The Brookbush Institute Publishes a NEW Glossary Term: 'P-value (Probability Value)'

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Excerpt from Glossary Term: P-value (Probability Value)
- Additional Glossary Term: Null Hypothesis
- Related Certification: Integrated Manual Therapist (IMT) Certification

P-Value - https://brookbushinstitute.com/glossary/p-value-probability-value
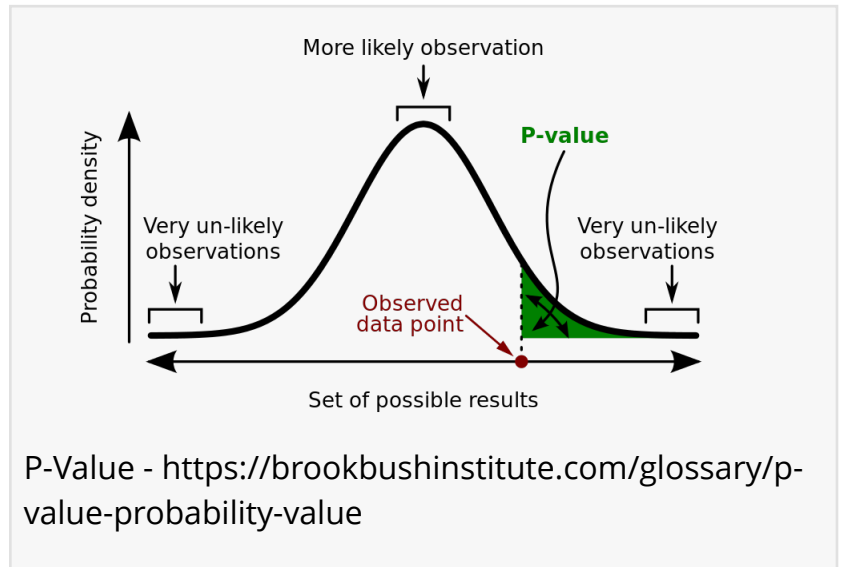
DEFINITION:
P-value (Probability Value): The p-value is a statistical measure used in research to help decide whether the results of a study are likely due to chance. More specifically, it represents the probability of observing results as extreme, or more extreme, than those found in the study, assuming the null hypothesis is true

> "P-values do not tell us whether the hypothesis is true; they tell us how surprising the observed data are if the null were true."
>
> *Dr. Brent Brookbush, CEO of Brookbush Institute*

Remember, the null hypothesis is the hypothesis of "no effect." A small or very small p-value (approaching 0.0) suggests that the observed results would be highly unlikely if the null hypothesis were true and there was truly no effect. A very small probability of no effect (typically less than 0.05) leads researchers to reject the null hypothesis.

INFORMAL DEFINITION: "The p-value is the degree to which the null (no effect) hypothesis is embarrassed by the data."

P-values are used in hypothesis testing to evaluate whether study results are statistically significant. A common threshold for significance is $p < 0.05$, meaning there is less than a 5% probability of observing the study's results, or more extreme results, assuming the null

hypothesis is true. In such cases, researchers may reject the null hypothesis and consider the findings statistically significant.

However, this does not mean there is a 5% chance the null hypothesis is true (this is a common misinterpretation). The p-value is a conditional probability: it tells us the likelihood of the observed data given that the null hypothesis is true, not the probability that the hypothesis itself is true.

For example, a p-value of 0.05 means that, if the null hypothesis were correct, we would expect to observe similar or more extreme results in roughly 5 out of every 100 repeated studies. This does not confirm an effect; however, it suggests that the results are unusual enough under the null hypothesis to warrant its rejection.

WHAT A P-VALUE IS NOT:
- Not the probability that the hypothesis is true or false
- Not a direct measure of the effect's size or importance
- Not a guarantee that the results are replicable
- Not a statement about clinical relevance

STATISTICAL SIGNIFICANCE
Rejecting the null hypothesis (e.g., $p < 0.05$) does not prove that a specific alternative hypothesis is correct, unless only one plausible alternative exists. It simply indicates that either:
- A real effect is present
- A rare event occurred under the assumption of no effect

APPLIED EXAMPLE
Statement from a study: "There were statistically significant differences between the intervention and control groups ($p < 0.05$)."
- Correct Interpretation: If we started with the assumption that no true difference exists, the chance of observing results this extreme, or more extreme, is less than 5%. That is, if the null (no effect) hypothesis were true, and the study were repeated 100 times, we would expect to see results like this fewer than 5 times in 100 repetitions.
- Poor Interpretation: "The intervention works and should be recommended for all cases."
- Better Interpretation: "Assuming no true effect, there is less than a 5% probability of observing results as extreme as those found in this study. Because this is considered an unlikely outcome, the null hypothesis is rejected. This suggests that an effect may have occurred under the conditions tested, but further research is needed to confirm the finding and assess its generalizability."

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