1. (From p. 536 #8) A reading test is given to both a control group and an experimental group (which received additional tutoring). The average score for the 30 subjects in the control group was 349.2 with a standard deviation of 56.6. The average score for the 30 subjects in the experimental group was 368.4 with a standard deviation of 39.5. Use a 4% level of significance to test the claim that the experimental group performed better than the control group.

**Answer.** (Version 1) We wish to conduct the test $H_0 : \mu_1 = \mu_2$ versus $H_1 : \mu_1 > \mu_2$ where population 1 is all people who received the special tutoring, and population 2 is all people who did not receive special tutoring. We use the formula 
\[
z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sigma_{x_1-x_2}}
\]
where
\[
\sigma_{x_1-x_2} = \sqrt{\frac{\sigma^2_1}{n_1} + \frac{\sigma^2_2}{n_2}}
\]
Thus
\[
\sigma_{x_1-x_2} = \sqrt{\frac{39.5^2}{30} + \frac{56.6^2}{30}} = 12.6013
\]
Therefore, $z = \frac{(368.4 - 349.2) - 0}{12.6013} = 1.52$. The P-value is $P(z > 1.52) = 1 - .9357 = .0643$. Because the P-value is larger than $\alpha = .04$, we do not reject the null hypothesis at a 4% level of significance. There is not sufficient evidence to show that the tutoring increases the mean score.

(Version 2) Notice we get the same conclusion, but we change from a right-tailed to a left-tailed test if we let population 2 be all people who received the special tutoring, and population 1 be all people who did not receive special tutoring. We then have the left-tailed test

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 < \mu_2$

and find
\[
\sigma_{x_1-x_2} = \sqrt{\frac{56.6^2}{30} + \frac{39.5^2}{30}} = 12.6013
\]
Therefore, $z = \frac{(349.2 - 368.4) - 0}{12.6013} = -1.52$. The P-value is $P(z < -1.52) = 0.0643$. Because the P-value is larger than $\alpha = .04$, we do not reject the null hypothesis at a 4% level of significance. There is not sufficient evidence to show that the tutoring increases the mean score.