

# Intransitive Dice

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Suppose we are given the following non-standard 6-sided dice:

Die A: 2, 2, 6, 6, 7, 7

Die B: 1, 1, 5, 5, 9, 9

Die C: 3, 3, 4, 4, 8, 8

The faces of these dice are stored in `die_A`, `die_B`, `die_C`

```
die_A <- c(2, 2, 6, 6, 7, 7)
die_B <- c(1, 1, 5, 5, 9, 9)
die_C <- c(3, 3, 4, 4, 8, 8)
```

We say that die X is “stronger” than die Y if X rolls higher than Y more than half the time. We will use simulation to investigate the question, “which die is strongest?”

First, let’s simulate 10000 rolls of each die, and assign them to `rolls_A`, `rolls_B`, and `rolls_C`. For example, the code to simulate 10000 rolls of die A looks like this:

```
rolls_A <- sample(die_A, 10000, replace = TRUE)
```

Once you’ve finished simulating 30000 dice rolls, use the following code to create a dataset that collects all the dice rolls.

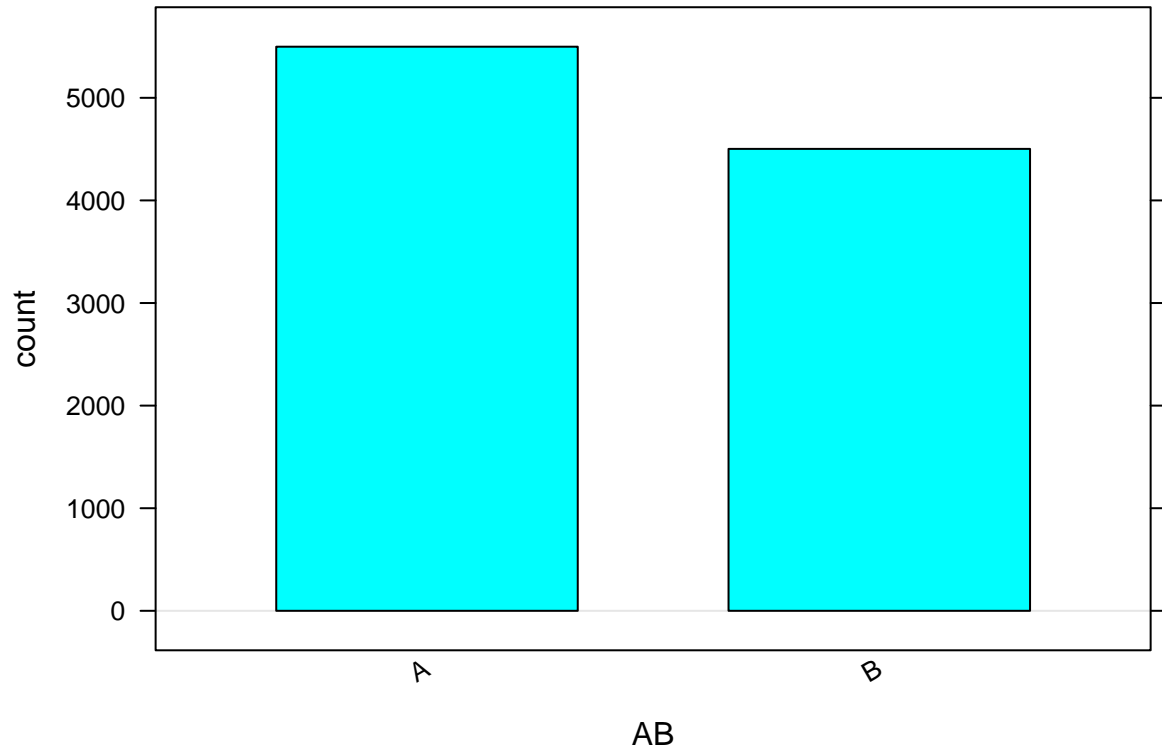
```
rolls <- data.frame(rolls_A, rolls_B, rolls_C)
```

Next we will add 3 variables to “rolls”, corresponding to the 3 pairs of dice (A and B, A and C, B and C). The observations of these new variables will be the winner of each of the 10000 rolls. For example, here’s how to add the column that compares die A and die B (if you’re wondering how the “ifelse” function works, type “?ifelse” in your console).

```
rolls <- mutate(rolls, AB = ifelse(rolls_A > rolls_B, yes = "A", no = "B"))
```

Now, let’s create bargraphs to determine which die is the strongest! For instance,

```
bargraph(~AB, data = rolls)
```



```
bargraph(~AC, data = rolls)
bargraph(~BC, data = rolls)
```

Based on your simulation, which die is the strongest? Hint: maybe there is no strongest die, and instead there is a “rock paper scissors relationship”!