3.78 Subjects who are unwilling to have their therapy chosen for them may be systematically different from those who give their consent. In other words, they may have personality (or other) characteristics which might affect the outcome of their therapy. This would defeat the purpose of randomization, which is to have control and experimental groups that are similar (except in the treatment they receive).

9. (a) False. (b) True. (c) False—that is the whole point of experiments.

Discussion. People who eat lots of fruits and vegetables are different from the rest of us in many other ways. Some other aspect of diet or lifestyle may be protective. Of course, the observational studies might be right; something in the fruits and vegetables other than the vitamins might be the protective factor.

6.66 (a) We reject $H_0$ if $\bar{x} \leq 124.54$ or $\bar{x} \geq 131.46$; these numbers are $128 \pm (1.96)(15/\sqrt{72})$. The power against $\mu = 134$ is $1 - P\left(\frac{124.54 - 134}{15/\sqrt{72}} \leq Z \leq \frac{131.46 - 134}{15/\sqrt{72}}\right) = 1 - P(-5.35 \leq Z \leq -1.43) = 0.9236$. (b) Power: 0.9236 (same as (a)). Over 90% of the time, this test will detect a difference of 6 (in either the positive or negative direction). (c) The power would be higher—it is easier to detect greater differences than smaller ones.
4. Note: In the data I inputted into JMP, the difference variable is before minus after rather than after minus before as in the handout. In the solution below, I define difference as in the JMP data, before minus after.

(a) There are many useful graphs that one can draw. Two particularly useful ones are a histogram to give you a basic idea about the general characteristics of a data set and a box plot which provides information about the skewness and spread of the data set as well as identifying outliers. These two graphs are depicted below for the variable difference. There are not that many data points but the histogram shows that the distribution of the differences does not have strong skewness and does not deviate dramatically from the normal distribution. The box plot does not identify any outliers. These two plots show that the t-test can be expected to provide reasonably accurate inferences because there is neither strong skewness nor outliers. Other useful plots include a normal quantile plot to investigate how close the distribution is to the normal distribution, a plot of before on the x-axis vs. difference on the y-axis to check for any patterns between the two variables and separate box plots and histograms for the before and after variables.

(b) First, note that this is a matched pairs problem and consequently, the one sample t procedures should be used. The before and after samples are not independent and consequently, the two sample t-test is not appropriate. We are interested in the population mean of the variable difference; in effect, we have one sample of the variable difference. Let \( \mu_D \) denote the mean of the variable difference. Several different choices for the formulation of the null and alternative hypotheses. One reasonable one is

\[
H_0 : \mu_D = 0 \\
H_a : \mu_D \neq 0
\]

Another reasonable choice would be \( H_0 : \mu_D = 0 \) vs. \( H_a : \mu_D < 0 \) on the grounds that a priori, smoking could only increase platelet aggregation, meaning that the mean of difference cannot be positive. We assume below that we use the two-sided test. The t-statistic is

\[
\frac{\bar{x} - 0}{s/\sqrt{n}} = \frac{-10.27 - 0}{7.976/\sqrt{11}} = -4.27
\]

The test statistic for a two-sided test is \(|t| = 4.27\). The critical value for a two-sided test at significance level 0.05 is equal to 2.228 (the entry for 10 degrees of freedom, tail probability 0.025 in Table D). Therefore we reject the null hypothesis and conclude that there is substantial evidence that \( \mu_D \neq 0 \). A 90% confidence interval for the population
mean of difference is

\[ \bar{x} \pm t^* \frac{s}{\sqrt{n}} = -10.27 \pm 1.812 \frac{7.976}{\sqrt{11}} = (-14.63, -5.91) \]

where \( t^* \) can be obtained from Table D by looking at confidence level 90% and degrees of freedom 10.

(c) The lettuce leaf cigarettes were controls to ensure that the effects of the experiment were due to tobacco specifically, not just due to smoking a lit cigarette. The unlit cigarettes were controls to ensure that the effects were due to lit tobacco, not just unlit tobacco.