

Homework #22
Stat 202

6.86 A role as a statistical consultant. You are the statistical expert for a graduate student planning her PhD research. After you carefully present the mechanics of significance testing, she suggests using $\alpha = 0.20$ for the study because she would be more likely to obtain statistically significant results and she *really* needs significant results to graduate. Explain in simple terms why this would not be a good use of statistical methods.

6.87 What do you know? A research report described two results that both achieved statistical significance at the 5% level. The P -value for the first is 0.048; for the second it is 0.0002. Do the P -values add any useful information beyond that conveyed by the statement that both results are statistically significant? Write a short paragraph explaining your views on this question.

6.88 Selective publication based on results. In addition to statistical significance, selective publication can also be due to the observed outcome. A recent review of 74 FDA-registered studies of antidepressant agents found 38 studies with positive results and 36 studies with negative or questionable results. All but 1 of the 38 positive studies were published. Of the remaining 36, 22 were not published with another 11 published in such a way as to convey a positive outcome.²⁹ Describe how this selective reporting can have adverse consequences on health care.

6.89 What a test of significance can answer. Explain whether a test of significance can answer each of the following questions.

- (a) Is the sample or experiment properly designed?
- (b) Is the observed effect compatible with the null hypothesis?
- (c) Is the observed effect important?

6.90 Vitamin C and colds. In a study to investigate whether vitamin C will prevent colds, 400 subjects are assigned at random to one of two groups. The

experimental group takes a vitamin C tablet daily, while the control group takes a placebo. At the end of the experiment, the researchers calculate the difference between the percents of subjects in the two groups who were free of colds. This difference is statistically significant ($P = 0.03$) in favor of the vitamin C group. Can we conclude that vitamin C has a strong effect in preventing colds? Explain your answer.

6.91 How far do rich parents take us? How much education children get is strongly associated with the wealth and social status of their parents, termed "socioeconomic status," or SES. The SES of parents, however, has little influence on whether children who have graduated from college continue their education. One study looked at whether college graduates took the graduate admissions tests for business, law, and other graduate programs. The effects of the parents' SES on taking the LSAT test for law school were "both statistically insignificant and small."

- (a) What does "statistically insignificant" mean?
- (b) Why is it important that the effects were small in size as well as insignificant?

6.92 Do you agree? State whether or not you agree with each of the following statements and provide a short summary of the reasons for your answers.

- (a) If the P -value is larger than 0.05, the null hypothesis is true.
- (b) Practical significance is not the same as statistical significance.
- (c) We can perform a statistical analysis using any set of data.
- (d) If you find an interesting pattern in a set of data, it is appropriate to then use a significance test to determine its significance.

Solutions

- 6.86.** Finding something to be “statistically significant” is not really useful unless the significance level is sufficiently small. While there is some freedom to decide what “sufficiently small” means, $\alpha = 0.20$ would lead the student to incorrectly reject H_0 one-fifth of the time, so it is clearly a bad choice.
- 6.87.** The first test was barely significant at $\alpha = 0.05$, while the second was significant at any reasonable α .
- 6.88.** One can learn something from negative results; for example, a study that finds no benefit from a particular treatment is at least useful in terms of what will *not* work. Furthermore, reviewing such results might point researchers to possible future areas of study.
- 6.89.** A significance test answers only Question b. The P -value states how likely the observed effect (or a stronger one) is if H_0 is true, and chance alone accounts for deviations from what we expect. The observed effect may be significant (very unlikely to be due to chance) and yet not be of practical importance. And the calculation leading to significance *assumes* a properly designed study.
- 6.90.** Based on the description, this seems to have been an experiment (not just an observational study), so a statistically significant outcome suggests that vitamin C is effective in preventing colds.
- 6.91. (a)** If SES had no effect on LSAT results, there would still be some difference in scores due to chance variation. “Statistically insignificant” means that the observed difference was no more than we might expect from that chance variation. **(b)** If the results are based on a small sample, then even if the null hypothesis were not true, the test might not be sensitive enough to detect the effect. Knowing the effects were small tells us that the statistically insignificant test result did not occur merely because of a small sample size.
- 6.92.** These questions are addressed in the summary for Section 6.3. **(a)** Failing to reject H_0 does not mean that H_0 is true. **(b)** This is correct; a difference that is statistically significant might not be practically important. (This does not mean that these are opposites; a difference *could* be both statistically and practically significant.) **(c)** This might be technically true, but in order for the analysis to be meaningful, the data must satisfy the assumptions of the analysis. **(d)** Searching for patterns and then testing their significance can lead to false positives (that is, we might reject the null hypothesis incorrectly). If a pattern is observed, we should collect new data to test if it is present.