



Mixing Active Learning and Lecturing: Using Interactive Visualization as a Teaching Tool

Ted Laderas, PhD¹ and Jessica Minnier, PhD²

¹Department of Medical Informatics & Clinical Epidemiology, Oregon Health & Science University

²OHSU-PSU School of Public Health, Oregon Health & Science University

Teaching Statistical Concepts to Beginners

OHSU Data Science Institute

Audience:

- Librarians, information scientists
- Very little mathematical/programming background

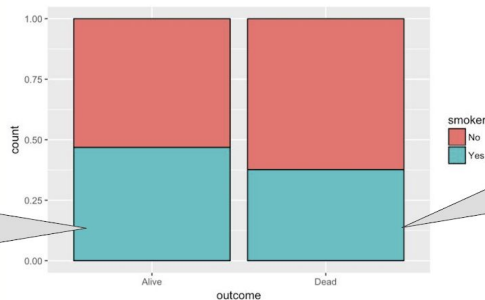
Goals:

- Use interactive visualizations in shiny to illustrate statistical concepts
- Empower students to explore data
- Understand relationships in data
- Interactive plots allow for exploration of multi-variable relationships

Teaching Simpson's Paradox with Shiny

Live Demo: <https://tladeras.shinyapps.io/categoricalData/>

Proportion of smokers alive is higher for smokers compared to non-smokers



Why is this so?
Distribution of age of participants is behind this!

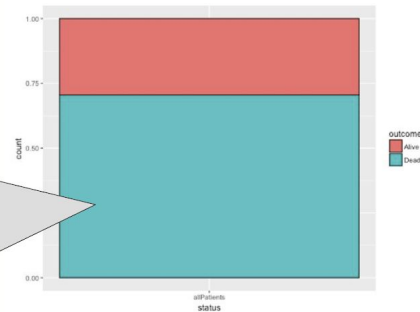
Age Cutoff



Slider allows students to explore relationship between age and outcome

Older population in cohort has a higher proportion of deaths

Age Cutoff



Teaching Correlation, Data Artifacts in NHANES

Live Demo: https://minnier.shinyapps.io/ODSI_continuousData/

Correlation explorer

Now you can try to get a feel for what correlation (linear and non-linear) looks like. Try a few pairs:

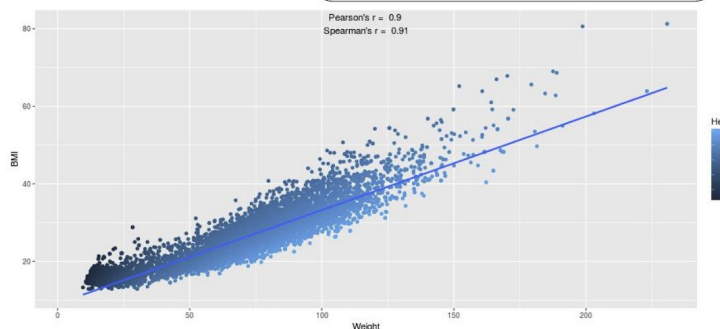
(For fun sometime, play the "guess the correlation" game at [guessthecorrelation.com](https://www.guessthecorrelation.com))

X-axis:

Y-axis:

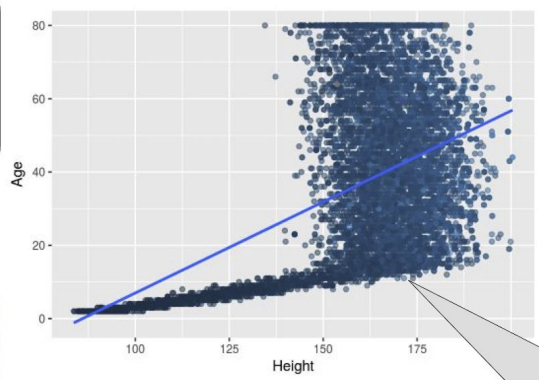
Color:

Drop down options allow exploration of variable relationships



Correlation is strongly linear for weight vs. BMI, but more complex relationship appears for height vs. age

```
Code Start Over Solution Run Code
1 # edit the ggplot code after x= and y= and color= to change the axes and the
2 # color
3 NHANES %>% ggplot(aes(x = Height, y = Age, color = Weight)) + geom_point(alpha = 0.5) +
4   stat_smooth(method = "lm", se = FALSE)
```



Interactive coding teaches data analysis, visualization in R

Why do you think there's a pile up of points at age 80?

- Everyone died at age 80.
- They oversampled from the 80 year olds.
- The data was truncated.

Submit Answer

Sparks questions:
- Why are height/age linearly correlated up to a certain age?
- Why are many subjects age 80?

Teaching Statistical Concepts to Beginners

Approach:

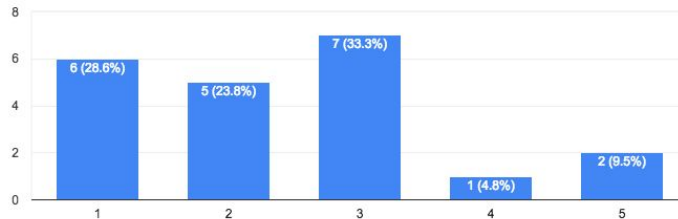
- Implement as a LearnR Tutorial, but used with didactic teaching
 - LearnR = R package that uses Shiny to create interactive workbooks
 - Can be deployed as a website, or on student's computer (requires R/Rstudio)
- Didactic lessons embedded in workbooks with interactive components
 - Interactive sliders, dropdown options allow interaction with data filtering and analysis
 - Interactive code teaches effect of changing code components on visualizations/analyses

Conclusions/Results

- LearnR package + Shiny in R → interactive workbooks
- Students were empowered to learn
- Students liked the visualizations
 - “Very well done and methodical treatment - the sliders were great!”
- Students felt engaged with the subject
 - “Explanation of key statistical concepts was effective and really made me want to learn more.”
- Pre/Post-workshop survey: 95% of learners felt they gained practical knowledge (n=22)

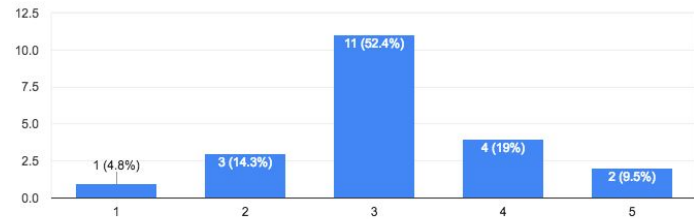
Please rate your level of ability for EDA prior to this session

21 responses



Please rate your level of ability for EDA after this session

21 responses



Impact

Pros:

- Accessible to beginners
- Mathematical concepts are more memorable
- Sparks discussions
- Empowers and engages students in scientific discovery/analysis

Cons:

- Advanced students may require more challenging activities
- Visualizations must be tested for effectiveness
- Requires programming skills to implement

Check it Out!

Categorical Data: <https://tladeras.shinyapps.io/categoricalData/>

Continuous Data: https://minnier.shinyapps.io/ODSI_continuousData/

LearnR package: <https://rstudio.github.io/learnr/>

DSIexplore LearnR package: <https://github.com/laderast/DSIExplore>

Thank You! Contact us:

Ted Laderas: <https://laderast.github.io/> @tladeras

Jessica Minnier: <http://jessicaminnier.com/> @datapointier

