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HYPOTHESIS TESTING

Likelihood vs. Probability: What's the Difference?

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likelihood and **probability**.

In contexts where numbers are not important, we can also talk about the likelihood of something happening.

Likelihood is used to talk in very general terms about whether there is a chance that something will happen or not.

Example:-

The treaty increases the likelihood that the cease-fire will hold.

There's every likelihood that he'll graduate university exam on time.

There's very little likelihood that the publisher will publish your book.

On the other hand,

Probability is , like chance, used to describe the level of how likely it is that something will happen.

Examples: -

What is the probability of winning a game?

What is the probability that result is distinction?

Here's the difference in a nutshell:

- **Probability** refers to the chance that a particular outcome occurs based on the values of parameters in a model.
- **Likelihood** refers to how well a sample provides support for particular values of a parameter in a model.

When calculating the probability of some outcome, we assume the parameters in a model are trustworthy.

However, when we calculate likelihood we're trying to determine if we can trust the parameters in a model based on the sample data that we've observed.

Example 1. Likelihood vs. Probability in Gambling

Suppose a casino claims that the probability of winning money on a certain slot machine is 40% for each turn.

If we take one turn , the **probability** that we will win money is 0.40.

Now suppose we take 100 turns and we win 42 times. We would conclude that the **likelihood** that the probability of winning in 40% of turns seems to be fair.

When calculating the probability of winning on a given turn, we simply assume that P(winning) =0.40 on a given turn.

However, when calculating the likelihood, we're trying to determine if the model parameter P(winning) = 0.40 is actually correctly specified or Not.

In the example above, winning 42 times out of 100 makes us believe that a probability of winning 40% of the time seems reasonable.

Example 2: Likelihood vs. Probability in Coin Tosses

Suppose we have a coin that is assumed to be fair. If we flip the coin one time, the **probability** that it will land on heads is 0.5.

Now suppose we flip the coin 100 times and it only lands on heads 17 times. We would say that the **likelihood** that the coin is fair is quite low. If the coin was actually fair, we would expect it to land on heads much more often.

When calculating the probability of a coin landing on heads, we simply assume that P(heads) = 0.5 on a given toss.

However, when calculating the likelihood, we're trying to determine if the model parameter (p = 0.5) is actually correctly specified or Not.

Hypothesis: -

P value is the prob of faliure.

Hypothesis Tests -→statistical analysis.

Hypothesis Testing is a **form of inferential statistics that allows us to draw conclusions about an entire population based on a representative sample**

In most cases, it is simply impossible to observe the entire population to understand its properties. The only alternative is to collect a random sample and then use statistics to analyze it

Suppose we toss a coin 10 times and we get 8 tails. Now we can start wondering whether the coin is fair.

So the question becomes, is getting 8 tails sufficient evidence to conclude that the coin is biased?

This is a question that's being addressed by what's called hypothesis tests.

some terminology: -

The null hypothesis which is sometimes written as H_0 null hypothesis says that nothing extraordinary is going on.

→Null hypothesis is the current situation whatever it is,
→Null hypothesis is not interested in change.

So that's a very generic description.

In the case of coin tossing, nothing extraordinary simply means that the coin is fair.

So in other words,

null hypothesis H_0 → probability of getting tails is a 0.5.

alternative hypothesis H_1 → probability of getting tails is not equal to 0.5

The purpose of Statistical hypothesis tests is to determine whether the null hypothesis is likely to be true given sample data.

If there is evidence against the null hypothesis given in the data, we might reject the null hypothesis in favor of the alternative hypothesis: that means something interesting is going on, some changes will be there.

Significance level: -

Once we have the null and alternative hypothesis in hand, we should have a significance level (often denoted by the Greek letter α.).

The significance level is a probability threshold that determines when we can reject the null hypothesis.

After carrying out a test, if the probability of getting a result as extreme as the one you observe due to chance is lower than the significance level, we reject the null hypothesis in favor of the alternative.

This probability is known as the p-value.

One medical example.

Suppose a company develops a new drug to lower blood pressure, then it tests the drug with an experiment that involves 1,000 patients.

Remember, the null hypothesis always means nothing extraordinary is going on.

In this case, nothing extraordinary means that the drug has no special effect.

So, our null hypothesis, → no change in the blood pressure of the patients,

whereas the alternative hypothesis → the blood pressure drop.

So, if you are a scientist in this company,

your goal actually is to reject the null Hypothesis.