

- Hypotheses:** The first step is to clearly state the hypotheses that we are testing in terms of the parameters involved, and to clearly define the parameters in terms of the problem at hand. There will always be two hypotheses, the null and the alternative. For our purposes, the alternative and the null hypotheses will always be the complements.
 - The Null Hypothesis will always contain a statement of equality. Generally this is the “status quo” hypothesis, that nothing has changed from some standard, or that the subset of interest has the same characteristic as the larger population.
 - The Alternative Hypothesis is often called the “research hypothesis” and is generally a statement of what we believe, or hope, to be true.
- Conditions:** Each method we discuss will have certain conditions which must be satisfied. These are conditions about the way we collected our data and the nature of the population, or populations, from which they came. Stating these conditions with each test will remind us what we need, and that these conditions can affect the validity of the test. If any of the conditions are violated, the conclusions we reach are not trustworthy. You should always clearly state which of the conditions are violated, or that all conditions are reasonable in this setting.
- Rejection Region:** In this step we will determine what values of the Test Statistic (see the next step) will lead us to reject

the null hypothesis in favor of the alternative, and which values will not enable us to reject the null hypothesis.

4. **Test Statistic:** This is a statistic (based on our data) whose distribution is known under the assumption that the null hypothesis is true. If the value is abnormal for this distribution, it causes us to doubt, and possibly reject, the null hypothesis.
 5. ***P*-value:** This is a measure of the probability, assuming the null is true, that we would see a test statistic as unusual, or “rare”, as the one we observed.
 6. **Conclusion:** We will then compare the Test Statistic to our Rejection Region, and our *P*-value to our predetermined cut off value α and determine our conclusion to either reject the null hypothesis or fail to reject the null hypothesis. Note that we will never “accept the null hypothesis”. This conclusion should be stated clearly in terms of the problem at hand, in plain English. “Reject the null” or “Fail to reject the null” is not sufficient.
-

Hypothesis Testing Details: For μ , large sample

1. Hypotheses:

$$H_0: \mu = \mu_0 \quad \mu \leq \mu_0 \quad \mu \geq \mu_0$$

$$H_a: \mu \neq \mu_0 \quad \mu > \mu_0 \quad \mu < \mu_0$$

Where: μ is the mean _____ for all _____

2. **Conditions:** We need independent, random observations from a single population and the sample size must be large enough that we can use the Central Limit Theorem.

3. Rejection Region: For the three types of tests:

Left: Reject H_0 if $TS < Z$

Right: Reject H_0 if $TS > Z$

Two: Reject H_0 if $TS < -Z$ or if $TS > Z$

4. Test Statistic:

$$TS = \frac{\bar{X} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$$

5. P-value: For the three types of tests:

Left: P - value = $P(Z < TS)$

Right: P - value = $P(Z > TS)$

Two: P - value = $2 \cdot P(Z > |TS|)$

6. Conclusion: We (do not) have enough evidence ($P=$ __) to suggest that the mean _____ for all _____ is (more than/less than/not) (value of μ_0). (If two tailed, add: "In fact, it is (more/less).")

Hypothesis Testing Details: For μ, σ unknown

1. Hypotheses:

$$H_0: \mu = \mu_0 \quad \mu \leq \mu_0 \quad \mu \geq \mu_0$$

$$H_a: \mu \neq \mu_0 \quad \mu > \mu_0 \quad \mu < \mu_0$$

Where: μ is the mean _____ for all _____

2. Conditions: We need independent, random observations from a normally distributed population and the population variance is unknown.

3. Rejection Region: For the three types of tests:

Left: Reject H_0 if $TS < -t$

Right: Reject H_0 if $TS > t$

Two: Reject H_0 if $TS < -t$ or if $TS > t$

4. Test Statistic:

$$TS = \frac{\bar{X} - \mu_0}{\frac{s}{\sqrt{n}}}$$

5. P-value: For the three types of tests:

Left: Look for $|TS|$ in the $n - 1$ row for df and give a range.

Right: Look for TS in the $n - 1$ row for df and give a range.

Two: Look for $|TS|$ in the $n - 1$ row for df and give a range.

6. Conclusion: We (do not) have enough evidence (α -P α) to suggest that the mean _____ for all _____ is (more than/less than/not) (value of μ_0). (If two tailed, add: "In fact, it is (more/less).")

Hypothesis Testing Details: For p

1. Hypotheses:

$$H_0: p = p_0 \quad p \leq p_0 \quad p \geq p_0$$

$$H_a: p \neq p_0 \quad p > p_0 \quad p < p_0$$

Where: p is the true proportion of all _____ that _____

2. Conditions: We need independent, random observations from a binomial experiment and there must be enough trials that we can use the Central Limit Theorem.

3. Rejection Region: For the three types of tests:

Left: Reject H_0 if $TS < Z$

Right: Reject H_0 if $TS > Z$

Two: Reject H_0 if $TS < -Z$ or $TS > Z$

4. Test Statistic:

$$TS = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 \cdot (1-p_0)}{n}}}$$

5. P-value: For the three types of tests:

Left: P - value = $P(Z < TS)$

Right: P - value = $P(Z > TS)$

Two: P - value = $2 \cdot P(Z > |TS|)$

6. Conclusion: We (do not) have enough evidence ($P=$ __) to suggest that the true proportion of all _____ that _____ is (more than/less than/not) (value of p_0). (If two tailed, add: "In fact, it is (more/less).")