Does Bayesianism Provide a Satisfactory Account of Confirmation?

Introduction

A characteristic feature of human beings is that we believe a lot of things. Presumably, these beliefs are all based on some sort of evidence – some reason for why we think it is so. But how exactly should one go from a piece of evidence to forming a belief based on it? This is important to understand, because only with an understanding of this can we figure out what conclusions we can reach based on our evidence. One might think that by the development of deductive logic we have already achieved an understanding of this process. Yet, as David Hume was one of the first to illuminate, in most real-life cases we cannot rely on deductive logic to form our beliefs. This is because our evidence rarely implies just one conclusion. Instead we usually have many different conclusions that are all logically compatible with the evidence. While some conclusions may be more probable than others, there is rarely a direct implication from our evidence to a conclusion so we cannot use deductive logic to form our beliefs.

This insight has led to the development *confirmation theory*, in which the main goal is to define models for non-deductive reasoning. One of the most popular of such theories is the Bayesian confirmation theory. To accommodate for the fact that we cannot always use deductive logic to become certain of a belief, Bayesians deal with beliefs in terms of probabilities. In this essay I will argue that the Bayesian approach does not provide a satisfactory account of confirmation because there is no reliable way we can assign our initial beliefs with accurate probabilities. I have the divided the essay into the following four parts:

1. What a satisfactory account of confirmation must provide.
2. Introduction to Bayesian confirmation theory.
3. The problem of the priors and how it restricts Bayesian confirmation theory from providing a satisfactory account of confirmation.
4. Discussion of possible solutions to the problem of the priors and why I think they don't work.

What Must a Satisfactory Account of Confirmation provide?

I stated in the introduction that the goal of confirmation theory is to define a model for non-deductive reasoning. Ideally, we want this model to work for reasoning in any type of situation, but in practice we are particularly interested in how it relates to scientific reasoning. The reason for this is that modern science seems to be uniquely effective in using observed evidence to establish general theories that we have a high degree of belief in. I will therefore assume in this essay that he most important goal for a confirmation theory is to provide an account of the principles that guide scientific argument. Keeping this in mind, I will move on to explain the fundamentals of Bayesian confirmation theory.

Bayesian Confirmation Theory

The core idea of Bayesian confirmation theory is that a scientist's beliefs are measured by a probability measure and that these beliefs as a whole must adhere to a set of probability axioms. New evidence is incorporated by Bayes' theorem in a process called conditionalization. The simple principle of conditionalization is expressed as follows:

$P(H)_f = P_i(H|E)$

Put into words, the final probability of a hypothesis H equals the initial probability of H given the initial probability of a piece of evidence E. This can be calculated using Bayes theorem:

$P_i(H|E) = P_i(E|H) \times P_i(H) / P_i(E)$

Where the term $P_i(E|H)$ is called the *likelihood* and is often given by the hypothesis H itself. It can be thought of as the probability predicted by our hypothesis that we will observe some evidence. If our hypothesis H gives a low probability that we will observe the evidence confirming it, then we will have a low degree of belief in the hypothesis. However, this can be offset if the initial probability of observing the evidence E is also very low.

A slightly more sophisticated account of conditionalization is Jeffrey conditionalization. This is used when you not certain of the new evidence in question. This will not be further explained as it is not needed for the purpose of this discussion.

Finally, the way in which evidence E confirms a hypothesis H is if the prior probability of H given E is larger than the prior probability of H:

$P_i(H|E) > P_i(H)$

These are the basics of Bayesian confirmation theory. In summary:

1. Beliefs are measured by probability measures which must obey the probability axioms.
2. Beliefs are updated by conditionalization.
3. Evidence confirms a hypothesis if the probability of the conditionalized hypothesis is larger than the initial probability of the hypothesis.

Before moving onto the weaknesses of Bayesian confirmation theory, I will mention what I think is its main strength. This is its simplicity and elegance. Using three simple rules Bayesians have created a probability calculus that is well defined and can be used for virtually any situation involving forming beliefs based on evidence. The rules are intuitive, relatively easy to use and seem prima facie to be able to accurately account for principles that guide scientific reasoning. So, what is the problem?

The Problem of the Priors

There are many objections that can be raised against Bayesian confirmation theory. Among these are whether or not our degrees of belief can accurately by represented by probabilities in the first place, whether or not it is only applicable to idealized agents and not actual people, and whether or not there are only certain kinds of evidence one can conditionalize upon. I think the Bayesian more or less can defend himself against all these objections and more, but there is a final obstacle I do not think can be overcome: the problem of the priors. I will illustrate this by way of example.

Let us say you have two statements, H and E:

H = "All ravens are black."

E = "I find a black raven."

You assign H a probability of $P_i(H) = 0.8$ and E a probability of $P_i(E) = 0.5$. The question is, what probability do you assign to $P_i(H\&E)$? If you believe that finding a black raven has no bearing on whether or not all ravens are black, then you can treat H and E as independent events and $P_i(H\&E) = P_i(H) * P_i(E) = 0.4$. However, if you believe in the so-called *uniformity of nature,* then finding a black raven slightly confirms your hypothesis that all ravens are black. In this case, there is a relation between H and E, and you would assign $P_i(H\&E)$ a higher probability than 0.4 - perhaps 0.45.

In the case where H and E are independent $P_f(H) = P_i(H|E) = P_i(H\&E) / P_i(E) = 0.4 / 0.5 = 0.8 = P_i(H)$. So, in this case the evidence does not confirm the hypothesis.

In the case where H and E are dependent $P_f(H) = P_i(H|E) = 0.45 / 0.5 = 0.9 > P_i(H)$. In this case the evidence **does** confirm the hypothesis. Therefore, simply by changing our belief in the uniformity of nature we can change a situation in which the evidence does confirm the hypothesis to a situation where it doesn't.

This is a problem because Bayesian confirmation theory does not tell us which of two sets of prior beliefs is correct - It does not tell whether we should believe in the uniformity of nature or shouldn't. In fact, a sub-group of Bayesians called subjective Bayesians believe there are no constraints one can put on prior beliefs whatsoever. So, in assigning probabilities to prior beliefs you can choose whatever values you like. However, as seen above, this leads to the same evidence having different effects on the same hypothesis of people with different prior beliefs.

To combat this, objective Bayesians have tried to define criteria with which prior beliefs must comply. One such criteria might be assuming the uniformity of nature. However, these types of criteria run into problems of their own, as described below.

Let us say we are an objective Bayesian and we want to find some criteria for prior beliefs. Should the uniformity of nature be one of them? In other words, does finding one black raven help confirm that all ravens are black? This is actually a well-known problem called the problem of induction, where induction means using particular instances to infer a general law. The problem is that we can only prove the problem of induction by using induction itself. In this case, we can only say that we believe in the uniformity of nature because nature has always been uniform in the past. However, in the same way that just because all ravens so far have been black doesn't mean all ravens are black, just because nature has been uniform in the past doesn't mean nature will be uniform in the future. The problem is that the only way to argue for the uniformity of nature is by using the uniformity of nature.

And this problem will arise no matter what criterion we choose. Remember, a criterion will determine what probability we assign prior beliefs. But this raises the question: what probability do we assign the criterion itself? The criterion is what enables us to assign probabilities, so in assigning a probability to our criterion we are already using the criterion. If we are already using the criterion, then we are assuming it has a probability of more than ½, but this might not be the case. We see that we run into the same problem as the with the problem of induction. Because of the inherent circle argumentation there is no way we can use any criterion with confidence. If we do insist on using a criterion, it must be taken on faith.

However, if there is no criterion we can use, and thus no constraints on prior beliefs, then conditionalizing on these beliefs can lead to very strange results. I have already that shown whether or not you believe in the uniformity of nature can make a difference in whether or not a piece of evidence confirms your theory. But we can come up with much stranger results than this. Let us say:

$P_i(H)$ = "God exists" = 0.5

$P_i(E)$ = "I will get a girlfriend today" = 0.1

$P_i(H\&E)$ = "God exists, and I will get a girlfriend today" = 0.099

These are prior probabilities that we set however we like. What happens if I happen to get a girlfriend today? Well, I will have to reassess my belief in that God exists to $P_f(H) = P_i(H|E) = P_i(H\&E) / P_i(E) = 0.99$. So, based on the simple piece of evidence that I got a girlfriend, I go from being agnostic to having a 99% belief in God.

The reason why this happens is that in my prior beliefs I have assumed a connection between God existing and me getting a girlfriend which does not exist. But with no constraints on prior beliefs, there is nothing stopping me from making this connection. It is also plausible that, in practice, a lot of people believe do believe that there are connections between things where there is no real connection. This makes the concern well-grounded.

In summary, the Bayesian cannot use a criterion for prior beliefs because his justification of the criterion involves using the criterion itself. At the same time, not using a criterion for prior beliefs can potentially lead to ridiculous posterior beliefs. Either way, it seems the Bayesian is doomed to fail.

Possible Remedies to the Problem of the Priors – and Why They are Not Sufficient

Is there anything the Bayesian can say in defence to this significant problem of the priors? Yes, there is. Especially the idea of the *Washing Out of Priors* has been frequently discussed in Bayesian literature. Proponents of this idea argue there is nothing wrong with people having completely different prior beliefs. In fact, this is exactly how science works in real life; scientists start out with very different beliefs but based on conditionalization over a bunch of evidence, a consensus of beliefs emerges over time. These Bayesians argue that it is the difference in prior beliefs that gives science its credibility in the first place – if everyone already agreed, conditionalization over time would yield nothing!

The claim is that in the long-term priors will be washed out and whatever priors agents started our with will be insignificant. Fortunately for the Bayesian, this claim is not just based on hope but on hard mathematical results. These results show that as long as agents are *equally dogmatic* and conditionalize on the same evidence, their beliefs will converge in the limit. Here, equally dogmatic simply means that agents must agree on beliefs they assign probability 0 - for any other belief they can assign whatever probability they like.

Enthusiastic Bayesians will say this is exactly in accord with the principles that guide scientific reasoning. Scientists can start out with different beliefs, but after some time they will converge so that the priors are insignificant. Scientists being equally dogmatic also seems reasonable because we can assume a community of scientists will not assign anything probability 0 before having any evidence.

However, there is one big problem with this account: Without a measure of the original spread of priors, there is no way to know how quickly these priors will converge. So, while one might think that scientists by now have been exposed to enough of the same evidence for their beliefs to converge, there is no real way to know that. Another problem that can be raised is what it means for scientists to exposed to the same evidence – for example, in practice one might think that scientists will interpret the same piece of evidence differently. In any case, the consequence is that even if priors do converge, we have no real way of knowing where in the convergence process science is or should be at right now. Are we in the limit, or have we just started?

As long as we do not have a satisfactory answer to this, I conclude that Bayesian Confirmation Theory is not useful enough for us to call it a satisfactory account of confirmation. While the theory **might** be able to tell us something about the long-term development in science, it can tell us little about what bearing a specific piece of new evidence should have on our current hypothesises, because we do not know where in the convergence process we are right now. I think this is too big of a flaw for Bayesian Confirmation Theory to be considered a successful theory of confirmation.