1. Find the article you found for your very first homework assignment. For this article, find (1) the population of interest, (2) a description of how the sample was taken, (3) the sample size, (4) an interpretation of a confidence interval (if one exists), (5) a description of the null and alternative hypotheses from a test (if one exists), and (6) the value of a test statistic, its null distribution, and a P-value (if one exists).

   Solution: This will vary greatly by student.

2. Exercise 7.18 (page 247). Also use the R function `pt` to determine P-values precisely.
   Use the t table and R to find two-tailed p-values.

   Solution:

   (a) $t = -3.13$. Using the t-table, $0.02 < p < 0.04$. Using R,

   ```
   > 2 * pt((735 - 854)/38, 4)
   [1] 0.03513171
   ```

   (b) $t = 1.25$. Using the t-table, $0.20 < p < 0.40$. Using R,

   ```
   > 2 * (1 - pt((5.3 - 5)/0.24, 12))
   [1] 0.2351279
   ```

   (c) $t = 4.62$. Using the t-table, $p < 0.001$. Using R,

   ```
   > 2 * (1 - pt((36 - 30)/1.3, 30))
   [1] 6.886451e-05
   ```

3. Exercise 7.20 (page 248).
   State whether or not H_0 would be rejected.

   Solution:

   (a) yes, $p < \alpha$.
   (b) no, $p > \alpha$.
   (c) yes, $p < 2(0.005) = 0.01 = \alpha$.
   (d) no, $p > 2(0.04) = 0.08 > \alpha$.

4. Exercise 7.24 (page 249). Also use the R function `pt` to determine P-values precisely.
   The data is concentration of amine serotonin in patients who had died of heart disease and controls.

   Solution:

   (a) **Use a t-test at the 5% significance level.**
   H_0: $\mu_1 = \mu_2$
   H_A: $\mu_1 \neq \mu_2$
   $t = -1.38$.
   $p = 0.19$.

   (b) **State the conclusion in the context of the setting.**
   There is insufficient evidence to conclude that mean amine serotonin concentration differs in patients who died from heart disease and a control group of patients who died from other causes ($p = 0.19$ from a two-sided t-test for two independent samples). The observed difference in sample means (-1470 ng/gm) can be explained by chance variation. If a difference of this size is of clinical importance, a large study would be necessary to find statistical significance.

   (c) **Verify the value of SE.**

   ```
   > sqrt(850^2 + 640^2)
   [1] 1064.002
   ```

5. Exercise 7.26 (page 250). Also use the R function `pt` to determine P-values precisely.
   Data is the weight of the thymus gland in chick embryos that had incubated 14 and 15 days.

   Solution:

(a) **Use a t-test to compare means with $\alpha = 0.10$.**
H_0: $\mu_1 = \mu_2$
H_A: $\mu_1 \neq \mu_2$
$t = 0.49$.
$df = 7.7$.
$p = 0.64$.

(b) **Is it surprising that the mean is smaller for the 15-day chicks?**
There is insufficient evidence to conclude that there is a difference in thymus gland weights between 14-day and 15-day old chicks (two-tailed $p = 0.64$ in an independent sample t-test to compare population means). The fact that the 15-day chicks have a smaller sample mean can be explained by chance variation.

6. Exercise 7.34 (page 260).
The null hypothesis is that the drug is not effective. If the FDA approves the drug, what type of error (Type I or Type II) could not have been made?

Solution: A Type I error is the mistake of rejecting the null hypothesis when it is true. A Type II error is the mistake of not rejecting the null hypothesis when it is false. Since the FDA rejected the null hypothesis, they could not have made a Type II error.

7. Exercise 7.41 (page 269).
The data is baseline measurements of total ventilation (liters of air per minute per square meter of body area) for an experimental and control group before a hypnosis experiment.

Solution:

(a) **Use a two-sided t-test to test the hypothesis of no difference in population means.**
H_0: $\mu_1 = \mu_2$
H_A: $\mu_1 \neq \mu_2$
$t = 2.76$.
$df = 14$.
$p = 0.015$.
There is evidence that the mean baseline total ventilation would be different for people expecting to be hypnotized and those who are not.

(b) **Use a one-sided test of no difference in population means versus the alternative that the experimental group will have a larger mean.**
H_0: $\mu_1 = \mu_2$
H_A: $\mu_1 > \mu_2$
$t = 2.76$.
$df = 14$.
$p = 0.0077$.
There is evidence that the mean baseline total ventilation would be higher for people expecting to be hypnotized and those who are not.

(c) **Which test is more appropriate?**
In the context of the problem, there is a reason to think that the experimental conditions could cause an increase in total ventilation in the experimental group as a response to their anticipation of being hypnotized. Therefore, the one-sided test is more appropriate.

[Note: this problem is typical in that you are asked to perform inference using procedures that assume random samples from populations on a data set in which individuals are not sampled from a populations, but rather, are volunteers. It would be more accurate to conclude that for this group of volunteers, knowledge of the treatment allocation affected the baseline measurement because the observed difference in sample means is large compared to what we might expect to see relative to all possible randomizations. Extrapolation of the results to other groups of people depends on belief that the results would apply more broadly, but should not be justified with statistical sampling theory.]

8. Exercise 7.47 (page 276).
Construct a 95% confidence interval for the difference in population mean fetal heart rates of males and females.

Solution:

We find that the formula for degrees of freedom gives 486.2, which is essentially the standard normal curve. R give a multiplier of 1.965 which is very close to the 1.960 for the standard normal. The confidence interval is $-1.57 < \mu_1 - \mu_2 < -1.57$. In the context of the problem, we are 95% confident that the mean difference in fetal heart rates between males and females is between -1.57 and -1.57 beats per minute. A difference of two beats per minute (in light of means near 137 and knowledge of variability in healthy individuals) is almost certainly not of any medical importance. The data suggests that any real difference between male and female mean fetal heart rates is of little or none practical importance.

9. Exercise 7.81 (page 308). Use R to construct a 95% confidence interval for the difference in population means as well as to conduct a t test. Interpret the results in the context of the problem.

Here is one way to use R for this problem. Enter the data as a text file using NotePad or some other text editor.

```
activity diet
42.3     low-chromium
51.5     low-chromium
.
.
.
52.1     low-chromium
53.1     normal
50.7     normal
.
.
.
53.7     normal
```

Say we named this file "`ex7-81.txt`". Read the data set into R to an object rats with the command

```
rats <- read.table("ex7-81.txt",header=T)
```

(You can also read in data from the File menu in the Windows version of R.)

You can use the `plot` function to produce side-by-side modified boxplots.

```
plot(activity ~ diet, data=rats)
```

You can do formal inference with the `t.test` command.

```
t.test(activity ~ diet, data=rats, conf.level=0.95)
```

The function `activity ~ diet` means that the response variable `activity` "is modeled as" a mean value that depends on the explanatory variable `diet` plus random error.

Data is activity of the liver enzyme GITH measured with counts per minute per gram of liver tissue of a radioactively labeled molecule. Compare rats on low-chromium and normal diets.

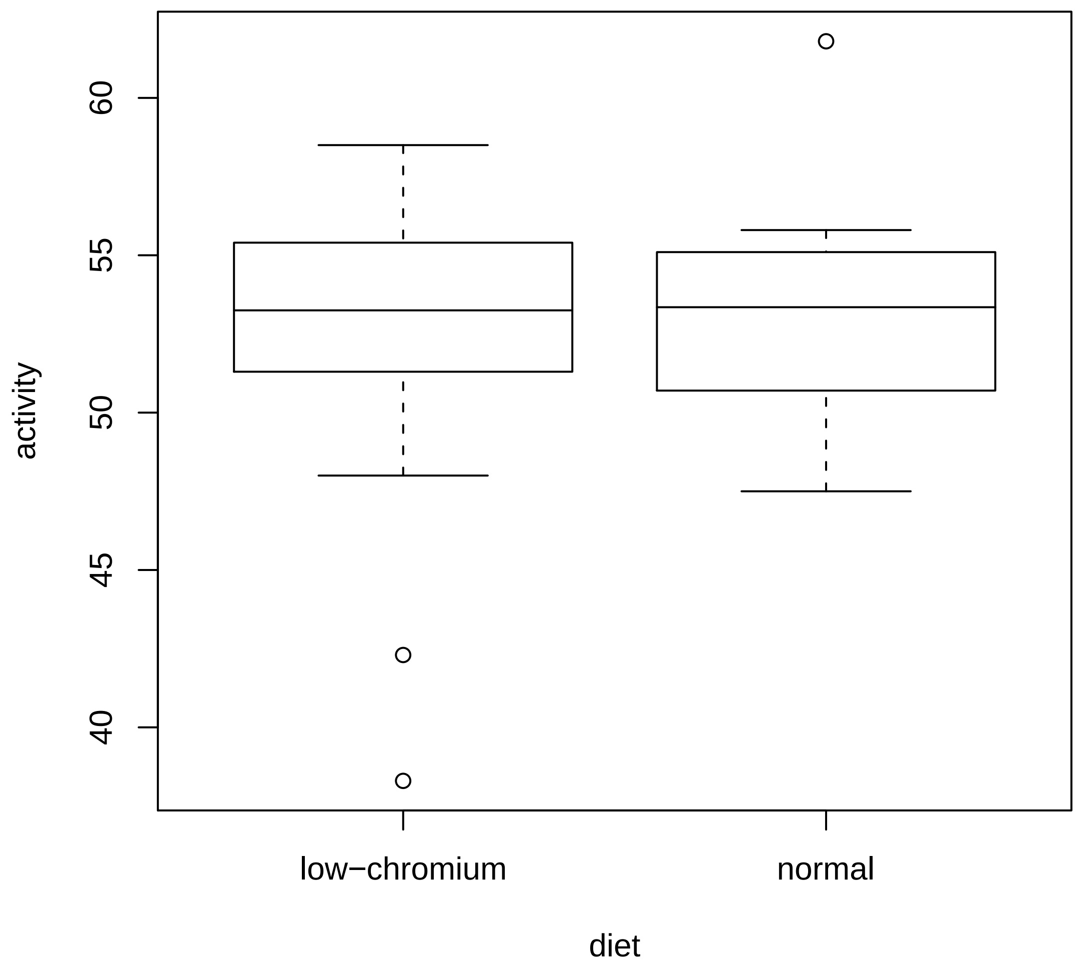
Solution:

```
> rats <- read.table("ex7-81.txt", header = T)
> plot(activity ~ diet, data = rats)
> t.test(activity ~ diet, data = rats, conf.level = 0.95)

        Welch Two Sample t-test

data:  activity by diet
```

```
t = -0.7208, df = 21.924, p-value = 0.4786
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -5.506389  2.666389
sample estimates:
mean in group low-chromium       mean in group normal
                     51.75                      53.17
```



The boxplot shows that the distributions are fairly symmetric except for a couple low outliers in the low-chromium sample and a high outlier in the normal diet sample. The spread is similar in both samples and the medians are quite close. The outliers and small sample sizes raise some concerns about the validity of the confidence interval and the t test, although the outliers are not too extreme. (It would be interesting to use a mehtod that is less prone to the effects of outliers to see how much of a difference they make.)

The observed p-value is 0.4786. This indicates that the observed data is consistent with the null hypothesis.

In the context of the problem we could say that there is little evidence that a low chromium diet affects the GITH in rats (two-sided p=0.48 from a t test for equality of population means) and that we are 95% confident that the true difference is between -5.5 and 2.7 counts per minute per gram of liver tissue.