Fisher and Bayes and Guided versus Unguided Evolution

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Abstract

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http://rasmusen.org/papers/id.pdf.

I thank xxx for their comments.

Sherlock Holmes quote

I. Introduction

In this paper I will approach the topic of intelligent design using the two statistical approaches of Fisherian hypothesis testing and Bayesianism. This has been done before, notably by Dembski (2002) and Sobel (xxx) from opposite sides of the debate, but I think it needs a fresh look. I will not be discussing the substance of the topic— whether evidence supports intelligent design or not—only how we should organize our thoughts on it. Before we begin thinking about the reasoning, however, let me set up the problem.

"Intelligent design" versus "Darwinism" is a misleading way to frame the debate, and I will quickly move away from those terms. The central debate now is between two forms of evolutionary theory. Both forms accept that evolution occurs, that it occurs over millions of years, that an animal's body is determined by its genes, that species existing now are different from those that existed in the Cambrian Era. Rather, the debate is over whether prehistoric changes in DNA—mutations— have in every case occurred randomly as the result of, for example, solar radiation, or whether in some cases mutations occur because of deliberate action by an intelligent being. I will call these two positions "unguided evolution" and "guided evolution".[1]

For this article, we will take it as given that unguided evolution requires a high degree of coincidence to explain how some features of the natural world arise. The flagellum of bacteria is such a feature: it is a complex structure whose evolution would require multiple, simultaneous, highly specific mutations. The question, then, is whether on observing flagella we should believe in unguided evolution, guided evolution, or neither.

The problem is analogous to what we should believe about a second coin toss if the first coin we toss turns up Heads 50 times in a row. Should we think the result is random, so the second coin is as likely as the first? Or should we think that someone who likes Heads has rigged the coin toss?

II. Fisherian Hypothesis Testing

[1] The term "intelligent design" does admit of a third theory: creationism. Creationism is the theory that while evolution occurs, its importance is trivial, because God created species directly, either in six days or over some longer period of time. Creationism differs logically from guided evolution in that creationism must explain away the large amount of evidence that supports evolution.

(1) How do we do a classical (or frequentist) test here?

Null: Randomness, according to some distribution.

Alternative: Non-Random,

Test: Are the parameters in confidence region R?

(2) A simple example Let possible values of X be in 0,1,2,...1000. Only $X = 1,000$ permits life.

Null: Randomness, X is U(0,1000).

Alternative: Non Random, X =1000 with probability 1.

Test: Reject if X is in R=[951,1000].

Probability(mistaken rejection) = 5%.

Probability(mistaken nonrejection if the Alternative is true) =0. (This test has very high– maximal– power.)

(3) Or, make Nonrandomness the Null.

Null: Nonrandomness, X =1000 with probability 1.

Alternative: Randomness, X is U(0,1000).

Test: Reject if X is in R=[0,999].

Probability(mistaken rejection) = 0%.

Probability(mistaken nonrejection if the Alternative is true) =1%. (This test has very high power too.)

(4) Now, condition on anyone being around to make the tests. The probability of mistaken rejection falls to 0 for both tests, and the probability of mistaken nonrejection rises to 1–minimal power.

This is a tricky argument, though. It has broad application. Here is one that might or might not be true in its premises, but which would work for other examples if not this one: Einstein's theory of general relativity. If it is true, that would lead Einstein to come up with the theory, and suggest a test, and the test would verify it. If it is false, then Einstein would not come up with the theory, so the test would not be performed. So does the test tell us anything?

(5) Suppose we don't do that existence-conditioning, though, and

reject randomness (or accept Nonrandomness). For the significance level of the test, we don't need to specify an alternative hypothesis. We just reject the Null and that's that. But "it takes a theory to kill a theory". We want to be able to Accept something, not just Reject something or fail to rejection something. We are talking about two particular theories, and we want to actually choose one. We need decision theory, which means we need Bayesian analysis.

III. Bayesian Decision Making

Randomness is not really a theory, but it is very attractive as a null anyway, and should be, since it is simple. Now let the two possible theories be

Theory 1, Chance: Randomness, X is U(0,1000).

Theory 2, Intelligent Design: Nonrandomness, X = 1000, because there is a God and He wished to create a world.

Which theory is more probable, given the data we observe? That depends on our prior that Intelligent Design is true, which we will denote by P. Bayes' Rule says:

Probability (Intelligent Designis true given X=1000) = Probability(X=1000 given Intelligent Design is true)* Probability (Intelligent Design is true)/Probability(X=1000)

Probability(Intelligent Design is true given X=1000) = (1)*P/[(1*P + .001*(1-P)]= P/[.999P+.001]

P= .5 if .5 =P/[.999P+.001], true if .4985P+ .0005 = P, true if .0005=.5015P, true if P = 00025075.

Thus, if your prior, the probability there is a God and He wished to create a world, is greater than .025075 percent, then you would Accept Intelligent Design after seeing that X=1000.

(6) There is a flaw in that reasoning. I assumed that there were only two theories. For the case of the special values of constants in physics, there is a third theory:

Theory 3, New Law: Nonrandomness, X = 1000, because of an underlying law of physics that we just haven't figured out yet, which would unify all the other laws.

For many scientists, I expect there is a higher prior on New Law than on Intelligent Design, which means it would have a higher posterior, and

New Law is what they would believe in the end. We don't prove Intelligent Design.

If, however, you are a scientist who believes in God already, for whatever reason, then Intelligent Design should be a very appealing theory, since you believe it introduces no new forces into the world. It makes no sense to leave your beliefs out of your theorizing. If you think it does, then I would say you do not really believe in God; you merely like to think you believe in Him, but drop the pretence when it comes to acting on the belief.

Even with the New Law theory, all this is bad news for most people who oppose Intelligent Design, because most of them seem to hold to the Chance theory, which we have rejected. New Law has very different implications. Chance implies that we should shrug our shoulders at seeing the coincidences in the constants of physics. New Law implies that we should eagerly think about those coincidences, and there is a Nobel Prize to to be won.

People who reject the kind of reasoning I've presented are unlikely to win Nobel Prizes.

One of the best-known stories in the history of scientific thought illustrates this. The Michaelsen-Morley experiment. Newtonian physics had a problem. What should one conclude? First, it was clear that Newtonian physics worked in most situations. The problem could be restricted to marginal areas. Scientists could reject the experimental results, or believe that some new theory would be discovered that would be superior to the Newtonian, or just stick with the Newtonian despite its poor fit with the facts. Intelligent design, by the way, was not a good option, which shows that it is not an all-purpose fix. The Newtonian system was just what one would expect of an intelligent designer; relativity and quantum mechanics are far less elegant. "God does not play with dice," Einstein said. The new theory is unappealing aesthetically, but, alas, it works far better than its elegant predecessor.

Perhaps another example would be the Copernican theory versus the Ptolemaic. Given the state of theory and observation at the time of Copernicus, the superiority of his theory was by no means obvious. His theory was wrong, in fact. He was correct that the Earth goes around the Sun, but wrong in thinking that its orbit was circular, not elliptical (which Brahe (?) discovered later). Thus, Copernicus required "fudges" in his theory too, no more elegant than the Ptolemaic epicycles.

(7) Intelligent Design as applied to Evolution is different. There, the coincidences become coincidental mutations. What matters about that is that our prior on New Law falls drastically. From history, we know that

anomalies in physics often are resolved by new laws; a single new law has often explained a puzzling observation. . Here we have just one more puzzling observation. In biology, though, everyone thinks of mutations as random, unconnected over time. We have not just one anomaly, like the constants being linked, but many anomalies, in the many creatures whose evolution is hard to explain. Thus, New Law isn't as attractive if we reject Chance.

Perhaps a theory is attractive if it is refutable— but not if it is refuted.

But refutability is a peculiar desideratum. What *do* you do if your theory is refuted? It takes a theory to kill a theory. Or does it?

I use myself as an example, not an authority, when I say what my priors are.

It is crucial to keep in mind that priors are not arbitrary, and their validity can be debated. To be sure, we ordinarily accept that if I say, "The probability I have at least $30 with me now is 90%, because I think I remember having $10 yesterday and then putting $15 more in my wallet from the cash machine, plus I might have some extra bills in my jacket," prior to actually checking my wallet, then I really believe that the probability is 90%. Before we go on to the information consisting of what is in my wallet, though, you can still argue about my prior. You might say, "Eric, 10 plus 15 is 25, not 30," and I would change my prior. Or you might say, "Eric, don't forget that you spent $16 on a book this morning," and I would change my prior. The prior belief is a modelling assumption, which means it is taken as exogenous for the analysis of the particular problem of how specific new information is incorporated into my beliefs. Behind that little model is the meta-problem of how I arrived at that prior. We do not have to solve that meta-problem, however, to figure out how I should go from my existing prior to my posterior on account of the specific new item of information.

Richard Dawkins says on page 5 of ¡I¿The Blind Watchmaker¡/I¿,

> ...one thing I shall not do is belittle the wonder of the living 'watches' that so inspired Paley. On the contrary, I shall try to illustrate my feeling that here Paley could have gone even further. When it comes to feeling awe over living 'watches' I yield to nobody. I feel more in common with the Reverend William Paley than I do with the distinguished modern philosopher, a well-known atheist, with whom I once discussed the matter at dinner. I said that I could not imagine being an atheist at any time before 1859, when Darwin's *Origin of Species*was published.

IV. Dembski and Sobel

V. Other Gap Theories

"7 World Trade Center: The Mysterious Leveling of Building 7" (http://911research.wtc7.net/wtc/analysis/wtc7/index.html) is an example of a gap theory that is not plausible.

VI. Conclusion

Suppose there is a gap in a theory. Standard subtheory X does not work. One response is to adopt Subtheory Y, Another is to admit that there is a gap, and say that one has no subtheory for it, but one expects a subtheory to arise later. Subtheory X is random mutation. Subtheory Y is intelligent design.

Hypothesis testing has to do with whether SubTheory X works. Bayesian learning has to with whether one is satisifed with SubTheory Y.

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