Math 464/564, O. Knill, **January 1997**

TWO CONTROVERSAL EXAMPLES

THE GIRL-BOY PROBLEM

"Dave has two childs. One child is a boy. What is the probability that the other child is a girl".

Solution. $\Omega = \{BG, GB, BB\}$, $\mathcal{A}$ = set of subsets of Ω and $\mathrm{P}[\{BG\}] = \mathrm{P}[\{GB\}] = \mathrm{P}[\{BB\}] = 1/3$. Now $A = \{BG, GB\}$ is the event that the other child is a girl. $\mathrm{P}[A] = 2/3$.

Solution with conditional probability. $\Omega = \{BG, GB, BB, GG\}$ with $\mathrm{P}[\{BG\}] = \mathrm{P}[\{GB\}] = \mathrm{P}[\{BB\}] = \mathrm{P}[\{GG\}] = 1/4$. Let $B = \{BG, GB, BB\}$ be the event that there is at least one boy and $A = \{GB, BG, GG\}$ be the event that there is at least one girl. We have $\mathrm{P}[A|B] = \mathrm{P}[A \cap B]/\mathrm{P}[B] = (1/2)/(3/4) = 2/3$.

Check out:

`http://www.wiskit.com/marilyn.boys.html`

THE MONTY-HALL PROBLEM

"Suppose you're on a game show and you are given a choice of three doors. Behind one door is a car and behind the others are goats. You pick a door-say No. 1 - and the host, who knows what's behind the doors, opens another door-say, No. 3-which has a goat. (In all games, the host opens a door to reveal a goat). He then says to you, "Do you want to pick door No. 2?" (In all games he always offers an option to switch). Is it to your advantage to switch your choice?"

Solution. The probability space is $\Omega = \{\mathrm{goat1}, \mathrm{goat2}, \mathrm{car}\}$ with $\mathrm{P}[\{\mathrm{goat1}\}] = \mathrm{P}[\{\mathrm{goat2}\}] = \mathrm{P}[\{\mathrm{car}\}] = 1/3$.
First case: No switching: The winning event is $A = \{\mathrm{car}\}$ which has probability 1/3.
Second case: Switching: The winning event is $A = \{\mathrm{goat1}, \mathrm{goat2}\}$ which has probability 2/3.

Check out:

`http://www.wiskit.com/marilyn.gameshow.html`

I recommend the cite

`http://http://www.cut-the-knot.com`

for more Mathematics puzzles.