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Topic: Unit 2 Foundation of Inference:Lecture 6: Introduction to Hypothesis Testing, and Type 1 and Type 2 Errors / 9. Example: Is this Coin Fair?

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Conclusion at end of video

discussion posted 3 months ago by **mrBB** (Community TA)

At the end of the video we're presented the conclusion "It is unlikely that the coin is unfair." The professor contrast that with "The coin is likely to be fair." To me these mean exactly the same, and I think we can't conclude neither of these. I think the conclusion should actually have been "It is *not* unlikely that the coin is fair." Would the logicians among us agree?

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4 responses

karenechu (Staff)
3 months ago

You're totally right! and none of us caught it. (May the students in class did but just didn't say anything.) I am adding a note. Thanks a lot MrBB.

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SergK (Community TA)
3 months ago

There is no such thing as a fair coin, but a particular test may not detect that a coin is unfair. This is confusing at this point, but the later videos make clear what is meant. The hypotheses "the coin is fair" and "the coin is unfair" are not symmetric, the first is null hypothesis, the second is alternative hypothesis. The purpose of test is to reject the null hypothesis, and it is quite possible that the test can't do it; then we say "it is unlikely that the coin is unfair", using natural language. This statement makes clear sense in context of hypotheses testing, while the statements "it is likely that the coin is fair" or "it is not unlikely that the coin is fair" do not, IMO.

I agree with everything you say, Serg, up to "then we say ...". Perhaps this is a language thingy, but to me "it is unlikely that the coin is unfair" is a *strong* statement saying it is unlikely H_1 is true, and by $\neg H_1 \implies H_0$, therefore that it is likely that H_0 is true (again strong statement).

On the other hand "it is not unlikely that the coin is fair" to me is a *weak* statement, only saying that H_0 is not unlikely ($\neq$ likely) and therefore can't be rejected. And it is exactly this weak conclusion that we want to express IMO.

posted 3 months ago by **mrBB** (Community TA)

@mrBB, I can't agree with your logic. H_0 is the "status quo" and if the data is not against it then it is against the alternative hypothesis.
So, it makes sense when rejecting H_1 to say that "It is unlikely that ... *whatever the alternative hypothesis is*".

posted 3 months ago by **KRKirov**

That's just not how hypothesis testing works. We don't reject H_1, but we accept or reject H_0. Rejecting H_0 is only done when we have strong evidence that H_0 is unlikely given the data. Accepting H_0 is the default and is a weak statement. It only means that we have not enough evidence to reject H_0. This doesn't imply the data provides strong evidence H_0 is true (or equivalently that $H_1 is false).

posted 3 months ago by **mrBB** (Community TA)

@mrBB, H_0 is the status quo, if the data is not against it it doesn't make sense to say that the status quo is likely. I think SergK's answer above encapsulates the matter very well and am bewildered by the correction note at the top of this page.

posted 3 months ago by **KRKirov**

"if the data is not against it it doesn't make sense to say that the status quo is likely"

I don't understand. Is this really what you intended to write?

We are talking about the evidence that the hypothesis test provides. That we might have established H_0 firmly previously is not relevant. Moreover, H_0 doesn't have to be firmly established status quo. I.e. when we test a new medicine and the null hypothesis is that the new medicine doesn't work better than a placebo, we can hardly call that "status quo". In any case, if we would reject H_0 that means we have strong evidence that the medicine works better. If don't reject H_0 that does *not* mean we have strong evidence that the new medicine doesn't work better. Stating that "it is unlikely that the new medicine works better" would then be a too strong statement. We have only established with the test that is isn't unlikely that the new medicine doesn't work better.

Also see the lecture example on "not guilty" $\neq$ "innocent" .

posted 3 months ago by **mrBB** (Community TA)

@mrBB, yep this is exactly what I meant to say. So, here is an example: H_0 : "It is 2019." H_1 : "It is not 2019. " (ignore the fact that H_0 is true). I start looking for evidence that it is not 2019. I look at the bottom of my computer screen - it says that today is 05/04/2019. I buy a newspaper and it is dated 05/04/2019. I read an article and it says "In 2018, there was a record number of ...". In, another article I read: "By 2020, the government is supposed to ...". And so on ... In the end, I can't find evidence that it is not 2019, so I can't reject H_0. Then my conclusion is: "It is unlikely that it is not 2019.". My conclusion should not be: "It is likely it is 2019.". Why? Because my H_0 from the very start has been that "It is 2019".

posted 2 months ago by **KRKirov**

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Ron_is_learning
3 months ago

I think the wording in the "correction" now posted at the top of the page as an intro to the video is actually wrong. (a "not" was missed in MrBB's wording)

That said, the "not unlikely", is, at least for me, a little mental manipulation because it sounds like a double negative, which feels like it should imply "likely".

Perhaps it's easier just to say, "there is insufficient evidence to conclude that the coin is unfair".

I just reread and realized it's definitely wrong.

posted 3 months ago by **karenechu** (Staff)

@Ron "Not unlikely" and "likely" to me have very different connotations. When I say "A is likely" I mean $P(A) > 80\%$ (the actual number is not important of course, but only that it is fairly close to 1): I have quite some confidence A actually is the case. When I say "A is unlikely" I mean $P(A) < 20\%$ (I'm quite sure A is *not* the case). Therefore when I say "A is not unlikely" it to me means $P(A) \not< 20\%$ or equivalently $P(A) > 20\%$ (A might be the case but I'm not sure whatsoever).

posted 3 months ago by **mrBB** (Community TA)

@mrBB. Sure, you can use the formal logic route. But if my only option are "likely" and "unlikely", then I would infer "likely" as more often than not, or p > 50%. And unlikely as p < 50%. Because I am not assuming just how likely, that likely has to be... just along the lines of a civil case: more likely than not. So if it's "not unlikly" than it is almost surely "likely" UNLESS it is equally likely: 50/50, but... the probability of any exact number is zero on our continuous p. Hahaha. So equally likely effectively doesn't exist.

All of that aside, my comment was more along the lines of everyday language usage and how people "hear it" to understand what is intended, versus if anybody is going to bother breaking out truth tables to parse sentences as a general habit. ;)

posted 3 months ago by **Ron_is_learning**

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ptressel
3 months ago

Perhaps the correction note has been changed...but here's what it reads currently:

"**It is not unlikely that the coin is fair.**"

Here is the hand-written statement on the slide for "Example 2":

"**It is unlikely that the coin is unfair.**"

These have identical logical meaning (and, IMO, even the same connotation, and very close to the same valence) in English. The correction appears unnecessary. Just apply negation to both terms "likely" and "fair" in the first statement, and you'll get the second.

To be pedantic 😒 let's use "not" for all negations so that unlikely becomes not likely, unfair becomes not fair. Start with the first form:

not not likely that coin is fair

Apply negation to both terms:

not not not likely that coin is not fair

not not is the identity (i.e. $\neg\neg A \equiv A$) so remove the double not:

not likely that coin is not fair

For speakers of languages that have double negation (which is very common), just treat an English statement containing negation as though it were formal logic -- each negation applied to the same object flips the sense.

I like how Ron_is_learning says it: "There is insufficient evidence to conclude that the coin is unfair".

What we'll likely soon learn to say is that we "fail to reject the null hypothesis". 😁

"not unlikely" to me has a very different connotation than "likely". These two would only be equal if everything is either likely or unlikely. But many things are neither. As I mentioned somewhere above, to me "likely" means that my measure of belief is $> 80\%$. And when my measure of belief is $< 20\%$ I deem something unlikely. Everything in between for me is neither likely nor unlikely. So to me "not unlikely" means that it can fall in either of the categories "likely" or "neither likely nor unlikely".

Do you really feel "it is not unlikely I will visit Paris this year" and "it is likely I will visit Paris this year" express the same level of certainty about visiting Paris later this year?

posted 3 months ago by **mrBB** (Community TA)

I am wondering how a linguist does statistics.

posted 3 months ago by **dxander**

Coming back to this linguistics discussion very late... mrBB, yes, "not unlikely" has a very strong positive valence -- it's not weak sauce, not hesitant. And "not at all unlikely" is much stronger still. "It's not unlikely that I'll visit Paris this year" does actually connote a strong likelihood of doing so. And to add emphasis, one would say, "It's not *at all* unlikely...". "It is likely..." is actually more hesitant. Body language and intonation can provide additional alteration to the valence and strength. Imagine a person saying "It is likely..." while scrunching up their nose, narrowing their eyes, and drawing out the "i" in "likely". That turns it into a "maaaaybe". Now imagine them saying "It's not unlikely..." with a bit of head bobbing, and eye widening, maybe raised eyebrows, wink. Yup yup yup, gonna do it. (I'm not making this up! Really truly!)

posted 2 months ago by **ptressel**

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