# Importance of Hypothesis Testing in Quality Management:

In modern manufacturing plants, people still seldom attach importance to hypothesis testing, which they believe is merely a matter of theory. However, the application of hypothesis testing in quality management should be promoted. Both parametric test (t-test and z-test) and nonparametric test (sign test and Wilcoxon rank-sum test) are appropriate for use in a manufacturing environment.

Data collection establishes the foundation for appraising quality of a product or service. But without correct data processing, it becomes challenging to make an objective conclusion. Sometimes, the observation is wrongly interpreted.

For instance, suppose that the fallout rate of samples drawn from two different groups is 15% and 10%, respectively. It would be a partial judgment saying that one is better than the other. On this occasion, hypothesis testing is instrumental in explanation of phenomena. Unfortunately, in many manufacturing facilities people tend to merely focus on descriptive statistics such as arithmetic mean and range. Simply put, application of hypothesis testing is indispensable to better understand quality data and provide guidance to production control.

**Parametric test.** In this test, samples are taken from a population with known distribution (normal distribution), and a test of population parameters is executed.

**Nonparametric test.** Also called distribution-free test, this test does not require the population to conform to a normal distribution, nor do the popular parameters need to be statistically estimated.

## Application of Parametric Test

1) Estimation of population mean with confidence interval
2) Paired Sample T-test used to determine disparity of measurement systems
3) Application of two-sample proportion z-test in evaluating different groups
4) Application of one-sample proportion z-test in verifying AQL of sampling plan

## Application of Nonparametric Test

1) Application of sign test in assessing measurement under different conditions
2) Application of Wilcoxon rank-sum test in assessing quality difference of products

## Importance of Hypothesis Testing in Real World:

It is one of the most important concepts in the whole statistics. This concept has many real-world applications from medicine to e-commerce.

Firstly, let us see some analogous explanation to hypothesis testing in the real world. The judiciary system in the world follows a rule or assumes that one is **Innocent until he is proven guilty.** Analogous to that in the world of statistics, the statisticians also do not attempt or try to prove the particular statement or hypothesis is true. Rather they assume that statement or hypothesis is incorrect (like not guilty) and then try to work or find the statistical evidence that would allow them to overturn their assumption. This works on the principle of Proof by Contradiction. I hope this gives some intuition what actually hypothesis testing does. It will be more clear when we go forward.

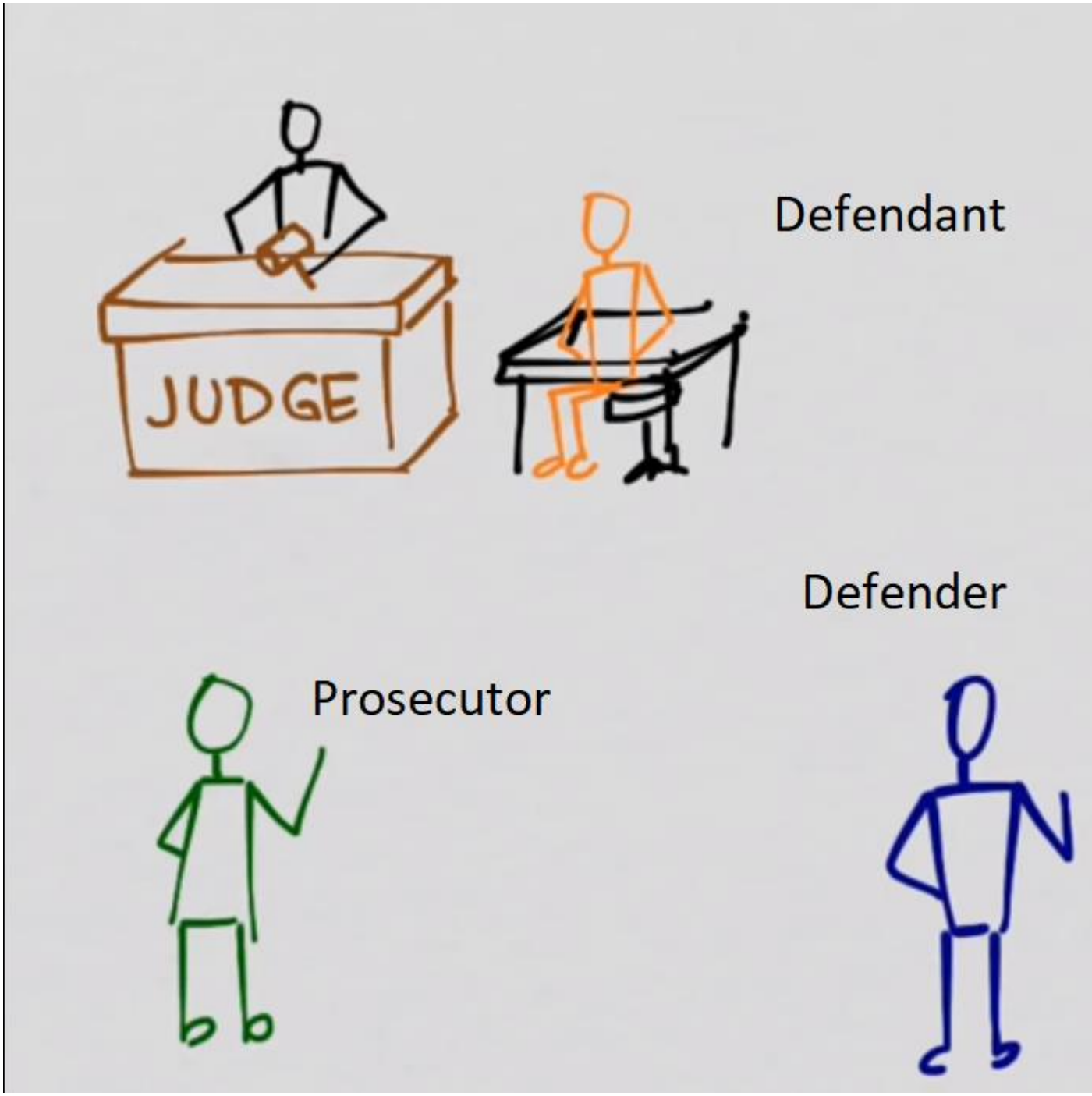
**Null Hypothesis (H0 called as "H zero"):** The defendant is not guilty or innocent.

**Alternate Hypothesis (H1 or Ha):** The defendant is guilty

Now, to test the hypothesis i.e. to find whether the defendant is guilty or not the judge will examine the evidence produced by the prosecutor which is called the **test statistic**.

**Test Statistic:** In this example, it is evidence produced by the prosecutor.

Now, the prosecutor will convince the judge if he (defendant) is innocent it is very unlikely to find the evidence. Now the decision of the judge depends on how much unlikely to find the evidence.




Here we have to make sure that until and unless we are **very sure** on the evidence we don't want to make him guilty.

HOW UNLIKELY?

Suppose, 50 percent chance he is innocent and yet we found that evidence which seems to condemn him. Should we call him guilty? The answer is definitely NO. Because we don't want to send an innocent man to jail on a coin flip.

What about 20 percent? It means out of 100 times still 20 of the times he is innocent.

5%, 2%, 1%, 0.1% all these are likelihoods. In this example, I should be very confident about his innocence so we set the **significance level** to 0.1%. Setting it to 0.1% says that if there are 1000 chances on the evidence out of that 999 times he found guilty.

**Significance Level:** It varies from application to application. Typically, we set it at 5 percent. In domains such as medicine, we set it to 0.1%.

Now we use this significance level to accept or reject the null hypothesis (to find whether he is innocent or not).

Suppose if the significance level is 0.1% and the unlikeliness we found out is 10% as the unlikeliness is greater than threshold or significance level we will accept null hypothesis(H0) and reject the alternate hypothesis(H1 or Ha). Here the calculation of unlikeliness (also called p-value) will be done through Resampling and permutation test which will be explained later. I hope all the terms **Test Statistic, Null Hypothesis, Alternate Hypothesis, p-value** are clear as of now.