Hypothesis Testing

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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:

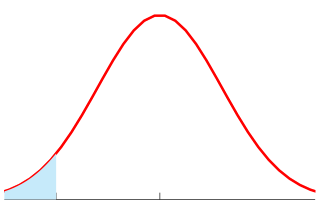
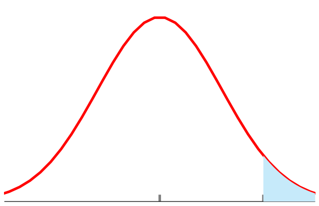
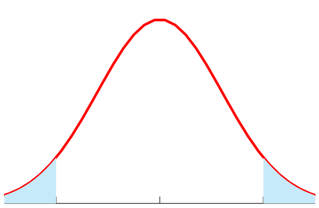
Right Tailed	$\mu > k$ You believe that μ is more than value stated in H_0
Left-Tailed	$\mu < k$ You believe that μ is less than value stated in H_0
Two-Tailed	$\mu \neq k$ You believe that μ is different from the value stated in H_0

Test μ When Known(P-Value Method)

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

$\bar{x}$ = mean of a random sample μ = value stated in H_0 n = sample size
 = 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 $H_0 : \mu = k \quad H_1 : \mu < k$ 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 $H_0 : \mu = k \quad H_1 : \mu > k$ 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 $H_0 : \mu = k \quad H_1 : \mu \neq k$ P-value $= 2P(z > \lvert z_{\bar{x}} \rvert)$ This is the probability of getting a test statistic either lower than $\lvert z_{\bar{x}} \rvert$ or higher than $\lvert z_{\bar{x}} \rvert$	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 Unknown(P-Value Method Continued)

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

Critical Region Method

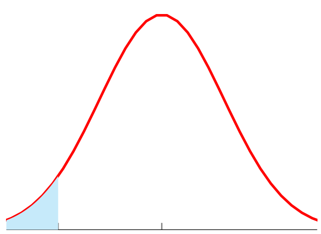
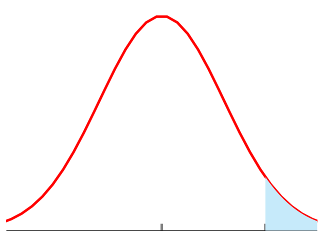
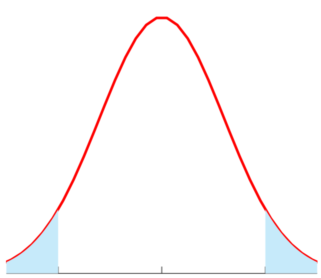
Testing μ when is known: test statistic: $z_0 = \frac{\bar{x} \quad \mu}{/\sqrt{n}}$ = population standard deviation

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-α if you are using the right tailed test.*

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

Graph	Method	Conclusion
	Left-tailed Test $H_0 : \mu = k \quad H_1 : \mu < k$ 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.
	Right-tailed Test $H_0 : \mu = k \quad H_1 : \mu > k$ 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 critical value, reject H_0 If sample test statistic $<$ critical value, fail to reject H_0.
	Two-tailed Test $H_0 : \mu = k \quad H_1 : \mu \neq k$ 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 30.*