Exercise 1. Researchers studying the effects of the drug ecstasy claim to have found a 5% smaller volume of gray matter in the brains of ecstasy users compared to non-users. The following data is hypothetical. MRI imaging of the brains of 10 ecstasy users (they averaged 281 tablets over the last 6 years) and 7 non-users who were otherwise similar gave

$$\overline{x} = 840 \text{ cm}^3 \text{ and } s_1 = 70 \text{ cm}^3$$
$$\overline{y} = 884 \text{ cm}^3 \text{ and } s_2 = 66 \text{ cm}^3.$$

a) Decide on some hypothesis to test.

b) Use a two-sample t-test to test your hypotheses.

c) Find a 95% confidence interval for the difference $\mu_1 - \mu_2$.

One basic assumption for our two-sample tests is the independence of the two samples. This assumption may not always be warranted. In the following problem the data are *paired* so we need a different technique to test our hypotheses.

Exercise 2. (Problem 41 of chapter 9) In an experiment designed to study the effects of illumination level on task performance ("Performance of Complex Tasks Under Different Levels of Illumination," *J. Illumination Eng.* 1976: 235-242) 9 subjects were required to insert a fine-tipped probe into the eyes of ten needles both for a low light level with a black background and a high light level with a white background. The data are as follows (time to completion in seconds)

	1	2	3	4	5	6	7	8	9
Black	25.85	28.84	32.05	25.74	20.89	41.05	25.01	24.96	27.47
White	18.23	20.84	22.96	19.68	19.50	24.98	16.61	16.07	24.59

We wish to determine whether the data is evidence that higher illumination levels yield a decrease of more than 5 seconds. Our analysis will be based on the differences in the two times for each of the test subjects. Our hypotheses can be expressed as $H_0 : \overline{D} = 5$ and $H_a : \overline{D} > 5$ where $\overline{D}$ is the mean of the differences. Carry out a 1-sample t-test for the differences.

a) Calculate the difference between the times for each subject.

b) Calculate the sample mean and sample standard deviation of the differences.

c) Calculate the P-value for the differences and evaluate the hypotheses.