

# Probabilities and Games













## 1 Probability

- Probability is a way to measure the likelihood of a random event.
- We start with a set of events,  $E$ . For instance, for rolling a standard six sided die:  $E = \{1, 2, 3, 4, 5, 6\}$
- The probability of any event  $e$  in  $E$  is computed by:

$$P(e) = \frac{\text{number of occurrences}}{\text{number of trials}}$$

- We often express probabilities as ratios, decimals, or percents.
- The probability of every event in a set of outcomes is called the probability distribution of the set.
- If each outcome is equally likely, we call the distribution a uniform probability distribution.
- The dice example is a uniform distribution, with each number having a 1/6 probability of occurring.
- The sum of all the probabilities in a distribution is always 1. Why?

## 2 The Game of Craps

						
	2	3	4	5	6	7
	3	4	5	6	7	8
	4	5	6	7	8	9
	5	6	7	8	9	10
	6	7	8	9	10	11
	7	8	9	10	11	12

- Craps is played with a pair of dice.
- There is a designated shooter who rolls the dice.
- The shooter will have one of two outcomes “Pass” (win) or “Don’t Pass” (lose).
- The other players bet on the outcome. (There are other bets in casino play, but we will focus on the simple win/lose outcomes.)
- Each round consists of two phases, the come-out roll and the point phase.

## 2.1 Come-Out Roll











- The shooter rolls the dice once.
- A roll of 7 or 11 is a “natural” and the pass line wins.
- A roll of 2, 3, or 12 is “crapping out” and the don’t pass line wins.
- Any other roll sets the point value. The dealer marks the value of the roll, and then play proceeds to the point phase.

## 2.2 Point Phase

- The shooter rolls the dice.
- If the shooter rolls the point value established in the come-out roll (“hit”), the “pass” line wins and the round ends.
- If the shooter rolls a 7 (“seven-out”), the “don’t pass” line wins and the round ends.
- If the shooter rolls any other number, the point phase continues and they roll again.

## 2.3 Exercises

1. What is the probability of rolling a natural?
2. What is the probability of crapping out?
3. What is the probability of proceeding to the point phase?
4. What is the probability of a seven-out?
5. What is the probability of hitting each of the possible point values?
6. In groups of three, play a few rounds of craps. Log the outcome of each game. Do your observations match your predictions?
7. Do the following names of the craps rolls make sense?

						
 Snake Eyes						
 Ace Deuce	Hard Four					
 Easy Four	Fever Five	Hard Six				
 Fever Five	Easy Six	Natural	Hard Eight			
 Easy Six	Natural	Easy Eight	Nina	Hard Ten		
 Natural	Easy Eight	Nina	Easy Ten	Yo-leven	Boxcars or Midnight	