Hypothesis Testing - Intro

Two major areas of statistics:

1) Descriptive (X, S, graphs, etc.)
2) Inference

Hypothesis testing is a procedure in which we use data to decide which of two hypotheses is more likely to be true.

Hypothesis testing allows us to make an inference.
7 Steps in Performing a Test of Hypothesis:
1) State null hypothesis, $H_0$
2) State alternate hypothesis, $H_1$
3) Decide on significance level, $\alpha$
4) Calculate the appropriate test statistic
5) Use tables to find the "p-value" of the test statistic
6) Make decision
7) State conclusions (and assumptions, if any)
Hypotheses

A hypothesis is a statement about a pop. parameter

A hypothesis may be either true or false

In hypothesis testing, we must decide which of two mutually exclusive hypotheses is supported by the data.
The null hypothesis is labeled $H_0$.

The alternate (or research) hypothesis is $H_1$ or $H_A$. 
Ho vs. Ha

The null hypothesis $H_0$ typically expresses the idea of "no difference," "no change" or "equality."

$H_0$ typically contains an $=$ (or $\geq$ or $\leq$) sign

The alternate hypothesis $H_1$ expresses the idea of "some difference" or "some change" or inequality.
$H_a$ typically contains an inequality symbol ($<$ or $>$ or $\neq$).

Ex: a) The mean age of all college students is 21 yrs

$H_0: \mu = 21$

b) The mean age of all college students is not 21 yrs

$H_a: \mu \neq 21$ (two-sided alternative)
c) Mean age of all college students is less than 21 yrs
   \[ H_0: \mu \leq 21 \]
   \[ H_a: \mu < 21 \]

(d) Mean age of all college students is greater than 21 yrs
   \[ H_0: \mu \geq 21 \]
   \[ H_a: \mu > 21 \]

(c), (d) are examples of one-sided alternatives

\[ H_0, H_a \] are specified before any data is collected.
The null hypothesis \( H_0 \) may also state
\( H_0: \) the observed results are due to chance

The alternate hypothesis \( H_A \) may say:
\( H_A: \) the observed results are due to the effect of some treatment.

EX: Randomized Controlled Experiment
Treatment - take aspirin
Control - " placebo

\( H_0: \) Any difference in rate of heart attack is due to chance

So \( H_0: \) \( P_T = P_c \)

\( H_A: \) Aspirin reduces the rate of heart attack

So \( H_A: \) \( P_T < P_c \)