Lwr. 2ndry Maths Made Easy

Name :.. No : ....

Class : .... Date : ....

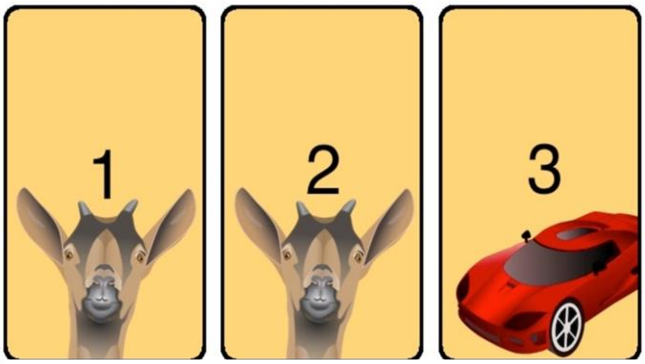
PROBABILITY - TREE DIAGRAMs

The Monty Hall Problem

This is a famous probability problem, as follows.
In the 1960s U.S. TV show **Let's Make a Deal,** the host, Monty Hall, shows a contestant three doors. Behind one door is a prize (win), behind the other two are goats (lose).
The contestant chooses a door, # **1**, **2** or **3** which remains closed.
Then Monty, the problem goes, opens one of the other doors to reveal a goat (it is always a goat) and then asks the contestant if they wish to change doors....

THE BIG QUESTION : What is the better strategy ?
Stay with the original choice, or switch doors ... ?

The answer is (assuming a few things, see next page)
switch doors



GOAT 1 GOAT 2 CAR

TREE DIAGRAM : Fill in the results below

Note there are two steps or choices , and we are given new information before making the second choice.

PROBABILITY	STEP 1: YOU CHOOSE	HOST REVEALS	STEP 2 : YOUR STRATEGY ?	RESULT	SUMMARY of RESULTS for each STRATEGY
1/3	GOAT 1	GOAT 2 (the other goat)	SWITCH STAY	....	SWITCHING (........... , ..., ...) ... / 3
1/3	GOAT 2	GOAT 1 (the other goat)	SWITCH STAY		------------------------
1/3	CAR	GOAT 1 or GOAT 2	SWITCH STAY		STAYING (........... , ..., ...) ... / 3

CONCLUSION from the tree diagram :

If the contestant initially picks the car (**1/3** chance), then switches, he loses.
If the contestant initially picks either goat (**2/3** chance), then switches, he wins the car.
But if stays with his first choice, he has only **1/3** chance of winning the car
So switching is better (**2/3** to **1/3**)

This problem makes a few assumptions, which should be understood :

1. Monty knows what is behind the doors (after all, he is the host)
2. Monty ALWAYS shows the contestant a goat (if he revealed the prize, it would be game over)
3. Monty does not exercise any bias, by offering someone the opportunity to change their door when they have chosen the car, or not chosen the car, etc.
4. The contestant must realize 1, 2 and 3 to see the advantage of switching doors. (otherwise he could think that Monty just happened to show him a goat on that day)

If Monty's choice were random, the probability would not change, and there would be no advantage in switching. But Monty's choice is **not** random, Monty always reveals a goat …

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Still don't get it ? Imagine this is a question on an exam paper, with **Part A** and **Part B** :

PART A : If in a game show, you are presented with three doors, behind one of which is a prize. You choose a door . **What are your chances of choosing the door with the prize ?** *Ans :* **1 out of 3** *OR* **1/3** chance *(a very easy question)*

PART B : All doors remain closed, until one of doors you didn't choose is deliberately opened to show it is NOT the prize. You are asked if you want to change doors. **Should you now choose the other closed door, or stay with your first choice ?**

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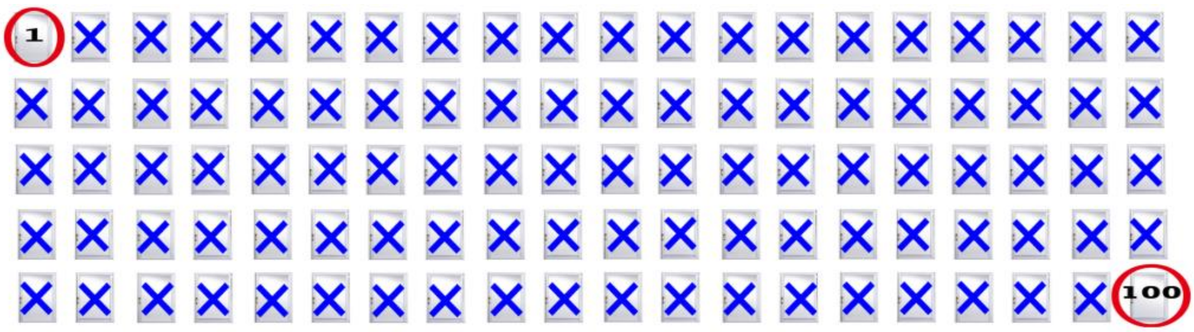
Another way of looking at the problem : Imagine a similar situation with **100** doors, behind one of which is the prize. **A** door is chosen (*e.g.* Door# 1 as below) The probability that this is the correct door is **1** out of **100**. Then the host opens **98** doors which **he knows are not the prize**. The chance of the prize being behind the other remaining unopened door is therefore **99** out of **100**. As they are **2** out of **3** above. Should you switch **?**



In reality, Monty Hall ran his games different ways, but he has gone on record as saying that he NEVER ran the game in the way in which it has become famous !! The problem was invented by someone who was watching who asked : if the contestant was given the chance of changing doors at a particular point, what should he do ? See https://www.youtube.com/watch?v=c1BSkquWkDo