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Hypothesis Tests

Population Mean for one sample

Population Standard Deviation for one sample

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Parametric Tests for Means

- Test for means is done under two assumptions:
  - Population Standard Deviation is known
  - Population Standard Deviation is unknown
- For Known Standard Deviation: Z-test
- For Unknown Std Deviation: t-test
- Assumption: Sample is drawn from a population which follows Normal Distribution

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Parametric Test

T-TEST FOR ONE SAMPLE MEAN

One Sample t-test

- One Sample t-test is test for mean of single population
- **Assumption**: Sample has been drawn from population which is Normal
- Suppose that we want to test whether population mean of the population from which sample is drawn is a particular value, say μ_0

$$H_0: \mu = \mu_0 \ against \quad H_1: \mu \neq \mu_0$$

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Test Statistic

- The test statistic of the t-test can be proved to be following t distribution with (n-1) degrees of freedom
- The test statistic is given by:

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Where

$\bar{x}$: Sample Mean

μ_0 : Population mean to be tested

s : Sample Standard Deviation

n : Sample Size

Example

- Given data on plant growth contains weights of dried plants for three different treatments
- We want to test the hypothesis whether the mean weight of the dried plants is 6 for the population

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Solution

$$H_0: \mu = 6 \ \ against \quad H_1: \mu \neq 6$$

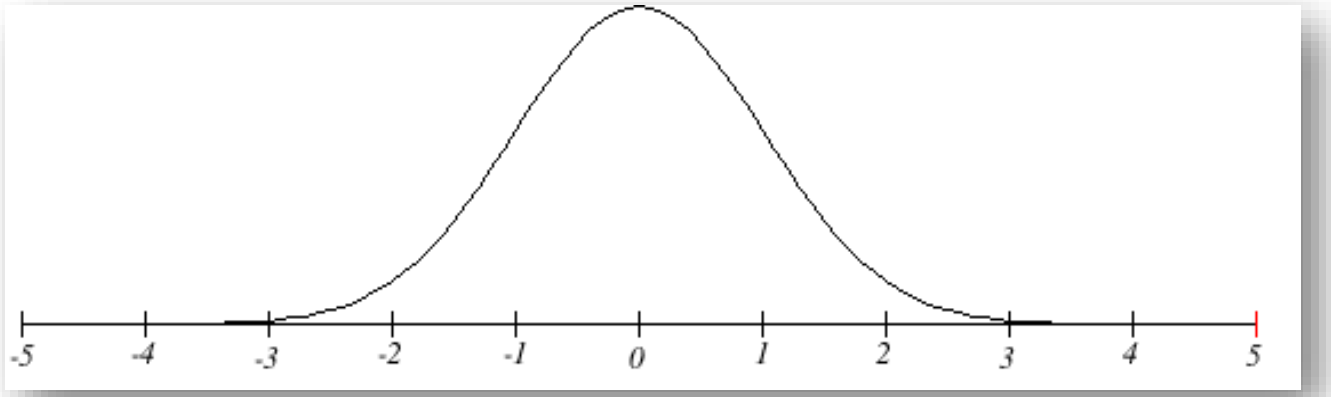
$$t = \frac{\bar{x} - 6}{s/\sqrt{n}}$$

Where

$\bar{x}$: Sample Mean
μ_0 : Population mean to be tested
s : Sample Standard Deviation
n : Sample Size

Calculations

$$t = \frac{\bar{x} - 6}{s/\sqrt{n}} = -7.241$$



- We see here that area under the curve at both sides is less than 0.01. Hence, we reject null hypothesis H_0

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One Sample t-test in Python

Syntax:

scipy.stats.ttest_1samp(a, popmean, …)

where

a : Numerical vector

popmean: Population mean to be tested (μ_0)

Python Program

```
In [1]: import pandas as pd
        from scipy import stats
        PlantGrowth = pd.read_csv("G:/Statistics (Python)/Datasets/PlantGrowth.csv")
        stats.ttest_1samp(PlantGrowth.weight,popmean=6.0)

Out[1]: Ttest_1sampResult(statistic=-7.241082682752039, pvalue=5.666151490495602e-08)
```

- We observe here that p-value is less than 0.05 and even 0.01. Hence, we reject H_0.
- Conclusion: Population mean of the weight of plants may not be 6 at 1% level of significance

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One-Tailed Test

- We can extend this problem to test the following hypothesis also:

$$H_0: \mu \geq 6 \ \ against \quad H_1: \mu < 6$$

```
In [1]: import pandas as pd
        from scipy import stats
        PlantGrowth = pd.read_csv("G:/Statistics (Python)/Datasets/PlantGrowth.csv")
        stats.ttest_1samp(PlantGrowth.weight,popmean=6.0)

Out[1]: Ttest_1sampResult(statistic=-7.241082682752039, pvalue=5.666151490495602e-08)
```

- We observe here that p-value is less than 0.01. Hence, we reject H_0.
- Conclusion Population mean of the weight of plants may be less than 6 at 1% level of significance

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Questions?