

Math 155 - Day #22: Rules for Probability

We write the probability of event A as: $P(A)$

$$P(A) = \frac{\# \text{ of ways event } A \text{ can occur}}{\# \text{ of possible outcomes}}$$

There are several rules that dictate what is a probability

Rules of Probabilities

1. For any event A , $0 \leq P(A) \leq 1$

Since $1 = 100\%$ This says that the probability of an event occurring must be between 0% and 100%

2. For any event A , $P(\text{not } A) = 1 - P(A)$

Note: We sometimes write "not A " as A^C and call it " A complement"

Example: If the probability that event A occurs is $P(A) = .2 = 20\%$ then the probability that A does not occur is

$$P(\text{not } A) = 1 - .2 = .8 = 80\%$$

3. If events A and B cannot happen at the same time, then

$$P(A \text{ or } B) = P(A) + P(B)$$

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To explain the third property, let's go back to the probability definition
If A and B cannot happen at the same time, then:

$$\begin{aligned}P(A \text{ or } B) &= \frac{\# \text{ of ways } A \text{ or } B \text{ can occur}}{\# \text{ of possible outcomes}} \\&= * \frac{\# \text{ of ways } A \text{ can occur} + \# \text{ of ways } B \text{ can occur}}{\# \text{ of possible outcomes}} \\&= \frac{\# \text{ of ways } A \text{ can occur}}{\# \text{ of possible outcomes}} + \frac{\# \text{ of ways } B \text{ can occur}}{\# \text{ of possible outcomes}} \\&= P(A) + P(B)\end{aligned}$$

*Note: These are only equal if A and B cannot happen at the same time. Otherwise, events that happen in both A and B get counted twice.

To work with these properties, we will build an example first

We will find the probabilities of dice rolls when rolling two dice and adding them together

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Suppose that you roll two fair dice then add their results together. The table below shows the outcome of each die with what their sum is.

	1	2	3	4	5	6
1	2	3				
2			5			
3						
4						
5						
6						

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Example: What is the probability of rolling an 8?

There are 5 outcomes where the dice sum to 8 out of 36 possible dice rolls

So, $P(\text{rolling an 8}) = \frac{5}{36}$

Example: What is the probability of rolling a 10?

Example: What is the probability of not rolling a 7?

Example: What is the probability of rolling a 5 or 6?

Example: What is the probability of rolling less than 10?