Two-Sample for Means - Key

1. The average amount of time boys and girls ages 7 through 11 spend playing sports each day is believed to be the same. It is already known that the distributions of the amounts of time boys and girls spend playing sports each day are Normally distributed. An experiment is done using a random sample of boys and girls, data is collected, resulting in the table below:

	n	$\bar{x}$	s_x
Girls	9	2	0.866
Boys	16	3.2	1

Is there sufficient evidence to suggest there is a difference in the mean amount of time boys and girls ages 7 through 11 play sports each day? Run the appropriate test at the 5% significance level.

Let μ_g = the mean amount of time girls ages 7-11 spend playing sports in a day and μ_b = the mean amount of time boys ages 7-11 spend playing sports in a day.

H_0: $\mu_g = \mu_b$

H_a: $\mu_g \neq \mu_b$

Two-Sample t Test for Means

Conditions:

Random sample of 9 girls and 16 boys.

10% Condition is met: $10n_g = 10(9) = 90 < N_g$ and $10n_b = 10(16) = 160 < N_b$

The population distributions are Normally distributed.

2-SampTTest ⇒ $t = -3.1424$ p-value = 0.0054

Our p-value of 0.0054 is less than $\alpha = 0.01$, thus we reject the null hypothesis in favor of the alternative hypothesis. There is sufficient evidence to suggest that μ_g = the mean amount of time girls ages 7-11 spend playing sports in a day and μ_b = the mean amount of time boys ages 7-11 spend playing sports in a day are not equal.

2. A study was conducted to investigate the effectiveness of hypnotism in reducing pain. Eight randomly selected patients measured their pain before and after being hypnotized. A higher pain score indicates that they were in more pain. A significance test with α = 0.05 for μ_d = the mean difference in pain after and before hypnosis (after - before) and a null hypothesis that $\mu_d = 0$ resulted in a test statistic of -2.37.

a. What would the p-value and decision be for the alternative hypothesis $\mu < 0$? Draw a picture of the t-distribution, label the test statistic, and shade the p-value.

tcdf(lower = -100, upper = -2.37, df = 7) = 0.0248

p-value = 0.0248

b. What would the p-value and decision be for the alternative hypothesis $\mu > 0$? Draw a picture of the t-distribution, label the test statistic, and shade the p-value.

tcdf(lower = -2.37, upper = 100, df = 7) = 0.9752

p-value = 0.9752

c. What would the p-value and decision be for the alternative hypothesis $\mu \neq 0$? Draw a picture of the t-distribution, label the test statistic, and shade the p-value.

tcdf(lower = -100, upper = -2.37, df = 7) = 0.0248

p-value = 2(0.0248) = 0.0496

3. A genetic engineering company claims that it has developed a genetically modified tomato plant that yields on average more tomatoes than other varieties. A farmer wants to test the claim on a small scale before committing to a full-scale planting. Ten genetically modified tomato plants are grown from seeds along with ten other tomato plants. At the season's end, the resulting yields in pounds are recorded as below.

Modified	20	23	27	25	25	25	27	23	24	22
Regular	21	21	22	18	20	20	18	25	23	20

Run the appropriate test at the 10% significance level.

Let μ_M = the mean number of pounds produced by modified plants and μ_R = the mean number of pounds produced by regular plants

H_0: $\mu_M = \mu_R$

H_a: $\mu_M > \mu_R$

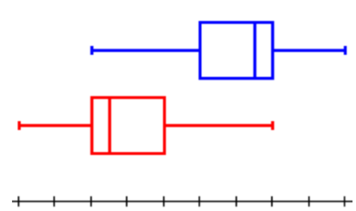
Two-Sample t Test for Means

Conditions:

Random sampling is not mentioned in the problem (oops!)

10% Condition is met: $10n_M = 10(10) = 100 < N_M$ and $10n_R = 10(10) = 100 < N_R$

The boxplot for both data sets are roughly symmetric, so it is reasonable to assume that the populations could be Normally distributed. (note: scale needed on x-axis)



2-SampTTest

$t = 3.4057$ p-value = 0.001576

Our p-value of 0.001576 is less than $\alpha = 0.1$, thus we reject the null hypothesis in favor of the alternative hypothesis. There is sufficient evidence to suggest that μ_M = the mean number of pounds produced by modified plants is greater than μ_R = the mean number of pounds produced by regular plants.

4. Engineers at a tire manufacturing corporation wish to test a new tire material for increased durability. To test the tires under realistic road conditions, new front tires are mounted on each of 11 company cars, one tire made with a production material and the other with the experimental material. After a fixed period the 11 pairs were measured for wear. The amount of wear for each tire (in mm) is shown in the table:

Car	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Production	5.1	6.5	3.6	3.5	5.7	5.0	6.4	4.7	3.2	3.5	6.4
Experimental	5.0	6.5	3.1	3.7	4.5	4.1	5.3	2.6	3.0	3.5	5.1

Let μ_d = the mean difference (regular - experimental) in the amount of wear for tires.

$H_0: \mu_d = 0$

$H_a: \mu_d > 0$

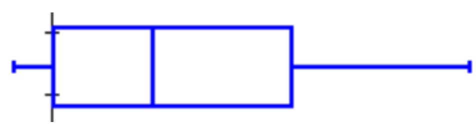
Two-Sample t Test for Means - Paired Data

Conditions:

A random sample of 11 pairs of tires.

10% Condition is met: 10n = 10(11) = 110 < N

The boxplot is fairly symmetric, so it is reasonable to assume that the population could be Normally distributed.



TTest

t = 3.0142 p-value = 0.0065

Our p-value of 0.0065 is less than $\alpha = 0.05$, thus we reject the null hypothesis in favor of the alternative hypothesis. There is sufficient evidence to suggest that μ_d = the mean difference in the amount of wear for regular and experimental tires is greater than zero.