

MONT 105N –Analyzing Environmental Data
The “Monty Hall Problem”
February 10, 2020

Background

On the TV game show *Let’s Make a Deal*, the old host Monty Hall would frequently play the following game with contestants:

- The contestant would be shown three large closed doors and told that behind one was a *new car*, while *live goats* were behind the other two.
- The contestant would select one of the doors.
- At this point Monty (who always *knew* where the car and the goats were) would reveal one of the goats, behind one of the doors the contestant *had not picked* – note that with two goats, there was always at least one such door to reveal.
- He then offered the contestant the option of *staying with the original door they had picked* or *switching to the other unopened door*.
- When they made their choice, what was behind the door they finally selected was revealed and the game concluded.

(In case you’re wondering, when the contestant “won” a goat, I don’t think the show ever discussed what happened next. I suppose it’s possible some contestants might have really wanted a goat instead of a car; others may have been at least willing to settle for a goat. But in most cases, the show probably allowed the contestant to go home without the goat even if they had “won” it(!))

What is the right strategy for the contestant? Should they stick with their original door or switch? To start today, we want to do a simulation to gather some evidence.

Directions

- Work in groups of two or three.
- In each group, one person will be Monty Hall, the other will be a contestant. If you have a third person, the third will be a recorder of the results. Otherwise, one of the two people should record what happens on each play.
- Your group will have three playing cards to represent the three doors (two low cards – the goats, and an ace – the car).
- **Round 1:** Repeat 20 times and record the results – how many times the contestant won the car and how many times the contestant won a goat: “Monty” shuffles the cards, deals them out *face down*, and notes which cards are in which locations. The “contestant” makes the initial choice but leaves the card face down, Monty reveals a “goat” (not the card chosen by the “contestant”), the contestant *keeps the original choice* and reveals it.
- **Round 2:** Repeat 20 times and record the results – how many times the contestant won the car and how many times the contestant won a goat: “Monty” shuffles the cards, deals them out *face down*, and notes which cards are in which locations. The “contestant” makes the initial choice but leaves the card face down, Monty reveals a “goat” (not the card chosen by the “contestant”), the contestant *switches to the other unrevealed card* and sees the result.
- When you have completed 20 iterations in Round 1, then 20 iterations in Round 2, we’ll combine results from all of the groups and try to understand what happened.
- If “Monty” forgets which cards are the goats and reveals the wrong card, or if the rules above are not followed in some way, discard the results of that iteration and *try again*.
- If you want to switch roles between the two rounds, go ahead. “Monty” needs to pay more careful attention to what’s going on so that a correct card is revealed in each repetition(!)

A curious case of overconfidence(?)

In 1990, in her *Parade* magazine column, Marilyn Vos Savant responded to a question from a reader about the best strategy for playing this game. She explained that the contestant’s best chance to win the car was to *always switch doors when offered the choice*. Immediately, hundreds of people—including a bunch of rather well-known professional mathematicians—wrote

to her saying she had made a mistake. They claimed there shouldn't be any difference between switching or keeping the original choice because at that point the chances were 50/50 the person had the door with the car.