

## The Monte Hall Problem: A Probability Paradox

*Let's Make a Deal* was a television game show hosted by Monte Hall that was first telecast in the 1960s. At the end of each half-hour show, Monte Hall would present a contestant with three numbered doors. Behind one door was a valuable prize, like a car. Behind the other two were things that were worthless, like goats. The game then proceeded in three steps. First, the contestant chose a door. Second, Monte Hall would open one of the two remaining doors to reveal a goat. (He can always do this, as there is only one car.) Finally, Hall would offer the contestant the opportunity to switch from the original choice to the remaining door. The question is: Should the contestant switch?

When asked this question, most people's reaction is that it doesn't matter. But it does. The answer is to always switch. Perhaps surprisingly, switching double the chances of winning! Here's why.

The subtlety in the problem is that when Hall opens the door in the second step, he does not choose randomly. He opens a door he knows not to have a car behind it. This conveys information. When he asks if you want to switch from the original choice to the remaining unopened door, he is really asking if you would like to switch to *either* of the two doors you did not originally choose.

To see this, let's enumerate all of the possibilities. First, the car can be behind any of the three doors, and so there are three possible combinations:

	Door		
Case	A	B	C
1	Car	Goat	Goat
2	Goat	Car	Goat
3	Goat	Goat	Car

Consider the consequences of initially choosing Door A. In Case 1, where Hall opens either Door B or C, if you stay with your original choice, you get the car. Switching gives you the goat. But in cases 2 and 3, when you choose door A, Hall will show you the goat that remains, leaving the car behind the door he has chosen not to open. In both of these cases, switching yields the car. In other words, if you stay with your original choice, you win 1/3 of the time, while if you switch, you win 2/3rds of the time.