ESTEEM ENHANCING STATISTICS TEACHER EDUCATION WITH E-MODULES

ESTEEM Webinar for Teacher Educators:
Implementing the *Teaching Statistical Association Module*

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January 30, 2020
4:00-5:45 p.m. EST

Webinar Goals

- Learn about the background for and content of the ***Teaching Statistical Association Module***
- Learn CODAP's capabilities for analyzing bivariate data
- Experience selected activities and consider how to use them with preservice mathematics teachers
- Hear from 1 faculty implementer!

To access and share ESTEEM modules

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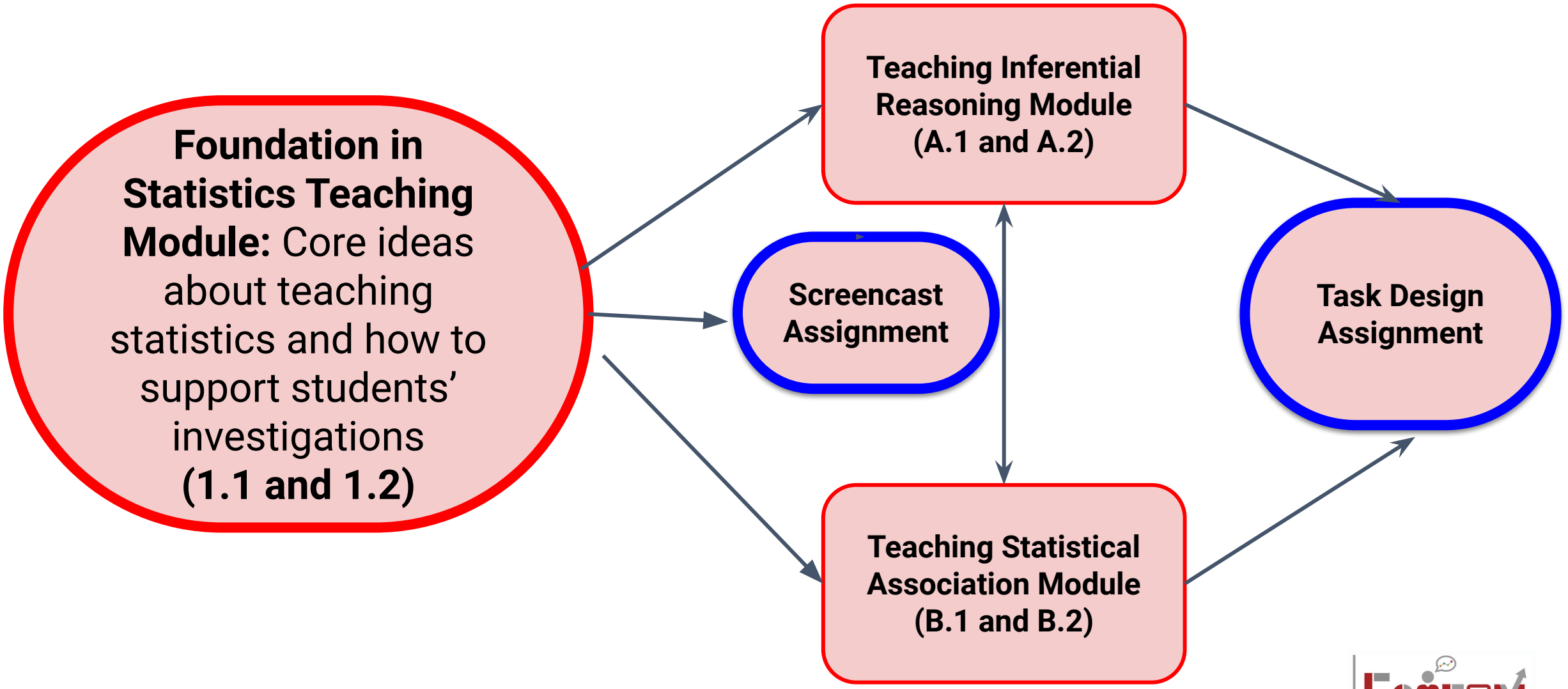
Open the following link:

https://place.fi.ncsu.edu

Direct link to ESTEEM page

https://place.fi.ncsu.edu/local/catalog/course.php?id=22&ref=3

ESTEEM Modular Approach



Structure of a Module

Each Module has 2 Parts. Each part about 5-7 hours of materials

Each Part has 3 Sections:

Read & Watch

- Essential Materials: Readings, videos and quizzes
- Learn from Practice: videos with teachers and students!

Engage with Data

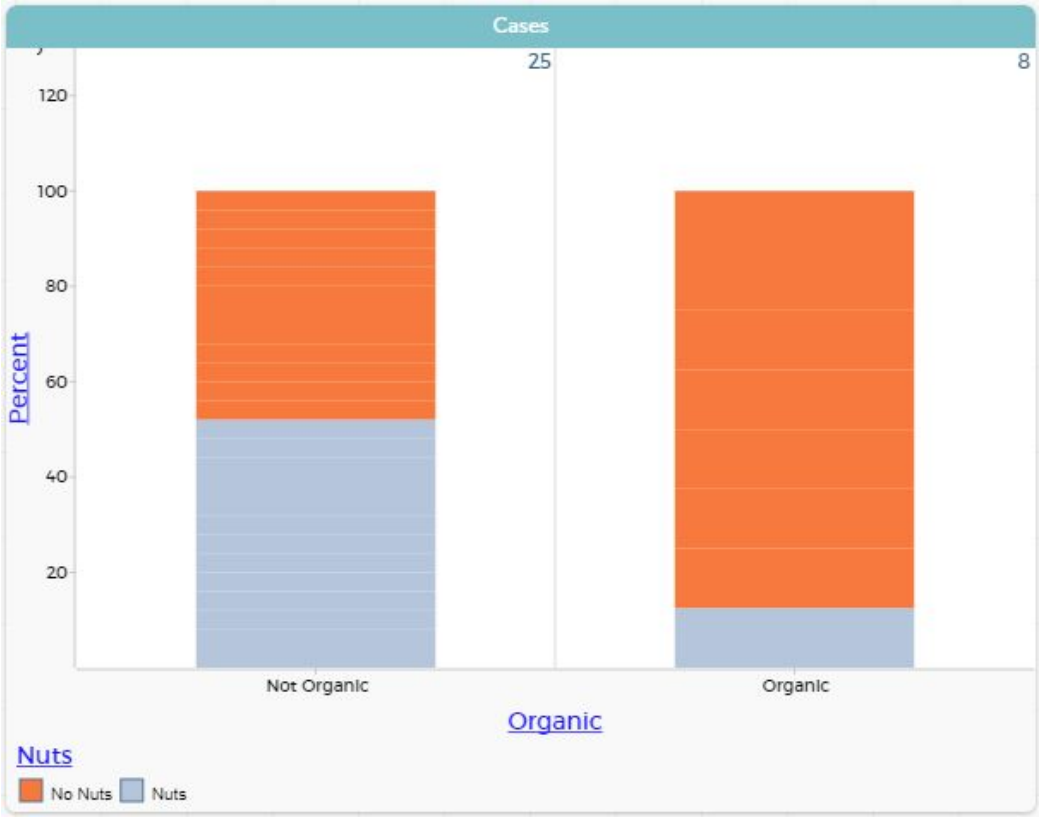
- Active statistics investigation using CODAP or other tools
- Focus on pedagogical aspects of investigations

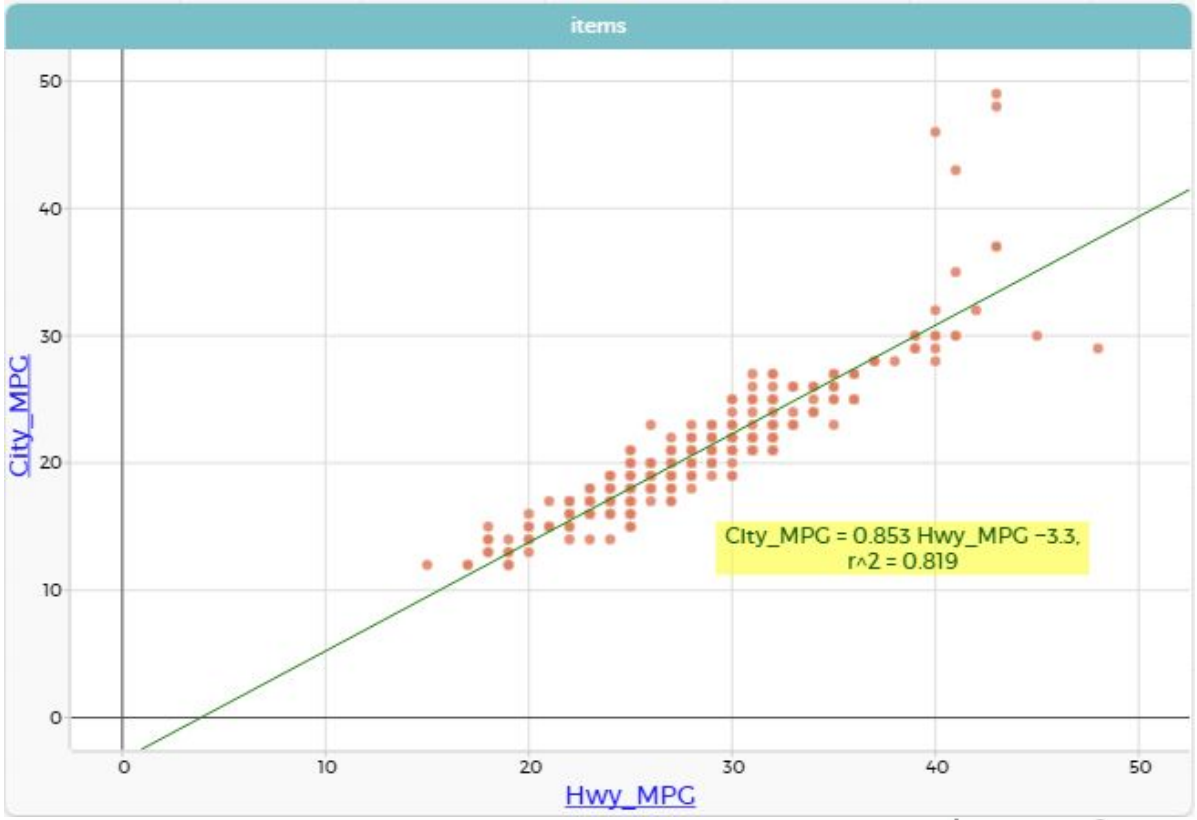
Synthesize & Apply

- Activities, reflections, discussions that help teachers connect ideas and apply to practice of teaching

Why is Statistical Association Important?

- Commonly included as a key idea in K-12 statistics





Why is Statistical Association Important?

- Commonly included as a key idea in K-12 statistics
- Included in Common Core State Standards and other College/Career Ready Standards
  - Cluster in 8th Grade (Investigate patterns of association in bivariate data -- 4 standards)
  - Two clusters in High School (Summarize, represent, and interpret data on two categorical and quantitative variables; Interpret linear models -- 5 standards)
- Careers in the Big Data era require individuals to consider how variables are related
- Correlation and linear regression are fundamental to more advanced topics in statistics (e.g., multiple regression)

B.1 Statistical Association of Categorical Variables

- Review content knowledge topics while introducing CODAP analyses (e.g., marginal, conditional and joint relative frequencies, what it means for categorical data to be associated, and common representations for bivariate categorical data)
- Additional emphasis on
  - Using CODAP to investigate data
  - Student reasoning about and represent bivariate categorical data

B.1 Statistical association of categorical variables

This module focuses on the teaching and learning of statistical association. Part 1 addresses association of categorical variables.

Time expectation: **5-6 hours**

Read & Watch

Essential Materials

- B.1.a Investigating Categorical Variables in CODAP
- B.1.b Common Student Approaches when Analyzing Bivariate Categorical Data
- B.1.c Quiz on Read & Watch material

Learn from Practice

- B.1.d Student-created Graphs of Bivariate Categorical Data

Engage with Data

- B.1.e Investigating Data about Granola Bars

Synthesize and Apply

- B.1.f Discuss Representations of Bivariate Categorical Data
- B.1.g Students' Reasoning about a Segmented Bar Graph

What do you notice?

What do you wonder?

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Mod B: Part 1

Granola Bar Investigation

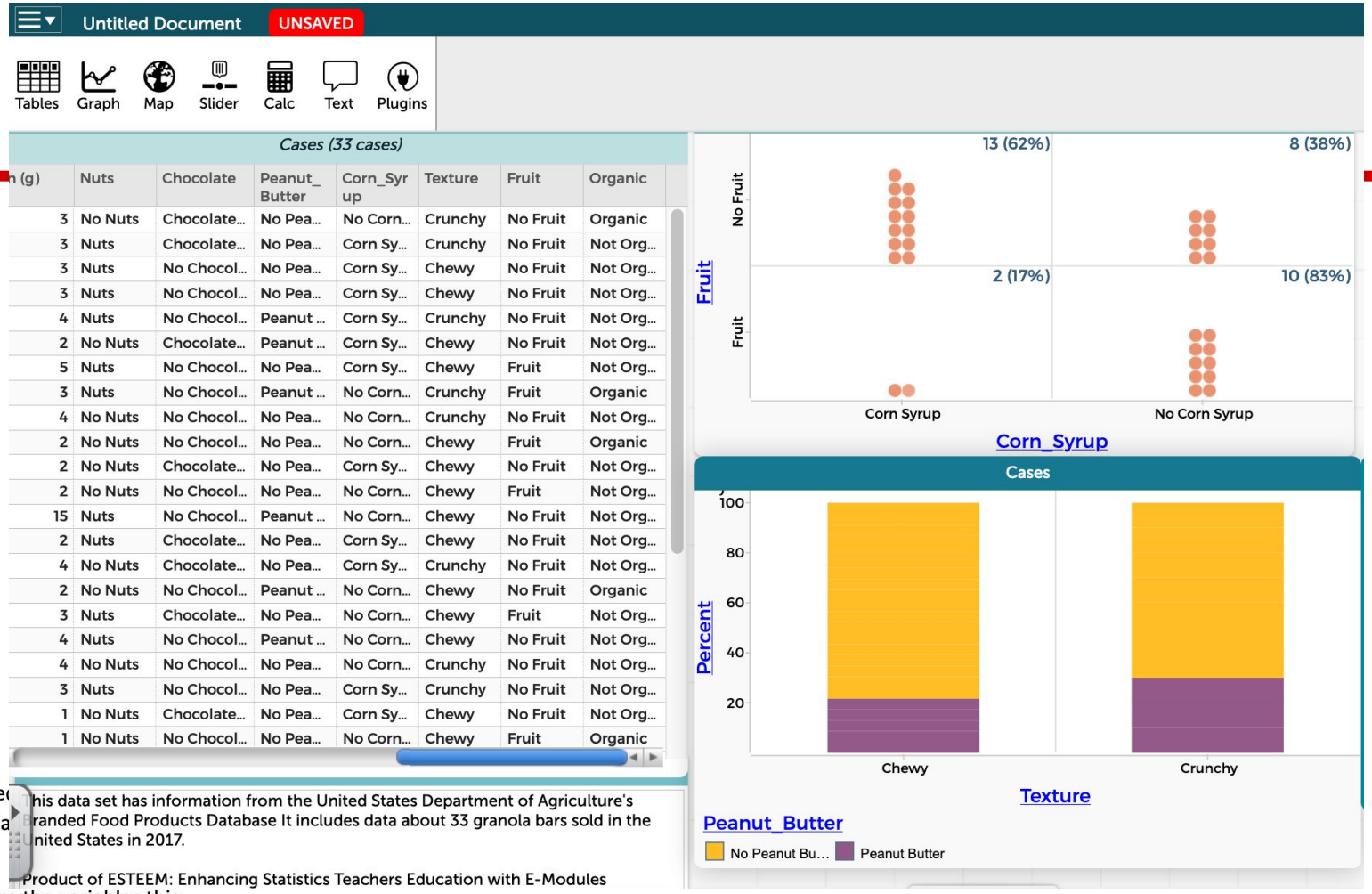
Open the granola bar data set in CODAP. This data set includes information from the Unite Department of Agriculture's Branded Food Products Database about a sample of 33 granola United States in 2017.

Begin by examining the data in the table. Look at the column headers of the table. These are the variables this data set has for the 33 granola bars.

1. What variables do you care about in a granola bar?

2. Select three categorical variables that a nutritionist might care about in determining whether a granola bar is 'healthy'?

3. What can we conclude about the texture of granola bars and whether their ingredients include nuts? Create a two-way binned plot using the attributes 'Nuts' and 'Texture'. Use this plot and CODAP's capabilities to complete the following statements.



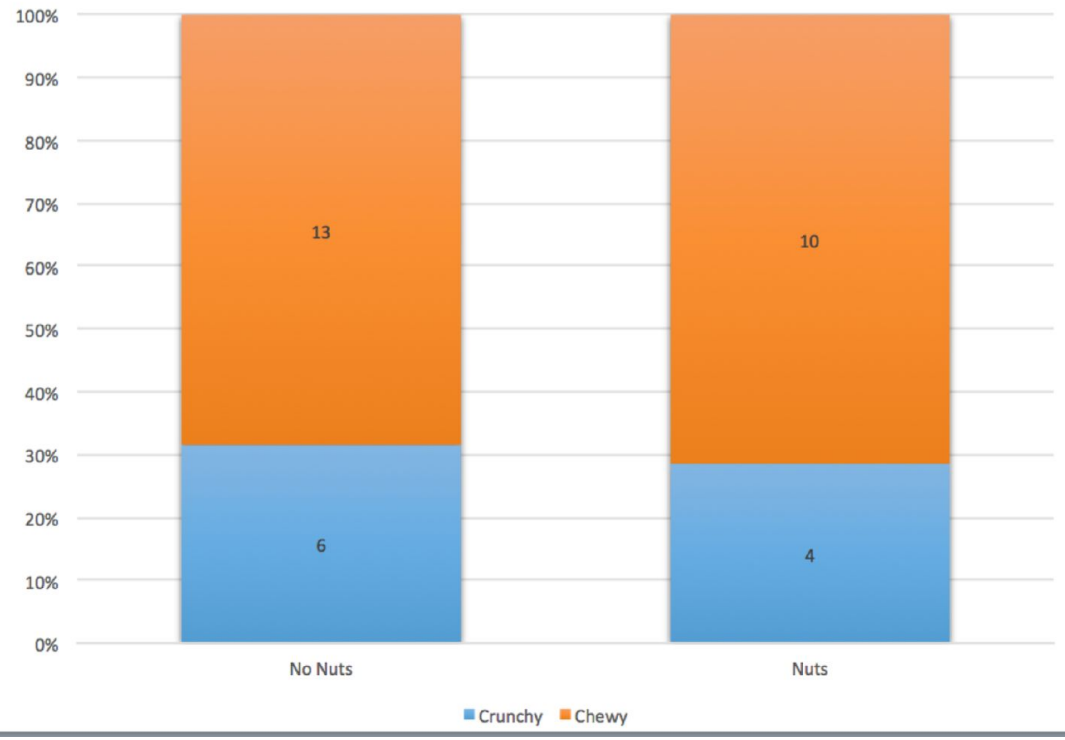
2017 Study on Interpreting Categorical Bivariate Data

Purpose: Explore how students ages 11-13 reason about association of categorical variables prior to instruction

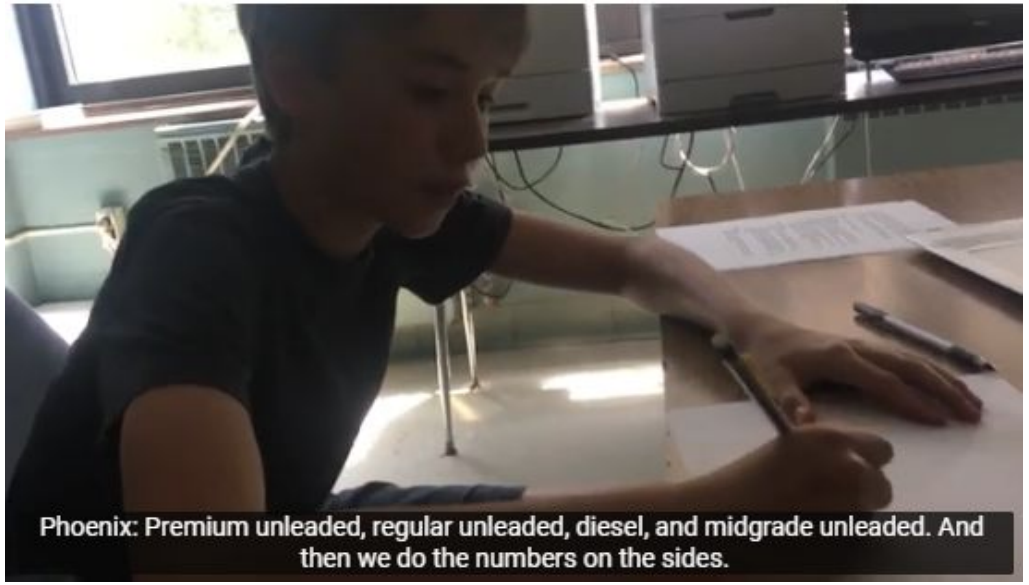
- 2 parts of study
  - Student-made graphs
  - Interpretation of pre-made graphs
- 13 students (7 males, 6 females) ages 11-13
- Semi-structured, task-based interview

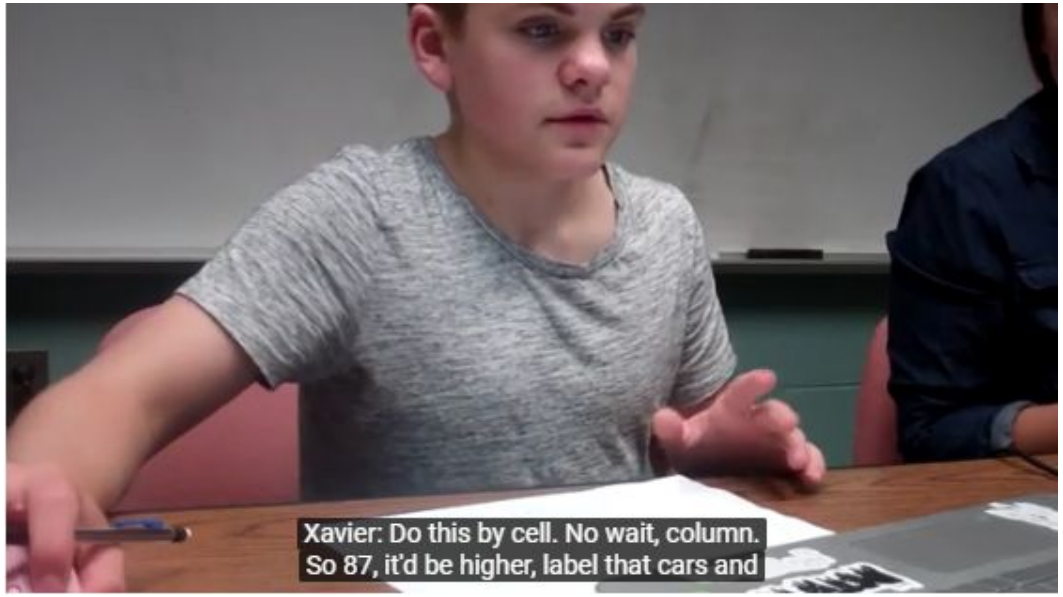
B.1.g Students' Reasoning about Segmented Bar Graph

	NO NUTS	NUTS
CHEWY	13	10
CRUNCHY	6	4



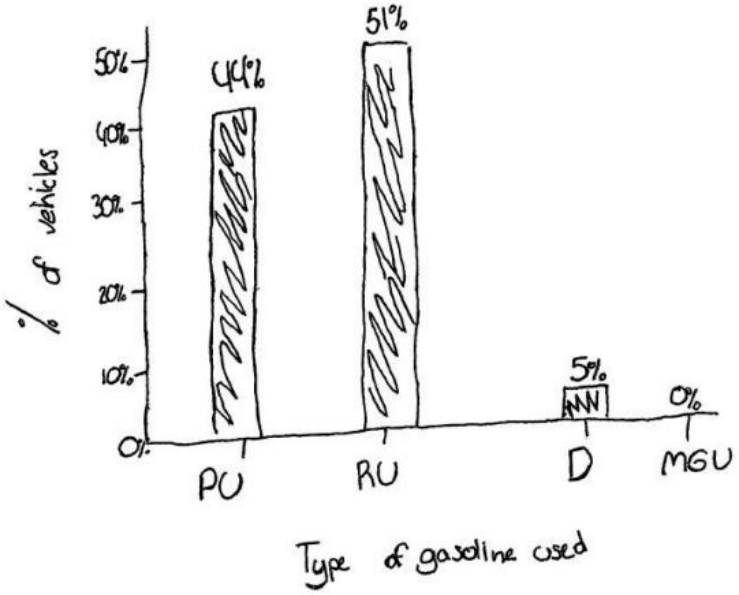
B.1.d Student-Created Graphs



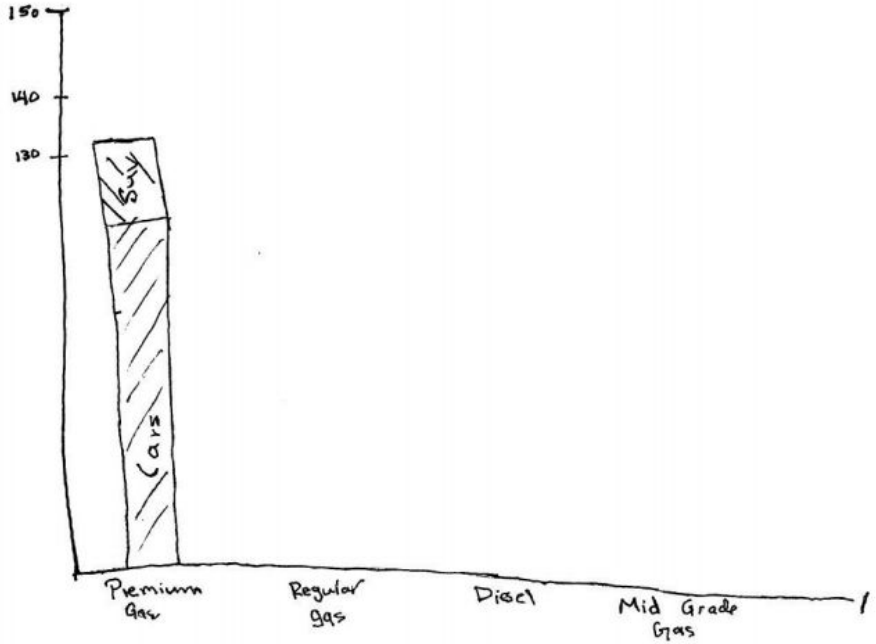


B.1.d Student-Created Graphs Cont.

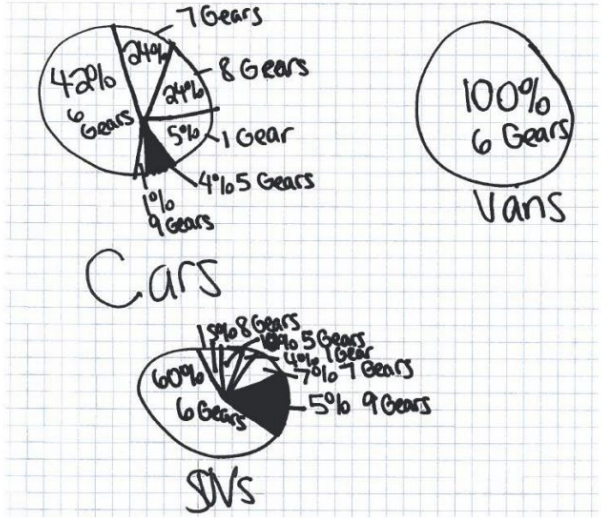
Phoenix:



Xavier:



Andrea:



Compare the three students' graph choices.

If you were to select/sequence these students' work for class discussion, how would you sequence them?

B.2 Statistical Association of Quantitative Variables

- Assume PSTs have a good level of common content knowledge (e.g., scatterplots, line of best fit, correlation coefficient)
- More emphasis on

  *data investigations with CODAP

  *how students intuitively think about, learn, and develop an understanding of quantitative association

B.2 Statistical Association of Quantitative Variables

This module focuses on the teaching and learning of statistical association. Part 2 addresses association of quantitative variables.

Time expectation: **6-7 hours**

Read & Watch

Essential Materials

- B.2.a Introducing Students to the Topic of Statistical Association
- B.2.b Measures of Association and Lines of Best Fit
- B.2.c Distinguishing Between Correlation and Causation
- B.2.d Quiz on Read and Watch Materials

Learn from Practice

- B.2.e Considering Student Approaches to Placing the Informal Line of Best Fit

Engage with Data

- B.2.f Investigating Data about Vehicles
- B.2.g Teaching Statistics with CODAP

Synthesize and Apply

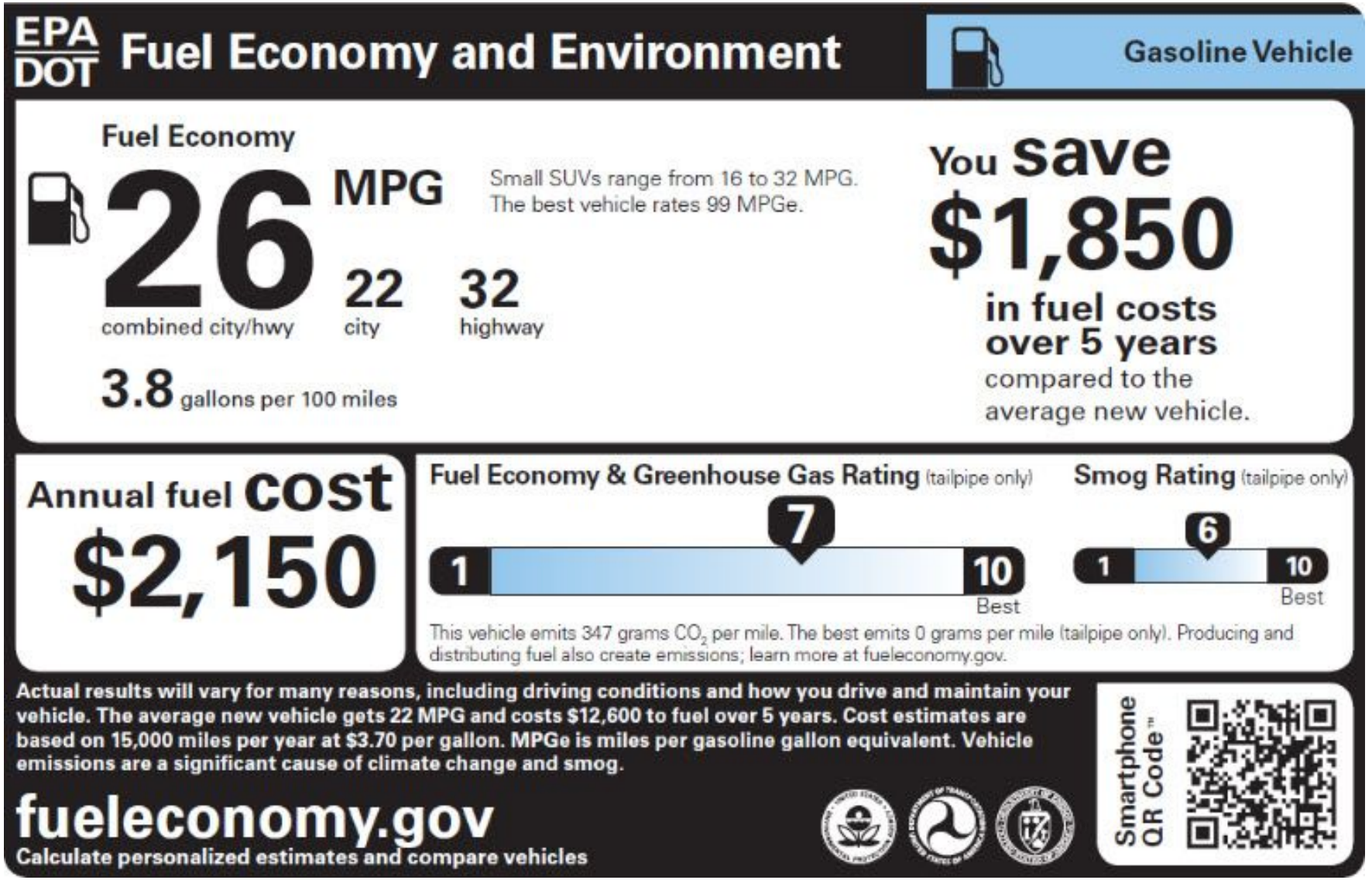
- B.2.h Discuss Differences between Mathematics and Statistics in the Study of Association
- B.2.i Investigating Data from the Census at School Random Sampler

B.2.e Considering student approaches to placing the informal line of best fit

Based on study I did with 8th graders “Examining Student Conceptions of Covariation: A Focus on Line of Best Fit”, published in March 2015 issue of *Journal of Statistics Education*

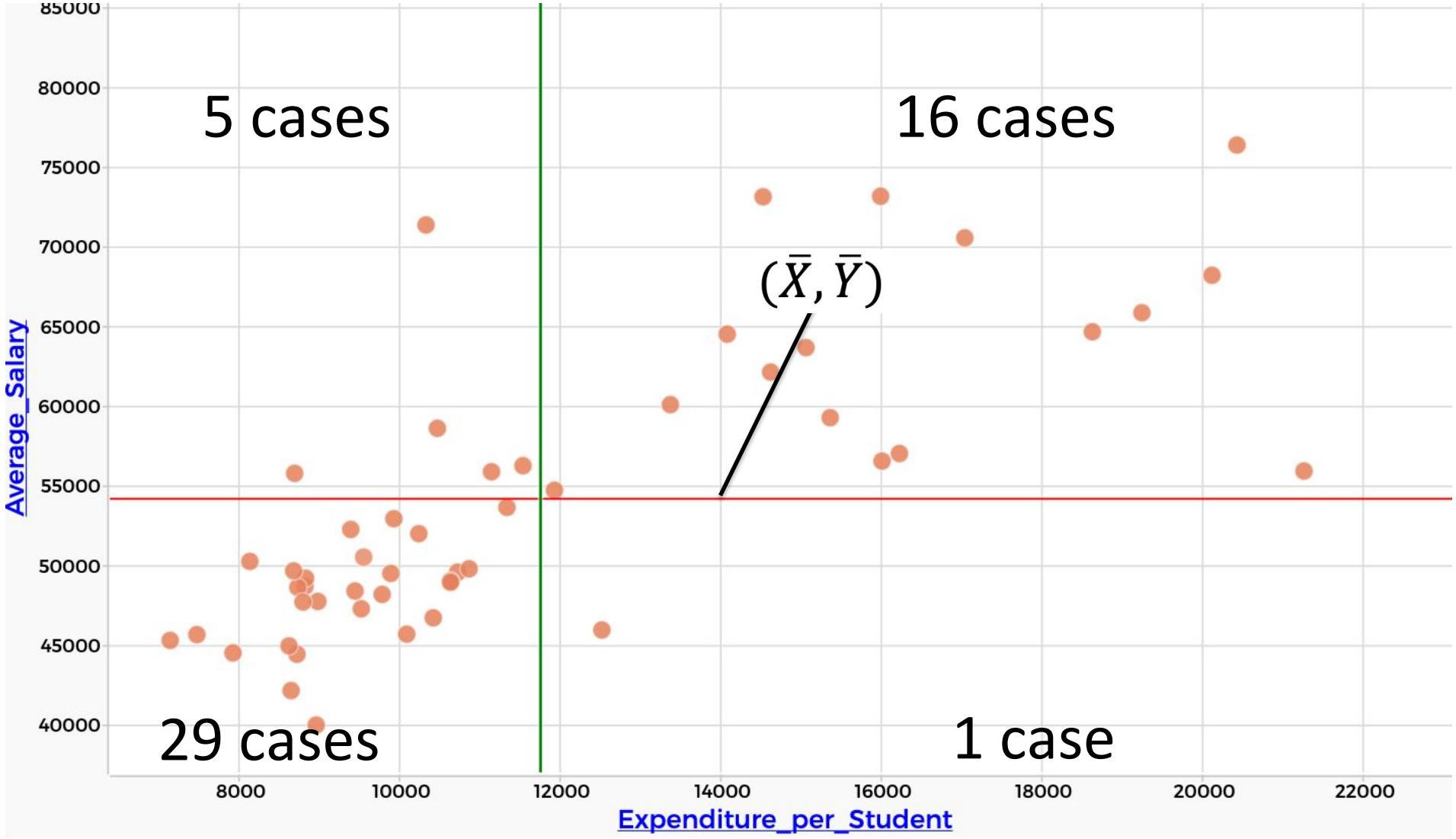
http://ww2.amstat.org/publications/jse

B.2.f Investigating Data about Vehicles



B.2.b Video: QCR

Middle grades students are ready to think about how to quantify strength of association in bivariate quantitative data → **Quadrant Count Ratio (QCR)**



N = 51 cases

$$QCR = \frac{[n(QI) + n(QIII)] - [n(QII) + n(QIV)]}{N} = \frac{[16 + 29] - [5 + 1]}{51} \approx 0.76$$

Reflections on Implementing the Module

Angela Broaddus

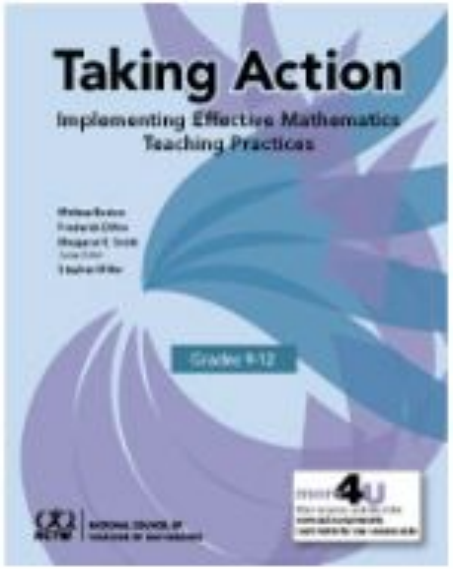
Benedictine College

Context

- School: Small Catholic liberal arts college
- Course: Secondary Math Methods
- Students: 4 seniors, 2 juniors
- Prior knowledge of statistics:
  - 4 seniors – Probability and Statistics
  - 2 juniors – no prior credit in Statistics

Course Rhythm

- 4 credits
- Two 2-hour meetings per week plus 20 clinical hours
- Implemented ESTEEM modules
  - 1.1, 1.2, A.1, A.2, B.1, B.2
  - Task Design Assignment
- Other course materials:



Implementation of B1 and B2

- 3 weeks
- B.1.a,b,c – HW
- B.1.d discussed in class and completed as HW
- B.1.e,g –in class
- B.1.f – HW
- B.2.a,b,c – in class
- B.2.d – HW
- B.2.e,f,g – in class
- B.2.h – HW – one student per thread/topic. Then respond to other posts.
- B.2.i – in class

Takeaways

B1:

- New considerations for everyone – particularly the representations
- Excellent comparisons for drawing on and clarifying proportional thinking.
- Each person developed “favorite” views
- These students developed new content knowledge as well as teaching ideas.

B2:

- Familiar content and representations
- Nice representations for revisiting the meaning of least squares regression
- Opportunity to revisit measures of association (i.e., r, r^2)
- Good opportunities to visit typical misconceptions of school-age students
- Good opportunity to revisit distinctions between math and statistics

Takeaways - Overall

- Time constraints
- “busywork” complaints
- Use class time effectively.
- My students preferred the teaching videos over the expert panels.
- Students love CODAP!
- Group work and conversations worked nicely.
- The task assignment incorporated best practices from the *Taking Action* text really nicely. It was a great way to end the semester!

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hirise.fi.ncsu.edu/projects/esteem/