

Null Hypothesis H_0 : Statement being tested; Claim about μ or historical value of μ

Given Null Hypothesis: $\mu = k$ k is a value of the mean given

μ is the population mean discussed throughout the worksheet

Alternative Hypothesis H_1 : Statement you will adopt in the situation in which evidence(data) is strong so H_0 is rejected.

Why do hypothesis testing? Sample mean may be different from the population mean.

Type of Test to Apply:

Right Tailed

$\mu > k$ You believe that μ is more than value stated in H_0

Left-Tailed

$\mu < k$ You believe that μ is less than value stated in H_0

Two-Tailed

$\mu \neq k$ You believe that μ is different from the value stated in H_0

Test μ When σ Known(P-Value Method)

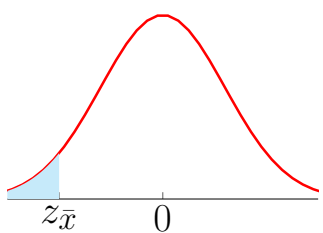
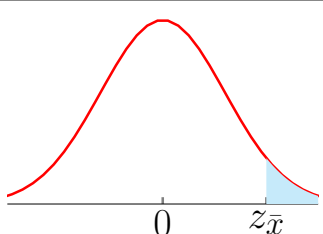
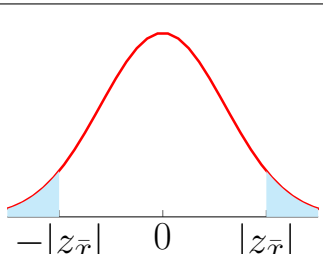
Given x is normal and σ is known: test statistic: $z_{\bar{x}} = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$

\bar{x} = mean of a random sample μ = value stated in H_0 n = sample size

σ = population standard deviation α : Preset level of significance*

***Note:** α is given in all of these approaches used

P-Values and Types of Tests:

Graph	Test	Conclusion
	1. Left-tailed Test $H_0 : \mu = k$ $H_1 : \mu < k$ P-value = $P(z < z_{\bar{x}})$ This is the probability of getting a test statistic as low as or lower than $z_{\bar{x}}$	If P-value $\leq \alpha$, we reject H_0 and say the data are statistically significant at the level α . If P-value $> \alpha$, we do not reject H_0 .
	2. Right-tailed Test $H_0 : \mu = k$ $H_1 : \mu > k$ P-value = $P(z > z_{\bar{x}})$ This is the probability of getting a test statistic as high as or higher than $z_{\bar{x}}$	If P-value $\leq \alpha$, we reject H_0 and say the data are statistically significant at the level α . If P-value $> \alpha$, we do not reject H_0 .
	3. Two-tailed Test $H_0 : \mu = k$ $H_1 : \mu \neq k$ P-value = $2P(z > z_{\bar{x}})$ This is the probability of getting a test statistic either lower than $- z_{\bar{x}} $ or higher than $ z_{\bar{x}} $	If P-value $\leq \alpha$, we reject H_0 and say the data are statistically significant at the level α . If P-value $> \alpha$, we do not reject H_0 .

Test μ When σ Unknown (P-Value Method Continued)

test statistic: $t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$ s = sample standard deviation

Critical Region Method

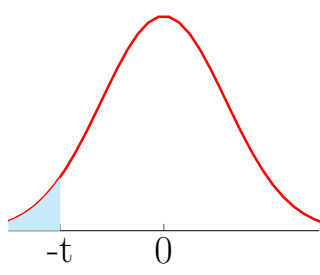
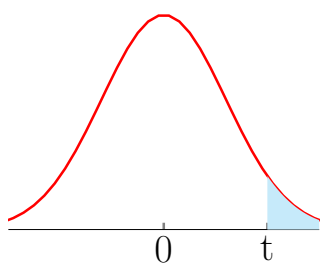
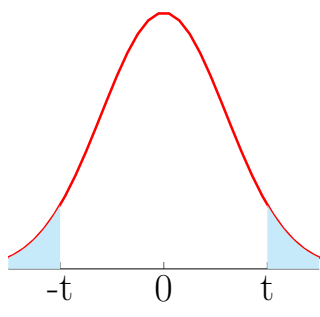
Testing μ when σ is known: test statistic: $z_0 = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$ σ = population standard deviation

μ is the population mean discussed throughout the worksheet

α : Preset level of significance

Note: Assuming a table of areas to the left of z is used, area α is converted to area $1-\alpha$ if you are using the right tailed test.

Also Note: Shaded area in figures below is the critical region.

Graph	Method	Conclusion
	<u>Left-tailed Test</u> $H_0 : \mu = k$ $H_1 : \mu < k$ P-value = $P(z < t)$	If P-value $\leq \alpha$, we reject H_0 . If P-value $> \alpha$, we do not reject H_0 .
	Given Area = α Critical Value: Find z-score of α : $z_c = -t$ Compare z_0 to z_c	If sample test statistic \leq critical value, reject H_0 If sample test statistic $>$ critical value, fail to reject H_0 .
	<u>Right-tailed Test</u> $H_0 : \mu = k$ $H_1 : \mu > k$ P-value = $P(z > t)$	If P-value $\leq \alpha$, we reject H_0 . If P-value $> \alpha$, we do not reject H_0 .
	Given Area = α Critical Value: Find z-score of α : $z_c = t$ Compare z_0 to z_c	If sample test statistic \geq critical value, reject H_0 If sample test statistic $<$ critical value, fail to reject H_0 .
	<u>Two-tailed Test</u> $H_0 : \mu = k$ $H_1 : \mu \neq k$ P-value = $2P(z > t)$	If P-value $\leq \alpha$, we reject H_0 . If P-value $> \alpha$, we do not reject H_0 .
	Area of each shaded region $= \frac{\alpha}{2}$ Critical Value: Find z-score of α : $z_c = -t$ Compare z_0 to z_c	If sample test statistic lies at or beyond critical values, reject H_0 . If sample test statistic lies between critical values, fail to reject H_0 . (Notation: $-t < z_0 < t$)

Note: For each formula to find z-scores, if you can assume that x has a normal distribution, then any sample size n will work. If you cannot assume this, use a sample size $n \geq 30$.