STATISTICS FOR DATA SCIENCE
HYPOTHESIS and INFERENCE

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STATISTICS FOR DATA SCIENCE

UNIT-4 HYPOTHESIS and INFERENCE

Session-2

Large-Sample Tests for a Population Mean

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Large-Sample Tests for a Population Mean

1. Define H_0 and H_1.

2. Assume H_0 to be true.

3. Compute a test statistic. A test statistic is a statistic that is used to assess the strength of the evidence against H_0.

4. Compute the *P*-value of the test statistic. The *P*-value is the probability, assuming H_0 to be true, that the test statistic would have a value whose disagreement with H_0 is as great as or greater than that actually observed. The *P*-value is also called the observed significance level.

5. State a conclusion about the strength of the evidence against H_0.

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Large-Sample Tests for a Population Mean

In any hypothesis test, we are calculating conditional probabilities based on the assumption that the null hypothesis is true.

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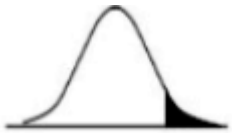
Introduction

Type of Hypothesis Tests:

Sl No	Type of Hypothesis Test	Alternate Hypothesis	Null Hypothesis
1	**Left Tailed Test** 	$<$	$\geq$
2	**Right Tailed Test** 	$>$	$\leq$
3	**Two Tailed Test** 	$\neq$	$=$

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Large-Sample Tests for a Population Mean

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Different Hypothesis Tests

Hypothesis Test	Test Statistic
z-test	z- statistic
t-test	t- statistic
Chi square test	Chi square statistic

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Large-Sample Tests for a Population Mean

Note:

Hypothesis Test	Population S.D. known	Population S.D. unknown
$n < 30$ Small sample drawn from Normal population	Use z- test	Use t-test
$n \geq 30$ Large sample	Use z- test	Use z- test Or t- test

Note:

A test that uses z-score as a test statistic is called z-test.

Example:

- The article "Wear in Boundary Lubrication" (S. Hsu, R. Munro, and M. Shen, *Journal of Engineering Tribology*, $2002: 427-441$) discusses several experiments involving various lubricants.

- In one experiment, 45 steel balls lubricated with purified paraffin were subjected to a $40\ kg$ load at $600\ rpm$ for $60\ minutes$.

Example:

- The average wear, measured by the reduction in diameter, was $673.2\ \mu m$, and the standard deviation was $14.9\ \mu m$.
- Assume that the specification for a lubricant is that the mean wear be less than $675\ \mu m$.
- Find the P-value for testing $H_0: \mu \geq 675$ versus $H_1: \mu < 675$.

Solution:

- The null hypothesis is that the lubricant does not meet the specification, and that the difference between the sample mean of 673.2 and 675 is due to chance.

- The alternate hypothesis is that the lubricant does indeed meet the specification.

$$z = \frac{673.2 - 675}{2.22} = -0.81$$

Soution:

- The $P-v$alue is 0.209 .
- Therefore if H_0 is true, there is a 20.9% chance to observe a sample whose disagreement with H_0 is as least as great as that which was actually observed.
- Since 0.209 is not a very small probability, we do not reject H_0.
- Instead, we conclude that H_0 is plausible.

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Large-Sample Tests for a Population Mean

Example:

- A scale is to be calibrated by weighing a 1000 g test weight 60 times.
- The 60 scale readings have mean 1000.6 g and standard deviation 2 g.
- Find the *P*-value for testing

$$H_0 : \mu = 1000 \; versus \; H_1 : \mu \neq 1000.$$

Solution:

$$H_0 : \mu = 1000 \; versus \; H_1 : \mu \neq 1000.$$

We assume H_0 is true

$$z = \frac{1000.6 - 1000}{0.258}$$

$$= 2.32$$

Solution:

- The *P*-value is the sum of the areas in both of these tails, which is 0.0204.
- Therefore, if H_0 is true, the probability of a result as extreme as or more extreme than that observed is only 0.0204.
- The evidence against H_0 is pretty strong. It would be prudent to reject H_0 and to recalibrate the scale.

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