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P-value is not the same as the probabilty of type 1 error, why??

question posted 4 days ago by sakimarquis

I argue that alpha is the **maximum** of the probabilty of type 1 error before you perform your test, and p-value is the **actual** probabilty of type 1 error in this test.

此帖对所有人可见。

SergK (Community TA)
4 days ago - 4 days ago 前被 sakimarquis 标记为答案

$\alpha\left(\theta\right)$ is probability of type 1 error **given** unknown parameter have value θ. **Given** does not mean conditional probability, because we do not consider unknown parameter as random variable here; α is maximal value of $\alpha\left(\theta\right)$ obtained at some θ^*:

$$\alpha = \max \alpha\left(\theta\right) = \alpha\left(\theta^*\right)$$

I don't understand what you mean by *before you perform your test*; it is just maximal probability of type 1 error. If you repeat your test infinitely many times, the frequency of type 1 errors will be at most α, so α is indeed a probability in frequentist sense.

p-value is not a probability in frequentist sense because it depends on a particular observation; it is just a value in interval $[0,1]$. If p-value of an observation is less than or equal to α, we reject null hypothesis; otherwise we fail to reject.

@SergK Thanks a lot, i've been confused by this question for many years.

Can you explain more on "given does not mean conditional probability"?

And, i don't understand why p-value is not a probability .I considered that p-value is probability i can't repeat the same result if i repeat the test infinite times.

sakimarquis 在4 days ago前发表

W.r.t. to your last paragraph. It seems quite natural to interpret/define the p—value as a probability. The p in p-value even stands for "probability", if I'm not mistaken. I.e. it is the probability, assuming the null hypothesis is true, to observe an outcome that is greater than or equal to the actual outcome of the experiment. Frequentist interpretation: if the outcome of my experiment has p-value a, then I would expect, assuming that the null hypothesis is true and if I would repeat the same experiment another n times, to see na outcomes that are greater than or equal to the outcome of the original experiment.

mrBB (Community TA) 在4 days ago前发表

I don't think you can define a probability, in frequentist sense, "assuming null hypothesis is true", you can define only probabilities "assuming true value of θ is equal to (something)". IMHO. Or else you can go Bayesian and think that θ is a random variable, but right away I don't want to go Bayesian.

"given does not mean conditional probability" because we can't condition on a constant unknown parameter. Better to say "assuming" instead of "given", to avoid misleading associations with conditional probabilities, my fault.

PS: if null hypothesis is a single parameter value, you can define a probability "assuming null hypothesis is true"; but not generally, IMHO.

SergK (Community TA) 在3 days ago前发表

I get your point. Still, if the null hypothesis is not a single point, the p-value would be the supremum over a range of probabilities, i.e. $\sup_{\theta\in\Theta_0} \mathbb{P}_\theta\left(T_n > x\right)$.

mrBB (Community TA) 在3 days ago前发表

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"p-value is not a probability in frequentist sense because it depends on a particular observation"
"I don't think you can define a probability, in frequentist sense, "assuming null hypothesis is true", you can define only probabilities "assuming true value θ of is equal to (something)""

I would disagree.

"The (asymptotic) p-value of a test ψ_α is the smallest (asymptotic) level α at which ψ_α rejects H_0. It is random, it depends on the sample."

It is a function of the test and therefore r.v. even in a frequentist sence and its *realization* depends on *realization* of the test (aka sample).

Mark_B2 在3 days ago前发表

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