FA2

Mercado, C & Sinocruz, A

2025-02-05

1. Use R to illustrate the probability of getting:

(a) a head is 0.5 if a fair coin is tossed repeatedly;
(b) a red card is 0.5 if cards are drawn repeatedly with replacement from an awell-shuffled deck;
(c) an even number is 0.5 if a fair die is rolled repeatedly.

A. A head is 0.5 if a fair coin is tossed repeatedly.

First, we need to simulate coin tosses.

```
set.seed(123)
n <- 10000  # for the number of trials
coin_tosses <- sample(c("H", "T"), size = n, replace = TRUE, prob = c(0.5, 0.5))
```

Then, compute for the probability of getting a head.

```
p_head <- sum(coin_tosses == "H") / n
p_head
```

```
## [1] 0.4943
```

So, the proportion is 0.4943 or approximately 0.5.

B. A red card is 0.5 if cards are drawn repeatedly with replacement from an awell-shuffled deck.

First, let's simulate again. In a standard deck of cards, there are 26 black cards and 26 red cards.

```
deck <- c(rep("Red", 26), rep("Black", 26))
draws <- sample(deck, size = n, replace = TRUE)
```

Then let's compute for the probability.

```
p_red <- sum(draws == "Red") / n
p_red
```

```
## [1] 0.4969
```

So, the proportion is 0.4969 or approximately 0.5.

C. An even number is 0.5 if a fair die is rolled repeatedly.

Like what we did in the first two, let's simulate a die roll

```
die_roll <- sample(1:6, size = n, replace = TRUE)
```

Then let's calculate the probability.

```
p_even <- sum(die_roll %% 2 == 0) / n
p_even
```

```
## [1] 0.4969
```

So, the proportion is 0.4969 or approximately 0.5.

Summary

```
sumtbl <- data.frame(
  Event = c("Coin Toss (Head)", "Drawing a Red Card", "Rolling an Even Number"),
  Theoretical_Probability = c(0.5, 0.5, 0.5),
  Simulated_Probability = c(p_head, p_red, p_even)
)
sumtbl
```

```
##                    Event Theoretical_Probability Simulated_Probability
## 1       Coin Toss (Head)                     0.5                0.4943
## 2     Drawing a Red Card                     0.5                0.4969
## 3 Rolling an Even Number                     0.5                0.4969
```

From there, we can see that all the simulated probability is very close to 0.5.