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## Statistics for laboratory scientists

### Homework problems for lecture 3

[Source: Freedman, Pisani, Purves (1998) *Statistics*, 3rd ed., Ch 2.]

1. In the U.S. in 1990, there were 2.1 million deaths from all causes, compared to 1.7 million in 1960---nearly a 25% increase. True or false, and explain: the data show that the public's health got worse over the period 1960-1990.
2. Data from the Salk vaccine field trial suggest that in 1954, the school districts in the NFIP trial and in the randomized controlled experiment had similar exposures to the polio virus.
  - a. The data also show that the children in the two vaccine groups (for the randomized controlled experiment and the NFIP design) came from families with similar incomes and educational backgrounds. Which two numbers in the table below confirm this finding?

<i>The randomized controlled double-blind experiment</i>			<i>The NFIP study</i>		
	Size	Rate		Size	Rate
Treatment	200,000	28	Grade 2 (vaccine)	225,000	25
Control	200,000	71	Grades 1 and 3 (control)	725,000	54
No consent	350,000	46	Grade 2 (no consent)	125,000	44

- b. The data show that children in the two no-consent groups had similar family backgrounds. Which pair of numbers in the table confirm this finding?
- c. The data show that children in the two control groups had different family backgrounds. Which pair of numbers in the table confirm this finding?

- d. In the NFIP study, neither the control group nor the no-consent group got the vaccine. Yet the no-consent group had a lower rate of polio. Why?
  - e. To show that the vaccine works, someone wants to compare the 44/100,000 in the NFIP study with the 25/100,000 in the vaccine group. What's wrong with this idea?
3. From the table above, those children whose parents refused to participate in the randomized controlled Salk trial got polio at the rate of 46 per 100,000. On the other hand, those children whose parents consented to participation got polio at the slightly higher rate of 49 per 100,000 in the treatment group and control group taken together. Suppose that this field trial was repeated the following year. On the basis of the figures, some parents refused to allow their children to participate in the experiment and be exposed to this higher risk of polio. Were they right? Answer yes or no, and explain briefly.
4. The Salk vaccine field trials were conducted only in certain experimental areas (school districts), selected by the Public Health Service in consultation with local officials. In these areas, there were about 3 million children in grades 1, 2, or 3; and there were about 11 million children in those grades in the United States. In the experimental areas, the incidence of polio was about 25% higher than in the rest of the country. Did the Salk vaccine field trials cause children to get polio instead of preventing it? Answer yes or no, and explain briefly.
5. There is a rare neurological disease (idiopathic hypoguesia) that makes food taste bad. It is sometimes treated with zinc sulfate. One group of investigators did two randomized controlled experiments to test this treatment. In the first trial, the subjects did not know whether they were being given the zinc sulfate or a placebo. However, the doctors doing the evaluations did know. In this trial, patients on zinc sulfate improved significantly; the placebo group showed little improvement. The second trial was run double-blind; neither the subjects nor the doctors doing the evaluation were told who had been given the drug or the placebo. In the second trial, zinc sulfate had no effect. Should zinc sulfate be given to treat the disease. Answer yes or no, and explain briefly.
6. (Continues the previous exercise.) The second trial used what is

called a "crossover" design. The subjects were assigned at random to one of four groups:

placebo placebo  
placebo zinc  
zinc placebo  
zinc zinc

In the first group, the subjects stayed on the placebo through the whole experiment. In the second group, subjects began with the placebo, but halfway through the experiment they were switched to zinc sulfate. Similarly, in the third group subjects began on zinc sulfate but were switched to placebo. In the last group, they stayed on zinc sulfate. Subjects knew the design of the study, but were not told the group to which they were assigned.

Some subjects did not improve during the first half of the experiment. In each of the four groups, these subjects showed some improvement (on average) during the second half of the experiment. How can this be explained?

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