Rickety Science and other facts of real life

M5 Crew

Friday February 25

Review

Wednesday we articulated an important law: $P(A \wedge B) = P(A) \cdot P(B|A)$

This let us calculate $P(B|A) = \frac{P(A \wedge B)}{P(A)}$. Note, these two laws are always valid, regardless of independence of A and B

Recall: $P(A|B)$ is the probability that A is true given that you know B is true.

Flipping Variables

Since A and B are arbitrary, I can switch them an obtain that $P(A|B) = \frac{P(A \wedge B)}{P(B)}$.

If I use these two equations I find that:

$$\frac{P(A|B)}{P(B|A)} = \frac{P(A)}{P(B)}$$

(So long as $P(A \wedge B) \neq 0$.)

Big Law

$$\frac{P(A|B)}{P(B|A)} = \frac{P(A)}{P(B)}$$

Gives us:

$$P(A|B) = \frac{P(A)}{P(B)} \cdot P(B|A)$$

[The above is true any time $P(B) \neq 0$]

Example

Let's say that Eli and Eunice are two people who take orders at the local pizzeria. For a given order, Eli is 3 times more likely to make an error in entering the order than Eunice is. Because of This Eunice answers the phone twice as often as Eli [Eli only gets it when Eunice is busy]. If $\frac{1}{10}$ of all pizzas that are ordered are mis-entered, what is the likelihood that Eli was the one who took your order given that your pizza was entered correctly?

Let $A =$ Eli took your order. And Let $B =$ your pizza was correctly made.

We want $P(A|B)$ we know that $P(A|B) = \frac{P(A)}{P(B)} \cdot P(B|A)$.

$P(A) = \frac{1}{3}$ since Eunice is twice as likely to answer the phone.

$P(B) = \frac{9}{10}$ since only $\frac{1}{10}$ of all orders are messed up when entering.

A little scratchwork shows $P(B|A) = 82$ percent.

So we plug in the numbers:

$$\frac{\frac{1}{3}}{\frac{9}{10}} \cdot \frac{82}{100} = \frac{82}{270}$$

Or approx 30.4 percent.

Key Trait

We are going to be looking at a number of examples where the Big Law has something to say. All the cases have something in common: **They deal with "backwards reasoning"**

Here: "backwards reasoning" is what happens when you say "X is what you would expect if Y is true. Y is true, so X is probably correct.

Argument From Design

Throughout the ages philosophers [and now some scientists] have attempted to show that the Universe was probably created by an "Intelligent Architect" because it appears to be designed well. Hume gave a rather general refutation to this argument, but even today some scientists [e.g. Hugh Ross] and many religious people have tried to use the "well-designedness" of the universe to show that it had an intelligent creator.

For Example

Scientists often cite many facts to support this claim. For example, the masses of certain subatomic particles [or the strengths of the various types of forces in the universe] have to be very close to what they are now or else almost all atoms would be unstable and instead of 82 naturally-occurring elements, we may have, say, 4 [= no water].

Another Example

Or, similarly, they cite the make-up of the solar system. For life to exist in any form similar to how it does [so the theory goes], you must have a sun that is not too much bigger or smaller than ours with a planet at about the radius we are. Furthermore, you need another large planet [in our case Jupiter] to deal with some other subtle issues, and it appears you need a second large planet [in our case Saturn] as well.

You can find example after example of these very delicately balanced forces [Actually, there is a known problem in science that variations in luminosity of the Sun means that the Earth itself [if you try to believe the current theory] has to have gone through a rather remarkable history just to have any life on it today]. And the conclusion has often been drawn that the chances of the universe being able to sustain life AT ALL are just so amazingly small by chance as to assume it could not have happened.

Let's try to think about this as intelligent M5 students instead of scientists!!!

Let's say that A represents the idea that a "random" Universe looks as our's does. And B represents the event that a "random" universe was made by an intelligent architect.

So, what we want to know is $P(B|A)$, the likelihood that the Universe was designed by an intelligent architect given that it appears as it is now.

However, all we can estimate is $P(A|B)$, the likelihood that the universe would look as it does given that there is an intelligent architect.

Let's use our important formula:

$$P(B|A) = \frac{P(B)}{P(A)} \cdot P(A|B)$$

The problem is now apparent. Let's pretend that we agree with those who are trying to make this argument that $P(A|B)$ is quite high. Even if this is the case, unless we have AT LEAST SOME IDEA what $P(B)$ is, we simply can make **NO** estimation of $P(B|A)$. None, Nadda, Zilch, Zero.....

So, in this case, unless you have SOME idea what the likelihood that a "random" Universe is made by an intelligent architect, you can make NO claim [not ANY!!!!!] about the likelihood that this universe was.

This is an inherent weakness to this type of argument. No matter how many constants scientists find that have to be precise to whatever degree, it will never,ever give **ANY** indication that the Universe was in fact designed by an intelligent architect.

Science

A famous quote about science is:

A first-rate theory predicts
A second-rate theory forbids
A third-rate theory explains after the fact

What is often not understood is the HUGE gap in quality between the second and the third of these. When you have a theory that merely explains [even if it sounds very reasonable] a phenomena, there is a significant likelihood that the theory is not only wrong, but it is completely off. [Even scientists seem not to realize the severity of the problem, as they often build their theories on other theories that are third-rate, leading to an overarching, tottering superstructure of theories that are all likely to be wrong to one degree or another].

Darwinian Evolution

A great example of this is Darwinian/Neo-Darwinian Evolution. The theory started being taught in schools around the 50s and NeoDarwinism was promulgated around 1930. The basic idea "makes sense:"

- Those whose genetics [either by favorable pairing up of parents or by mutation] are more likely to have more offspring.
- Since their offspring will share their genetic code, the things that made one more fit will tend to be inherited and the proportion of individuals having more fit genes will increase.
- Over time new species, better fit to their environment than their ancestors, will develop.

What Happened?

This was taught in schools for decades [and still is], but about 20 years ago biologists [and mathematicians] began to have problems with the theory [which appeared to make sense and explain the data].

" The results of the last 20 years of research on the genetic basis of adaptation has led us to a great Darwinian paradox. *Those [genes] that are obviously variable within a natural population do not seem to lie at the basis of many major adaptive changes, while those that seemingly do constitute the foundation of many, if not most, major adaptive changes apparently are not variable within natural populations*" - geneticist John McDonald

Mathematicians have given proofs that evolution does not allow enough change to account for life in the generally held time frame. Transitional forms continued not to be found in any great numbers, and more and more biologists and mathematics began to doubt the theory. Instead there are now various types of theories given to replace Darwinian evolution [which still, remarkably, is taught by benighted biology teachers in classrooms everywhere], but their theories are also simply explanatory.

The Sun

A similar example is the sun. Scientists had an intelligent, reasonable theory for how the sun evolves. It is the theory you probably were taught in high school. It seemed correct, and as far as I know everyone believed it. But it did not predict things. It just explained [or tried to explain] the evolution of the sun.

And then...in 1976

A group of astronomers made some measurements and published their findings [that were later confirmed] that showed that the sun could not be more than 100,000 years old [and therefor not even be using fusion yet!] if the current theory was correct.

Astronomers did not like the idea of the sun being less than 100,000 years old, so they have hence created a much more complex, convoluted theory in an attempt to explain the results.

Possible Final Projects

There are lots of things you can think about and analyze using only the laws we have given. I gave an exact example of how to use the equations yesterday [with the jury trial]. Here are some possibilities:

- What is the likelihood the sun will rise tomorrow [obviously you will want to consider various assumptions.]

- What is the likelihood, given that the boyfriend or girlfriend you are with now is your favorite among all those you have ever dated, that he or she is the best you will ever date [The "marriage" problem]

- If there are a pool of analysts making estimations of football games [or the stock-market], and one of them is particularly accurate in the games so far, what is the likelihood that e has some real skill?

- Find a collection of scientific discoveries that are held today and try to analyze how much confidence one can have in them.

- Some say that the prophet Daniel correctly prophesied to the very day Christ's entry into Jerusalem prior to His arrest. How compelling is this?

- What is the likelihood that there is no other intelligent life in the universe given that we have not [supposedly] found any yet?

- Justice: There are <u>tons</u> of possible ideas for talking about justice issues. How much more [or less] likely is someone to commit a crime given that e has already been convicted of one? How much more likely is a jury to convict someone if e is a prior convict. How much more likely is someone to be indicted, etc...How much more likely is someone to receive the death penalty if...[insert condition here]. How much more likely is someone to be wrongfully convicted if...[insert condition here]. Note, if you do a project like this, do not simply cite figures, etc. You should have some mathematically interesting calculation/deduction as well.

- Late Betting: How much should you change the betting odds if someone wants to bet at the end of the first quarter on a team that is ahead by x number of points [you can have lots of fun with this one].

- A coin is <u>bent</u>, that is that it is more likely to come up one way or the other. You do not know how bent it is [or to what side]. If I tell you that I tossed it 3 times and got 2 heads and 1 tail, what is the likelihood that the next toss is a head? [there are lots of different things you can do in this problem....you may find calculus useful].