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Normal Distribution Assumptions

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Normal distribution assumptions are important to note because so many experiments rely on assuming a distribution to be normal. In most cases, the assumption of normality is a reasonable one to make.

However, there are important special scenarios when this is not the case. An understanding of the normal distribution assumptions will help researchers know the limitations of their experiment and also help them understand their own study and where it breaks down.

Normal distribution assumptions can be relaxed in some situations but it forms a more complex analysis. If the physical process can be approximated by a normal distribution, it will yield the simplest analysis. However, some basic properties are retained even when distributions are not normal. For example, one might assume symmetry, as in a t-distribution even if the distribution is not truly normal.

In fact, a number of different non-normal distributions are just variations of the normal distribution. For example, a distribution might have a longer tail, which is a variation of the normal distribution. Such distributions too are frequently encountered.

The reason for the normal distribution assumptions is that this is usually the simplest mathematical model that can be used. In addition, it is surprisingly ubiquitous and it occurs in most natural and social phenomena. This is why the assumption of normality is usually a good first approximation.



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Error Analysis

One of the most used assumption of normality is in error analysis. We usually assume that the random errors follow a normal distribution. This assumption can break down when there are multiple sources of errors and they are correlated. In addition, if the errors are not truly random, then too this assumption might not be valid. If the error distribution is not normal and the assumption of normality is made, then there could lead to an incorrect statistical analysis and thus erroneous conclusions.

Tests

There are statistical tests that a researcher can undertake which help determine whether the normal distribution assumptions are valid or not. One quick way is to compare the sample means to the real mean. For a normally distributed population, the sampling distribution ^[1] is also normal when there are sufficient test items in the samples ^[2].

The assumption of normality is valid in most cases but when it is not, it could lead to serious trouble. Also, since this assumption is made so inherently, it is hard to spot and sometimes difficult to question. Therefore care must be taken to ensure that the researcher is aware of not just the assumption of normality but in fact all the assumptions that go into a statistical analysis. This will help define the scope of the experiment and if something is not as expected, one can find the reason for the discrepancy.

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Links

[1] <https://explorable.com/sampling-distribution>

[2] <https://explorable.com/sample-group>