Why Is It Fun To Be A Statistician?

What is Statistics?

Statistics is a field whose objective is to provide crucial guidance in determining what information is reliable and which predictions can be trusted.

Statistics are used in a variety of fields, including medicine, government, education, agriculture, business, and law.

They often help search for clues to the solution of a scientific mystery, and sometimes keep investigators from being misled by false impressions.

The steps of statistical analysis involve:

1. Collecting information
2. Evaluating the data
3. Drawing conclusions and making inferences

Statisticians in Action

Surveys: Survey statisticians collect information from a sample and extend the results to an entire population. Sample surveys might be used to:

- Determine which political candidate is more popular
- Discover what foods teenagers prefer for breakfast
- Estimate the number of children living in a given school district
- Fluctuations in the economy and employment patterns

Scientific Research: Statistical sciences are used to enhance the validity of conclusions in:

- Radiocarbon dating to estimate the risk of earthquakes
- Clinical trials to investigate the effectiveness of new treatments
- Field experiments to evaluate irrigation methods
- Psychological tests to study how we reach the everyday decisions in our lives

Business And Industry: Statisticians quantify unknowns in order to optimize resources. They:

- Predict the demand for products and services
- Check the quality of items manufactured in a facility
- Manage investment portfolios
- Forecast how much risk activities entail, and calculate fair and competitive insurance rates

What is this Statistician Doing in an Airplane?

- Does knowledge of an aircraft's maintenance history improve a pilot's decision making in an emergency?
- Statisticians can help in the design and analysis of experiments that can answer this question.

Why is this Statistician Observing a Cow?

Statistician

- Cows and sheep can be identified using nose prints. However, this often leads to errors.
- Retinal imaging is more expensive, but can it identify animals more accurately?
- Statisticians can help answer this question!

Statistics in Multi-Disciplinary Research

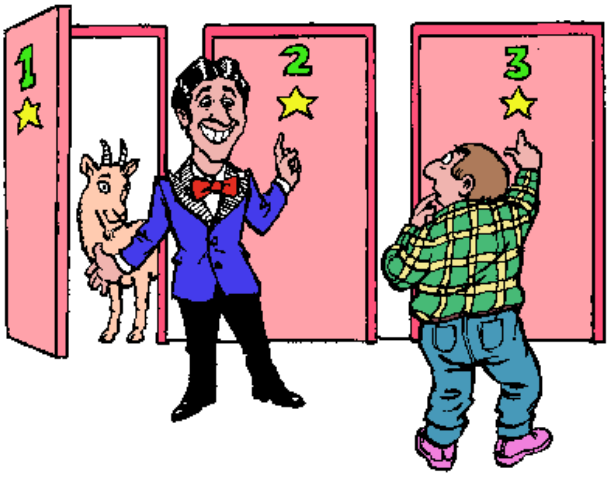
This statistician is experiencing a client's data collection process first hand.

- Department: Earth & Atmospheric Sciences
- Problem: How do land use and climate affect the carbon cycle in a local watershed?
- Statistician's Role: Assist with experimental design & data analysis

Statistics in Community Organizations

- How effective are a rehabilitation center's programs?
- Why is there high staff turnover at some organizations?
- How can an organization increase the response rate of a survey?
- Which community services should be expanded?
- Statisticians can help answer questions like these & more!

The Monty Hall Problem



Scenario:

This story comes from an American TV game show. Here is the situation. Finalists in a TV game show are invited up onto the stage, where there are three closed doors. The host explains that behind one of the doors is the star prize - a car. Behind each of the other two doors is just a goat. Obviously the contestant wants to win the car, but does not know which door conceals the car. The host invites the contestant to choose one of the three doors. Let us suppose that our contestant chooses door number 3. Now, the host does not initially open the door chosen by the contestant. Instead he opens one of the other doors - let us say it is door number 1. The door that the host opens will always reveal a goat. Remember the host knows what is behind every door! The contestant is now asked if they want to stick with their original choice, or if they want to change their mind, and choose the other remaining door that has not yet been opened. In this case number 2.

Question:

What is the best strategy for the contestant? Does it make any difference whether they change their mind or stick with the original choice?

The answer to this question is not intuitive. Basically, the theory says that if the contestant changes their mind, the odds of them winning the car double. And over many episodes of the TV show, the facts supported the theory - those people that changed their mind had double the chance of winning the car.

Why?

The contestant doesn't know which door the car is behind, and so the chance of the car being behind any one particular door is one third, isn't it? So surely the chance of winning the car if they stick with their first choice is one third, and the chance of winning if they switch doors is one third. How can there chance of winning double?

The answer goes like this. When the contestant makes their first choice, the chance of them being correct is indeed one in three, or one third. And if, after the host has done his patter and opened another door, they stick with their original choice, then their chance of being correct is unaltered, it is one third. Indeed, how could this possibly change?

However, as we said, it is counter-intuitive, and the math that most people do in school does not cover this. This is NOT an example of simple probability (suppose there are two doors, therefore there is a 1 in 2 chance of the car being behind either of the doors). This is an example of conditional probability: what is the chance of something happening, *given that something else already has*.

OK, so how does this puzzle work? Here is one way of explaining it. Let's say the contestant has chosen door 3 and will not change their mind. There are three equally likely possibilities. In one case out of three, the contestant will win the car.

Door 1	Door 2	Door 3	Outcome
Car	Goat	Goat	Loss
Goat	Car	Goat	Loss
Goat	Goat	Car	Win

The green background shows the door that the host opened. Only in the last case did he have a choice, when he could have opened either door 1 or door 2.

Winning Strategy:

Now let us consider what happens if the contestant always changes their mind. Again they initially pick door 3. Their chance of being right initially is still only 1 in 3.

Door 1	Door 2	Door 3	Outcome
Car	Goat	Goat	Win
Goat	Car	Goat	Win
Goat	Goat	Car	Loss

Now in both the first two cases the host opens a door revealing a goat, and the contestant changes their mind - and 2 times out of 3 they will be right. So, if the contestant sticks with their original choice, they will win the car 1 time in 3, and if they switch doors, they will win the car 2 times in 3.

Extreme Example:

Some of you will still be shaking your heads at this, and saying we are wrong. So here is another way of thinking about it. Imagine there are 100 doors, with a car behind only 1 of them. You choose a door. Your chance of being right is 1 in 100, right? Now the host opens 98 of the remaining 99 doors, in each case revealing a goat. You can now either stick with your original choice, or you can switch to the one remaining door that is closed. We say if you stick with your original choice, you still have a 1 in 100 chance of being right. And if you switch, you have a 99 in 100 chance of being right.

Simulators on the Internet:

To try this out on your own there are many websites with programs that simulate this game. These are two of them:

1. **http://www.grand-illusions.com/simulator/montysim.htm**
2. **http://math.ucsd.edu/~crypto/Monty/monty.html**

Reference:

1. **http://www.amstat.org/careers/index.cfm?fuseaction=whatisstatistics**