MONT 107N – Understanding Randomness
Group Discussion 3 – Hypothesis Testing
March 24 and 26, 2010

Background and Goals

We have now introduced the terminology and "yoga" of statistical hypothesis testing in the "large sample case" (samples of size 30 or more):

- We have some *alternative hypothesis* H_a that usually represents the pattern we are trying to demonstrate from our data
- The *null hypothesis* H_0 is a different possible way to explain what happened with the data – almost always, it comes down to essentially saying those results were just a product of chance variation.
- A *test statistic* is computed. For all of our examples so far, this has the form

$$z = \frac{\text{observed} - \text{expected from } H_0}{\text{SE}}.$$

  Depending on the type of problem, the SE may come from H_0 as well, or it might need to be estimated from the data.
- The chance that the test statistic would come out that way, or even "more extremely" is the *observed significance level*, or p-value of the test; the smaller it is, the stronger the evidence is to reject the null hypothesis on the basis of the observed data.

Your solutions for the following problems will be due at the end of class on Friday, March 26.

Discussion Questions

A. With a perfectly balanced roulette wheel, in the long run, green numbers should turn up 18 times out of 38. To test one of its wheels, a casino records the outcome of 3800 spins, finding 1890 green numbers. Is that too many greens? Or is it just chance variation?

   1. Formulate the null hypothesis for a test to answer these questions. What is a corresponding box model that represents H_0?
   2. What is the alternative hypothesis H_a?
   3. Calculate z and p for the data given.
   4. Interpret the results of your test.

B. A newspaper article says that on average first-year college students spend 7.5 hours per week partying. One student life administrator at a university with 4000 first-year students does not believe this. So she takes a random sample of 100 first year students at her school, and asks them how many hours a week they spend partying. Their average time partying is 6.6 hours per week, with an SD of 9 hours (!!). Is this difference real, or is it chance variation?

1. What does the fact that the SD is so big say here? What might the sample's histogram for the number of hours partying look like?
2. Formulate null and alternative hypotheses. Describe a box model giving the representation of the null hypothesis.
3. Calculate z and p for the data given.
4. Interpret the results of your test.

C. A manufacturer of washing machines offers a new model in three different colors A, B, C. Of the first 1000 machines of that model sold, 400 were of color A. Does this evidence support the conclusion that customers have a higher preference for color A than for the other colors?

1. Design and carry out a statistical hypothesis test to answer this question. (Follow the outline in questions A and B.)
2. Might there be some problem with assuming that the first 1000 machines sold constitute a random sample of customer preferences?

D. A clinical trial for a new anticoagulant drug for coronary artery disease worked like this: In a month with 30 days, eligible patients who were admitted to participating hospitals on an odd-numbered day were assigned to the treatment group and given the new drug. Those who were admitted on an even-numbered day were assigned to the control group and given a different established drug (one of the accepted standard treatments for the condition). At the end of the month, there were 580 patients in the treatment group (who had been given the new drug), and 442 patients in the control group. The design of the trial was justified by arguing that the odd-even assignment is objective and impartial, so it is just as good as randomizing. But of course, the difference between the 580 and the 442 sticks out here. Was this just as good as randomizing?

1. Design and carry out a statistical hypothesis test to decide whether it is reasonable to assume that difference was just due to chance variation. (Follow the outline from problems A and B.)
2. If this was not chance variation, can you guess what it was? (Note: the participating doctors did know about the design of the trial!)