

Using Probability in the Game of Craps

The game of craps is a dice game, played with two dice, that has three rules:

- (1) They can win by rolling a total of 7 or 11 on the first roll.
- (2) They lose by rolling a 2, 3 or 12, on the first roll.
- (3) If they roll anything else (4, 5, 6, 8, 9 or 10) on their first roll (we will call this number, your “point”), then they roll again and again and again until one of two things happen:
 - (1) They repeat their first roll (their “point”) and then they win.
 - (2) They roll a 7, and then they lose.

So, the 7 is your “friend” on the first roll only. If you have not won or lost on the first roll then you are chasing only two numbers, your “point” or the number 7. All other numbers, including 2, 3, 11 and 12, are meaningless after the first roll. Here are some sample games:

Game	Results of the rolls	Win or Lose
1	7	Win
2	12	Lose
3	6, 8, 2, 10, 9, 7	Lose
4	9, 11, 6, 12, 2, 8, 8, 9	Win
5	4, 6, 8, 11, 9, 2, 6, 10, 12, 5, 5, 7	Lose

As you can see, in games 3 and 5, the blue 7 showed up before the “point”, so you lose. Whereas in game 4, the red 9, which was your “point” showed up first, before a 7, hence you win.

Now let’s see some of the probabilities involved. First of all I’ll give you a probability table for the results of rolling two dice:

Rolling a	Probability	Rolling a
2	$\frac{1}{36}$	12
3	$\frac{2}{36}$	11
4	$\frac{3}{36}$	10
5	$\frac{4}{36}$	9
6	$\frac{5}{36}$	8
7	$\frac{6}{36}$	

$$(1) P(\text{winning on the first roll}) = P(\text{rolling a 7 or 11}) =$$

$$P(\text{roll a 7}) + P(\text{roll an 11}) = \frac{6}{36} + \frac{2}{36} = \frac{8}{36} = \frac{2}{9}$$

$$(2) P(\text{losing on the first roll}) = P(\text{rolling a 2, 3 or 12}) =$$

$$P(\text{roll a 2}) + P(\text{roll an 3}) + P(\text{roll an 12}) =$$

$$\frac{1}{36} + \frac{2}{36} + \frac{1}{36} = \frac{4}{36} = \frac{1}{9}$$

$$(3) \text{Odds of winning on the first roll compared to losing on the first roll: } \frac{2}{9} : \frac{1}{9} = 2 : 1$$

$$(4) P(\text{Needing more than one roll to win or lose the game}) = \frac{36}{36} - \frac{8}{36} - \frac{4}{36} = \frac{24}{36} = \frac{2}{3}$$

So, one way that I have made money is on the side bets. I wait until the first roll has happened. If there is no decision (rolled a 4, 5, 6, 8, 9 or 10), then I bet the guy next to me that the thrower will lose. Since 7 is rolled more often than any other roll, the chances of a loss are greater than a win. I once bet a guy \$5 when the first roll was a 4 ! He accepted, thinking the thrower was on a hot streak, by the odds of win : loss were equal to 3 : 6 or 1 : 2. He was quite upset when the thrower lost and I collected my \$5. See next page.

Total probability of winning or losing in the game of craps

<u>The thrower will win</u>	<u>Working</u>	<u>Probability</u>
1. By throwing a natural (7 or 11)	$\frac{6}{36} + \frac{2}{36} = \frac{8}{36} = \frac{2}{9} =$	$\frac{220}{990}$
2. By throwing and making a 6 or 8		$\frac{125}{990}$
3. By throwing and making a 5 or 9		$\frac{88}{990}$
4. By throwing and making a 4 or 10		$\frac{55}{990}$
<u>Probability, that thrower will win:</u>		$\frac{488}{990} = 49.29\%$
<u>The thrower will lose</u>	<u>Working</u>	<u>Probability</u>
1. By throwing "craps" (2, 3 or 12)	$\frac{1}{36} + \frac{2}{36} + \frac{1}{36} = \frac{4}{36} = \frac{1}{9} =$	$\frac{110}{990}$
2. By throwing and losing with a 6 or 8		$\frac{150}{990}$
3. By throwing and losing with a 5 or 9		$\frac{132}{990}$
4. By throwing and losing with a 4 or 10		$\frac{110}{990}$
<u>Probability, that thrower will lose:</u>		$\frac{502}{990} = 50.71\%$