Prof. Ksir received her Ph.D. in math from the University of Pennsylvania in Philadelphia, PA. She wrote her thesis on algebraic geometry and its connections with string theory. Meanwhile, for fun, Prof. Ksir played the accordion in *Broadside Electric*, a band which plays European and American folk music with electric instruments. That's how she met her husband, Tom Rhoads, the lead singer and guitar player.

Following a 3-year postdoctoral position at SUNY Stony Brook, Prof. Ksir joined the USNA math faculty in Spring 2002. Since arriving, she has taught the full spectrum of math courses, from calculus to capstone courses in geometry and relativity. She has supervised an honors project on the mathematics of the Rubik's Cube and co-supervised a Trident project on counting conics. She also organized the 2005 Michelson Lecture by Dr. Jeffrey Weeks on "The Shape of Space." Though her research interest remains algebraic geometry, the focus has turned from physics to coding theory and number theory.

This semester, Prof. Ksir is teaching one of her courses, SM 291 (Fundamentals of Math), using a method called "Inquiry-Based Learning", pioneered by Prof. R. L. Moore. There is no text and no lecture. Rather, Prof. Ksir poses problems to her students, and they present the solutions. The class itself judges whether the solutions are correct, and Prof. Ksir's role is that of a coach/moderator. Her hope is that the students leave the course with a greater sense of ownership of the material, and so far she is encouraged by the results.

Prof. Ksir lives in Severna Park with her husband and their daughter Laura (born January 2007). Laura's hobbies include unloading the dishwasher and jumping on the trampoline!

★★★ Problem of the Month ★★★

Let X and Y be vertices of a simple polygon P. We say that vertex X "sees" vertex Y if the straight line from X to Y does not intersect the exterior of P. For example, in a square, every vertex sees every other vertex. This is definitely not the case for a "star-shaped" polygon. Problem: Draw a simple 5-sided polygon P whose vertices A, B, C, D, and E satisfy the following "visibility" conditions:

- Vertex A sees B and E only.
- Vertex B sees A, C, D, and E.
- Vertex C sees B and D only.
- Vertex D sees B, C, and E only.
- Vertex E sees A, B, and D only.

Mids who submit a correct solution to Asst. Prof. Vrej Zarikian (`zarikian@usna.edu` or Chauvenet 304) will be entered in a random prize drawing.

The Math News*

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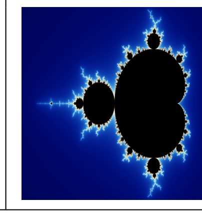


$$$ Let's Make a Deal! $$$

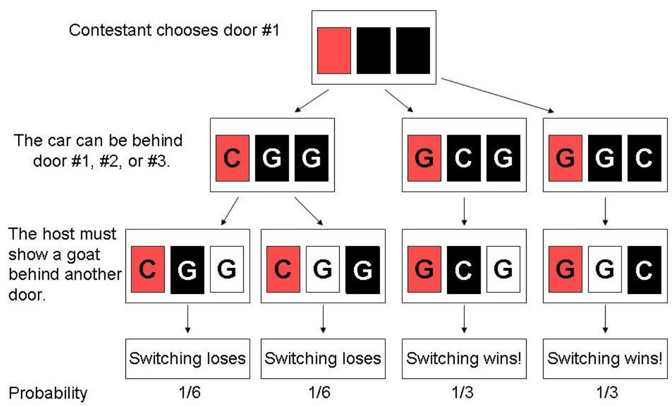
by Asst. Prof. Leah Jager (`jager@usna.edu`)

As a contestant on a game show, you are presented with three doors to choose from – behind one door is a car and behind the other two are goats. (Put your love for Billy aside for a few minutes – you are trying to win the car, not a goat!) You choose door #1. The host doesn't open your chosen door, however. Instead, because he knows where the car is located, he opens one of the doors you didn't pick to reveal a goat. He then gives you the option to stick with your original door (#1) or switch your choice to the other remaining closed door. What should you do?

At first glance, switching might not seem to make a difference. Since one remaining door must contain a car and the other must contain a goat, would your probability of winning be 1/2 either way? The answer is no – you actually have a much higher probability of winning (2/3 vs. 1/3) if you switch doors!

Look at the chart on the following page. When you first select door #1, there are three possibilities, each with probability 1/3 – the car can be behind door #1, behind door #2, or behind door #3. If the game stopped now, you would have a 1/3 chance of winning the car. However, now the host must open a door and show you a goat. (Remember, he knows where the car is, so he won't show you a car!) If the car is behind your chosen door #1, then he can randomly choose to open door #2 or door #3 to show you a goat. If the car is behind either of the other doors, he only has one choice of door to open.

*On the cover: The USNA seal (left) and the Mandelbrot set (right).

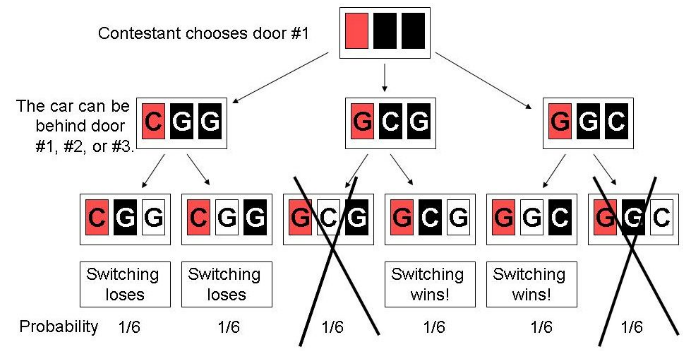


As you can see, only if the car is behind your original door will switching result in losing the game. In fact, 2/3 of the time you will benefit by switching doors.

This particular problem is called the "Monty Hall Problem," after the host of the 1970s gameshow "Let's Make a Deal." This is a famous probability problem – in 1990, this problem appeared in the "Ask Marilyn" column of *Parade* magazine. The solution given was the one we just found – you should switch doors because your chances of winning if you switch are 2/3, compared to 1/3 if you don't switch. Thousands of people wrote into the magazine claiming the solution was wrong!

This problem is an example of conditional probability – knowing some additional information can change the possible outcomes of the game and their associated probabilities. For example, initially each door has a 1/3 chance of hiding the car. But once the host shows you one of the doors you didn't pick is a goat, the probability the other door is a car increases to 2/3.

In this case, a critical piece of additional information you're given is that the host knows where the car is hidden, and therefore must show you a goat. If instead the host were to randomly open a door (which could have been a car, but just happened to be a goat), then there would be no additional benefit to switching doors. We can see this by looking at the chart on the opposite page. After crossing out the cases where the host randomly opens a door to show a car (which didn't happen in this case), half the time a switch results in a win and half the time a switch results in a loss.



This is still a conditional probability – the probability the car is behind each door increases from 1/3 to 1/2 after the host reveals the goat. But in this case you have less additional information than before, since the host is not required to show you a goat.

Faculty Profile: Assoc. Prof. Amy Ksir

Associate Professor Amy Ksir was born in Bloomington, IN. She was raised in Laramie, WY, home of the University of Wyoming, where her father was a professor of psychology. Growing up, Prof. Ksir was interested in both music (she played the piano) and mathematics. Her interest in mathematics was especially kindled by her 8th grade geometry class. Her teacher had a Ph.D. in mathematics from Penn State, and they "talked about the 4th dimension every day." While still in high school, Prof. Ksir took math classes at the University of Wyoming. By time she graduated, she had completed Calc. I-III and matrix theory.

Torn between music and math, Prof. Ksir chose to attend college at Rice University in Houston, TX, home of a nationally-ranked math department and the prestigious Shepherd School of Music. Prof. Ksir soon realized that, for her, music was a recreation, not a full-time pursuit, and she majored in math instead. Ironically, her mathematical career at Rice did not get off to a good start—she ended up dropping her partial differential equations (PDEs) class. In her defense, PDEs is a junior-level class and Prof. Ksir was a freshman at the time!