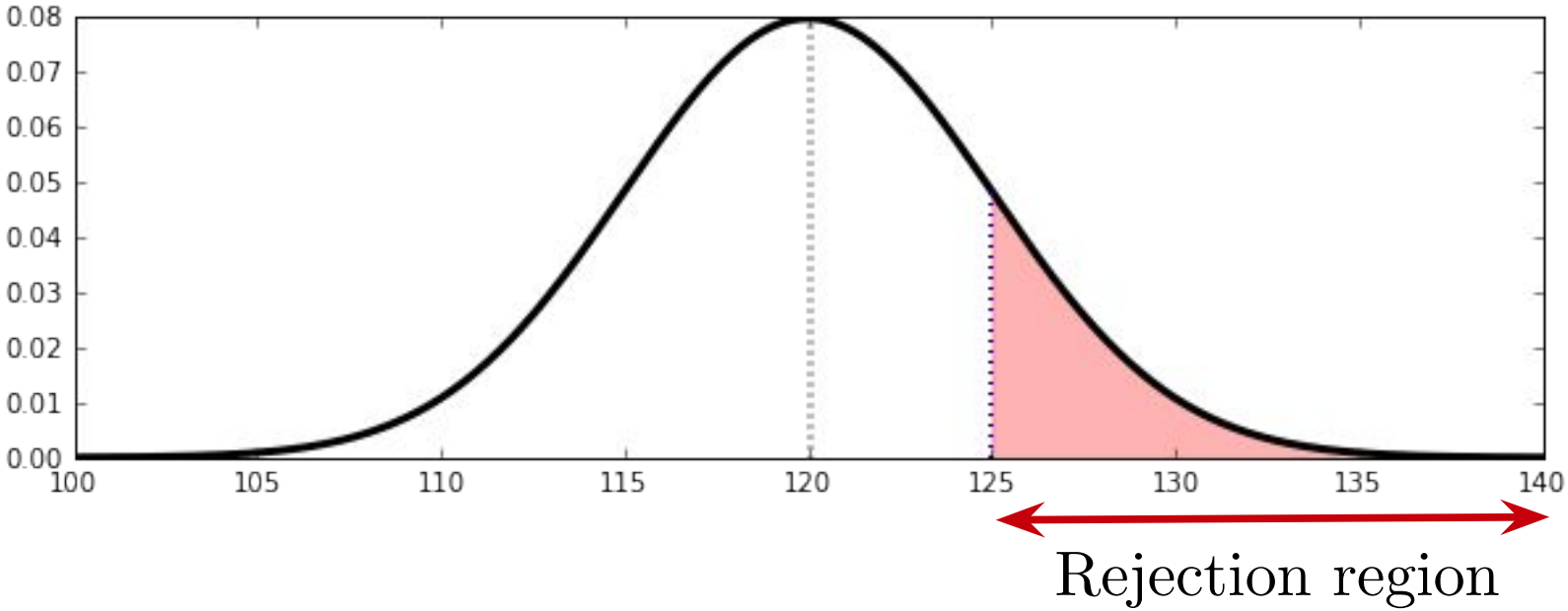
통계분석
Statistical Analysis

P-Values

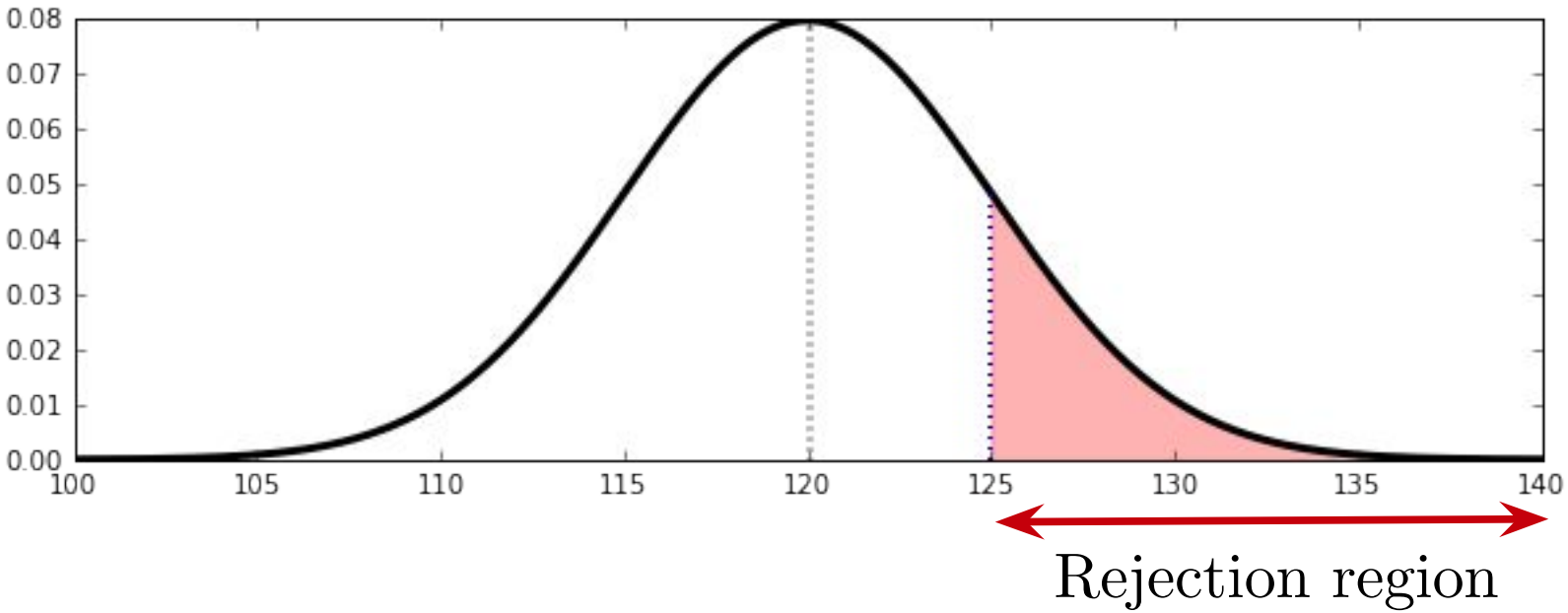
Significance Test (Hypotheses Testing) with Rejection Region



- Null hypothesis: $\mu = \mu_0$
- Alternative hypothesis: $\mu > \mu_0$

Significance Test with Rejection Region:

STEP 1. Set-up Rejection Region



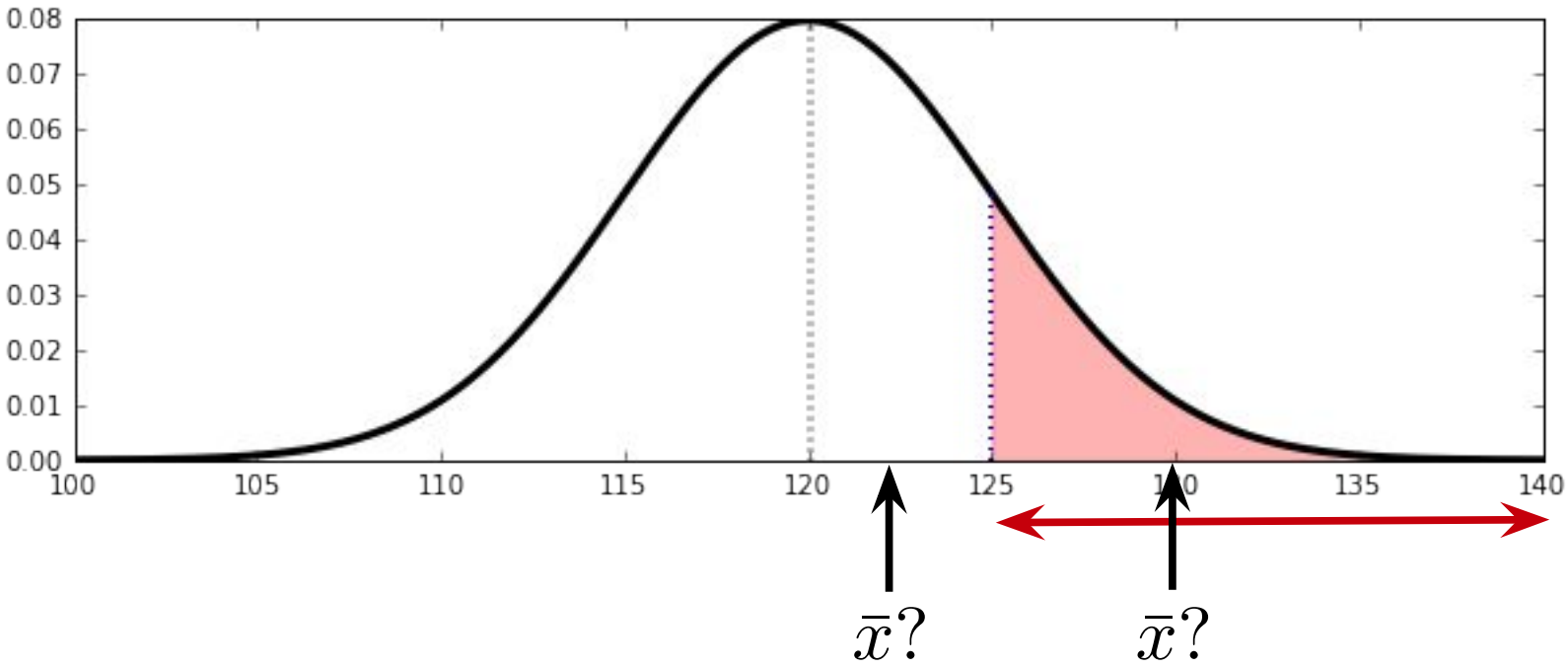
- Setting up rejection regions and the significance level

1) We specify the rejection region, and then calculate the significant level corresponding to the rejection region.

2) After we specify the significance level, we can decide the rejection region corresponding to the level.

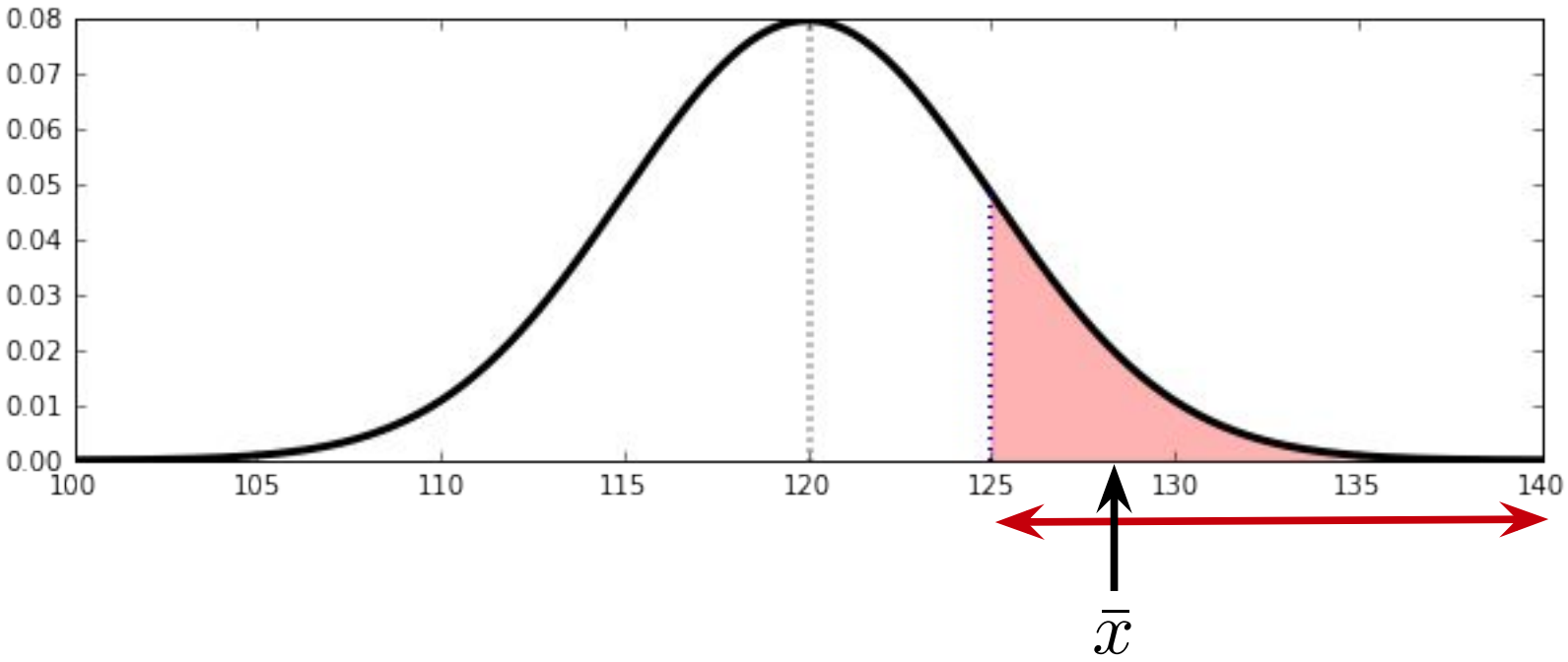
Significance Test with Rejection Region

STEP 02. Compare Test Statistic and Rejection Region



After specifying the rejection region, we find out whether a test statistic is included in the rejection region or not.

Significance Test with Rejection Region

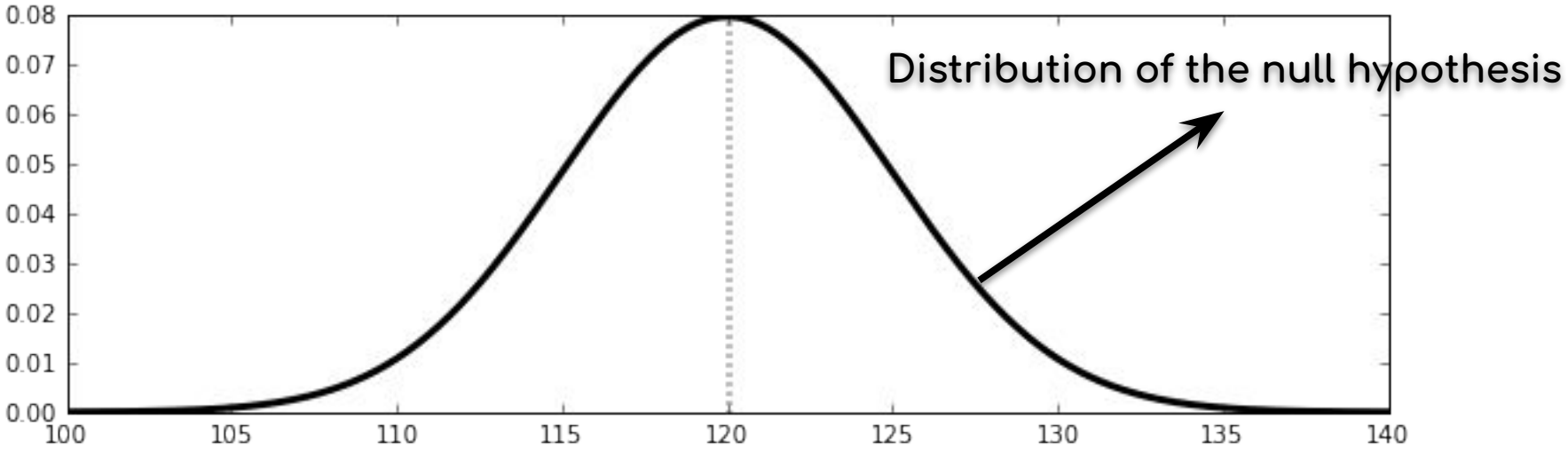


1. First, choose a significance level α.
2. Calculate a rejection region from α.
3. H_0 is rejected if a test statistic $\in$ Rejection region

   H_0 not is rejected if a test statistic $\notin$ Rejection region

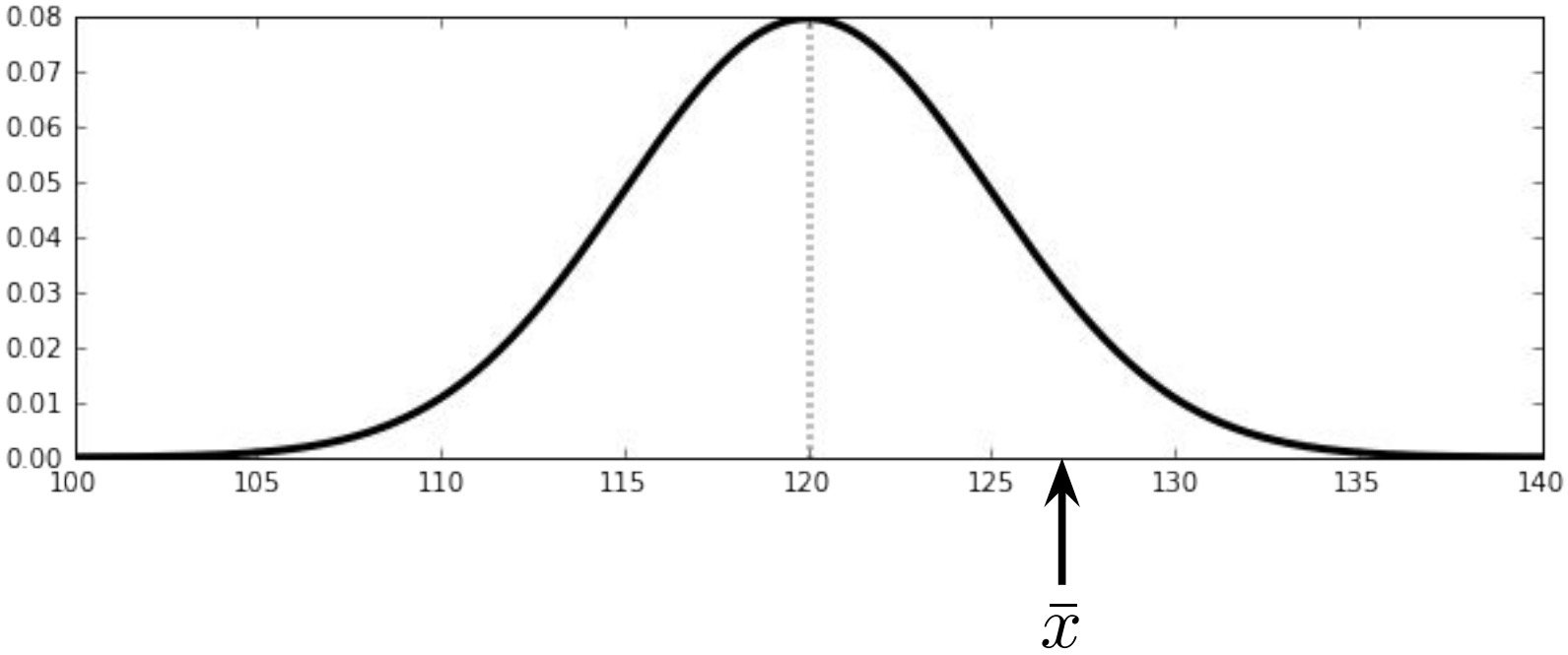
Second Approach to Test Hypotheses

P-Values



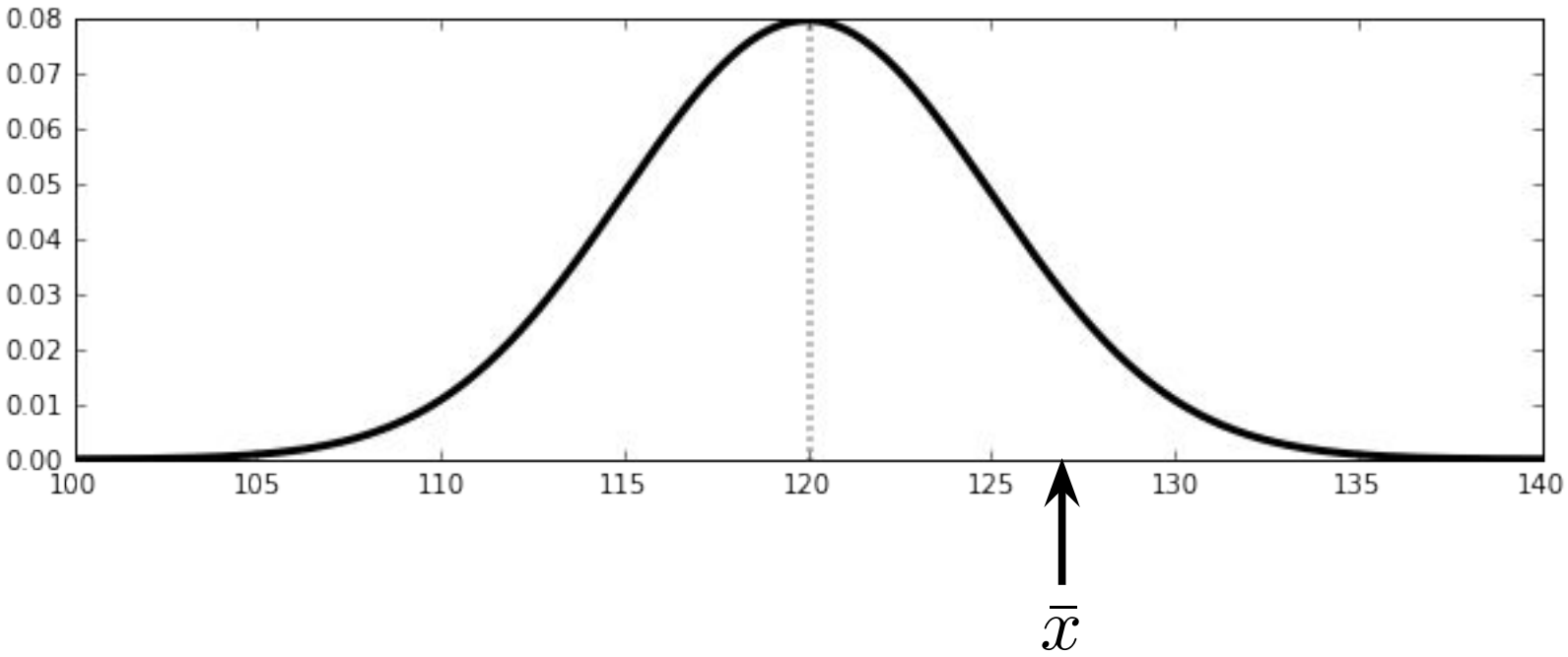
Let us do the hypothesis test in a different way. That is using the "P-Values."

P-Values



1. First we obtain a test statistic from experiments.

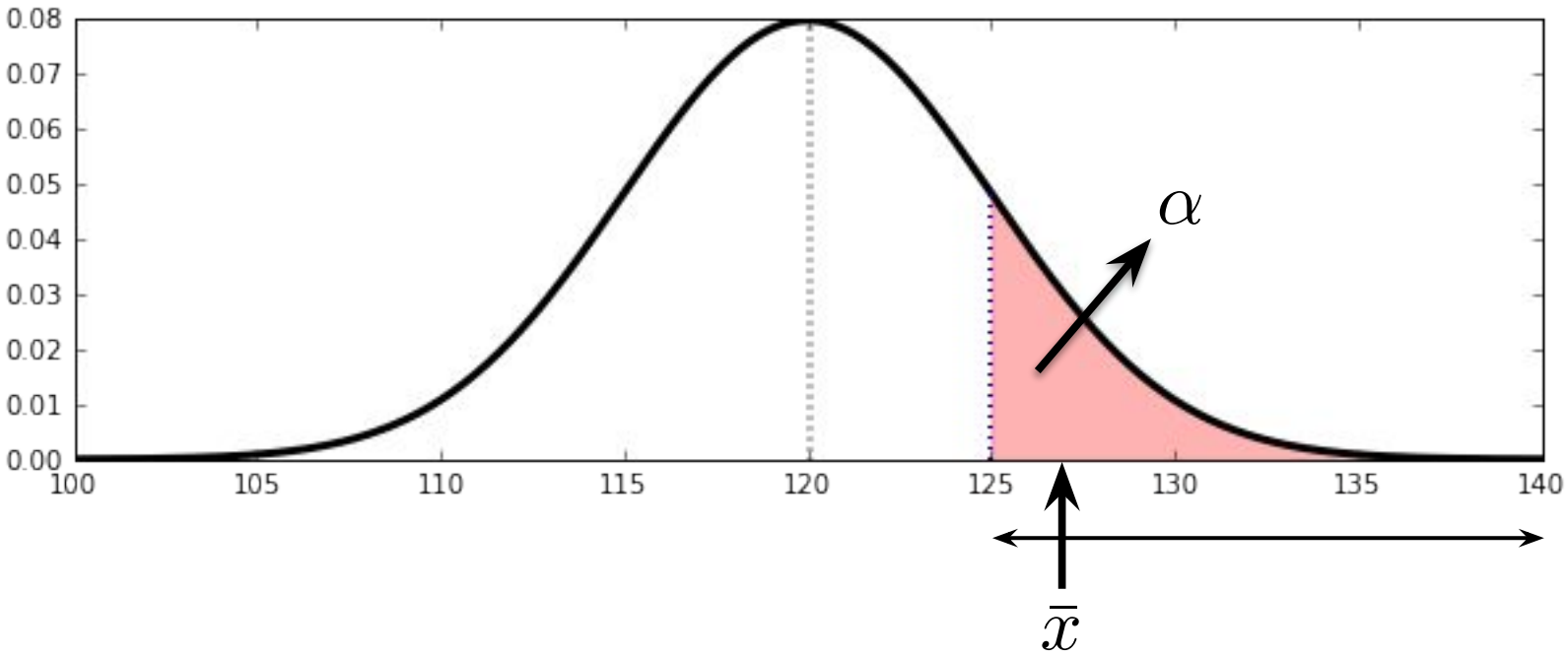
P-Values



2. Then, we can calculate the ***smallest*** significance level such that ***the test statistic obtained from experiment rejects the null hypothesis***.

(Determining significance level implies that you have the rejection region)

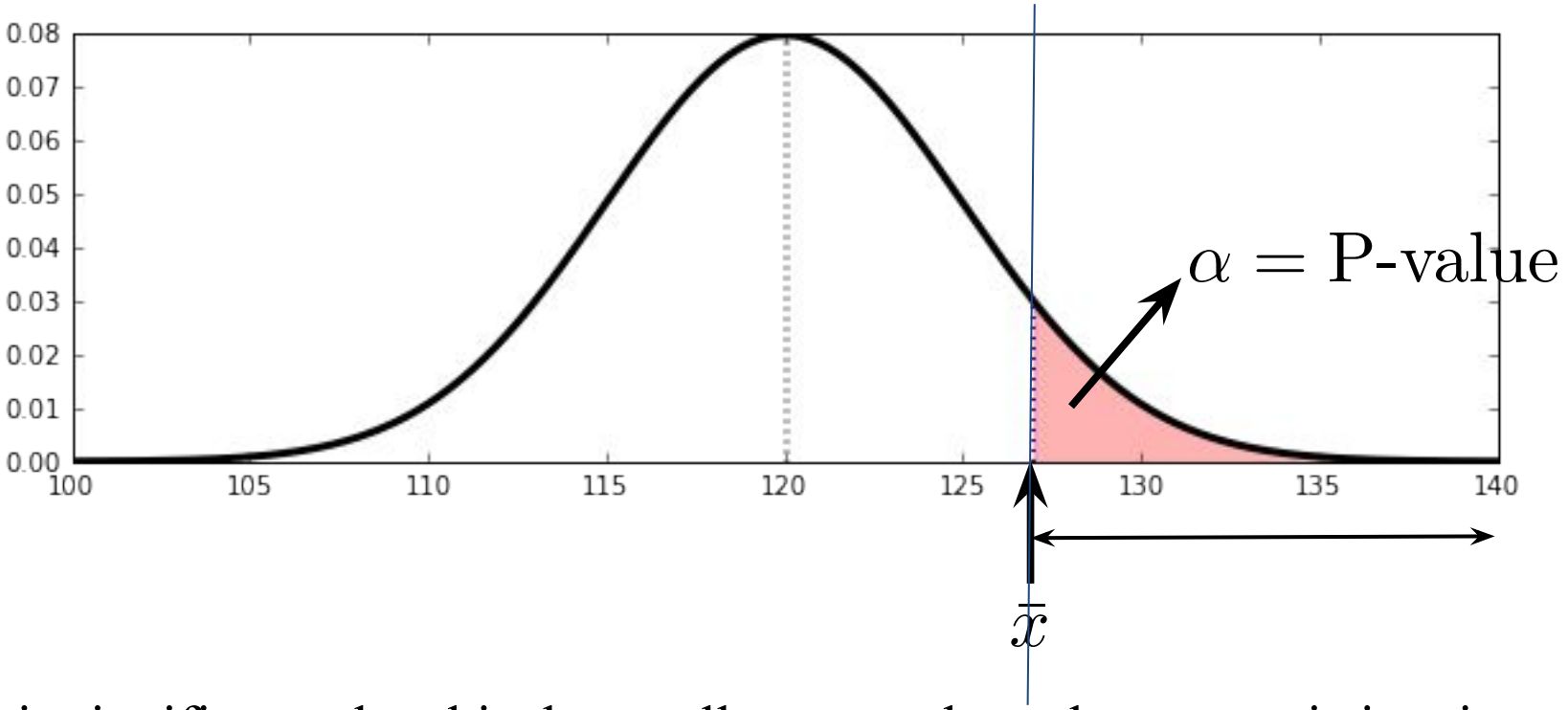
P-Values



This significance level obviously indicates that the test statistic rejects the null hypothesis.

But, this is NOT the smallest one.

P-Values

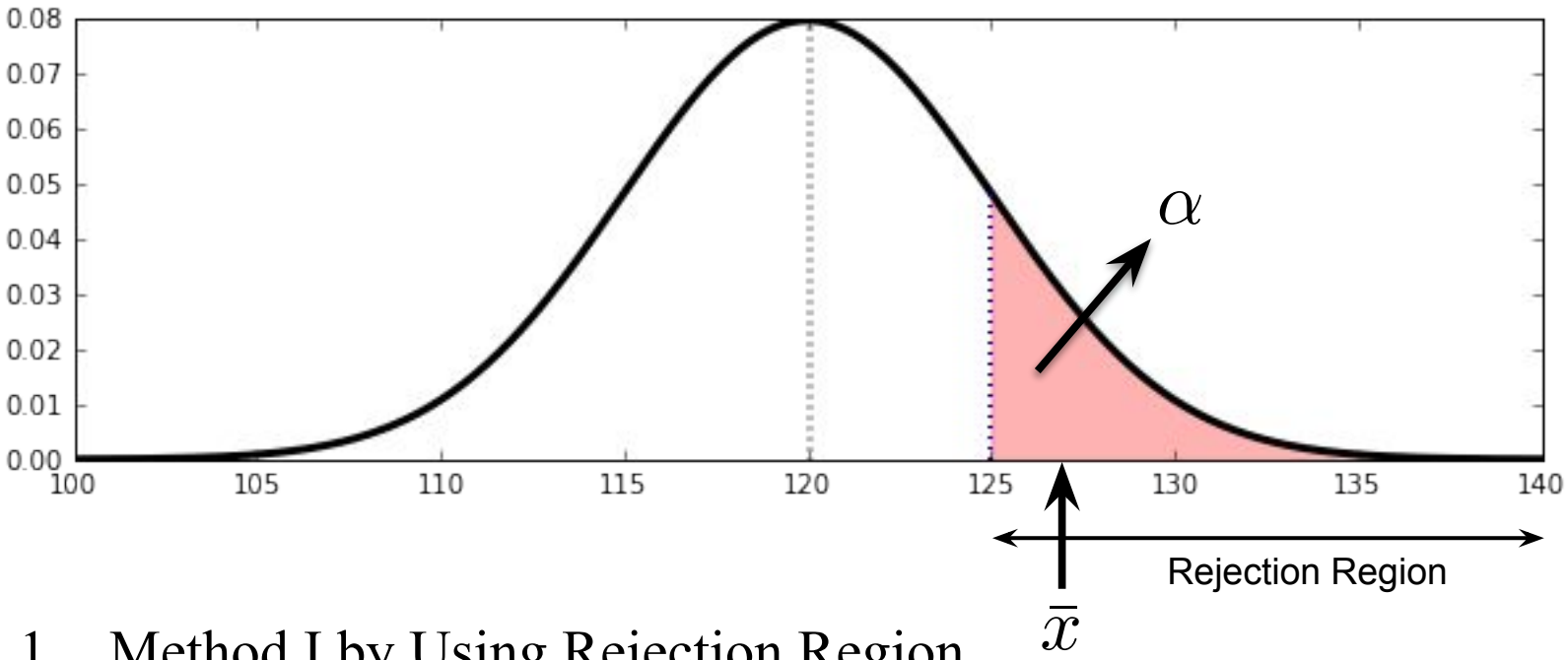


This significance level is the smallest one where the test statistic rejects the null hypothesis.

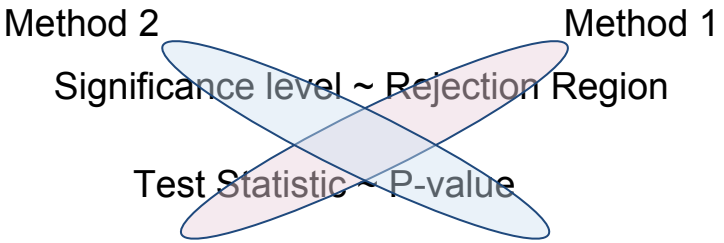
This smallest value is called the P-value.

Once a test statistic is calculated, we can determine the P-value.
The P-value is the area whose boundaries are given by the test statistic.

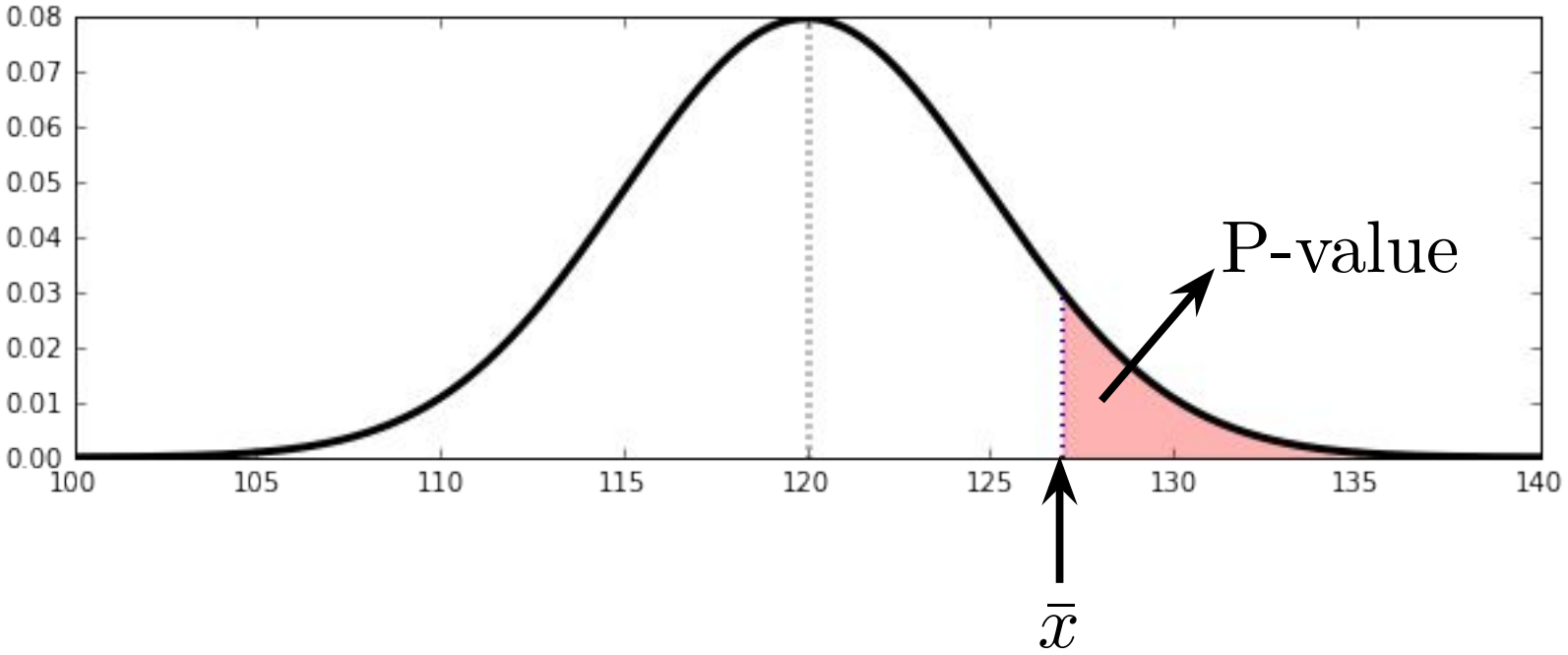
Rejection Region vs P-Values



1. Method I by Using Rejection Region
   Compare Test Statistic and Rejection Region
2. Method II by Using P-Value
   Compare Significance Level α and P-value



How to Calculate P-Values

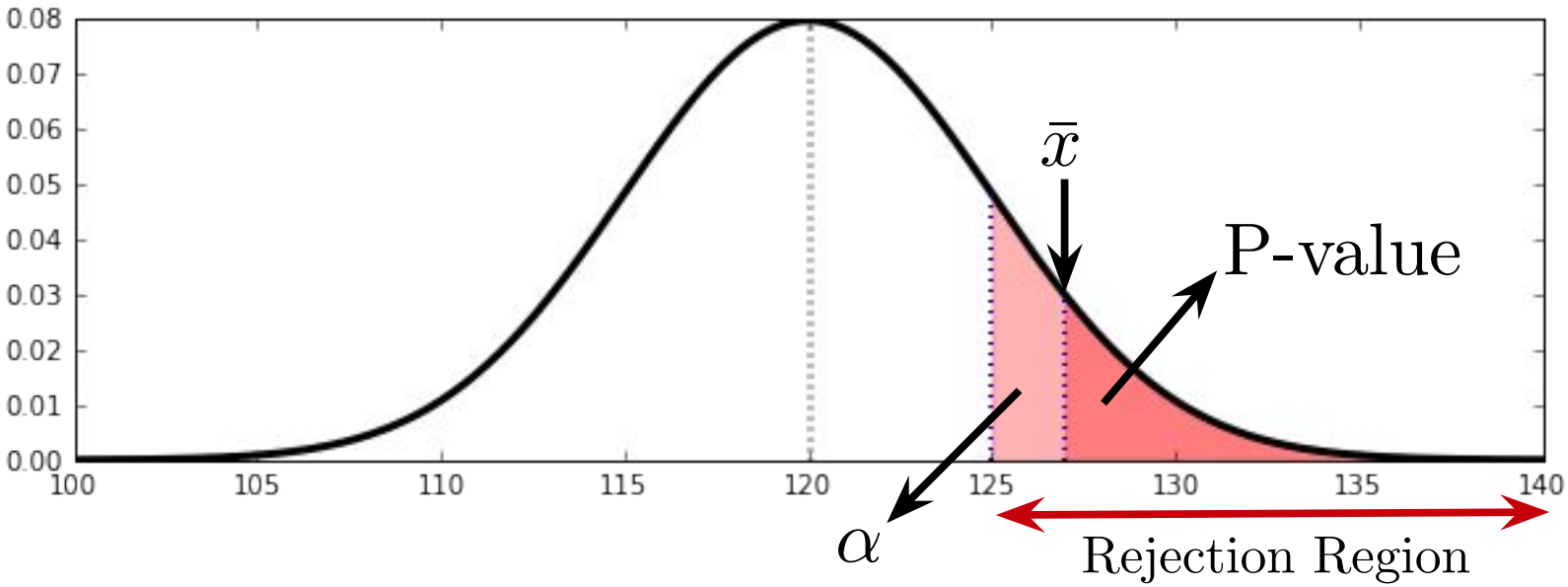


For example, using the standard normal distribution

$$Z = \frac{X - \mu}{\sigma/\sqrt{n}} \sim N(0,1) \longrightarrow \bar{z} = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \sim N(0,1)$$

$$\text{P-value} = P(Z \geq \bar{z} | H_0 \text{ is true})$$

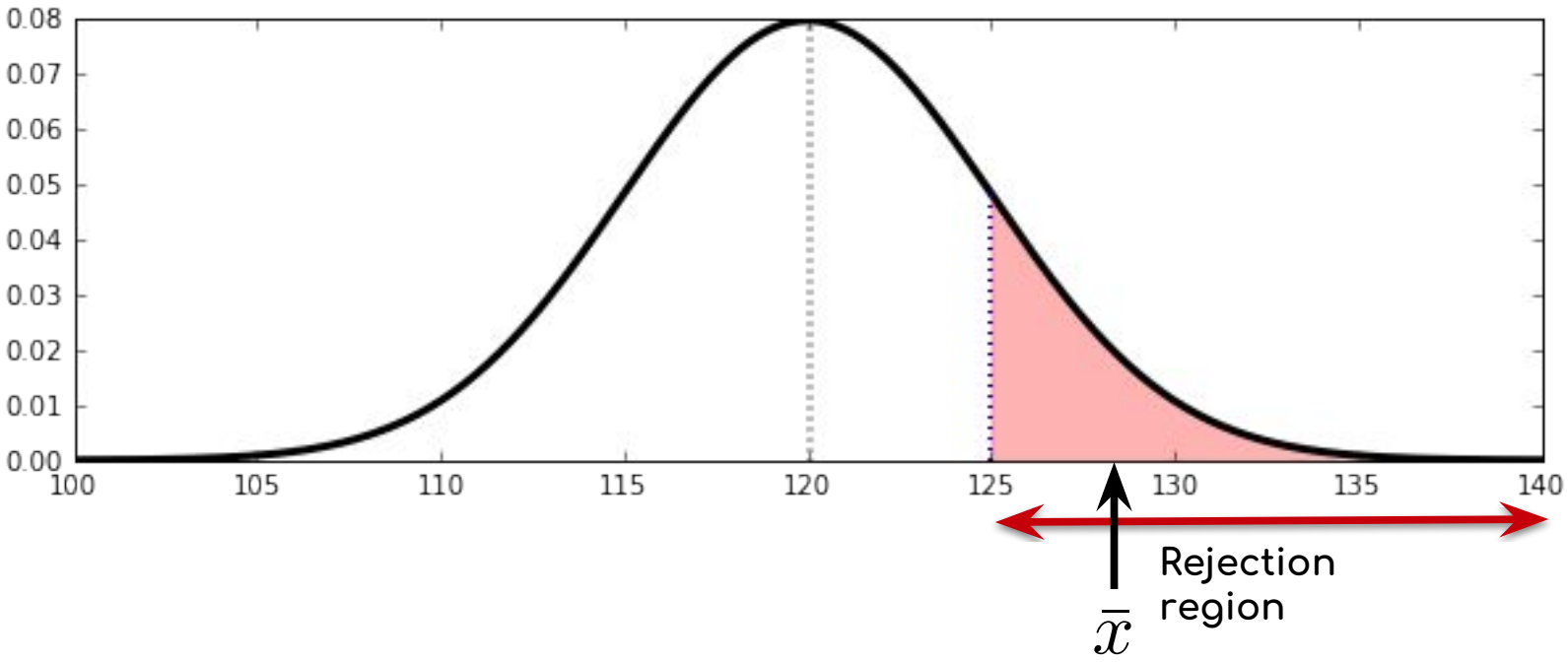
Significance Test with P-value



1. First, choose a significance level α.
2. Calculate a P-value from a test statistic.
3. H_0 is rejected if P-value $\leq \alpha$

   H_0 is not rejected if P-value $> \alpha$

Recall: Significance Test with Rejection Region



1. First, choose a significance level α.
2. Calculate a rejection region from α.
3. H_0 is rejected if a test statistic $\in$ Rejection region

   H_0 not is rejected if a test statistic $\notin$ Rejection region