Hypothesis testing is a statistical method that is used in making statistical decisions using experimental data. Hypothesis Testing is basically an assumption that we make about the population parameter.

One-tailed test: When the alternative hypothesis is “less than” or greater than”

- Some key words that might be used for “less than”: less than, fewer than, under filling, below expectations
- Some key words that might be used for “greater than”: greater than, more than, improvement, above speculations, overfilling, exceeds

Two-tailed test: When the alternative hypothesis is “not equal”

- Some key words than might be used for “not equal”: incorrect, differently, is not, different from, not the same as, has changed

<u>Formulas:</u>

Critical Value (Significant Level): C.V. = α (*alpha* usually given), C.V. = $\frac{\alpha}{2}$ (two-tailed test)

If α wasn’t given, then assume it is .05

Degrees of Freedom (needed for t-table): df = n -1

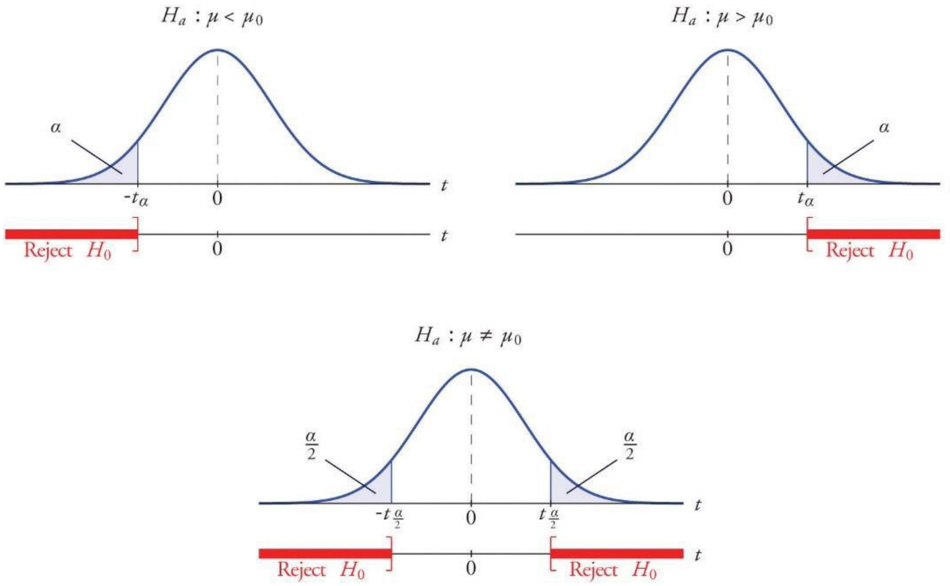
Calculate z-score: $z = \frac{x-\mu}{\sigma/\sqrt{n}}$, use z-score for big sample sizes (n > 30) OR given population standard deviation (σ)

Calculate t-score: $t = \frac{x-x}{s/\sqrt{n}}$, use t-score for small sample sizes (n < 30) OR given sample standard deviation (s)

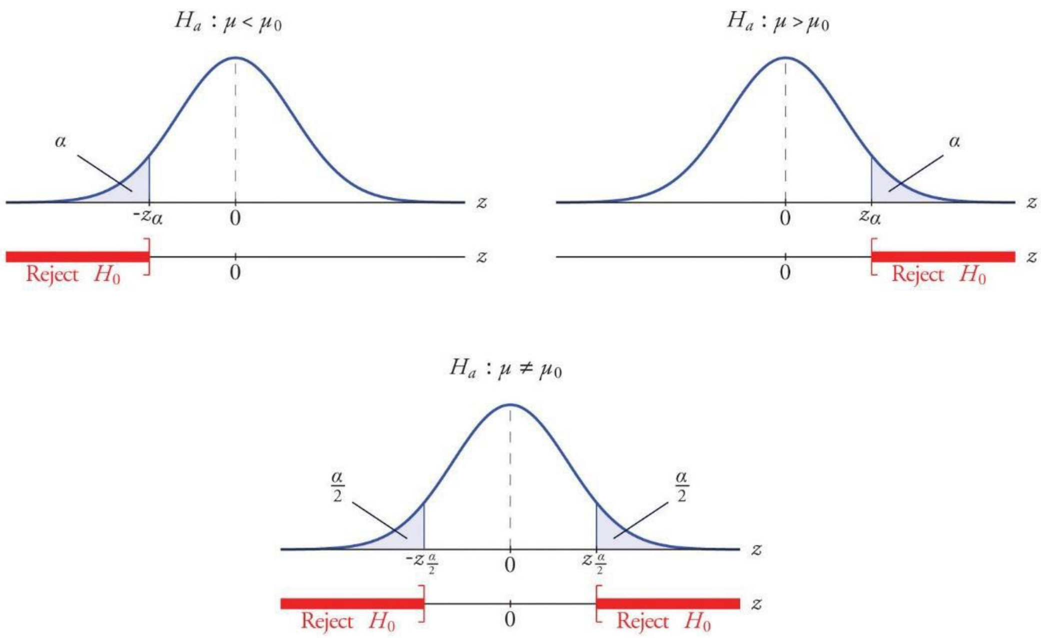
Hypothesis Testing Procedure:

Critical-Value Approach	*P*-Value Approach
Step 1 State the null and alternative hypotheses.	**Step 1** State the null and alternative hypotheses.
Step 2 Decide on the significance level, α.	**Step 2** Decide on the significance level, α.
Step 3 Compute the value of the test statistic.	**Step 3** Compute the value of the test statistic.
Step 4 Determine the critical value(s).	**Step 4** Determine the P-value.
Step 5 If the value of the test statistic falls in the rejection region, reject H_0; otherwise, do not reject H_0.	**Step 5** If $P \leq \alpha$, reject H_0; otherwise, do not reject H_0.
Step 6 Interpret the result of the hypothesis test.	**Step 6** Interpret the result of the hypothesis test.

Hypothesis testing: One-sample t-test



Hypothesis testing: One-sample z-test



Compare the critical value with the test statistic:

Two-Tailed

If $t < -t_{\alpha/2}$ or $t > t_{\alpha/2}$, reject the null hypothesis

Left-Tailed

If $t < -t_\alpha$, reject the null hypothesis

Right-Tailed

If $t > t_\alpha$, reject the null hypothesis

Two-Tailed

If $Z < -z_{\alpha/2}$ or $Z > z_{\alpha/2}$ reject the null hypothesis

Left-Tailed

If $Z < -z_\alpha$ reject the null hypothesis

Right-Tailed

If $Z > z_\alpha$ reject the null hypothesis

Explanation of the pictures:

For one-tailed z OR t test:

less than (<) hypothesis means the critical value will be negative

greater than (>) hypothesis means the critical value will be positive

If $p < \alpha$ **OR** $z_{test} < z_{critical}$ then you will Reject H_o due to sufficient evidence

If $p > \alpha$ **OR** $z_{test} > z_{critical}$ then you will Fail to Reject H_o due to insufficient evidence

If $p < \alpha$ **OR** $t_{test} < t_{critical}$ then you will Reject H_o due to sufficient evidence

If $p > \alpha$ **OR** $t_{test} > t_{critical}$ then you will Fail to Reject H_o due to insufficient evidence

For two-tailed z OR t test:

not equal (≠) means the critical value will be negative AND positive which is why an absolute value will be used

If $p < \alpha$ **OR** $z_{test} < -z_{critical}$ **OR** $z_{test} > +z_{critical}$, then you will Reject H_o due to sufficient evidence

If $p > \alpha$ **OR** $-z_{critical} < z_{test} < +z_{critical}$, then you will Fail to Reject H_o due to insufficient evidence

If $p < \alpha$ **OR** $t_{test} < -t_{critical}$ **OR** $t_{test} > +t_{critical}$, then you will Reject H_o due to sufficient evidence

If $p > \alpha$ **OR** $-t_{critical} < t_{test} < +t_{critical}$, then you will Fail to Reject H_o due to insufficient evidence

Population Proportion Hypothesis Testing

If $p_0 \geq 5$ and $n(1 - p_0) \geq 5$, then the appropriate test statistic is given by:

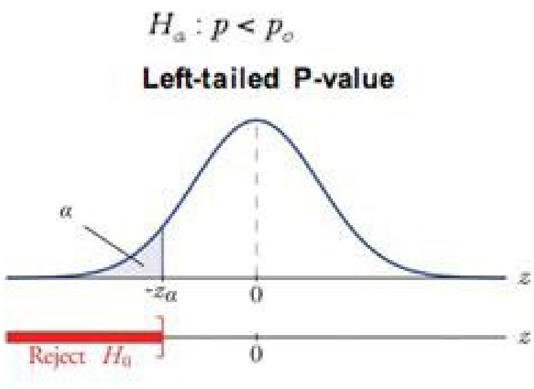
Calculate the test statistic, z

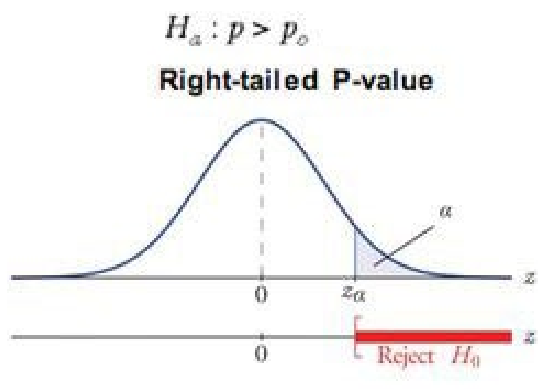
$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

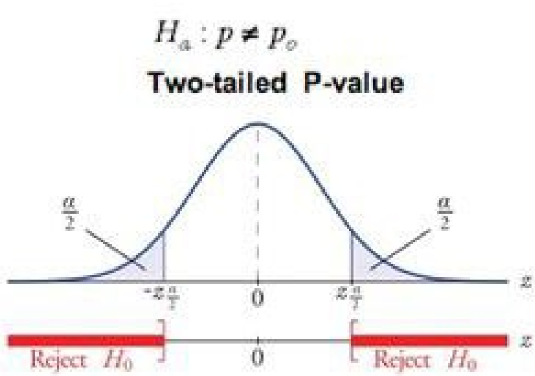
$\hat{p}$ = sample proportion

p_0 = hypothesize population proportion

n = sample size







Two-Tailed

If $Z < -z_{\alpha/2}$ or $Z > z_{\alpha/2}$ reject the null hypothesis

Left-Tailed

If $Z < -z_\alpha$ reject the null hypothesis

Right-Tailed

If $Z > z_\alpha$ reject the null hypothesis

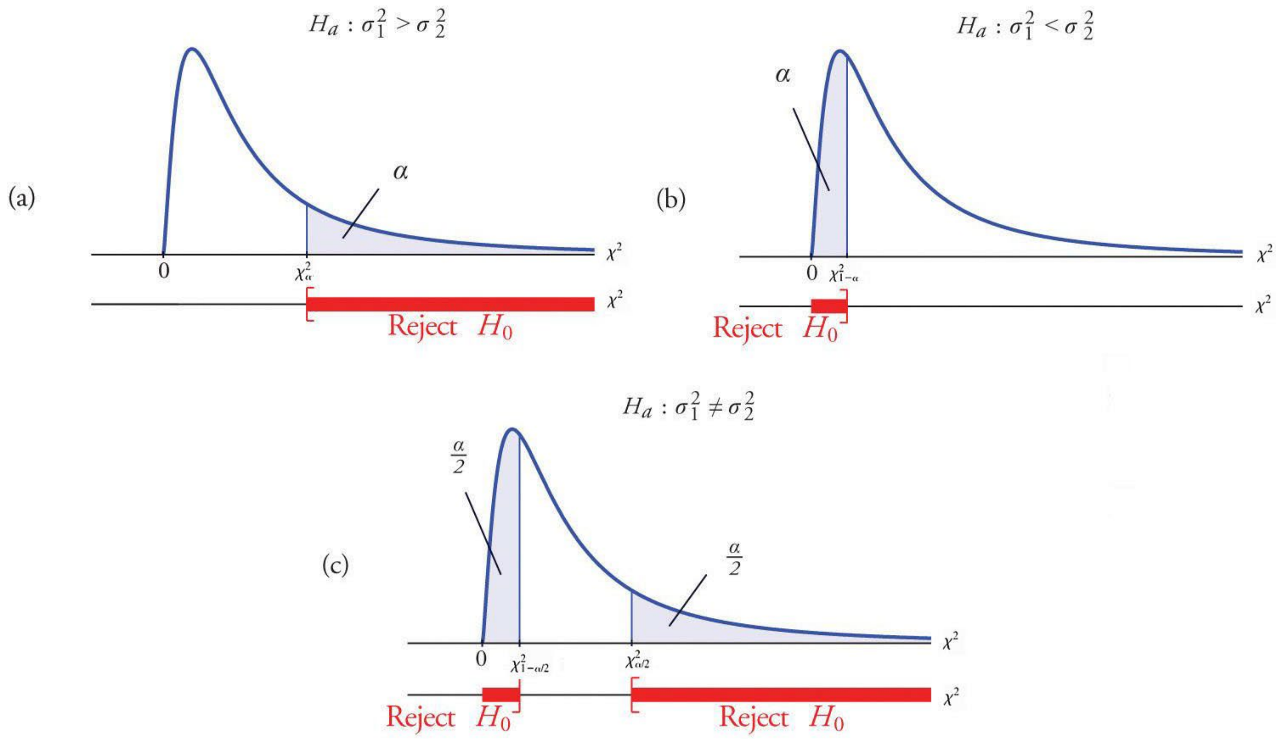
Chi-Squared Hypothesis Testing

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

where s = sample standard deviation and σ = population standard deviation

When using the chi-square table to look for the critical value: degrees of freedom (df) = n – 1

Hypothesis testing: One-sample chi-squared test



Compare the critical value with the test statistic.

Two-Tailed

If $\chi^2 < \chi^2_{1-\alpha/2}$ or $\chi^2 > \chi^2_{\alpha/2}$, reject the null hypothesis.

Left-Tailed

If $\chi^2 < \chi^2_{1-\alpha}$, reject the null hypothesis.

Right-Tailed

If $\chi^2 > \chi^2_{\alpha}$, reject the null hypothesis.