Innovations in Teaching Introductory Statistics at Pitt

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Models or Catalysts for Courses in Other Disciplines

Honors Applied Statistical Methods 1000

- Consider what students in your own discipline can accomplish

Honors Statistics in Journalism 1010

- Consider what collaborations are possible for cross-disciplinary courses

Honors Stat 1000

- Inspired by sitting in on UHC Reading Seminar
- Encouraged by late UHC Dean Alec Stewart
- Enhanced with Seminars by Students

(otherwise approx. same curriculum as Stat 1000)

  - 3 x 15 minutes a week (replace ordinary recitations)
  - Reflect content of previous week's lectures
  - Presenter chooses article/activity based on personal interest

Examples of Student Seminars

- Consensus among Economists?
- Effects of Bullying on Adolescents
- Estimation Skills Predict Math Ability

1. Consensus Among Economists?

Find an article about a study that uses a chi-square test to explore the relationship between two categorical variables…

"IS THERE A GLOBAL ECONOMIC CONSENSUS?"

Economists from 6 groups (government, academia, business, etc.) were surveyed on matters of theory or policy. Response rates ranged from 28% to 41%. Ben showed class how chi-square was used to reject hypothesis of identical response rates at the 0.05 level. (Ben explained goodness of fit test not covered in lecture.)

1. Consensus Among Economists?

Researchers rejected H_0* of no consensus on all 40 items, eg.

#16. "A ceiling on rents reduces the quantity and quality of housing available."

Response	%	Entropy ε
1 (generally disagree)	6.5	0.52 (not very disparate)
2 (agree with provisos)	16.6	
3 (generally agree)	76.3	

#12. "Antitrust laws should be enforced vigorously to reduce monopoly power from its current level."

Response	%	Entropy ε
1 (generally disagree)	27.6	0.92 (more disparate)
2 (agree with provisos)	36.9	
3 (generally agree)	34.9	

*H_0: $p_1=p_2=p_3=$ 33.3%

- According to my calculations, minimal results of (0.30, 0.30, 0.38) would reject the null hypothesis. However, this really isn't evidence of "economic consensus", per se. This is merely evidence against the null hypothesis, that there is a *completely even split* amongst all responses.
- It would depend on how one defines consensus. Most uses of the term, however, would probably apply a higher bar than "not total entropy across possible responses"
- Furthermore, the responses are "generally disagree", "agree with provisos", and "generally agree". The second option is not necessarily a middle-ground.

1. Consensus Among Economists?

All students must write up at least 2 questions/comments per article, which they have read in advance…

- "In my opinion, having response options `generally agree,' `agree w/provisos,' and `generally disagree' doesn't seem quite right."
- etc.

2. Effects of Bullying on Adolescents

Find an article about a study that uses ANOVA to compare mean values of a quantitative variable for more than two populations, based on samples...

Student #2 chose article “BULLYING AND PSYCHIATRIC SYMPTOMS…” which used Kruskall-Wallis, beyond scope of the course, so instructor suggested “PREVALENCE OF BULLYING AND AGGRESSIVE BEHAVIOR AND THEIR RELATIONSHIP TO MENTAL HEALTH PROBLEMS AMONG 12- TO 15-YEAR-OLD NORWEGIAN ADOLESCENTS.”

This study compared various aspects of psychological well-being for bullied vs. aggressors vs. uninvolved.

Causation

Social Acceptance: Students being bullied had lower scores on this subscale than those classified as noninvolved or aggressive to others.

Global Self-Worth: Students that are noninvolved had higher scores than students classified as being bullied or aggressive to others.

Despite the test score differences that were found, causation cannot be inferred. However, we can conclude that students who are bullied *or* aggressive to each other seem to be more likely to exhibit mental health problems and depression symptoms, and have a lower self-esteem based on score differences.

2. Effects of Bullying on Adolescents

Student questions/comments:

- "I found it surprising that bullied boys got more help than bullied girls."
- "I'm not surprised that bullied boys got more help than bullied girls…because girl bullying tactics can be subtle enough to fly under the radar of adults."
- "I think because half of participants were girls they should have included more questions about emotional bullying."
- etc.

3. Estimation Skills Predict Math Ability

Find an article about a study concerning the relationship between two quantitative variables…

(In computer lab) Matt reported on "INDIVIDUAL DIFFERENCES IN NON-VERBAL NUMBER ACUITY CORRELATE WITH MATHS ACHIEVEMENT."

Then he led online estimation activity, followed by exploration of scores' relationship with Math SAT scores using on-the-spot statistical software analysis.

Study Overview

- Use a simple test of numerical approximation to determine acuity of subject's "approximate number system" (ANS)
- Determine if there is a correlation between ANS acuity and mathematical skill

ANS Test

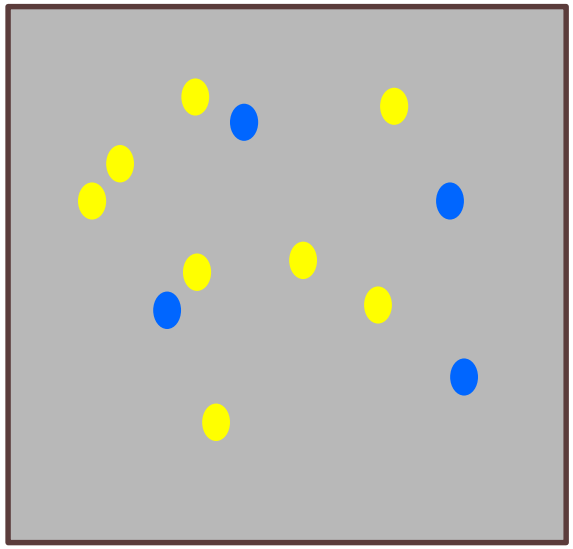
- Blue and yellow dots appear randomly on screen for 200ms
- Subjects decide which color was more numerous by a keypress. Performance measured as “Weber fraction”, simply put the ratio of colored dots needed for subject to average 75% correct
- Lower Weber fraction indicates higher ANS acuity (able to discriminate ratios closer to 1:1)

Weber fraction

$$W = \frac{\text{(\# dots in larger set – \# dots in smaller set)}}{\text{\# dots in larger set}}$$

$W = (8 – 4) / 8$

$W = 4 / 8 = 0.5$

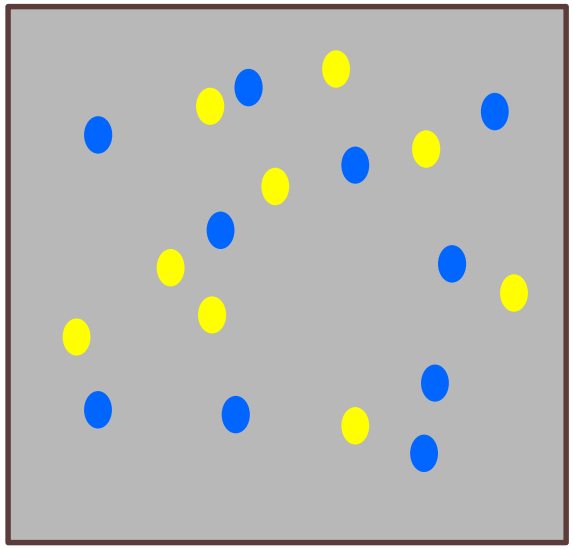


Weber fraction

$$W = \frac{\text{(\# dots in larger set – \# dots in smaller set)}}{\text{\# dots in larger set}}$$

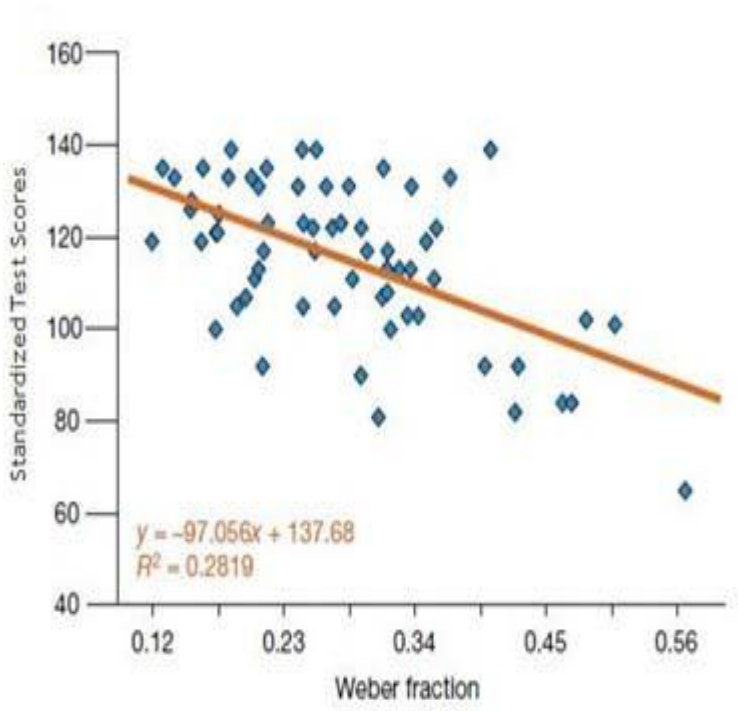
$W = (10 – 9) / 10$

$W = 1 / 10 = 0.1$



Results

- Compared Weber fractions to scores on two standardized tests
- Strong evidence for moderate to weak correlation



3. Estimation Skills Predict Math Ability

After summarizing study, Matt had students try the Approximate Number System estimation test

http://www.nytimes.com/interactive/2008/09/15/science/20080915_NUMBER_SENSE_GRAPHIC.html?_r=0

then anonymously report their % correct and Math SAT score. He performed a regression and found no significant relationship.

Possible explanation: Honors Intro Stats students' Math SATs exhibit too little variation.

4. To investigate the stroop effect

Inferentials

RTs t-test (p value): t(20) = 8.34, p = <.001

Errors t-test (p value): t (20) = 4.82, p = <.001

The chosen statistical analysis was a t-test. This allows us to compare the results in terms of reliability as the t value obtained is related to a specific value for the degrees of freedom for the experiment. The calculated t value at the confidence level of p=<.001 is less than the value predicted for the p-value. This allows us to reject the null hypothesis and accept the alternate as the results obtained can be said to be 99% concurrent due to the independent variable.

Learning Gains in Enhanced Course

- Searching for articles of interest
- Making sense of dense, technical journal articles
- Preparing and presenting a talk
- Reading, reflecting on others' articles
- Meaningful use of statistical software
- In-depth discussion

(high OMET scores on getting to know classmates)

“Dream Course” in your discipline

If you had all the time and resources you needed, what would be the most stimulating course(s) you could imagine teaching to undergrads in your discipline?

(If you already teach such a course, describe it.)

Sit with faculty from your department (if possible) and discuss (10 min.); volunteers report results afterwards to entire group (5 min).

Honors Stats in Journalism 1010

Created 1-credit honors class, team-taught with journalism prof Cindy Skrzycki in Spring 2013. Addressed weaknesses in

- how journalists present statistical results
- how research studies arrive at those results

Cross-disciplinary approach

1st half of semester: students were to find a media article(s) that caught their interest, and read the underlying research report.

Were there flaws in the reporting?

Were there flaws in the research?

2nd half of semester: students were to find recently-published research of interest and write their own news story about it.

Follow-up to Course

Just the Facts? by Pfenning and Skrzycki appeared in Chronicle of Higher Ed, June 2013

- Sample of comments:

"This class sounds amazing!"

"Such a course should be part of the core curriculum required of all students."

- Requests for more on stats in journalism by 3 audiences: high school, college, grad school

Looking for Pitfalls in Articles Chosen by Stats In Journalism Students

Are high heels really bad for your knees?

Does owning a gun make you more likely to be shot?

Do Japanese baseball players with wider faces perform better?

Can “Ecstasy” help in treating PTSD in veterans?

Do students do worse if their parents help with tuition?

Common Pitfalls in Drawing Conclusions from Scientific Studies

- Overlooking confounding variables; interpreting association as causation (especially common in observational studies)
- Conflict of interest: source of funding?
- Failing to adjust for multiple tests
- Overstating subtle results from large samples
- Measuring the wrong variable
- “File-drawer” problem
- Too much focus on counter-intuitive findings (sensationalizing versus common sense)
- Over-generalizing, such as from animals to humans
- Anecdotal evidence
- Careless mistakes

Learning Gains in Interdisciplinary Course

- Witness instructors' sharing of expertise
- Making sense of dense, technical journal articles
- Preparing and presenting a talk
- Reading, reflecting on others' articles
- In-depth discussion
- Balance priorities, fuse two approaches: Whole becomes more than sum of its parts

Interdisciplinary “Dream Course”

If you were to team up with someone from another department (represented by others in attendance) and create a cross-disciplinary course (or club), what would it be, ideally?

(Or why would such a hybrid not be possible?)

Sit next to faculty from other departments and discuss. Volunteers report afterwards to group.

Thank You!

And please keep me and other colleagues informed about innovative ways to teach in the natural sciences.

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