HW6

Zachary Palmore

3/6/2021

```r
C <- function(n,k){ # create a function to compute the combination of choices
  E <- (factorial(n))/(factorial(k)*(factorial(n-k))) # Equivalent to within 'n' pick 'k'
  return(E)
}
P <- function(n,k){ # create a function to compute permutations
  R <- (factorial(n)/factorial(n-k))
  return(R)
}
```

Question 1

A bag contains 5 green and 7 red jellybeans. How many ways can 5 jellybeans be withdrawn from the bag so that the number of green ones withdrawn will be less than 2?

```r
g <- 5 # green jellybeans
r <- 7 # red jellybeans
n <- g + r
C(n,5) # total number of ways to pick out 5 jellybeans from the bag
```

```
## [1] 792
```

```r
C(7, 5) # within 7 red jellybeans pick 5
```

```
## [1] 21
```

```r
C(7, 4) # within 7 red jellybeans pick 4
```

```
## [1] 35
```

```r
C(7, 4)*5 # multiply it by 5 since there are 5 possibles ways to pick 1 green
```

```
## [1] 175
```

```r
C(7,5) + C(7,4)*5 # Bring it all together
```

```
## [1] 196
```

```r
q1 <- C(7,5) + C(7,4)*5
```

There are 196 ways.

Question 2

A certain congressional committee consists of 14 senators and 13 representatives. How many ways can a subcommittee of 5 be formed if at least 4 of the members must be representatives?

```r
C(13, 4) # Pick 4 reps from the 13 available
```

```
## [1] 715
```

```r
C(13, 4)*14 # For each combination of reps, there are 14 potential senators
```

```
## [1] 10010
```

```r
            # (they just have to pick one of them but it does not matter which)
C(13, 5) # Pick 5 reps from the 13 available
```

```
## [1] 1287
```

```r
sum(C(13,4)*14, C(13,5)) # Add outcomes together
```

```
## [1] 11297
```

```r
q2 <- sum(C(13,4)*14, C(13,5))
```

There are 1.1297×10^4 ways.

Question 3

If a coin is tossed 5 times, and then a standard six-sided die is rolled 2 times, and finally a group of three cards are drawn from a standard deck of 52 cards without replacement, how many different outcomes are possible?

```r
2^5 # 2 possibilities for each of 5 different tosses
```

```
## [1] 32
```

```r
6^2 # 6 possibilities for each of 2 rolls
```

```
## [1] 36
```

```r
C(52,3) # from 52 cards pick any 3
```

```
## [1] 22100
```

```r
2^5 * 6^2 * C(52,3)
```

```
## [1] 25459200
```

```r
q3 <- 2^5 * 6^2 * C(52,3)
```

There are 2.54592×10^7 possible outcomes.

Question 4

3 cards are drawn from a standard deck without replacement. What is the probability that at least one of the cards drawn is a 3? Express your answer as a fraction or a decimal number rounded to four decimal places.

```r
PA <- 4/52 # Odds of pulling a 3 from the deck
PB <- 4/51 # Odds of pulling a 3 from the deck after pulling one and
      # assuming the 3 was not pulled from the deck
PC <- 4/50 # Odds of pulling a 3 from the deck after pulling two and
      # assuming the 3 was not pulled from the deck
q4 <- prod(PA, PB, PC)
```

The probability is about $\frac{1}{2000}$ or 4.8265×10^{-4}.

Question 5

Lorenzo is picking out some movies to rent, and he is primarily interested in documentaries and mysteries. He has narrowed down his selections to 17 documentaries and 14 mysteries.

Step 1. How many different combinations of 5 movies can he rent?

```r
k <- 14 + 17 # total movies available
q5.1<- C(k, 5) # from the 31 options pick 5 movies
```

There are 1.69911×10^5 possible combinations.

Step 2. How many different combinations of 5 movies can he rent if he wants at least one mystery?

```r
C(17, 4) # from 17 docs pick 4
```

```
## [1] 2380
```

```r
o1 <- C(14, 5) # from 14 mysteries pick 5
o2 <- C(14, 4) * C(17, 1) # from 14 mysteries pick 4
         # with 17 options for one doc
o3 <- C(14, 3) * C(17, 2) # from 14 mysteries pick 3
         # then pick 2 docs from 17 available
o4 <- C(14, 2) * C(17, 3) # from 14 mysteries pick 4
         # then pick 2 docs from 17 available
q5.2 <- sum(o1, o2, o3, o4)
```

There are 1.30403×10^5 possible combinations.

Question 6

In choosing what music to play at a charity fund raising event, Cory needs to have an equal number of symphonies from Brahms, Haydn, and Mendelssohn. If he is setting up a schedule of the 9 symphonies to be played, and he has 4 Brahms, 104 Haydn, and 17 Mendelssohn symphonies from which to choose, how many different schedules are possible? Express your answer in scientific notation rounding to the hundredths place.

```r
# Each must be 3 since they must be equal amounts of 3 in 9
b <- C(4,3) # from 4 pick 3 symphonies from Brahms
h <- C(104, 3) # from 104 pick 3 symphonies from Haydn
m <- C(17, 3) # from 4 pick 3 symphonies from Mendelssohn
prod(b, h, m)
```

```
## [1] 495322880
```

```r
q6 <- prod(b, h, m)
```

There are 4.95e+08 possible schedules.

Question 7

An English teacher needs to pick 13 books to put on his reading list for the next school year, and he needs to plan the order in which they should be read. He has narrowed down his choices to 6 novels, 6 plays, 7 poetry books, and 5 nonfiction books.

Step 1. If he wants to include no more than 4 nonfiction books, how many different reading schedules are possible? Express your answer in scientific notation rounding to the hundredths place.

```r
c.1.1 <- C(5,4) # from 5 pick 4 nonfiction - no more than this
c.1.2 <- C(19, 9) # from the rest of the books (nonfiction excluded)
        # pick 9 - any book will do from these
c.2.1 <- C(5, 3) # from 5 pick 3 nonfiction
c.2.2 <- C(19, 10) # from the rest of the books (nonfiction excluded)
        # pick 10 - any book will do from these
c.3.1 <- C(5, 2) # from 5 pick 2 nonfiction
c.3.2 <- C(19, 11) # from the rest of the books (nonfiction excluded)
        # pick 11 - any book will do from these
```

```r
c.4.1 <- C(5, 1) # from 5 pick 1 nonfiction
c.4.2 <- C(19, 12) # from the rest of the books (nonfiction excluded)
        # pick 12 - any book will do from these
# add them to find the total combinations
q7.1 <- sum(c.1.1, c.1.2,c.2.1, c.2.2,c.3.1, c.3.2,c.4.1, c.4.2)
```

There are 3.11e+05 possible schedules.

Step 2. If he wants to include all 6 plays, how many different reading schedules are possible? Express your answer in scientific notation rounding to the hundredths place.

```r
# total books with plays removed
books <- sum(6,6,7,5)-6
# assuming 18 total books after removing plays and because we pick only 13
# subtract 6 plays from our pick, 7 picks remain
q7.2 <- C(books, 7) # from 18 pick 7
```

There are 3.18e+04 possible schedules.

Question 8

Zane is planting trees along his driveway, and he has 5 sycamores and 5 cypress trees to plant in one row. What is the probability that he randomly plants the trees so that all 5 sycamores are next to each other and all 5 cypress trees are next to each other? Express your answer as a fraction or a decimal number rounded to four decimal places

```r
q8 <- 2 / C(10, 5) # from 10 (5+5) positions there 5 random trees
            # in which there is only 2 ways for both to line up in rows
           # all cypress on one side and all sycamore on the other and its inverse
```

The probability is about 0.0079.

Question 9

If you draw a queen or lower from a standard deck of cards, I will pay you $4. If not, you pay me $16. (Aces are considered the highest card in the deck.)

Step 1. Find the expected value of the proposition. Round your answer to two decimal places. Losses must be expressed as negative values.

```r
v.low <- 4 # value of low cards
v.high <- 16 # value of high cards
p.low <- 44/52 # probability of queen or lower
p.high <- 8/52 # probability of higher than queen
e.low <- p.low * v.low
e.high <- p.high * v.high
ev <- e.low - e.high
```

The expected value is $0.92.

Step 2. If you played this game 833 times how much would you expect to win or lose? Round your answer to two decimal places. Losses must be expressed as negative values.

```r
winings <- (833 * ev)
```

Expect to win about $768.92

If you pulled every single card in the deck you would make $48 dollars. The kings and aces would need to cost about $24 before an expected loss.