Lab 2 - IE 6200 - Sec 09

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Problem Statement

For this lab assignment, I used my notes from class and the Lab 2 packet to help me complete the 4 tasks assigned. I also used my probability notes to double check the probabilities and sample spaces determined in the tasks below.

Output

Task 1

Consider an experiment of rolling a die three times. Calculate the probabilities for the following events

```
library(prob)
```

```
## Warning: package 'prob' was built under R version 4.0.3
```

```
## Loading required package: combinat
```

```
##
## Attaching package: 'combinat'
```

```
## The following object is masked from 'package:utils':
##
##     combn
```

```
## Loading required package: fAsianOptions
```

```
## Loading required package: timeDate
```

```
## Loading required package: timeSeries
```

```
## Loading required package: fBasics
```

```
## Loading required package: fOptions
```

```
##
## Attaching package: 'prob'
```

```
## The following objects are masked from 'package:base':
##
##      intersect, setdiff, union

R3 <- rolldie(times = 3, nsides = 6, makespace = TRUE)
```

a) Find the probability of getting the same numbers on all three rolls of a die.

```
a <- subset(R3, X1 == X2 & X2 == X3)
a
```

```
##      X1 X2 X3      probs
## 1    1  1  1 0.00462963
## 44   2  2  2 0.00462963
## 87   3  3  3 0.00462963
## 130  4  4  4 0.00462963
## 173  5  5  5 0.00462963
## 216  6  6  6 0.00462963
```

```
Prob(a)
```

```
## [1] 0.02777778
```

b) Find the probability such that the sum of numbers on all three rolls of a die is greater than 6.

```
b <- subset(R3, X1 + X2 + X3 > 6)
Prob(b)
```

```
## [1] 0.9074074
```

c) Find the probablility of getting the number 2 on the first and second roll of a die and any number on the third roll of a die

```
c <- subset(R3, X1 == 2 & X2 == 2)
c
```

```
##      X1 X2 X3      probs
## 8    2  2  1 0.00462963
## 44   2  2  2 0.00462963
## 80   2  2  3 0.00462963
## 116  2  2  4 0.00462963
## 152  2  2  5 0.00462963
## 188  2  2  6 0.00462963
```

```
Prob(c)
```

```
## [1] 0.02777778
```

Task 2

Consider an experiment of tossing a coin three times. Calculate the probabilities for the following events

```
T3 = tosscoin(times = 3, makespace = TRUE)
T3
```

```
##   toss1 toss2 toss3 probs
## 1     H     H     H 0.125
## 2     T     H     H 0.125
## 3     H     T     H 0.125
## 4     T     T     H 0.125
## 5     H     H     T 0.125
## 6     T     H     T 0.125
## 7     H     T     T 0.125
## 8     T     T     T 0.125
```

a) Getting head on the first toss.

```
a <- subset(T3, toss1 == "H")
a
```

```
##   toss1 toss2 toss3 probs
## 1     H     H     H 0.125
## 3     H     T     H 0.125
## 5     H     H     T 0.125
## 7     H     T     T 0.125
```

```
Prob(a)
```

```
## [1] 0.5
```

b) Getting tails on the last toss

```
b <- subset(T3, toss3 == "T")
b
```

```
##   toss1 toss2 toss3 probs
## 5     H     H     T 0.125
## 6     T     H     T 0.125
## 7     H     T     T 0.125
## 8     T     T     T 0.125
```

```
Prob(b)
```

```
## [1] 0.5
```

c) Getting all heads

```
c <- subset(T3, toss1 == "H" & toss1 == toss2 & toss2 == toss3)
c
```

```
##   toss1 toss2 toss3 probs
## 1     H     H     H 0.125
```

```
Prob(c)
```

```
## [1] 0.125
```

    d) Getting at least 1 tail

```
d <- subset(T3, toss1 == "T" | toss2 == "T" | toss3 == "T")
d
```

```
##   toss1 toss2 toss3 probs
## 2     T     H     H 0.125
## 3     H     T     H 0.125
## 4     T     T     H 0.125
## 5     H     H     T 0.125
## 6     T     H     T 0.125
## 7     H     T     T 0.125
## 8     T     T     T 0.125
```

```
Prob(d)
```

```
## [1] 0.875
```

Task 3

Consider an experiment of sampling 2 balls from a urn containing 3 colored balls { red, green ,blue}. Provide only the sample space for the following conditions. Keep **ordered** = TRUE and **replacement** = TRUE.

Note: No need to find the probability for this problem only provide the sample space.

```
balls <- c("red", "green", "blue")

task3 = urnsamples(balls, size = 2, replace = TRUE, ordered = TRUE)
task3
```

```
##       X1    X2
## 1    red   red
## 2  green   red
## 3   blue   red
## 4    red green
## 5  green green
## 6   blue green
## 7    red  blue
## 8  green  blue
## 9   blue  blue
```

    a) All balls are of the same color

```
same_color = subset(task3, X1 == X2)
same_color
```

```
##       X1    X2
## 1    red   red
## 5 green green
## 9  blue  blue
```

b) At least 1 red colored ball

```
red_color = subset(task3, X1 == "red" | X2 == "red")
red_color
```

```
##       X1    X2
## 1    red   red
## 2 green   red
## 3  blue   red
## 4    red green
## 7    red  blue
```

Task 4

Consider an experiment of drawing cards from a pack of cards. Calculate the following probabilities.

```
draw_cards = cards(jokers = FALSE, makespace = TRUE)
draw_cards
```

```
##     rank    suit        probs
## 1      2    Club 0.01923077
## 2      3    Club 0.01923077
## 3      4    Club 0.01923077
## 4      5    Club 0.01923077
## 5      6    Club 0.01923077
## 6      7    Club 0.01923077
## 7      8    Club 0.01923077
## 8      9    Club 0.01923077
## 9     10    Club 0.01923077
## 10     J    Club 0.01923077
## 11     Q    Club 0.01923077
## 12     K    Club 0.01923077
## 13     A    Club 0.01923077
## 14     2 Diamond 0.01923077
## 15     3 Diamond 0.01923077
## 16     4 Diamond 0.01923077
## 17     5 Diamond 0.01923077
## 18     6 Diamond 0.01923077
## 19     7 Diamond 0.01923077
## 20     8 Diamond 0.01923077
## 21     9 Diamond 0.01923077
## 22    10 Diamond 0.01923077
## 23     J Diamond 0.01923077
```

```
## 24    Q Diamond 0.01923077
## 25    K Diamond 0.01923077
## 26    A Diamond 0.01923077
## 27    2   Heart 0.01923077
## 28    3   Heart 0.01923077
## 29    4   Heart 0.01923077
## 30    5   Heart 0.01923077
## 31    6   Heart 0.01923077
## 32    7   Heart 0.01923077
## 33    8   Heart 0.01923077
## 34    9   Heart 0.01923077
## 35   10   Heart 0.01923077
## 36    J   Heart 0.01923077
## 37    Q   Heart 0.01923077
## 38    K   Heart 0.01923077
## 39    A   Heart 0.01923077
## 40    2   Spade 0.01923077
## 41    3   Spade 0.01923077
## 42    4   Spade 0.01923077
## 43    5   Spade 0.01923077
## 44    6   Spade 0.01923077
## 45    7   Spade 0.01923077
## 46    8   Spade 0.01923077
## 47    9   Spade 0.01923077
## 48   10   Spade 0.01923077
## 49    J   Spade 0.01923077
## 50    Q   Spade 0.01923077
## 51    K   Spade 0.01923077
## 52    A   Spade 0.01923077
```

a) The card belongs to the suit of diamonds.

```
a <- subset(draw_cards, suit == "Diamond")
a
```

```
##    rank    suit      probs
## 14    2 Diamond 0.01923077
## 15    3 Diamond 0.01923077
## 16    4 Diamond 0.01923077
## 17    5 Diamond 0.01923077
## 18    6 Diamond 0.01923077
## 19    7 Diamond 0.01923077
## 20    8 Diamond 0.01923077
## 21    9 Diamond 0.01923077
## 22   10 Diamond 0.01923077
## 23    J Diamond 0.01923077
## 24    Q Diamond 0.01923077
## 25    K Diamond 0.01923077
## 26    A Diamond 0.01923077
```

```
Prob(a)
```

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

b) The card belongs to the suit of hearts and has a rank K.

```
b <- subset(draw_cards, suit == "Heart" & rank == "K")
b
```

```
##    rank  suit      probs
## 38    K Heart 0.01923077
```

```
Prob(b)
```

```
## [1] 0.01923077
```

c) The card is either a Ace, King, Queen, Jack.

```
c <- subset(draw_cards, rank == "J" | rank == "Q" | rank == "K" | rank == "A")
c
```

```
##    rank    suit      probs
## 10    J    Club 0.01923077
## 11    Q    Club 0.01923077
## 12    K    Club 0.01923077
## 13    A    Club 0.01923077
## 23    J Diamond 0.01923077
## 24    Q Diamond 0.01923077
## 25    K Diamond 0.01923077
## 26    A Diamond 0.01923077
## 36    J   Heart 0.01923077
## 37    Q   Heart 0.01923077
## 38    K   Heart 0.01923077
## 39    A   Heart 0.01923077
## 49    J   Spade 0.01923077
## 50    Q   Spade 0.01923077
## 51    K   Spade 0.01923077
## 52    A   Spade 0.01923077
```

```
Prob(c)
```

```
## [1] 0.3076923
```

d) The card is an Ace given it belongs to suit of clubs.

```
d1 <- subset(draw_cards, suit == "Club")
d1
```

```
##   rank suit      probs
## 1    2 Club 0.01923077
## 2    3 Club 0.01923077
## 3    4 Club 0.01923077
## 4    5 Club 0.01923077
## 5    6 Club 0.01923077
```

```
## 6      7 Club 0.01923077
## 7      8 Club 0.01923077
## 8      9 Club 0.01923077
## 9     10 Club 0.01923077
## 10     J Club 0.01923077
## 11     Q Club 0.01923077
## 12     K Club 0.01923077
## 13     A Club 0.01923077
```

```
d2 <- subset(d1, rank == "A")
d2
```

```
##    rank suit      probs
## 13    A Club 0.01923077
```

```
Prob(d2, given = d1)
```

```
## [1] 0.07692308
```

Conclusion

There were a lot of probabilities and sample spaces calculated in this lab. There was not much to deduce from these probabilities, as they were relatively straightforward. Regardless, this lab has made me more comfortable with conditional probability and R programming, which will serve me well going forward.