Problems for Chapter 1

Introduction

A case study in multiple comparisons. You want to study how vitamins affect people's strength. You randomly divide 100 people into five groups of 20, asking each person to take a daily vitamin pill. One group (the control) takes a dummy pill that contains no vitamins (a placebo). The remaining four groups take, respectively, a low dose of vitamin brand A, a high dose of vitamin brand A, a low dose of vitamin brand B, and a high dose of vitamin brand B.

Problems 1–6 relate to this case study.

1. List the comparisons of interest. There should be several. State why you are interested in each of the stated comparisons.
2. Consider the bullet points on page 5, at the beginning of Section 1.3. State how each bullet point applies to your collection of comparisons noted in problem 1.
3. Look at Section 1.4.
    a. State your statistical modeling assumptions that apply to this situation. (Examine the list on pages 6–7. Which model or models apply in this example?)
    b. State your testing objectives. (Consider the list on page 8. Which objectives apply in this case?)
    c. State the family of comparisons of interest. (Consider the list on page 9. Which objectives apply in this case?)
4. What are the controversial aspects of MCPs as they apply to this particular case setting? Use Section 1.5.1 and Section 1.5.2 to discuss these controversies; use 1.5.3 only if you know something about Bayesian statistics.
5. Attempt to identify "costs" (in a financial sense, in a pain sense, or perhaps in some other sense) for the situation where there are one or more Type I errors in your "family of tests" in this case study.
6. Attempt to identify "costs" (in a financial sense, in a pain sense, or perhaps in some other sense) for the situation where there are one or more Type II errors in your "family of tests" in this case study.

Another case study in multiple comparisons. You are a geneticist, screening thousands of particular genotypes (specific genetic sequences) for association with a particular disease. Each genotype gives rise to a test for genetic association, which is simply a comparison of percentages of genotypes with and without the disease. For example, if 90% of the people with the disease

have that particular genotype while only 15% of the people without the disease have it, this is potentially strong evidence that the particular genotype is associated with the disease.

You do not intend to make a firm determination of genotype/disease association from this initial screening study. Rather, you will only identify a collection of genotypes to study further using a new sample of individuals with and without the disease.

Problems 7, 8, 9, 10, 11, 12: Repeat problems 1–6, but with reference to this case study. Be sure to highlight differences between these two cases, particularly with regard to the multiple comparisons issue.