Bringing Visual Inference to the Classroom

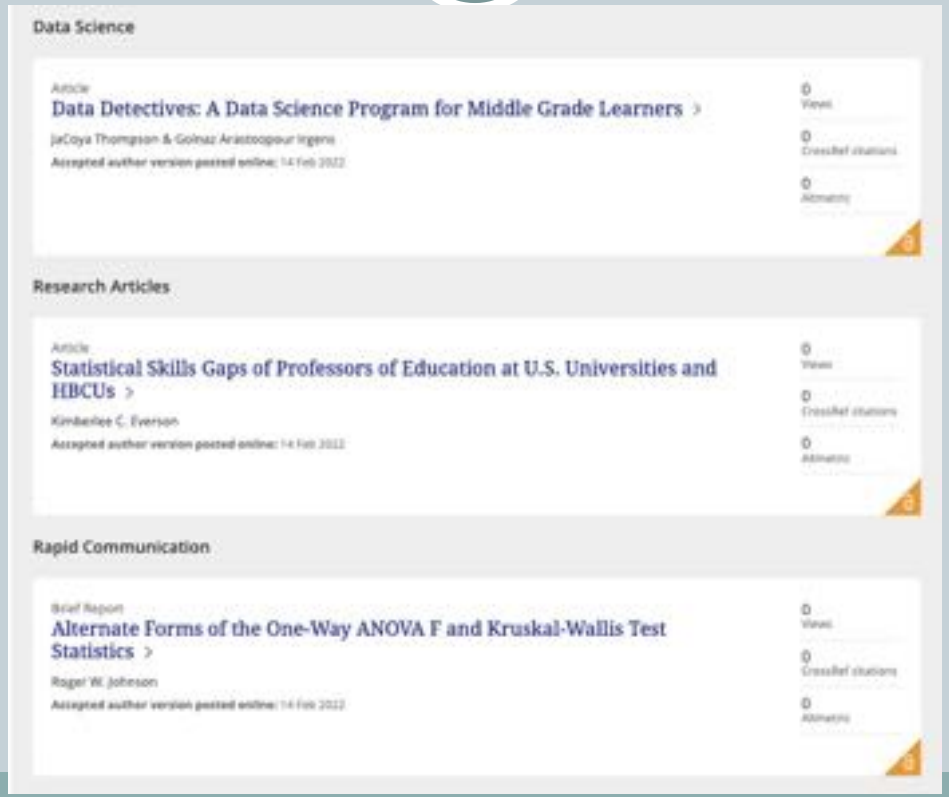
Adam Loy

CAUSE/JSDSE webinar series

Welcome from our host and moderator

Leigh Johnson

What's new in the journal?



Data Science

Article

Data Detectives: A Data Science Program for Middle Grade Learners >

JaCoya Thompson & Golnaz Arastoopour Irgens

Accepted author version posted online: 14 Feb 2022

0 Views

0 CrossRef citations

0 Altmetric

Research Articles

Article

Statistical Skills Gaps of Professors of Education at U.S. Universities and HBCUs >

Kimberlee C. Everson

Accepted author version posted online: 14 Feb 2022

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Rapid Communication

Brief Report

Alternate Forms of the One-Way ANOVA F and Kruskal-Wallis Test Statistics >

Roger W. Johnson

Accepted author version posted online: 14 Feb 2022

0 Views

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March CAUSE/JSDSE Webinar

Details coming soon!

Signup at https://www.causeweb.org/cause/webinars

Webinars are recorded and posted (with slides) at that same site

Consortium for the Advancement of Undergraduate Statistics Education

https://www.causeweb.org/cause

Save the date!
May 23rd - 26th, 2022, with
pre-conference workshops May 19th - 20th
https://causeweb.org/cause/ecots/ecots22/about

Regional Conferences proposals are due today!!

Virtual posters & beyond and birds-of-a-feather proposals are due on March 13th, 2022

Consortium for the Advancement of Undergraduate Statistics Education

https://www.causeweb.org/cause

USPROC | The Undergraduate Statistics Project Competition

More info at https://www.causeweb.org/usproc

Adam Loy

Adam Loy is an assistant professor of statistics at Carleton College in Northfield, Minnesota. He received his PhD in statistics from Iowa State University. Adam's research interests include incorporating realistic computation and visualization into the classroom, exploring the potential of visual inference, developing better visualizations to explore complex models, and developing useful and useable R packages.

Bringing Visual Inference to the Classroom

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The move to a simulation-based curriculum

Since 2007, we've seen a shift to simulation-based inference in the intro course

Validation studies (Tintle et al. 2014; Maurer & Lock 2014; Hildreth et al. 2018)

Implementation in other courses

- Statistical inference (Cobb 2011; Chihara & Hesterberg 2011)
- Throughout curricula (Tintle et al. 2015)

All have similar approach to visualization of the inferential process

Do Distracting Colors Influence the Time to Complete a Game?

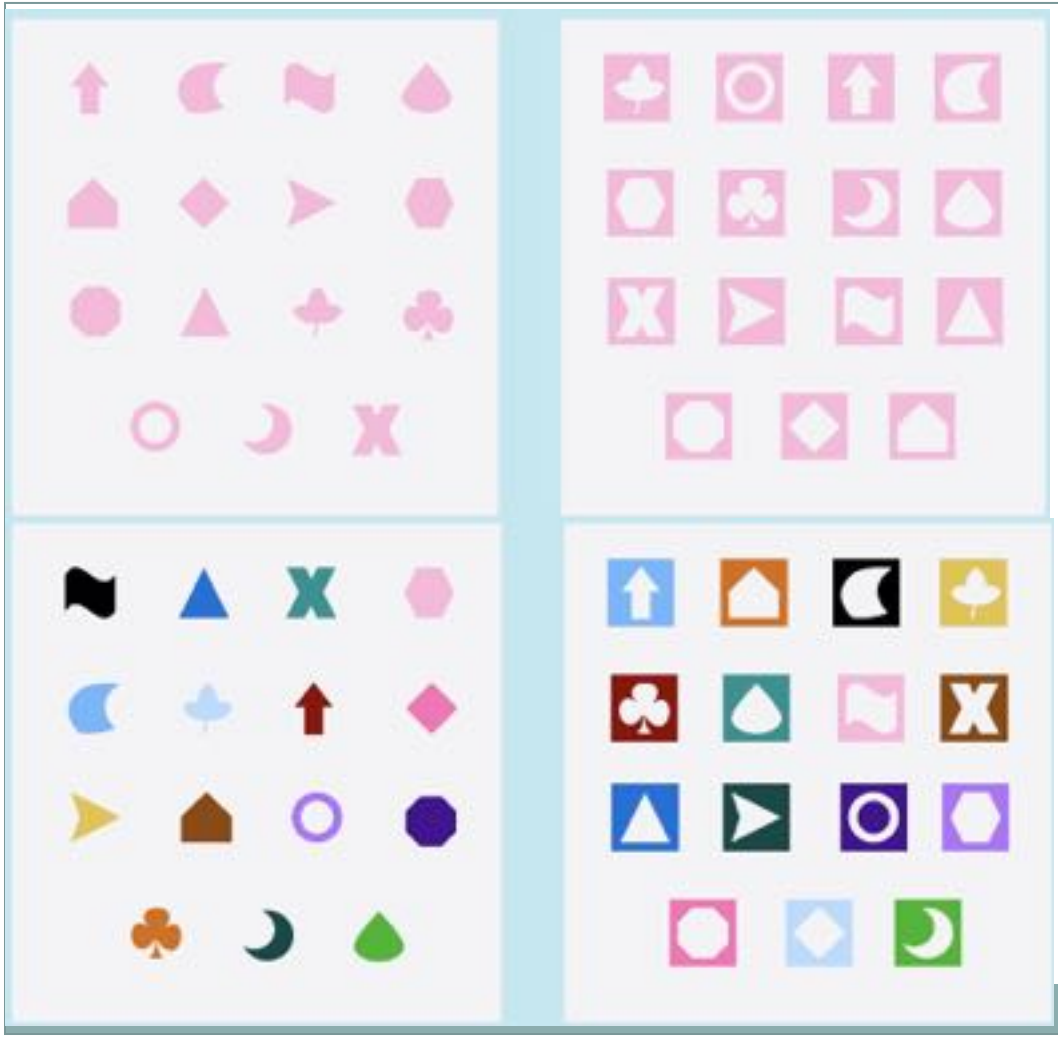
20 students randomly assigned to the standard game
20 students a game with a color distracter

Subjects played the game in the same area with similar background noise

Collected the the time, in seconds, required to complete the game

Example taken from Kuiper and Sklar (2013)

https://stat2games.sites.grinnell.edu



Standard game

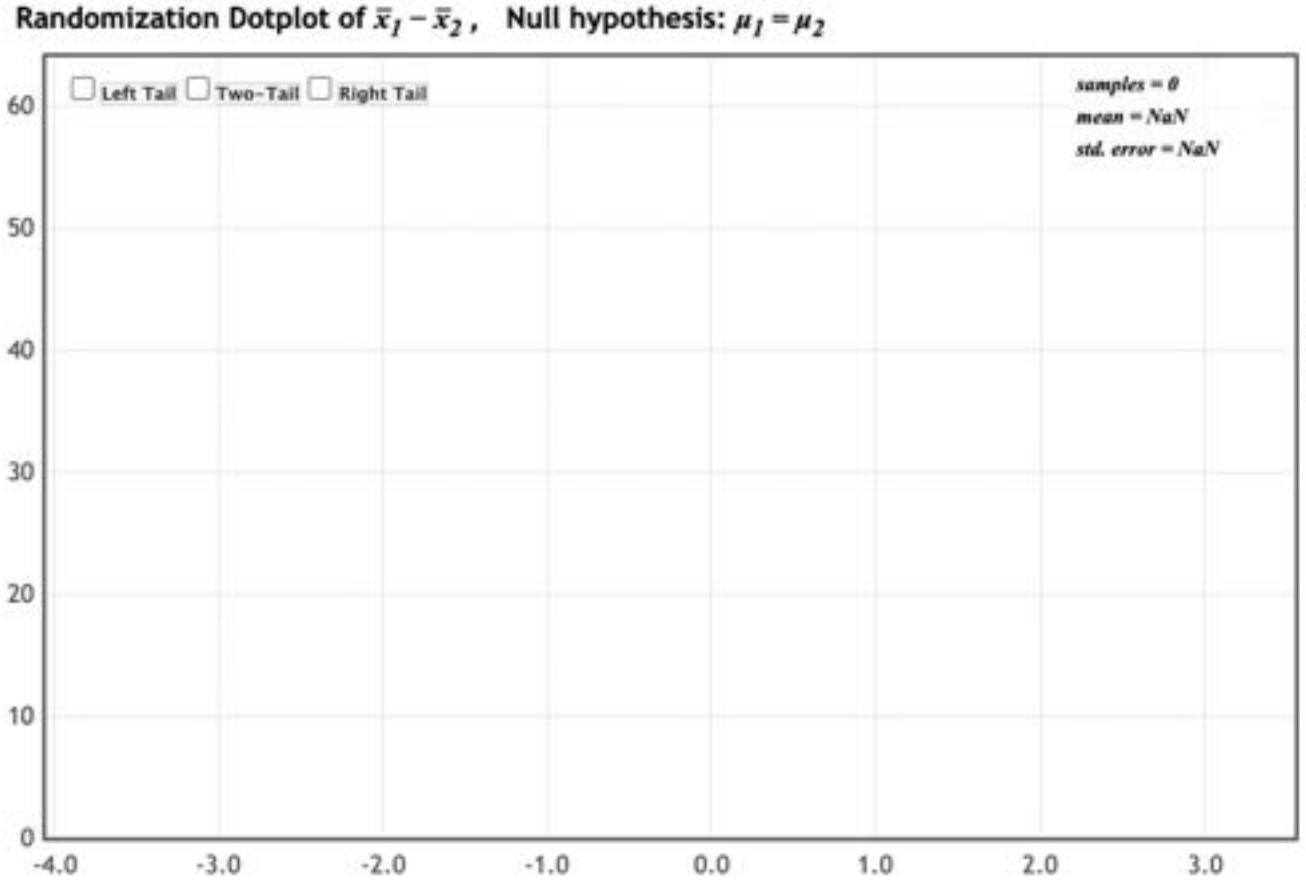
Color distracter

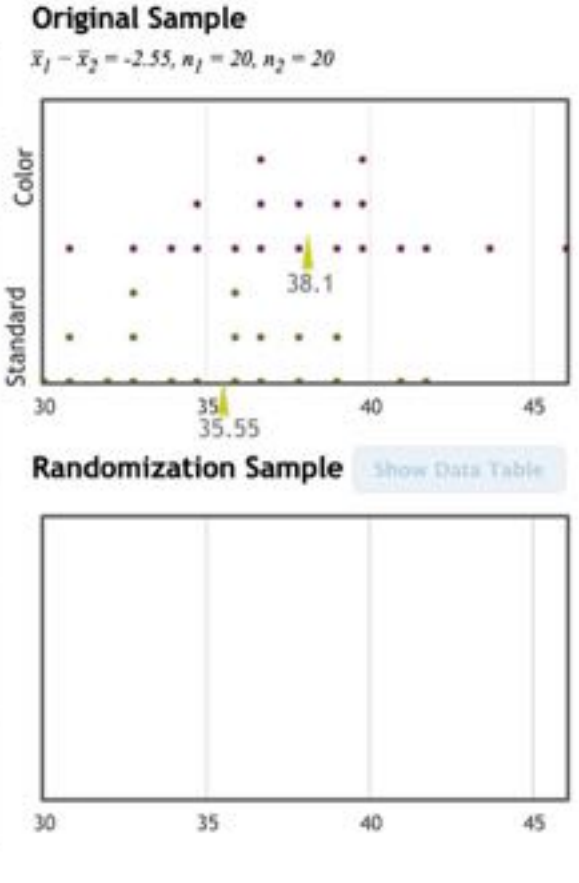
Initial group discussion

What competing claims are being investigated in this study?

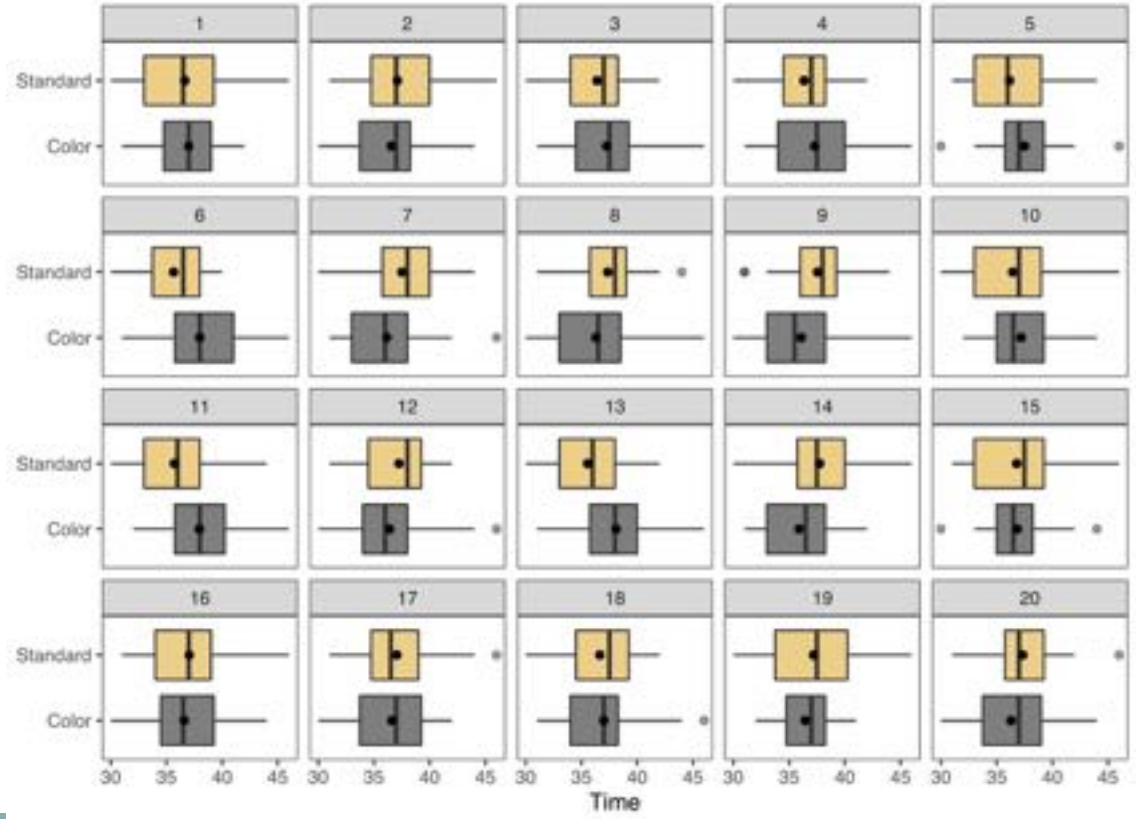
What do the sample data have to say? $\bar{x}_1 - \bar{x}_2 = 2.55$

The gap between apps and understanding





Choose which plot is most different from the others and justify your choice



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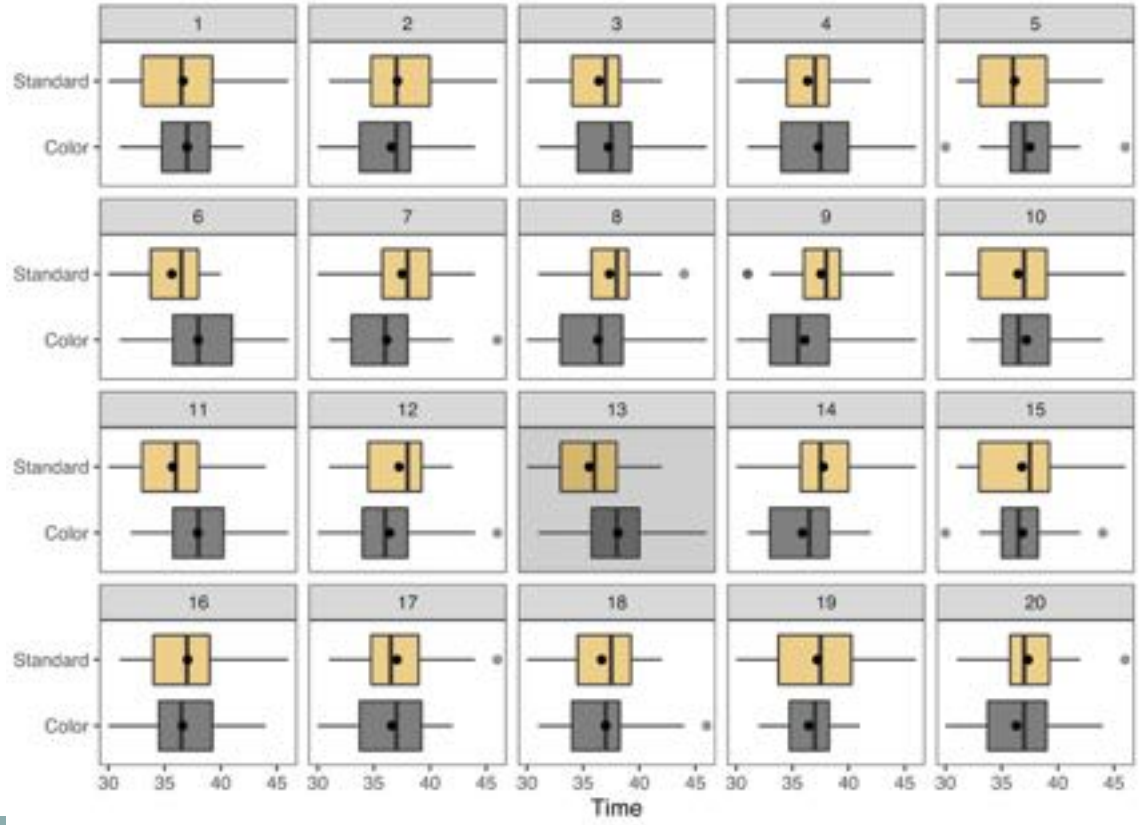


What did we just do?

We compared the **data plot** with **decoy** (**null) plots** of samples where, by construction, there is no association

This forces us to make decisions by comparing what we observe to what we would expect under the null

All of this is done using "Sesame Street logic"

How do I use it in class?

Brief overview of logic of hypothesis testing → group discussion

Quick discussion of how decoy plots are created

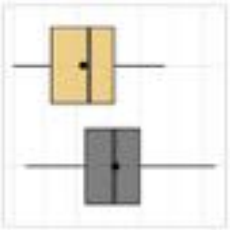
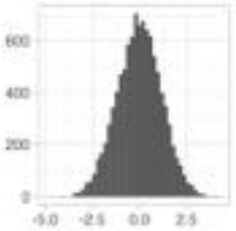
→ individual evaluation of lineup

→ group discussion

Reveal observed panel

→ group discussion of implications of identification/no identification

Debrief

	Simulation-based inference	Lineup
Hypotheses	H_o: equal means	H_a: mean larger for color distractor
Test statistic	$T(x) = \bar{x}_1 - \bar{x}_2$	
Reference distribution		
Evidence against null if…	Far out in the tail(s)	Identifiable

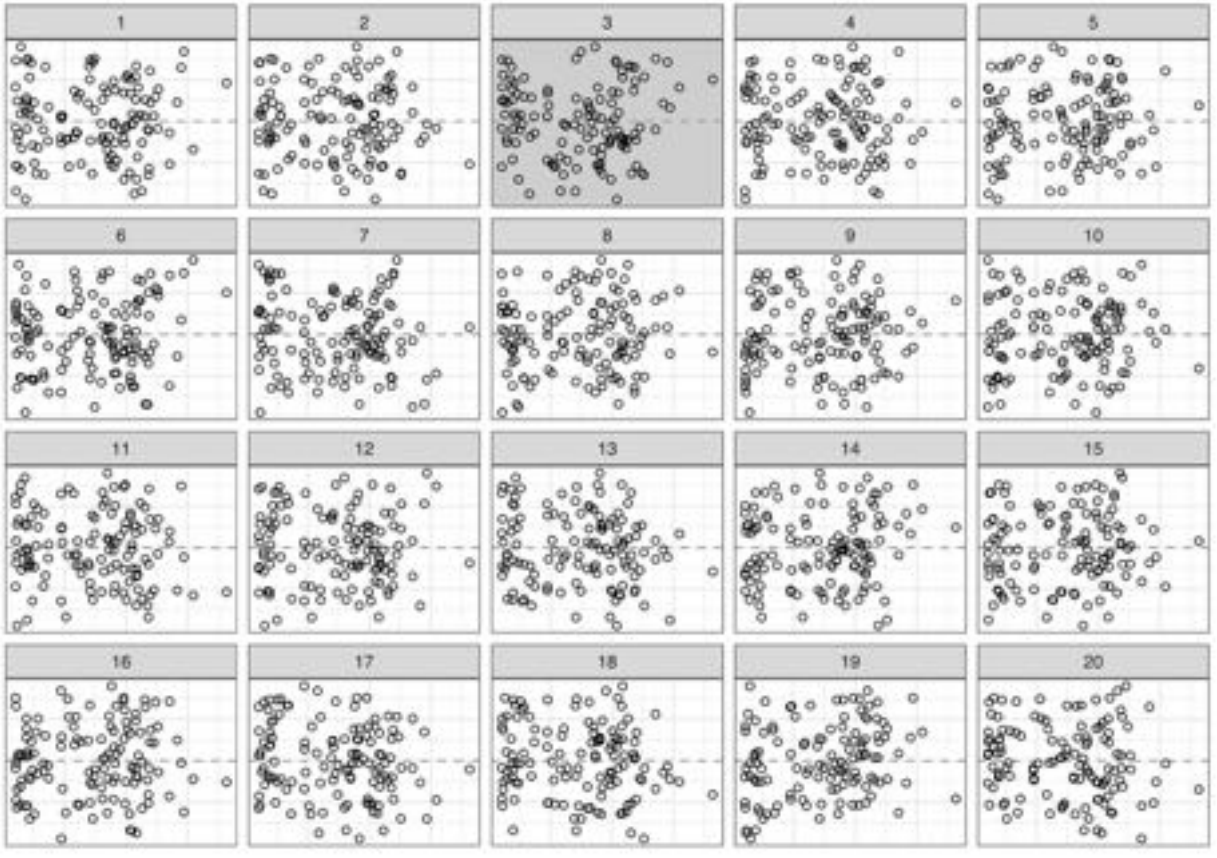
Where else is the lineup protocol useful?

Apophenia

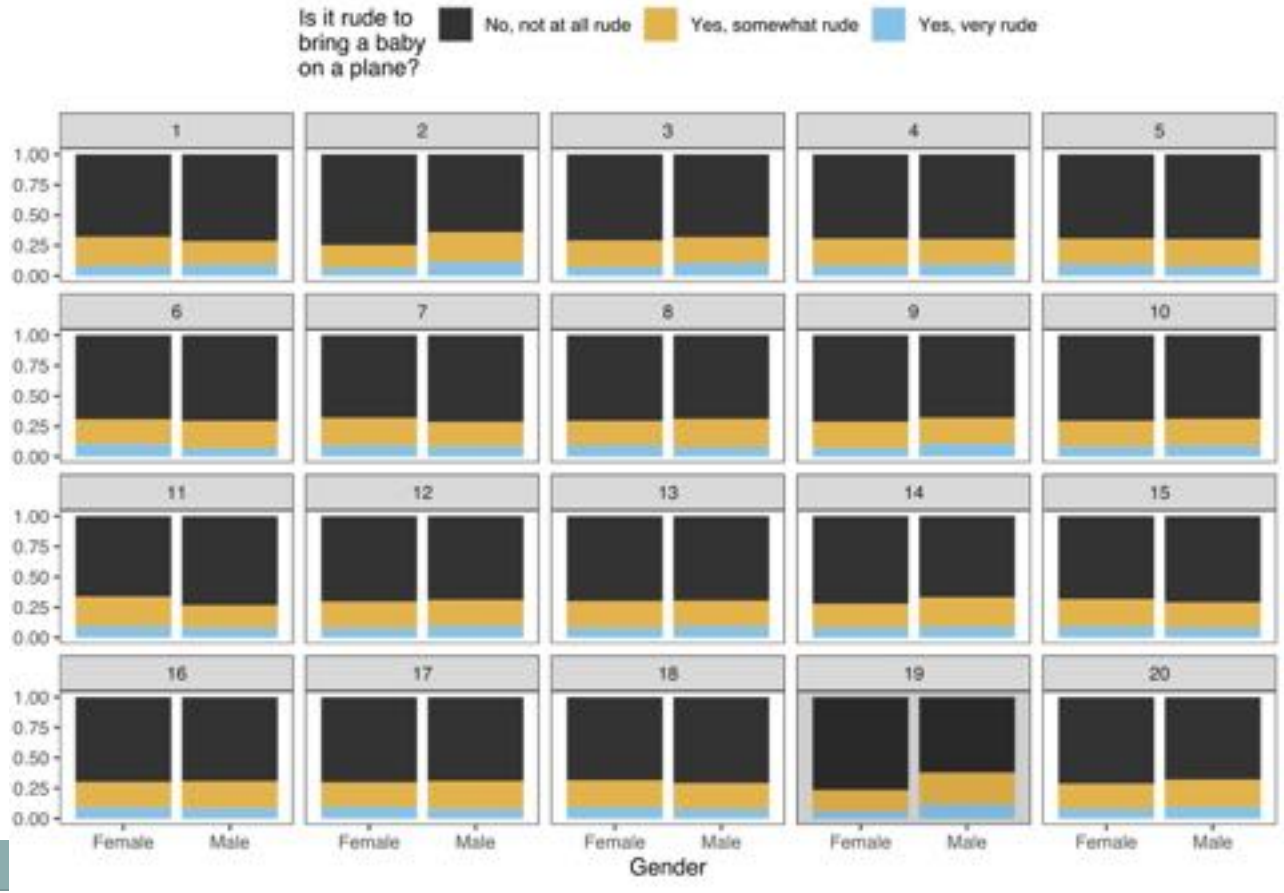
"the tendency to perceive a connection or meaningful pattern between unrelated or random things (such as objects or ideas)"

Meriam-Webster Dictionary Online, merriam-webster.com

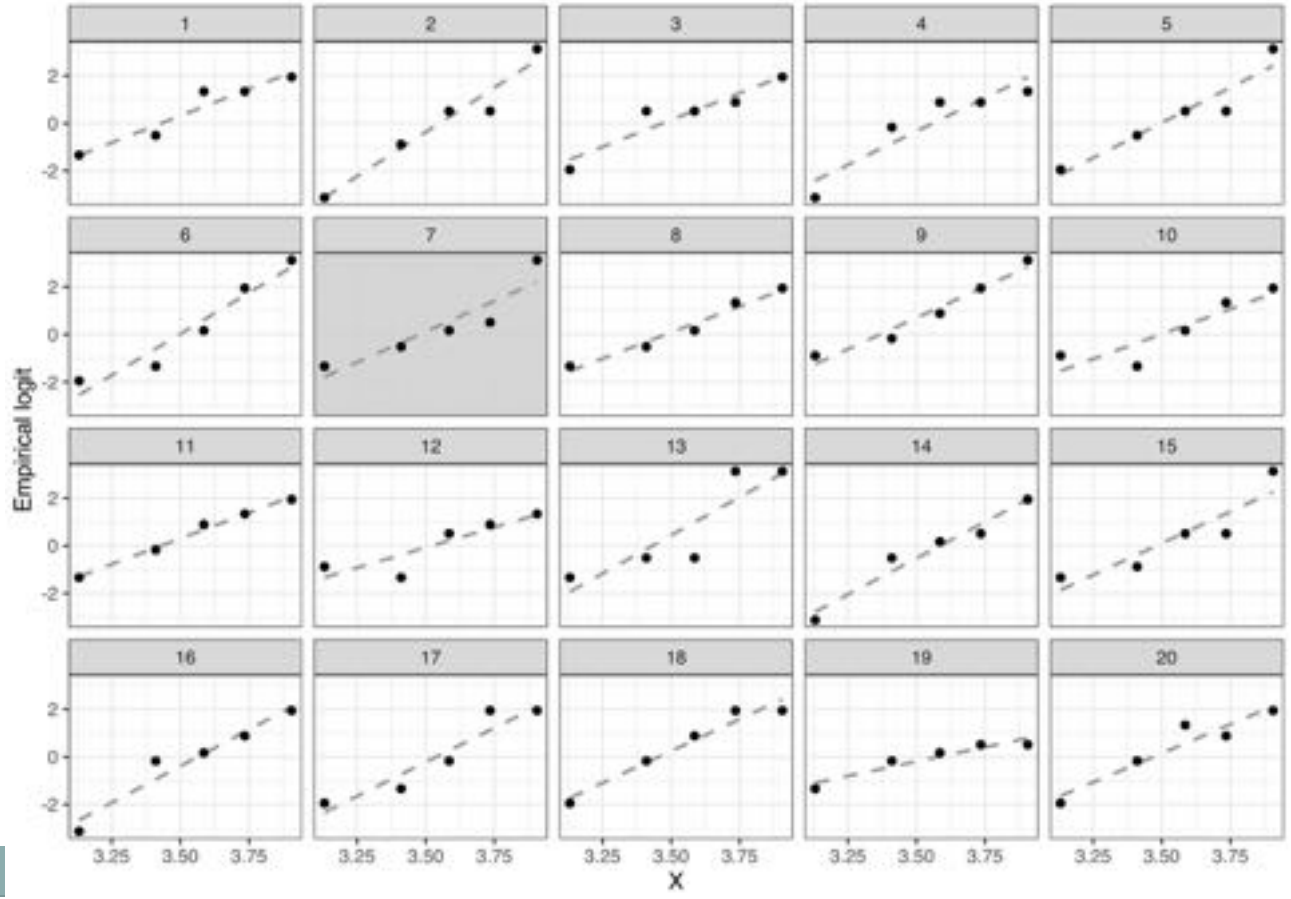
Does the observed residual plot stand out?



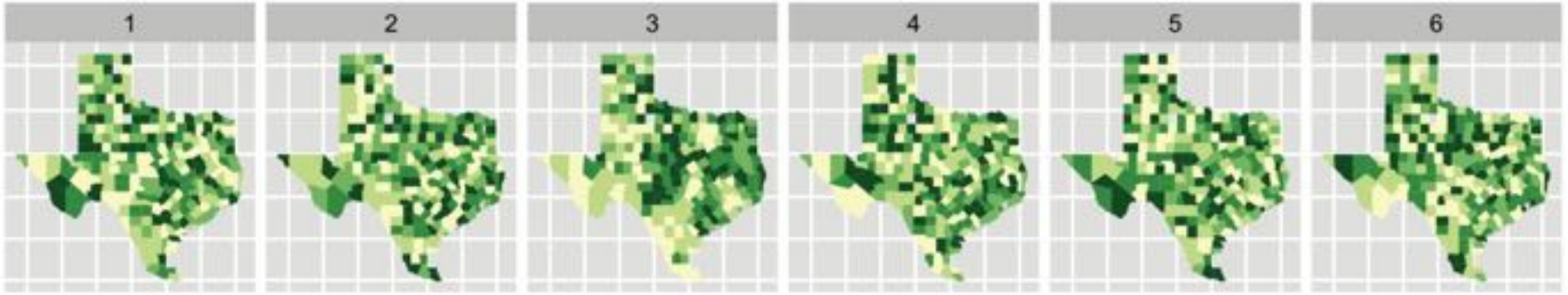
Is it rude to bring a baby on a plane?



Are the empirical odds linear?



Is there spatial association in this chloropleth map?



Wickham et al (2010)

Conclusions

Lineup introduces students to logic behind testing without need for technical discussions

Lineup provides a framework to help students interpret new statistical graphics

Lineup is a rigorous tool for statistical investigation later in the curriculum

Classroom support

https://aloy.github.io/classroom-vizinf/

Two activities + instructor guide

Tutorial on creating lineups in R

Shiny apps to create lineups for class activities