Recap

- What is type-1 vs type-2 error?
- What is the significance level α? What is the p-value?

NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.

ME 794

Statistical Design of Experiments

Chapter 2.1

Classical Design of Experiments

Comparative Experiments

NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.

Comparison with a number

Three cases of Hypothesis Testing

1. $H_0: \mu = \mu_0, \quad H_1: \mu \neq \mu_0$

   Example

   H_0: Sachin Tendulkar's ODI batting average is 50 runs

   H_1: Sachin Tendulkar's ODI batting average is NOT 50 runs

2. $H_0: \mu \geq \mu_0, \quad H_1: \mu < \mu_0$

   Example

   H_0: Sachin Tendulkar's ODI batting average is at least 50 runs

   H_1: Sachin Tendulkar's ODI batting average is less than 50 runs

3. $H_0: \mu \leq \mu_0, \quad H_1: \mu > \mu_0$

   Example

   H_0: Sachin Tendulkar's ODI batting average is at max 50 runs

   H_1: Sachin Tendulkar's ODI batting average is greater than 50 runs

How to draw statistical conclusions?

NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.

Comparative Experiments

- Comparing two processes/products/datasets
- Comparing a process/product/dataset with a reference

Case 1: When we have ALL the population data

Examples:

1. Who is **a better ODI batsman**, based on runs scored in an inning, **Sachin or MS Dhoni**?
2. Is Sachin's ODI average greater than 'X'?

NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.

Comparative Experiments

Case 2: What happens when we have PARTIAL population data?

Example

To test the newspaper claim that the mean wage rate of local foundry workers is \$16 an hour, 25 foundry workers were randomly surveyed. It was found that the average wage rate for the sample of workers was \$14.50. Historical data suggest that the wage rates follow the normal distribution and the standard deviation of wage rates is \$3. Can the Union claim that the average wage is not \$16 an hour? Assume α =0.05.

newspaper claim : $\mu = 16$

Sample survey $n = 25$, $\bar{y} = 14.50$

we know $\sigma = 3$ (somehow)

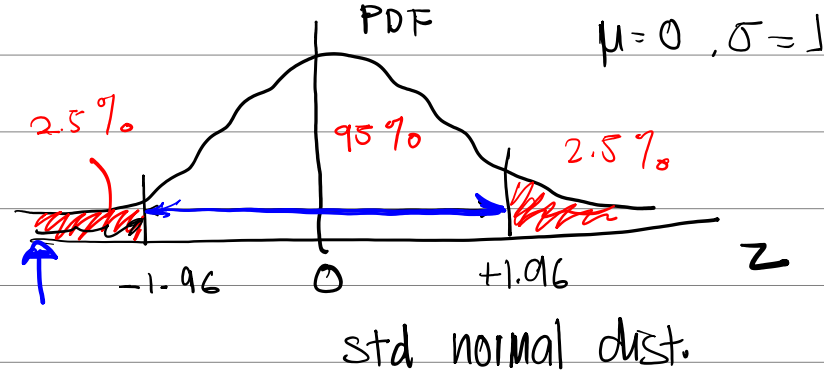
Hypothesis testing

$H_0 : \mu = 16$ ✗

$H_1 : \mu \neq 16$ ✓

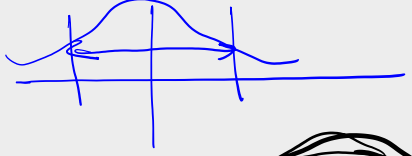
$$z = \frac{\bar{y} - \mu}{\sigma/\sqrt{n}} = \frac{14.5 - 16}{3/\sqrt{25}}$$

$$z = \frac{-1.5}{0.6} = -2.5$$



NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.

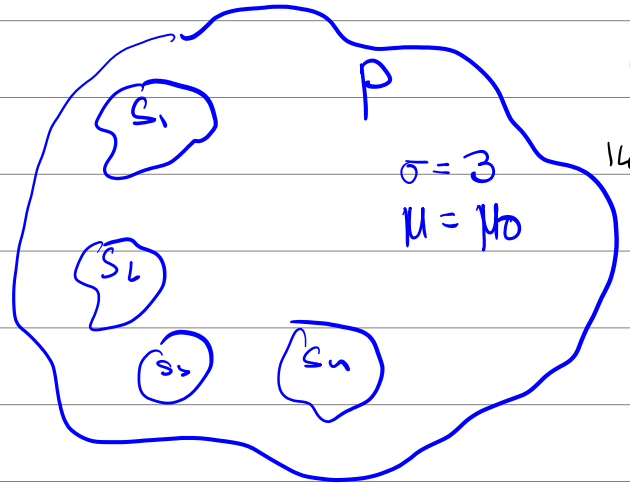
Comparative Experiments



$\mu = 16$ (?) $\quad \sigma = 3$

14.5 , 14.8 , 16.8 , 17.5 ...

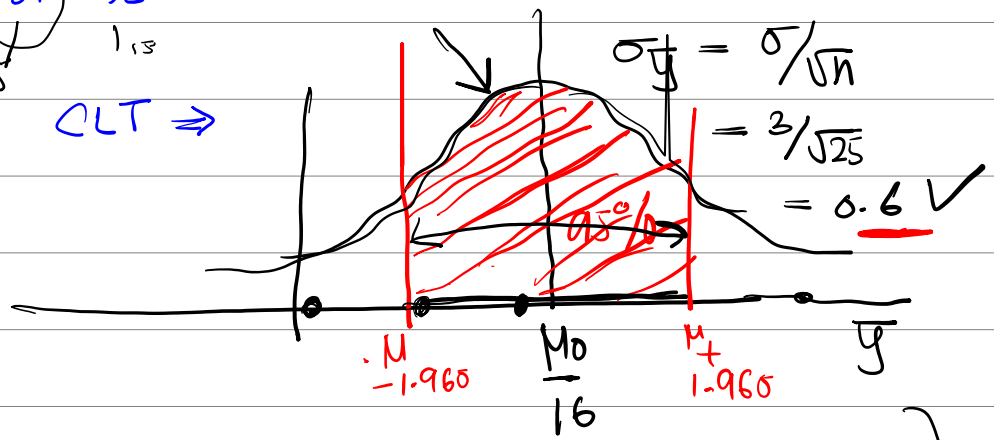
Example



$\bar{y}_1, \bar{y}_2, \dots \bar{y}_n$

14.5 , ...

CLT $\Rightarrow$



95% $\quad \alpha = 5\%$

99% $\quad$ If $\alpha = 1\%$

99.73% $\quad \alpha = 0.27\%$

$\mu \pm 1.96\sigma$

$16 \pm 1.96 \times 0.6$

$[14.824, \ 17.176]$ ✓

14.5

$16 \pm 1.96\sigma$

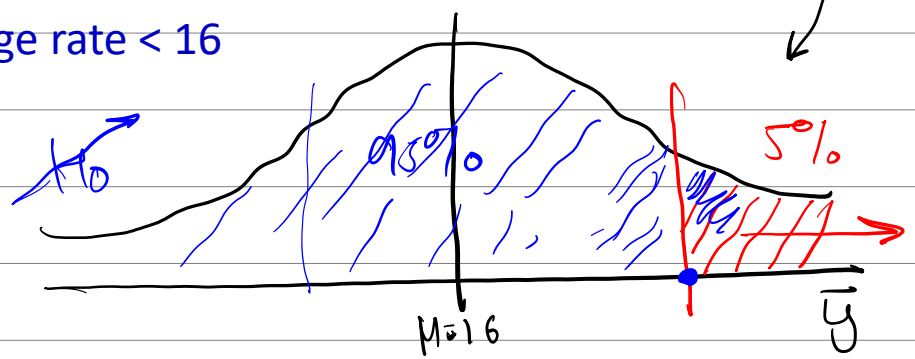
How do you test for wage rate > 16 or wage rate < 16

$H_0 : \mu \leq 16$

$H_1 : \mu > 16$ ✓

$\bar{y} = 14.5$

$[-\infty, 1.64]$



$\dfrac{\bar{y} - \mu}{\sigma/\sqrt{n}}$

NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.

Comparative Experiments

Example 2: Who is a better player? Virat or Babar? (α = 5%)

Batsman	One sample each of 10 ODI innings	Sample Mean	Assume Known, Same Population Std
Virat	00, 53, 34, 31, 00, 54, 96, 20, 10, 19	**31.7**	~~29.6~~ 28
Babar	12, 09, 91, 79, 51, 45, 41, 46, 29, 33	**43.6**	~~26.0~~ 28

NOTE: You do NOT have permission to share this file or any of its contents with anyone else, and/or upload it on internet or any of the platforms where it can be accessed by others.