Weekly Assignment 3

BDA201 - Winter 2020 Sean Leggett - February 15, 2020

Question 1

1. A die is rolled and a coin is tossed, find the probability that the die shows an even number and the coin shows a tail.

Answer:

There is a base probability of rolling an even number on a fair die of 3/6 or 1 chance in 2. There is a base probability of 1 chance in 2 resulting in tails on a coin flip.

P($A \cap B$) = P(A) x P(B) P($A \cap B$) = 3/6 x 1/2 = 3/12 = 1/4

There is a 1 in 4 chance (25%) of rolling an even number and also flipping tails on a coin toss.

We can achieve the same answer by multiplying the percentage probabilities of .5 x .5 to obtain the same result .25 probability.

Question 2

Using R, simulate a fair 6 sided dice roll 1000 times. Generate sample space, then find and display mean value of the 1000 randomly generated roles?

Answer:

```
## we are comfortable with data frame structure so tend to default to this even if others would suffice
sampleSpace = data.frame('Roll' = sample(1:6, 1000, replace = TRUE))
x = mean(sampleSpace$Roll)
x
```

```
## [1] 3.437
```

Question 3

What is the probability of getting a sum of greater than 20 when 2 fair 12-sided dice are rolled. (Simulate this in R, by generating sample space)

Answer:
We understand the rolling of two dice to be a single event rather than 2 separate events. That is to say a single roll of 2 dice rather than 2 events rolling each die. To achieve a sum greater than 20 when rolling 2 12-sided dice, it requires a score of 11 or 12 on at least one die. Combinations that would result in a sum >20 are 10 + 11, 11 + 11, 11 +12 and 12 +12. Only 4 eventualities out of a possible 72 will satisfy the experiment.

There is a 1 in 18 chance of generating a sum greater than 20, or a 5.6% chance. To validate/demonstrate this, please see the code below. We generate a sample of numbers between 2 and 24, 1000 times, to simulate 1000 times rolling 2 x 12-sided dice.

```r
rollsum <- data.frame('Die1' = sample(1:12, 1000, replace = TRUE),
                      'Die2' = sample(1:12, 1000, replace = TRUE))
##calculate and add sum column to data frame
rollsum$Total <- (rollsum$Die1 + rollsum$Die2)
b <- sum(rollsum$Total >20) / 1000 * 100
## using the > criteria generates boolean results
## however in R TRUE and FALSE are counted as 1 and 0 also.
##Thus permitting sum to be used for count of TRUE.
b
```

```
## [1] 5.9
```

Running this code three times yields 6.7%, 6.6% and 7.3% rolls greater than 20. We consider this sufficiently close to the projected probability of 5.6% given limited tries.

Question 4

Using the mtcars dataset, Find the probability of choosing a car at random from the dataset that has more than 5 cylinders and has manual transmission as well.

Answer:
We understand the variable 'am' to denote transmission where 0 = automatic and 1 = manual. Therefore:

```r
transcyl <- read.csv('mtcars.csv')
```

Total number of cars = 32

```r
totalcars <- nrow(transcyl)
totalcars
```

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

Number of cars with cylinders >5 = 21

```r
cyl6 <- sum(transcyl$cyl >5)
cyl6
```

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

Number of cars with manual transmission = 19

```r
mxmission <- sum(transcyl$am == 0)
mxmission
```

```
## [1] 19
```

To find the intersection of probabilities cylinders > 5 and transmission == automatic:

P($A \cap B$) = P(A) x P(B) P($cyl > 5 \cap am == 0$) = (21/32)0.66 + (19/32)0.59 = .39 or 39% chance of randomly choosing a car with more than 5 cylinders and automatic transmission.

Question 5

Answer the above questions but with 5 cylinders OR manual transmission.

Answer:
The formula for calculating probability of one event but not the other, given two events: $P(A\Delta B) = P(A) + P(B) - 2P(A\cap B)$ $P(A\Delta B) = .66 + .59 - .78 = .47$ There is a 47% chance of choosing a car with either 5 cylinders or manual transmission.

Reference Material

1. Course Material

2. Sams Teach Yourself R in 24 Hours, Andy Nicholls, Richard Pugh, Aimee Gott. Sams, 2016.

3. To validate results and help confirm our understanding, we used https://www.calculator.net/probability-calculator.html to test results.