Stat 13, Intro. to Statistical Methods for the Life and Health Sciences.

1. Hand in HW.
2. Causation and prediction.
3. Multiple testing and publication bias.
3. Relationship between CIs and tests.
4. Review list.
5. Example problems.

NO LECTURE THU NOV 3 or TUE NOV 8. Also no office hour Nov 8.
The midterm Thu Nov 10 will be on ch1-7.
Bring a PENCIL and CALCULATOR and any books or notes you want. No computers.
All numerical answers will be rounded to 3 significant digits.
http://www.stat.ucla.edu/~frederic/13/F16 .

1. Hand in HW1.
2. Causation and prediction.

Note that for prediction, you sometimes do not care about confounding factors.

* Forecasting wildfire activity using temperature.

Warmer weather may directly cause wildfires via increased ease of ignition, or due to confounding with people chooseing to go camping in warmer weather. It does not really matter for the purpose of merely *predicting* how many wildfires will occur in the coming month.

* The same goes for predicting lifespan, or liver disease rates, etc., using smoking as a predictor variable.

3. Multiple testing and publication bias.

A p-value is the probability, assuming the null hypothesis of no relationship is true, that you will see a difference as extreme as, or more extreme than, you observed.

So, 5% of the time you are looking at unrelated things, you will find a statistically significant relationship.

This underscores the need for followup confirmation studies.

If testing many explanatory variables simultaneously, it can become very likely to find something significant even if nothing is actually related to the response variable.

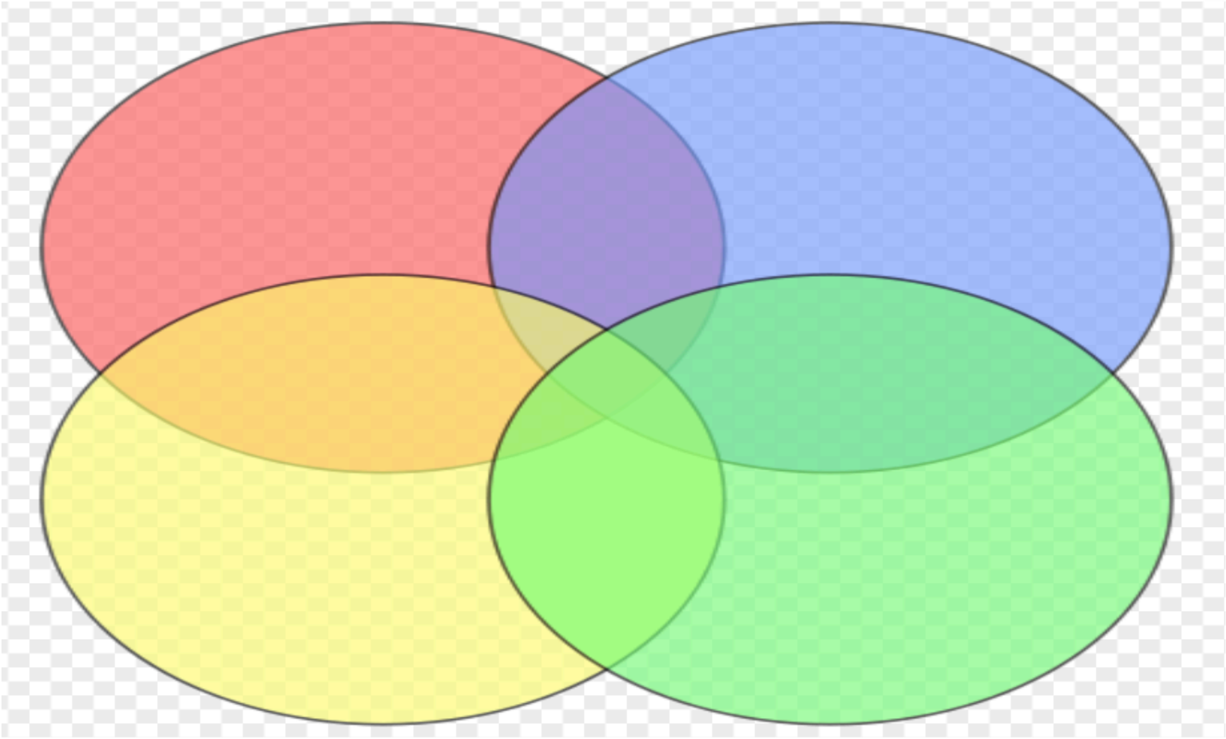
3. Multiple testing and publication bias.

* For example, if the significance level is 5%, then for 100 tests where all null hypotheses are true, the expected number of incorrect rejections (Type I errors) is 5. If the tests are independent, the probability of at least one Type I error would be 99.4%.

* To address this problem, scientists sometimes change the significance level so that, under the null hypothesis that none of the explanatory variables is related to the response variable, the probability of rejecting *any* of them is 5%.

* One way is to use Bonferroni's correction: with *m* explanatory variables, use significance level 5%/m.

P(at least 1 Type I error) will be ≤ m (5%/m) = 5%.



P(Type I error on explanatory 1) = 5%/m.

P(Type I error on explanatory 2) = 5%/m.

P(Type 1 error on at least one explanatory) ≤

P(error on 1) + P(error on 2) + ... + P(error on m) = m x 5%/m.

Multiple testing and publication bias.

Imagine a scenario where a drug is tested many times to see if it reduces the incidence of some response variable. If the drug is testes 100 times by 100 different researchers, the results will be stat. sig. about 5 times.

If only the stat. sig. results are published, then the published record will be very misleading.

Multiple testing and publication bias.

A drug called Reboxetine made by Pfizer was approved as a treatment for depression in Europe and the UK in 2001, based on positive trials.

A meta-analysis in 2010 found that it was not only ineffective but also potentially harmful. The report found that 74% of the data on patients who took part in the trials of Reboxetine were not published because the findings were negative. Published data about reboxetine overestimated its benefits and underestimated its harm.

A subsequent 2011 analysis indicated Reboxetine might be effective for severe depression though.

4. CIs and tests.

Suppose we are comparing death rates in a treatment group and a control group. We observe a difference of 10.2%, do a test, and find a p-value of 8%.

Does this mean the 95%-CI for the difference in death rates between the two groups would contain zero?

4. CIs and tests.

Suppose we are comparing blood pressures in a treatment group and a control group. We observe a difference of 10.2 mm, do a 2-sided test, and find a p-value of 3%.

Would the 95%-CI for the difference in blood pressures between the two groups contain zero?

4. CIs and tests.

Suppose we are comparing blood pressures in a treatment group and a control group. We observe a difference of 10.2 mm, do a 2-sided test, and find a p-value of 3%.

Would the 95%-CI for the difference in blood pressures between the two groups contain zero or not?

No. It would not contain zero.

For what confidence level would the CI just barely contain 0?

97%.

4. CIs and tests.

The p-value is 3%. A 97%-CI would just contain zero.

```
                    Ho
          (         95%        )        (          95%-CI        )
-----------------------------------------------------------------------------
                     |                              |
                     0                          10.2mm

                    Ho
(                   97%                            )
                     (                             97%-CI                 )
-----------------------------------------------------------------------------
                     |                              |
                     0                          10.2mm
```

4. Review list.

1. Meaning of SD.
2. Parameters and statistics.
3. Z statistic for proportions.
4. Simulation and meaning of pvalues.
5. SE for proportions.
6. What influences pvalues.
7. CLT and validity conditions for tests.
8. 1-sided and 2-sided tests.
9. Reject the null vs. accept the alternative.
10. Sampling and bias.
11. Significance level.
12. Type I, type II errors, and power.
13. CIs for a proportion.
14. CIs for a mean.
15. Margin of error.
16. Practical significance.
17. Confounding.
18. Observational studies and experiments.
19. Random sampling and random assignment.
20. Two proportion CIs and testing.
21. IQR and 5 number summaries.
22. CIs for 2 means and testing.
23. Paired data.
24. Placebo effect, adherer bias, and nonresponse bias.
25. Prediction and causation.
26. Multiple testing and publication bias

5. Example problems.

Some good hw problems from the book are 1.2.18, 1.2.19, 1.2.20, 1.3.17, 1.5.18, 2.1.38, 2.2.6, 2.2.24, 2.3.3, 2.3.25, 3.2.11, 3.2.12, 3.3.8, 3.3.19, 3.3.22, 3.5.23, 4.1.14, 4.1.18, 5.2.2, 5.2.10, 5.2.24, 5.3.11, 5.3.21, 5.3.24, 6.2.23, 6.3.1, 6.3.12, 6.3.22, 6.3.23, 7.2.20, 7.2.24, 7.3.7, 7.3.24.

5. Example problems.

NCIS was a top-rated tv show in 2014. It is currently 3rd in 2016.

A study finds that in a certain city, people who watch NCIS are much more likely to die than people who do not watch NCIS. Can we conclude that NCIS is a dangerous tv show to watch?

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A study finds that in a certain city, people who watch NCIS are much more likely to die than people who do not watch NCIS. Can we conclude that NCIS is a dangerous tv show to watch?

No. Age is a confounding factor. The median age of a viewer is 61 years old.

5. Example problems.

In the portacaval shunt example, why did the studies with historical controls find that the portacaval shunt seemed to be associated with lower death rates?

a. Those getting the shunt smoked more.

b. Those getting the shunt were healthier.

c. Those getting the shunt were genetically predisposed to die younger.

d. The explanatory variable is a confounding factor t-test with 95% central limit theorem.

5. Example problems.

In the portacaval shunt example, why did the studies with historical controls find that the portacaval shunt seemed to be associated with lower death rates?

b. Those getting the shunt were healthier.

5. Example problems.

Suppose you sample 100 UCLA students and 80 2nd graders and record their blood glucose levels. The mean at UCLA is 5.5 mmol/L, with an SD of 1.5, and the mean in 2nd grade is 7.5 mmol/L, with an SD of 2.2.

a. Find a 95%-CI for how much less an average UCLA student's blood glucose level is than an average 2nd grader.

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a. Find a 95%-CI for how much less an average UCLA student's blood glucose level is than an average 2nd grader.

$2.0 +/- 1.96 \sqrt{(1.5^2/100 + 2.2^2/80)} = 2.0 +/- 0.564.$

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b. Is the difference observed between the mean blood glucose at UCLA and in 2^{nd} grade statistically significant?

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b. Is the difference observed between the mean blood glucose at UCLA and in 2nd grade statistically significant?

Yes. The 95%-CI does not come close to containing 0.

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c. Is this an observational study or an experiment?

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Observational study.

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d. Does going to UCLA cause your blood glucose level to drop?

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d. Does going to UCLA cause your blood glucose level to drop?

No. Age is a confounding factor. Young kids eat more candy.

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e. The mean blood glucose level of all 43,301 UCLA students is a

parameter random variable t-test

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f. If we took another sample of 100 UCLA students and 80 2nd graders, and used the difference in sample means to estimate the difference in population means, how much would it typically be off by? $SE = \sqrt{1.5^2/100 + 2.2^2/80} = .288$ mmol/L

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g. How much does one UCLA student's blood glucose level typically differ from the mean of UCLA students?

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1.5 mmoL/L.

Do bike helmets make you less likely to get into a collision?

Study A looked at data from 40 States, the year before and the year after implementing mandatory helmet laws. They had millions of observations. In every State, a significantly higher percentage of cyclists wore helmets the year after the law was passed than the year before. Combining data from all 40 States, study A found no significant difference in collision rates before or after the law was passed.

Study B surveyed 1000 people who bought a bicycle in the previous year, and found that a significantly lower percentage of those who wore helmets had been in collisions.

Study A looked at data from 40 States, and found no significant difference in collision rates before or after the law was passed.

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Which study is more convincing, and why?

a. Study A, because the sample size in study B is too small to be representative of the population.
b. Study B, because it is unclear whether study A is an experiment or an observational study.
c. Study A, because a confounding factor in study B is how conscientious the bicyclists are.
d. Study A, because it has higher power and is statistically significant.
e. Study A, because a confounding factor in study B is the weight of the bicycle.

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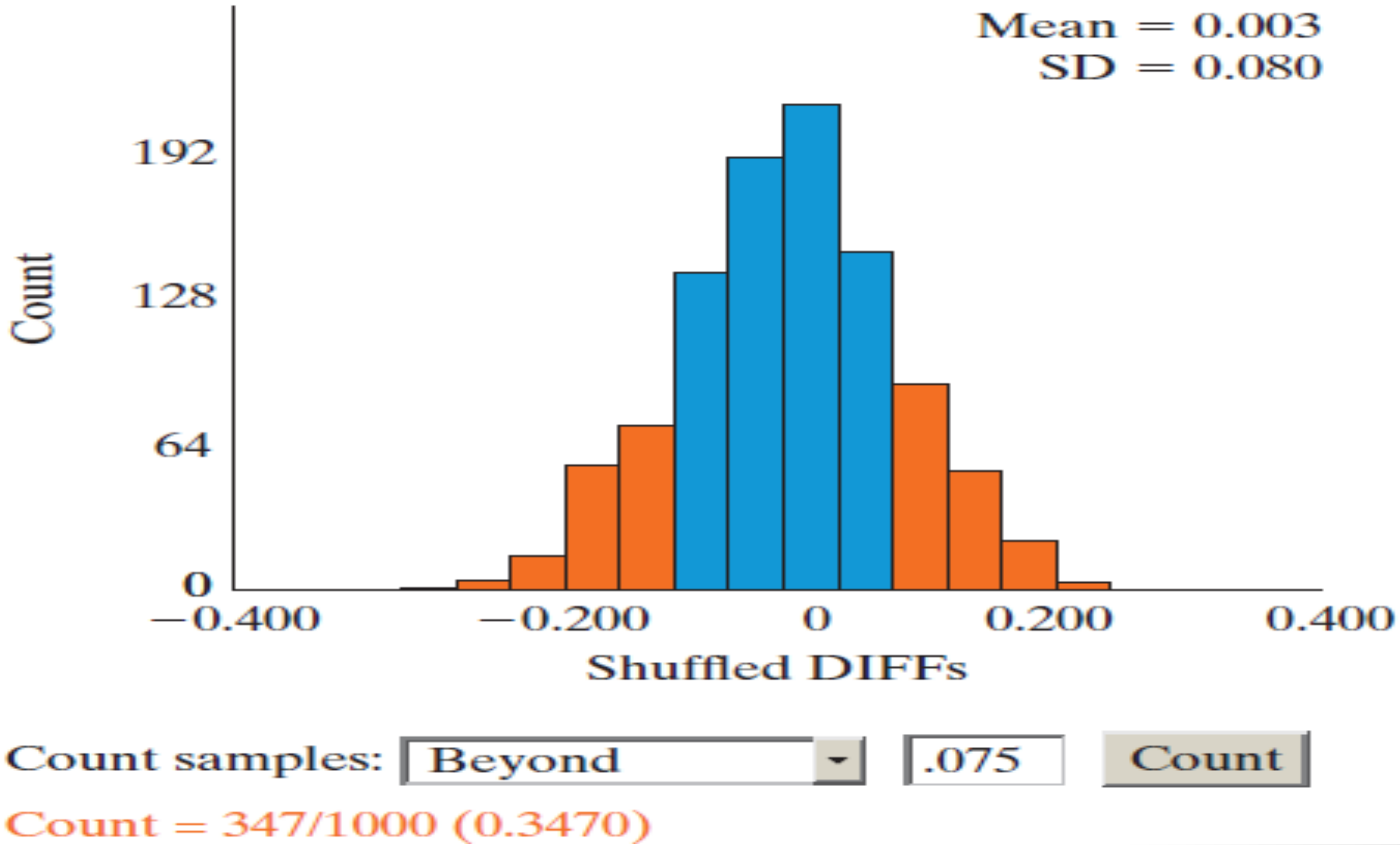
d. Study A, because it has higher power and is statistically significant.
e. Study A, because a confounding factor in study B is the weight of the bicycle.

A histogram of the simulated mean difference between the bicycling to work with bike 1 minus bike 2, under Ho, is shown. What is the SE for the difference?



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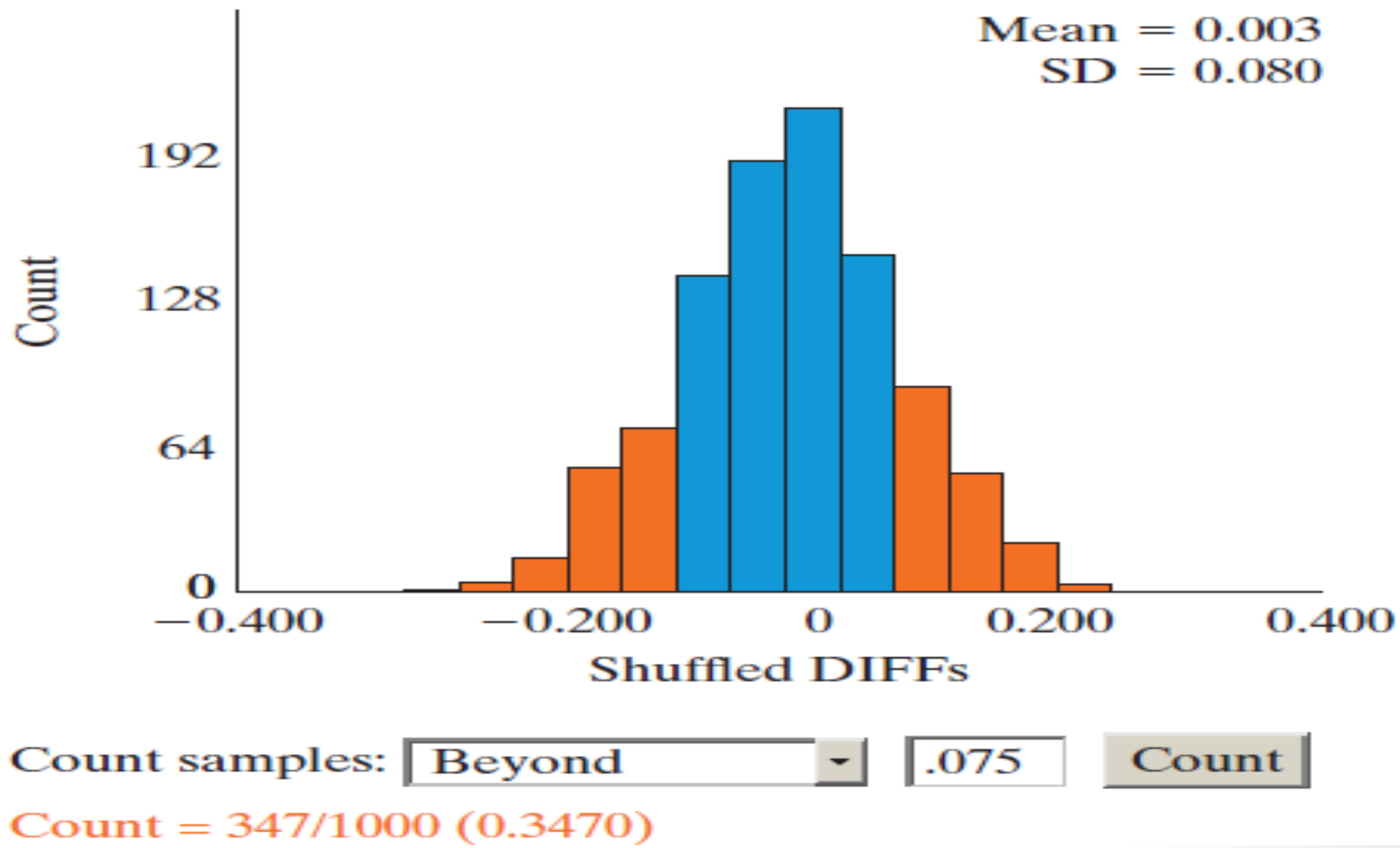
0.080.



A histogram of the simulated mean difference between the bicycling to work with bike 1 minus bike 2, under Ho, is shown. What would the margin of error be for a 95% CI?

1.96 (0.080) = 0.157.