3 4 3 4 6 3 3 2 2 3 5 4 3 3 6 3 2
[235] 1 6 3 2 1 2 3 3 1 3 6 5 1 3 6 1 3 2 6 4 1 1 3 1 5 4 4 3 2 1 1 3 3 1 6 1 1 3 1
[274] 3 4 2 6 2 2 1 2 5 2 1 3 2 5 5 2 4 2 2 6 2 3 2 4 3 1 6 1 5 5 4 4 1 1 5 2 3 5 2
```

```
[313] 1 2 3 2 1 4 1 3 3 2 1 6 4 5 6 2 4 6 2 4 2 1 3 5 6 5 3 3 2 2 6 2 5 2 3 4 5 6 2
[352] 2 6 4 6 6 2 4 5 1 1 5 3 4 1 1 3 5 3 1 1 5 5 1 1 1 4 4 4 3 2 5 6 5 3 6 4 6 6 5
[391] 5 5 2 2 5 5 3 5 1 5 4 2 3 3 1 3 2 2 4 2 2 1 4 5 3 5 2 2 2 5 6 2 4 2 4 2 2 5 2
[430] 4 3 4 1 4 2 1 4 5 1 4 6 2 5 6 5 6 4 3 6 6 6 4 4 5 2 1 2 6 3 1 5 5 5 5 3 6 1 2
[469] 3 6 6 2 6 6 5 3 1 6 4 4 4 3 4 2 5 2 1 2 6 3 4 5 1 4 5 2 6 5 1 6
table(a)
 1  2  3  4  5  6
75 99 91 76 93 66

library(ggplot2)
qplot(a,binwidth=1)
mean(a)
[1] 3.422
mode(a)
[1] 2
median(a)
[1] 3
var(a)
[1] 2.709335
sqrt(var(a))
[1] 1.646006
summary(a)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   2.000   3.000   3.422   5.000   6.000
sd(a,na.rm=TRUE)
[1] 1.646006]
hist(a)
We see here that the average is 3.422 with a standard deivation of 1.646006. The fairness of the dice is
```