Introduction to Statistics and Data Science using *eStat*

Chapter 7 Testing Hypothesis for Single Population

7.3 Testing Hypothesis for a Population Proportion

Jung Jin Lee
Professor of Soongsil University, Korea
Visiting Professor of ADA University, Azerbaijan

7.3 Testing Hypothesis for a Population Proportion

- Examples for testing hypothesis of population proportions.

  - Will the approval rating of a particular candidate exceed 50 percent in this year's presidential election?

  - The unemployment rate was 7 percent last year. Has this year's unemployment rate increased?

  - 10,000 car accessories are imported by ship, of which 2 percent were defective according to past experience. Is the defective product 2% this time again?

7.3 Testing Hypothesis for a Population Proportion

Table 7.3.1 Testing hypothesis for population proportion
– large sample case such as $np_0 > 5$, $n(1-p_0) > 5$

Type of Hypothesis	Decision Rule
1) $H_0 : p = p_0$ $H_1 : p > p_0$	If $\frac{\hat{p}-p_0}{\sqrt{p_0(1-p_0)/n}} > z_\alpha$, then reject H_0, else accept H_0
2) $H_0 : p = p_0$ $H_1 : p < p_0$	If $\frac{\hat{p}-p_0}{\sqrt{p_0(1-p_0)/n}} < -z_\alpha$, then reject H_0, else accept H_0
3) $H_0 : p = p_0$ $H_1 : p \neq p_0$	If $\left\| \frac{\hat{p}-p_0}{\sqrt{p_0(1-p_0)/n}} \right\| > z_{\alpha/2}$, then reject H_0, else accept H_0

Note: The null hypothesis in 1) can be written as $H_0 : p \leq p_0$ and in 2) as $H_0 : p \geq p_0$

7.3 Testing Hypothesis for a Population Proportion

[Example 7.3.1] A survey was conducted last month for the election of a national assembly member.

- According to the survey of the last month, the approval rating of a particular candidate was 60 percent.
- In order to see if there is a change in the approval rating, a sample survey of 100 people has been conducted and 55 people supported it.

1) Test whether the current approval rating for a particular candidate is changed comparing with the one of last month of 60%. Use 5% significance level.

2) Check the result using 『eStatU』.

7.3 Testing Hypothesis for a Population Proportion

<Answer of Example 7.3.1>

1) Hypothesis is $H_0 : p = 0.6$, $H_1 : p \neq 0.6$, .

Since np_0 = 60, $n(1-p_0)$ = 40, it can be considered as a large sample.

Decision rule is as follows:

'If $\left| \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \right| > z_{\alpha/2}$, reject H_0 '

Since $\hat{p}$ = 55/100 = 0.55,

$$\left| \frac{0.55 - 0.6}{\sqrt{\frac{0.6\,(1-0.6))}{100}}} \right| = | -1.005 | = 1.005$$

$z_{\alpha/2} = z_{0.05/2}$ = 1.96

Hence, H_0 is accepted.

7.3 Testing Hypothesis for a Population Proportion

<Answer of Example 7.3.1 > 2) Select 'Testing Hypothesis p' at 『eStatU』 menu. Enter p_0 = 0.6, select two sided test and 5% significance level. Then enter sample size n = 100, and the sample proportion $\hat{p}$ = 0.55. If you click the [Execute] button, confidence interval of p and testing result will be shown.

Testing Hypothesis p Menu

[Hypothesis] $H_o : p = p_o$ 0.6 $0 < p_o < 1$

◉ $H_1 : p \neq p_o$ ○ $H_1 : p > p_o$ ○ $H_1 : p < p_o$

[Test Type] Z test

Significance Level α = ◉ 5% ○ 1%

[Sample Data]

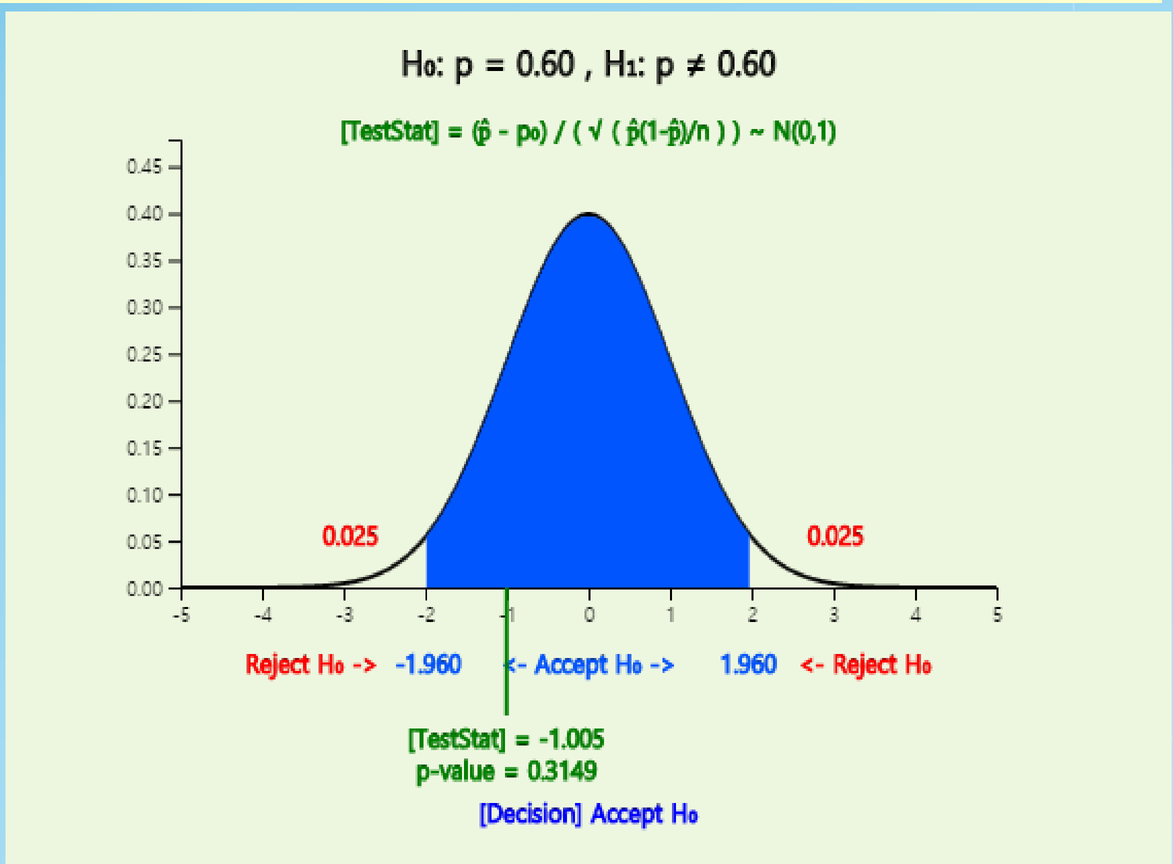
Sample Size n = 100

Sample Proportion $\hat{p}$ = 0.55 $0 < \hat{p} < 1$

Execute

[Confidence Interval]

$\hat{p} \pm z_{\alpha/2} \sqrt{\hat{p}(1-\hat{p})/n} \Leftrightarrow$ (0.452 , 0.648)



Thank you