ROYAL STATISTICAL SOCIETY

DATA | EVIDENCE | DECISIONS

Stick or switch?

Activity Summary:

This activity introduces people to the concept of conditional probability via the Monty Hall problem - a brain teaser, loosely based on the American television game show Let's Make a Deal and named after its original host, Monty Hall.

Activity Learning Outcomes:

- Understand what the phrase "conditional probability" means
- Use conditional probability to determine the best strategy to win a game

Suggested Resources:

- Mock set as shown in the picture above comprising 3 doors, 2 goat pictures & 1 car picture
- Results table (available from website)
- Graph paper

How to run the activity:

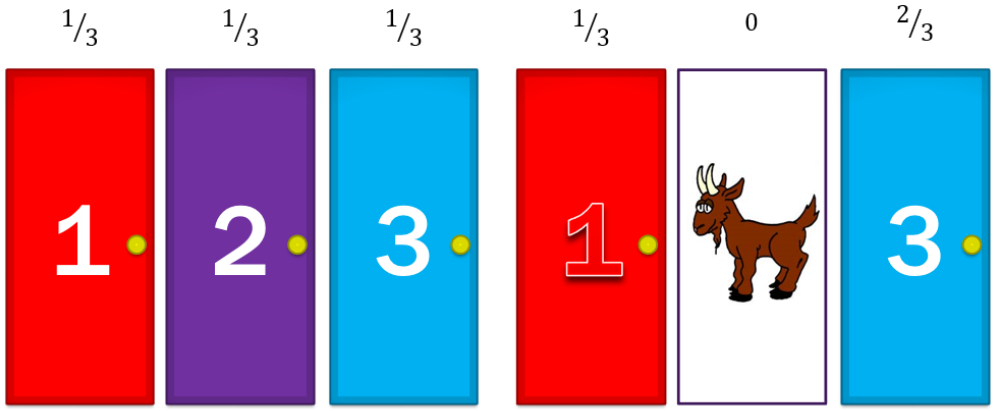
- Prior to each participant's engagement with the activity, pre-load the set by putting a car behind one door, and goats behind two doors, remembering where the car is located!
- Show the set to the participant(s)
- Explain that the star prize of a car is hiding behind one door, but that goats hide behind the other two doors, and as the host, you want them to win
- Get the participant to be the contestant, and the organiser should play the role of the host
- Game rules:
    a. All three doors must be closed
    b. The host asks the contestant to select the door which they believe is concealing the car but do not open it
    c. The host acts in the contestant's favour and opens another door to reveal a goat
    d. The host then asks the contestant if they wish to stick with their original choice of door, or swap to the other unopened door
    e. The host opens the door the contestant has selected to reveal the contestant's prize
- Fill in the results table, and the chart, to show the participant(s) the results over time

Exploring the activity:

- What are the participants' initial reactions? Stick or switch?
- What happens over time (i.e. repeating the game)?
- How often do the contestants who choose to stick win?
- How often do the contestants who choose to switch win?

What's going on?

- At the start of the game (with all doors shut), there is a 1/3 probability of the car being behind each door, as there is one car, and three doors.
- After the contestant has selected a door, and the host has opened another door to reveal a goat, the probability of the car behind the opened door is 0 – we know that there is a goat there!
- The probability that the car is behind the door the contestant has selected is still 1/3 as nothing has changed for this door.
- However, given that probabilities must sum to one, the probability of the car being behind the remaining door is now 1-1/3 = 2/3.
- Therefore, the contestant will be more likely to win the car if they swap from their original choice of door.



At the start **After contestant picked & host opened door**

- This is a demonstration of conditional probabilities as the probability of one event (winning the car), depends on a previous event (the host revealing a goat).

Video demonstration:

A video demonstrating this activity is available on the RSS website at www.rss.org.uk/hands-on

Risk assessment:

There are no risks associated with this activity

Additional information and taking it further:

Online Monty Hall simulation: https://math.ucsd.edu/~crypto/Monty/monty.html

Wikipedia explanation of The Monty Hall Problem: http://en.wikipedia.org/wiki/Monty_Hall_problem including situations where the host is not on the participant's side

Basic conditional probability tutorial within BBC Bitesize: http://www.bbc.co.uk/schools/gcsebitesize/maths/statistics/probabilityhirev3.shtml

Credits:

Idea & photographs by Laura Bonnett (University of Liverpool).

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