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Meaning of P-value

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INTRODUCTION

In medical and dental research, we are usually interested in understanding the real effect of two or more interventions (such as drugs or surgeries) on an outcome (such as signs and symptoms of a disease). To test such effects, we typically establish two hypotheses: the null hypothesis and the alternative hypothesis. In the null hypothesis, the researcher assumes that there is no difference between the two interventions on the outcome, while the alternative hypothesis assumes that a difference exists. We collect, clean, and analyze data using an appropriate statistical test. The test produces a p-value, which ranges from 0 to 1. The researcher sets a significance level (usually p = 0.05). A small p-value (typically = 0.05) suggests there is enough evidence to reject the null hypothesis in favor of the alternative hypothesis. Conversely, a larger p-value indicates a lack of evidence to reject the null hypothesis.[1-3]

Let's consider a hypothetical example in which we are assessing the effects of two drugs (A and B) on cholesterol levels (LDL) measured in mg/dL. In one trial, we included 300 patients, while in the other, we included 20 patients with hyperlipidemia. After three months of treatment with these drugs, we obtained the following results and analyzed (using an independent sample t-test).

Table 01. Comparison of two drugs on LDL level

Sample size per group	LDL level (mg/dl)		p-value
	Drug A	Drug B	
n=300	169.96 ± 22.87	164.91 ± 22.96	0.007
n=20	172.65 ± 30.88	177.00 ± 22.23	0.61

In the first scenario, a low p-value of 0.007 suggests that the likelihood of observing a 3-month difference in LDL levels between the two drugs, assuming no actual difference exists (H0 is true), is very low (7 in 1000). Consequently, this difference is unlikely to be attributed to chance alone; thus, we reject the null hypothesis (H0). In the second scenario, a high p-value of 0.61 indicates that the probability of observing a 3-month difference in LDL levels between the two drugs, assuming no actual difference exists (H0 is true), is rather high (about 61%). Therefore, we do not have enough evidence to reject the null hypothesis (H0) in this case, and we accept it.

The above example demonstrates that although the mean LDL levels in both scenarios are close to each other, the difference in sample sizes and standard deviation leads to a variation in the p-values.

Figure below shows that with increasing sample size using the p-value decreases.

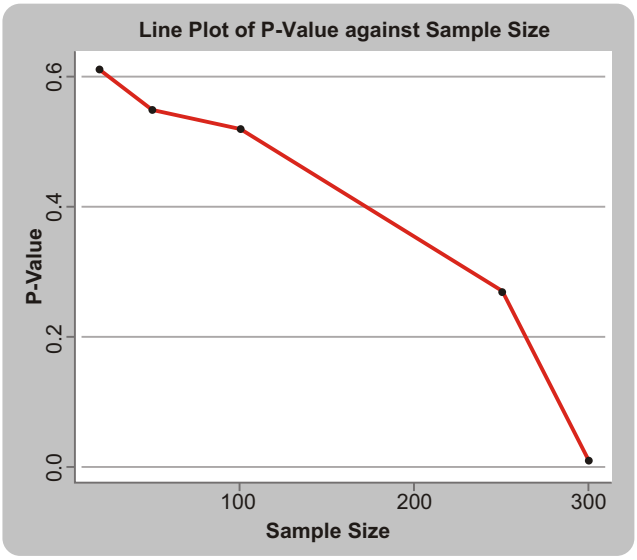


Fig 01. Relation of P-value with sample size

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