Risks in Hypothesis Testing

Become Future Fit

You will learn

Learn about various risks involved in decision making with respect to hypothesis testing

Level of Difficulty

High

Destructive Testing

In a 1-sample t-test which consists of a very expensive destructive testing, only 3 samples where collected.

Are 3 samples sufficient?

What are the associated risks with this sample size?

Result of Test	Population	
	$\mu = \mu_0$	$\mu \neq \mu_0$
Do Not Reject	Correct	Type II Error
Reject	Type I Error	Correct

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	$\mu = \mu_0$	$\mu \neq \mu_0$
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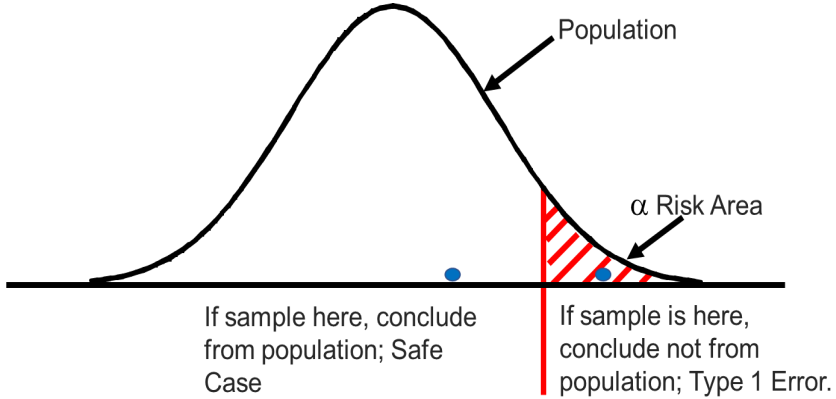
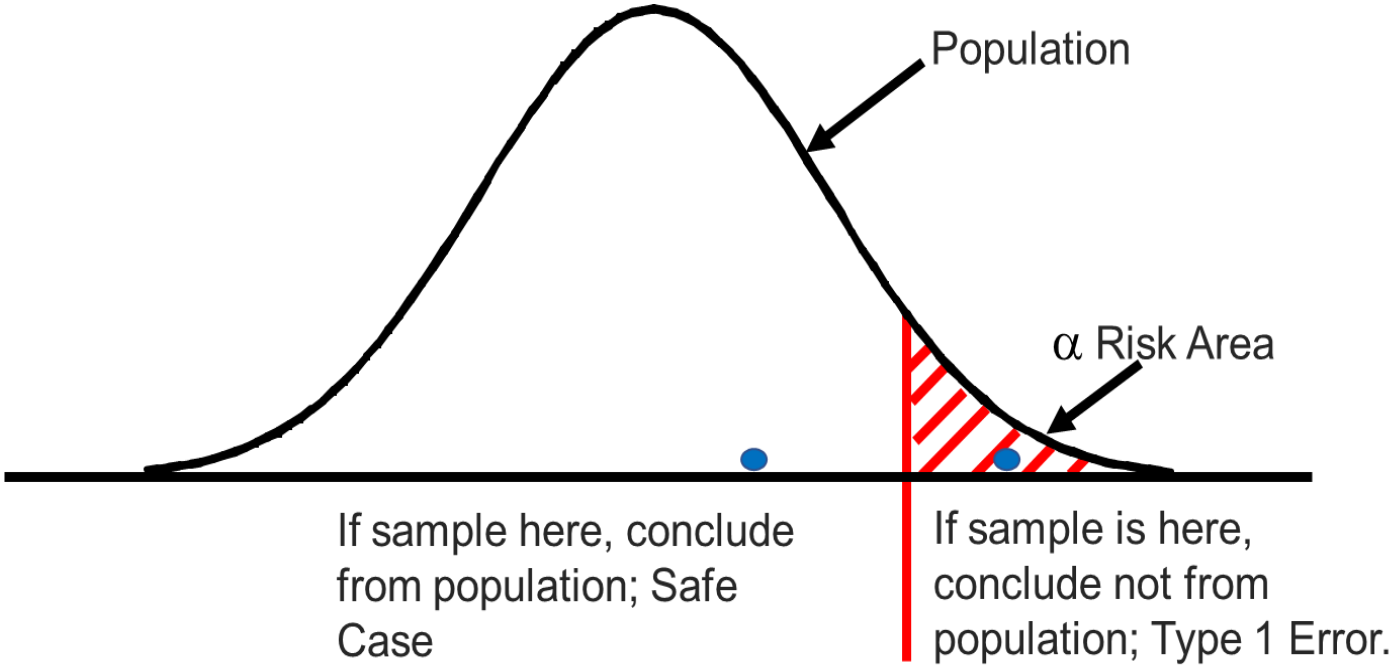
Verdict of Jury	Defendant	
	Innocent	**Guilty**
Not Guilty	Correct	Incorrect
Guilty	Incorrect	Correct

Alpha Risk Graphically



Truth is: Sample is from this population



Truth is: Sample is from this population

Alpha or Type 1 Error

- Alpha (α) risk is defined as the risk or probability of rejecting the null hypothesis when, in fact, it is true.
- **Alpha risk is stated in terms of probability (such as 0.05 or 5%).**
- Confidence Level = (1- α)

Alpha or Type 1 Error

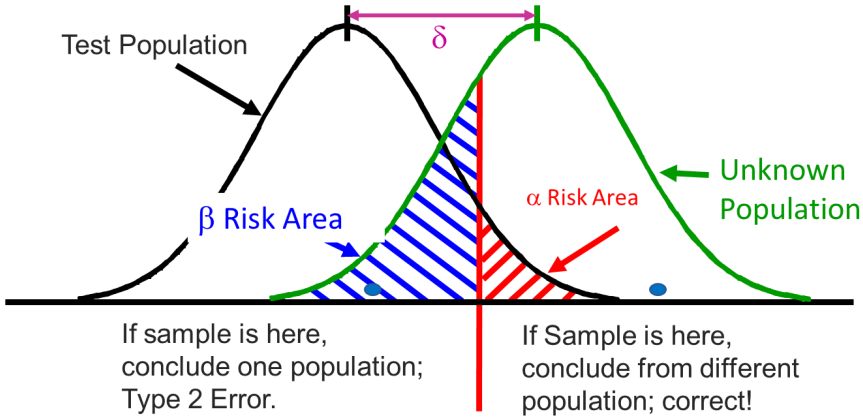
Tampering with the process : Stating that a difference exists when actually there is none.

Decision Factors

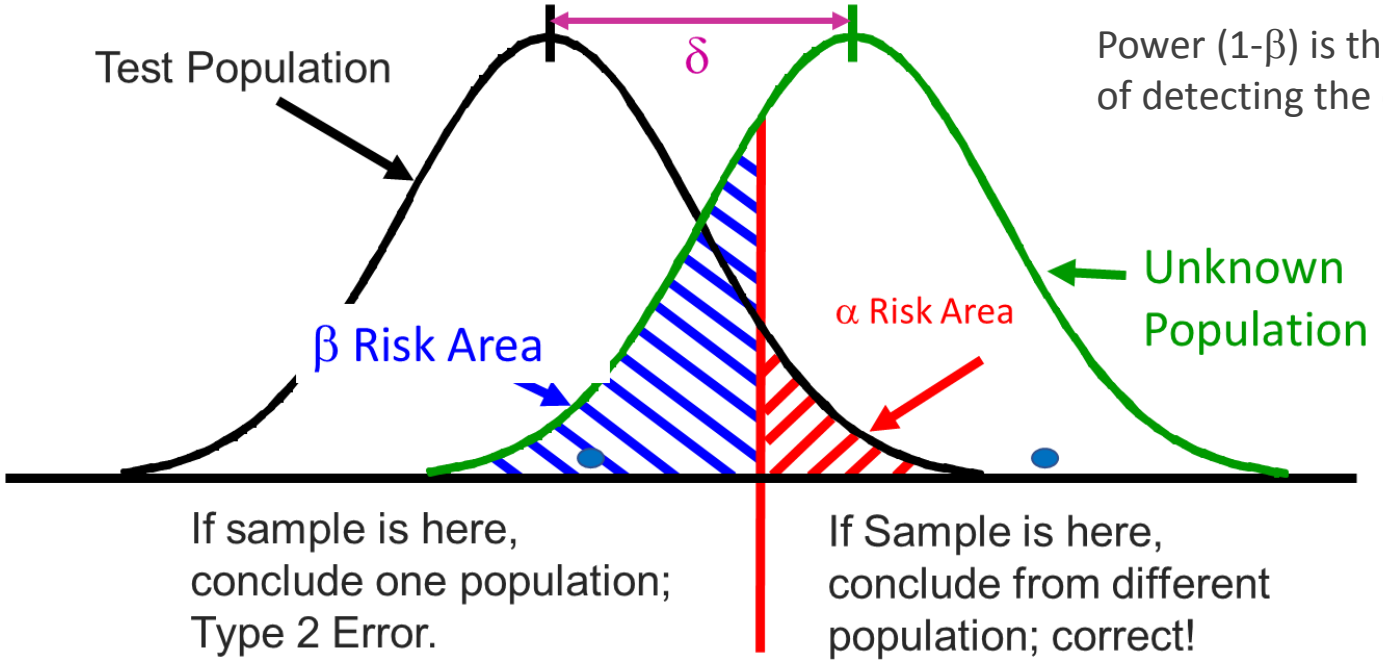
Factors in choosing Alpha

1. Cost to implement a change produces no real improvement?
2. Modification costs & process risks
3. Delays in implementing the real solution

Beta Risk Graphically



Truth is: Sample is from different population



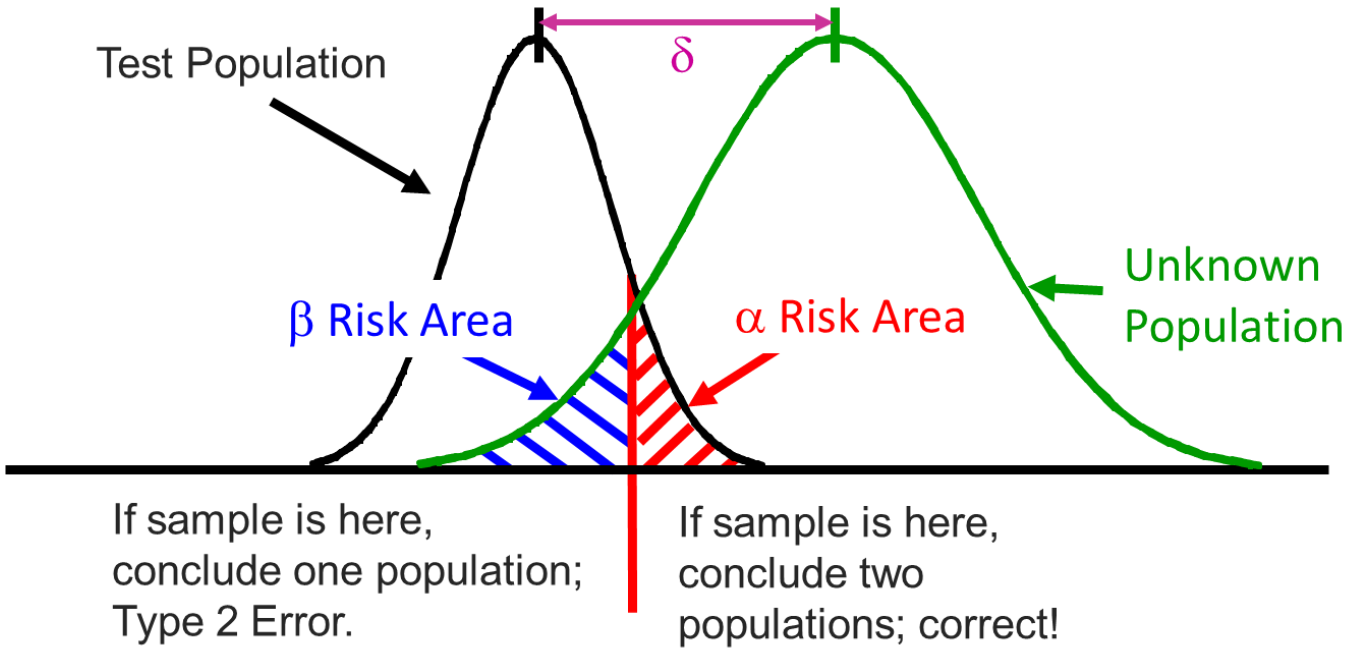
Truth is: Sample is from different population

Beta (β) risk

Risk or probability of accepting the null hypothesis when, in fact, the alternate hypothesis is true. (Stating that no difference exists when actually there is)

β is taken as 20% (0.2)

Power = 1-β (Probability of detecting a real effect)



Truth is: Sample is from different population

Beta (β) risk

Increasing the Sample Size,

mitigates Beta Risk

Beta (β) risk

It is the probability of under-controlling, not taking action when.

Decision Factors

Factors in choosing Beta

1. Cost of missing an opportunity?
2. Continuing product losses

Delta

The size of the real effect you want to be sure to detect if in fact it is there. Often expressed as a multiple of σ.

Decision Factors

Choosing Delta

1. Practical (important to the customer) difference?
2. Large delta may miss a benefit
3. Small delta may waste resources

Sampling for Hypothesis Testing

Become Future Fit

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Learn to compute sample size for hypothesis test

based on risk factors & purpose of test

Level of Difficulty

High

Destructive Testing

In a 1-sample t-test which consists of a very expensive destructive testing, only 3 samples where collected. Sigma was found to be 0.4.

So the team decided that their test should be able to detect a true difference of at least 1 sigma.

1. What is the power of this test? Is it sufficient
2. How many more samples are needed if the power should be kept at 0.8
3. If more samples cannot be collected, then, how will you conclude the results of the test

Summary

- Sample Size is not a fixed number
- Can be optimized based on purpose of testing by adjusting:
  - Alpha, Belta, Delta
  - One or Two Sided Test