4.2 Basic Probability Rules: Probability Models

Our work so far suggests two common sense rules that a valid probability model must obey:

1. **The probability of any event is a number between 0 & 1**. This rule follows from the definition of probability: the proportion of times the event would occur in many repetitions of the chance process.

2. **All possible outcomes together must have probabilities that add up to 1**. Any time we observe a chance process, some outcome must occur.

Here's one more rule that follows from the previous two:

3. **The probability that an event does *not* occur is 1 minus the probability that the event does occur.** Earlier, we found that the probability of getting a sum of 5 when rolling two fair, six-sided dice was 4/36. What's the probability that the sum is *not* 5?

$$P(\text{sum is not 5}) = 1 - P(\text{sum is 5}) = 1 - \frac{4}{36} = \frac{32}{36} = 0.889$$

We refer to the event "not A" as the **complement** of A and denote it by A^C. For that reason, this handy result is known as the **complement rule**. Using the complement rule in this setting is much easier than counting all 32 possible ways to get a sum that isn't 5.

The **complement rule** says that $P(A^C) = 1 - P(A)$ where A^C is the **complement** of event A; that is, the event that A does not happen.

Example: Suppose you tear open the corner of a bag of M&M's Milk Chocolate Candies, pour one candy into your hand, and observe the color. According to Mars, Incorporated (the maker of M&M's), the probability model is:

.412 0.333 0.255

Color	Blue	Orange	Green	Yellow	Red	Brown
Probability	0.207	0.205	0.198	0.135	0.131	0.124

a.) Explain why this is a valid probability model. All probabilities add up to 1.

0.412 + 0.333 = 0.745 + .255 = 1.000

b.) Find the probability that you don't get a blue M&M.

0.207

1 − 0.207 = 0.793