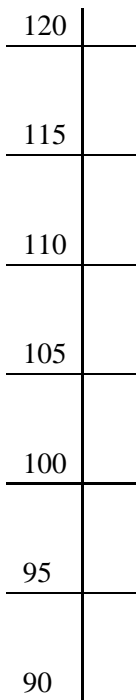


1. Radon is a colorless, odorless gas that is naturally released by rocks and soils and may concentrate in tightly closed houses. There is some concern that radon may pose a health risk because of its radioactivity. Homeowners sometimes buy detectors designed to measure the radon level in a home. A company that manufactures thousands of radon detectors selected 11 of its detectors at random for careful testing. Researchers placed the sample of 11 detectors in a chamber where they were exposed to 105 picocuries per liter of radon over seven days. Here are the readings given by the detectors at the end of the seven day period.

91.9 95.0 96.6 97.8 99.6 101.7 103.8 104.8 105.4 111.4 119.3

The average of the 11 readings is 102.48. The standard deviation of the 11 readings is 7.82.

- (a) Give the five-number summary for these 11 readings and make the corresponding box plot to the right of the scale below.



- (b) If the researchers could have exposed the population of all the company's detectors to 105 picocuries per liter of radon over seven days, do you think the mean reading of all detectors in the population would be 105? Support your answer with a 95% confidence interval for the mean reading of all detectors.

2. Seven small hog operations spread throughout Iowa agree to participate in an experiment to compare the effect of two diets on lean percentage of hogs at the time of slaughter. At each of the seven hog operations, two pens containing five hogs each are available for use in the experiment. One of the pens at each hog operation is assigned at random to receive diet A. The other pen receives diet B. Because of the way the hogs are fed, all hogs in any one pen must receive the same diet. Thus the experimental unit is a hog pen in this problem. At the time of slaughter the researchers determine the average lean percentage of the five hogs in each pen. Those averages are presented in the table below. You can ignore the fact that the numbers in the table are actually averages. Just treat them as single observations on each pen.

Hog Operation	Diet A Pen Average	Diet B Pen Average
1	58	57
2	59	57
3	55	52
4	57	56
5	55	53
6	64	62
7	60	57

Is there a significant difference between diets? Provide a test statistic,  $p$ -value, and conclusion to answer this question.

3. The following article appeared in the *Second Opinion* column of the September 16, 2001 issue of *Parade* magazine.

### **Do Naps Lead to Heart Attacks?**

A nice long siesta is good for you, right? Maybe not. I was surprised to read about a Harvard study of 1000 men and women in Cost Rica, half of whom had suffered a heart attack. It found that the heart-attack patients, as a group, were much more likely to have enjoyed daily siestas – and longer ones – than their healthy peers.... The researchers postulated that increased blood pressure after resting or sleeping, or some change in blood coagulability, may predispose persons to heart attacks.

- (a) Does the article describe an experiment or an observational study? Explain.
- (b) One interpretation of the results is that long daily siestas (i.e., naps) cause a person to be more likely to suffer a heart attack. Is it possible to provide an alternative explanation for the findings of the investigation that does not make long naps seem harmful? Provide one such explanation if possible.

4. In a controlled environment laboratory, 5 men and 5 women were tested to determine the room temperature they found to be most comfortable. The results were as follows.

Men: 74 72 73 75 67

Women: 76 80 79 78 76

Assuming these temperatures resemble a random sample from their respective populations, is the average comfortable temperature the same for men and women? Support your answer to this question by computing the exact two-sided  $p$ -value for a permutation test. It should take you less than one minute to compute the  $p$ -value if you know what you are doing. (Hint: Is any difference in averages more extreme than the one observed?)

5. A randomized experiment was performed to determine whether two forms of iron, Fe<sup>3+</sup> and Fe<sup>4+</sup>, are retained differently. If one type is retained especially well, then it may be more useful as a dietary supplement for humans. Thirty-six mice were randomly divided into two groups of 18. One of the two groups was randomly selected to receive Fe<sup>3+</sup> orally. The other group received Fe<sup>4+</sup> orally. The iron was radioactively labeled so that the initial amount and the amount retained after a fixed time interval could be measured. The measurements of interest are the percentages of iron retained in each mouse after the time period had elapsed.

(a) The data, rounded to the nearest tenth of a percent, are provided in the table below. Use this rounded data to make back-to-back stem-and-leaf plots.

Fe <sup>3+</sup>	Fe <sup>4+</sup>
0.7	2.2
1.7	2.7
2.0	3.5
2.2	3.8
2.4	3.8
2.4	4.1
2.6	4.3
2.6	4.5
3.3	5.3
3.6	6.2
3.7	6.2
3.7	6.3
4.4	7.0
4.5	7.0
5.1	7.5
5.3	8.4
8.2	11.7
8.2	12.5

(b) The researchers wished to know if there is higher retention for one type of iron than for the other. If so, which type has higher retention and by how much? Included with your exam are two SAS programs with the output produced by each. Use the appropriate output to answer the researchers' questions. State your answer in one to three concise sentences that include a *p*-value and an appropriate 95% confidence interval.