

## 19.3: Why Be a Bayesian?

Up to this point I've focused exclusively on the logic underpinning Bayesian statistics. We've talked about the idea of "probability as a degree of belief", and what it implies about how a rational agent should reason about the world. The question that you have to answer for yourself is this: how do *you* want to do your statistics? Do you want to be an orthodox statistician, relying on sampling distributions and p-values to guide your decisions? Or do you want to be a Bayesian, relying on Bayes factors and the rules for rational belief revision? And to be perfectly honest, I can't answer this question for you. Ultimately it depends on what you think is right. It's your call, and your call alone. That being said, I can talk a little about why *I* prefer the Bayesian approach.

### 19.3.1 Statistics that mean what you think they mean

*You keep using that word. I do not think it means what you think it means*  
– Inigo Montoya, *The Princess Bride*<sup>260</sup>

To me, one of the biggest advantages to the Bayesian approach is that it answers the right questions. Within the Bayesian framework, it is perfectly sensible and allowable to refer to "the probability that a hypothesis is true". You can even try to calculate this probability. Ultimately, isn't that what you *want* your statistical tests to tell you? To an actual human being, this would seem to be the whole *point* of doing statistics: to determine what is true and what isn't. Any time that you aren't exactly sure about what the truth is, you should use the language of probability theory to say things like "there is an 80% chance that Theory A is true, but a 20% chance that Theory B is true instead".

This seems so obvious to a human, yet it is explicitly forbidden within the orthodox framework. To a frequentist, such statements are a nonsense because "the theory is true" is not a repeatable event. A theory is true or it is not, and no probabilistic statements are allowed, no matter how much you might want to make them. There's a reason why, back in Section 11.5, I repeatedly warned you *not* to interpret the p-value as the probability of that the null hypothesis is true. There's a reason why almost every textbook on statistics is forced to repeat that warning. It's because people desperately *want* that to be the correct interpretation. Frequentist dogma notwithstanding, a lifetime of experience of teaching undergraduates and of doing data analysis on a daily basis suggests to me that most actual humans thing that "the probability that the hypothesis is true" is not only meaningful, it's the thing we care *most* about. It's such an appealing idea that even trained statisticians fall prey to the mistake of trying to interpret a p-value this way. For example, here is a quote from an official Newspoll report in 2013, explaining how to interpret their (frequentist) data analysis:<sup>261</sup>

*Throughout the report, where relevant, statistically significant changes have been noted. All significance tests have been based on the 95 percent level of confidence. **This means that if a change is noted as being statistically significant, there is a 95 percent probability that a real change has occurred, and is not simply due to chance variation.** (emphasis added)*

Nope! That's *not* what  $p < .05$  means. That's *not* what 95% confidence means to a frequentist statistician. The bolded section is just plain wrong. Orthodox methods cannot tell you that "there is a 95% chance that a real change has occurred", because this is not the kind of event to which frequentist probabilities may be assigned. To an ideological frequentist, this sentence should be meaningless. Even if you're a more pragmatic frequentist, it's still the wrong definition of a p-value. It is simply not an allowed or correct thing to say if you want to rely on orthodox statistical tools.

On the other hand, let's suppose you are a Bayesian. Although the bolded passage is the wrong definition of a p-value, it's pretty much exactly what a Bayesian means when they say that the posterior probability of the alternative hypothesis is greater than 95%. And here's the thing. If the Bayesian posterior is actually thing you *want* to report, why are you even trying to use orthodox methods? If you want to make Bayesian claims, all you have to do is be a Bayesian and use Bayesian tools.

Speaking for myself, I found this to be the most liberating thing about switching to the Bayesian view. Once you've made the jump, you no longer have to wrap your head around counterintuitive definitions of p-values. You don't have to bother remembering why you can't say that you're 95% confident that the true mean lies within some interval. All you have to do is be honest about what you believed before you ran the study, and then report what you learned from doing it. Sounds nice, doesn't it? To me, this is the big promise of the Bayesian approach: you do the analysis you really want to do, and express what you really believe the data are telling you.

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