IDENTIFYING STATISTICAL CONCEPTS ASSOCIATED WITH HIGH AND LOW SELF-EFFICACY TO TEACH STATISTICS:

USING THE SETS INSTRUMENT WITH PRE-SERVICE MIDDLE GRADES TEACHERS

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CONTINUING THE FUN FROM YESTERDAY'S WORLD STATISTICS DAY

https://worldstatisticsday.org/

THE RESEARCH TEAM

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Self-Efficacy, Attitudes, and Beliefs

Teacher efficacy affects

- teacher motivation
- willingness to use more innovative techniques
- student achievement
- time spent teaching certain concepts

(Czerniak, 1990; Riggs & Enochs, 1990; Wenta, 2000).

Existing Instruments Measured

- attitude towards statistics (SATS, ATS)
- efficacy for learning/doing statistics (CSSE, SELS)
- statistical knowledge (SCI, CAOS)
- statistics anxiety (STARS)

SETS DEVELOPMENT PROCESS

Identified representative behaviors from GAISE and state standards items

Draft items created for instrument using language aligned with GAISE and state standards

Revised item wording based on input from practicing elementary & middle school teachers

MIDDLE GRADES SETS INSTRUMENT

26 items in this format:

Please rate your confidence in teaching middle grades students the skills necessary to complete the following tasks successfully:

Scale of 1 "Not at all confident" to 6 "Completely confident"

MIDDLE GRADES SETS INSTRUMENT

Appendix - All Items on the Middle Grades SETS Instrument

The instrument below uses the two-factor structure presented in Harrell-Williams et al. (2014). Applying the language of Friel, Curcio, and Bright (2001), the two-factor structure in the column headings represents levels A and B, respectively, of the preK-12 GAISE (Franklin et al. 2007). Readers interested in using the SETS instrument should contact the authors.

Factor 1 Items: "Reading the Data"	Factor 2 Items: "Reading Between the Data"
1. Collect data to answer a posed statistical question in contexts of interest to middle school students.	12. Distinguish between a question based on data that vary and a question based on a deterministic model (for example, specific values of rate and time determines a particular value for distance in the model $d = r \times t$).
2. Recognize that there will be natural variability between observations for individuals.	13. Identify what variables to measure and how to measure them in order to address the question posed.
3. Select appropriate graphical displays and numerical summaries to compare individuals to each other and an individual to a group.	14. Describe numerically the variability between individuals within the same group.
4. Create dotplot, stem and leaf plot, and tables (using counts) for *summarizing* distributions.	15. Create histograms for summarizing distributions.
5. Use dotplot, stem and leaf plot, and tables (using counts) for *describing* distributions.	16. Use histograms for comparing distributions.
6. Create boxplots for *summarizing* distributions.	17. Compute interquartile range and five-number summaries for summarizing distributions.
7. Use boxplots, median, and range for *describing* distributions.	18. Use interquartile range, five-number summaries, and boxplots for comparing distributions.
8. Identify the association between two variables from scatterplots.	19. Recognize the role of sampling error when making conclusions based on a random sample taken from a population.

SETS DEVELOPMENT PROCESS (CONT.)

2010 - 2011

Data Collection Study for Validation Purposes

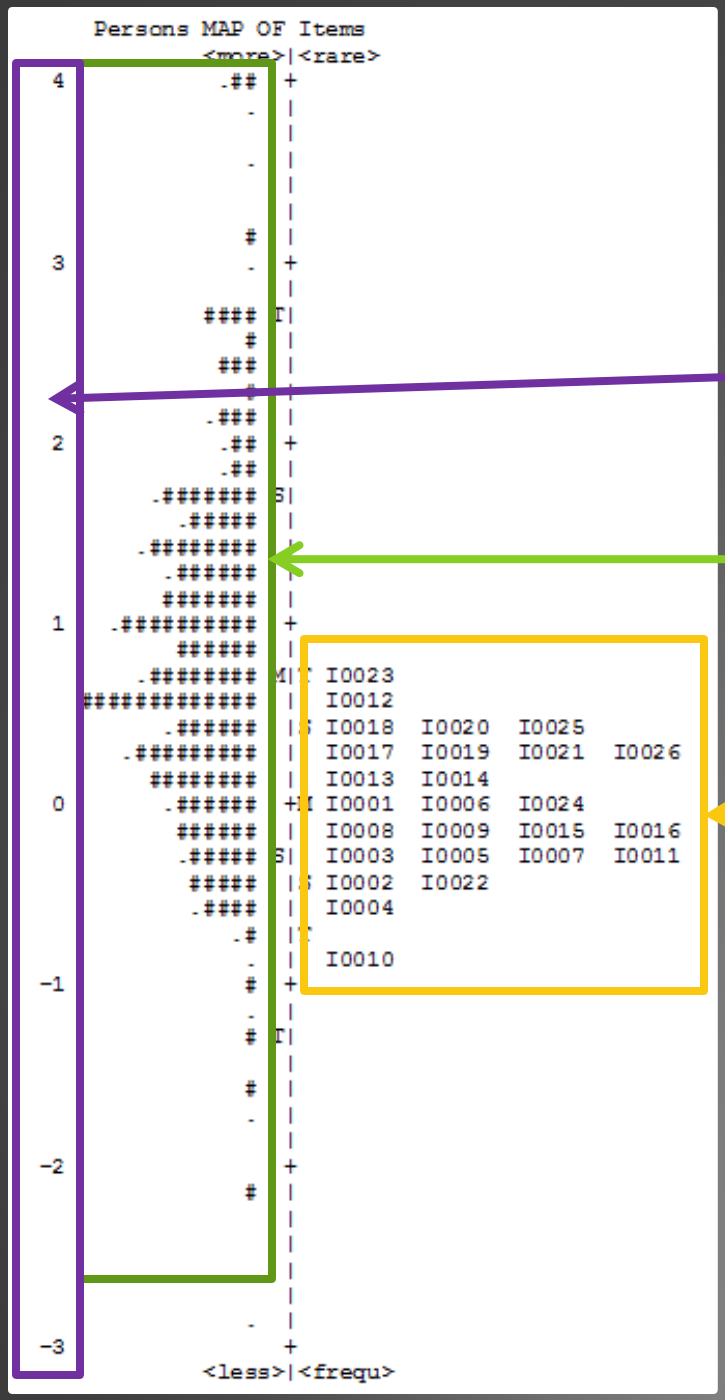
2012

Analysis of Data for Psychometric Properties of Instrument

2013

Evaluation of "Easiest" and "Hardest" Items

WHAT INFORMATION CAN WE LEARN FROM THE DATA?



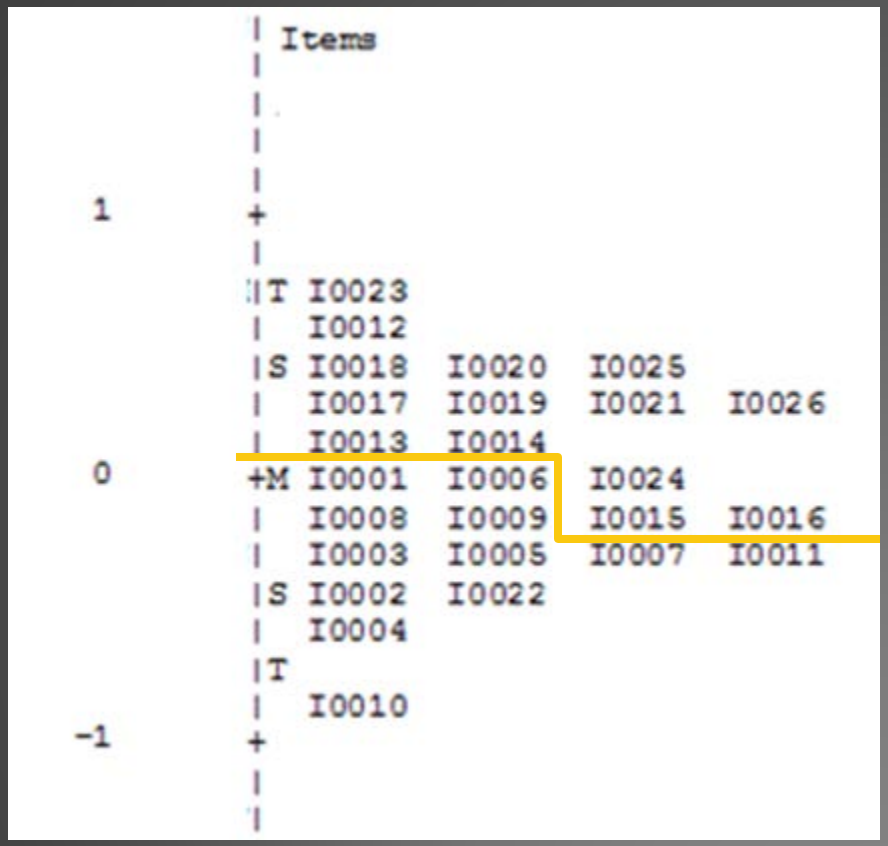
USING THE WRIGHT MAP

Estimates for items and persons are in logits

Distribution of persons

Distribution of items

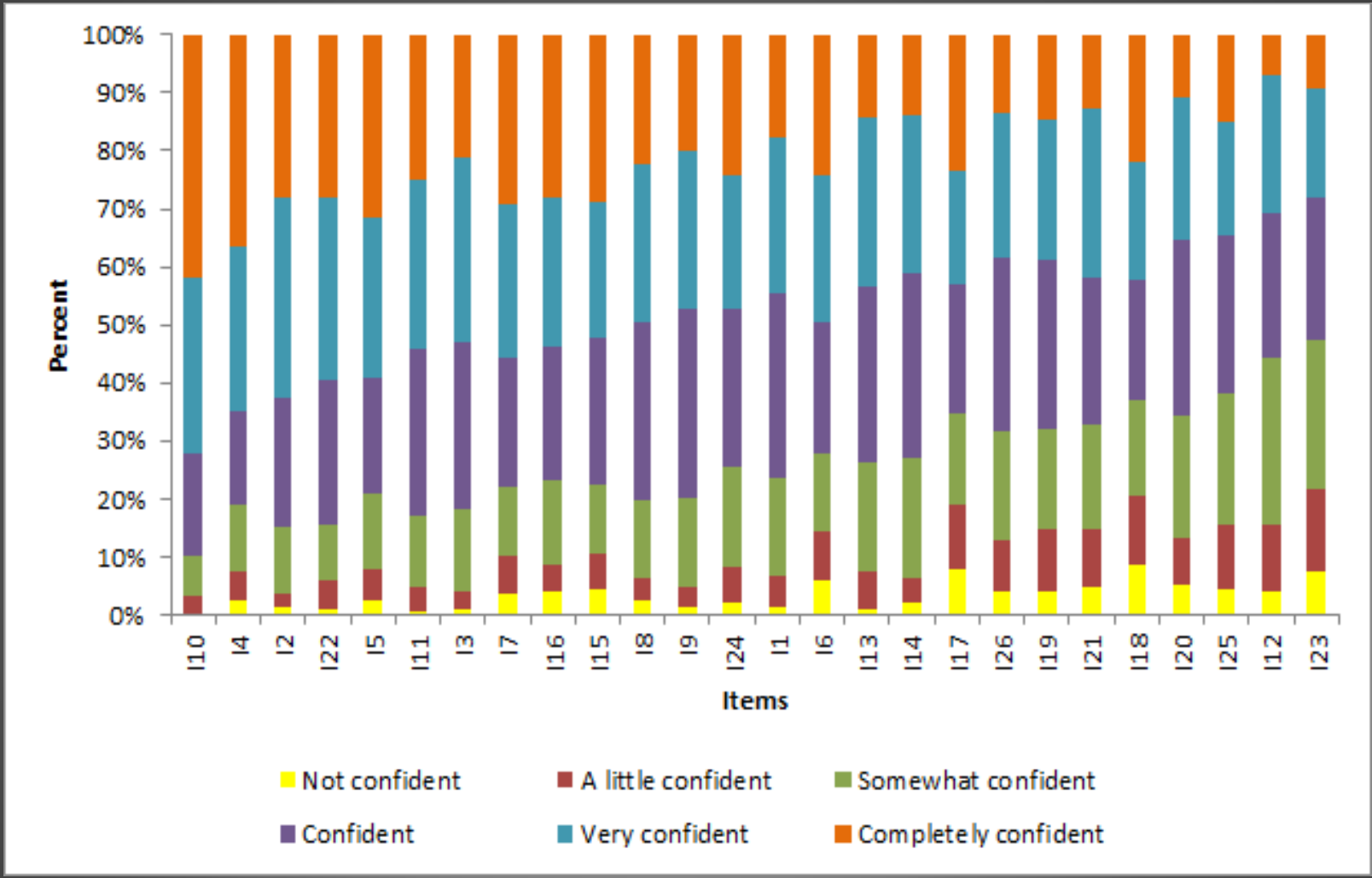
FOCUS ON ITEMS



Level B items

Level A items

RESPONSES FOR EACH CATEGORY BY ITEM



ITEMS WITH HIGHEST EFFICACY RATINGS

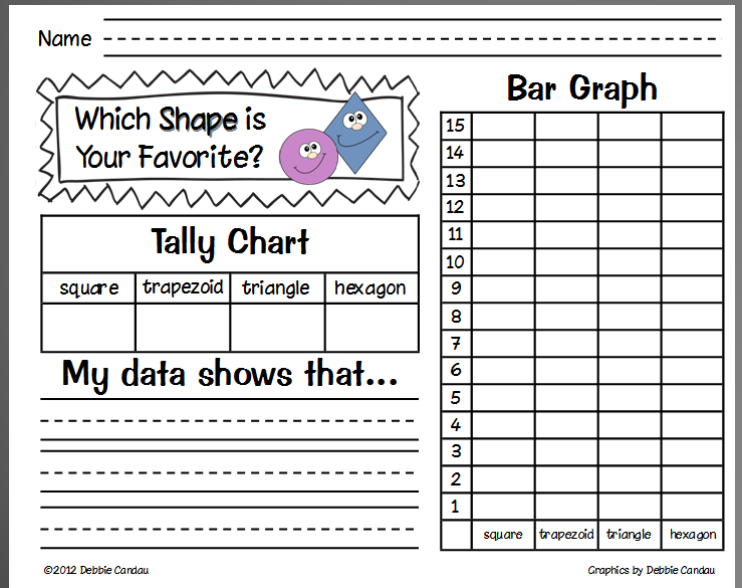
Item #	Difficulty Estimate	S.E.	Item Description
5	-0.34	0.06	Use dotplot, stem and leaf plot, and tables (using counts) for describing distributions.
22	-0.41	0.06	Recognize that a sample may or may not be representative of a larger population.
2	-0.48	0.06	Recognize that there will be natural variability between observations for individuals.
4	-0.50	0.07	Create dotplot, stem and leaf plot, and tables (using counts) for summarizing distributions.
10	-0.90	0.07	Recognize that statistical results may be different in another class or group.

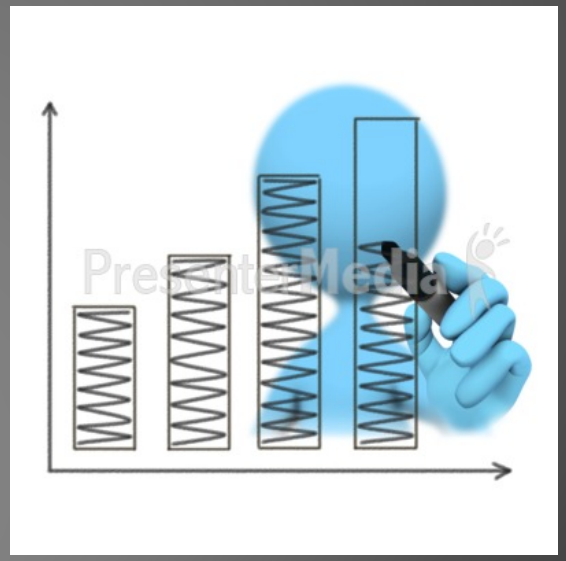
ITEMS WITH LOWEST EFFICACY RATINGS

Item #	Difficulty Estimate	S.E.	Item Description
23	0.74	0.06	Interpret measures of association.
12	0.61	0.06	Distinguish between a question based on data that vary and a question based on a deterministic model.
25	0.43	0.06	Distinguish between "association" and "cause and effect."
20	0.41	0.06	Describe numerically the strength of association between two variables using linear models.
18	0.36	0.06	Use interquartile range, five-number summaries, and boxplots for comparing distributions.
21	0.31	0.06	Explain the differences between two or more groups with respect to center, variability, and shape.

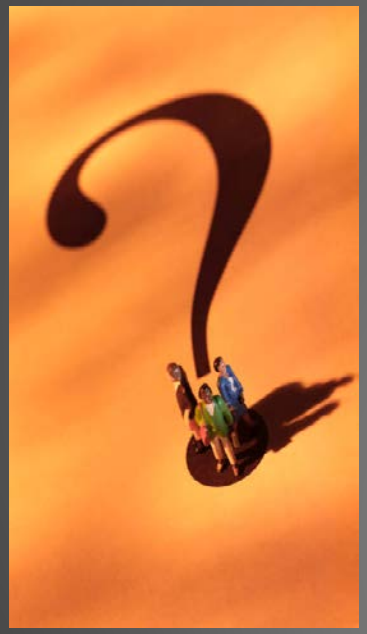
SUMMARY OF TRENDS

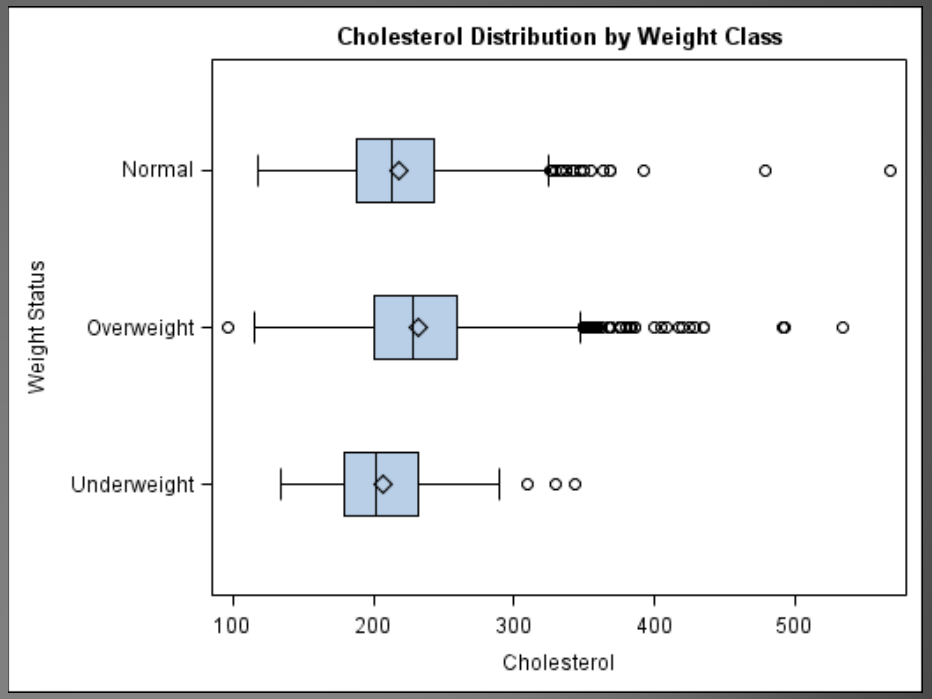
- Statistical topics where PSTs report feeling more efficacious:
  - generalizability of results
  - variability among results (2 items)
  - creating and using graphs and/or tables to summarize a distribution of univariate data (2 items)





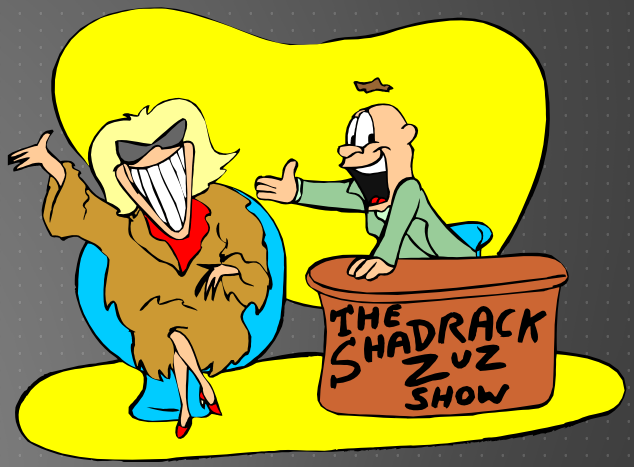
- Statistical topics where PSTs report feeling less efficacious:
  - question generation
  - association (2 items)
  - group comparisons (3 items)





ONGOING WORK

- Validation study for High School SETS instrument
- Investigation of why PSTs feel more/less confident about teaching certain statistical topics



TO GET SETS

Email Rebecca Pierce
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SETS REFERENCES

Harrell-Williams, L.M., Sorto, M.A., Pierce, R.L., Lesser, L.M., & Murphy, T.J. (2015). Identifying statistical concepts associated with high and low levels of self-efficacy to teach statistics in middle grades. *Journal of Statistics Education, 23*(1), 1–20.

Harrell-Williams, L.M., Sorto, M.A., Pierce, R.L., Lesser, L.M., & Murphy, T.J. (2014). Validation of scores from a measure of teachers' self-efficacy to teach middle grades statistics. *Journal of Psychoeducational Assessment., 32*(1), 40–50.

SETS REFERENCES

Harrell-Williams, L.M., Sorto, M.A., Pierce, R.L., Lesser, L., & Murphy, T.J. (August 2012). Measuring confidence to teach statistics to middle and high school grades: The development and validation of the SETS instruments. Webinar for Consortium for the Advancement of Undergraduate Statistics Education (CAUSE).

Harrell, L.M., Pierce, R.L., Sorto, M.A., Murphy, T.J., Lesser, L.M., & Enders, F.B. (2009). On the importance and measurement of pre-service teachers' efficacy to teach statistics: Results and lessons learned from the development and testing of a GAISE-based instrument. *Proceedings of the 2009 Joint Statistical Meetings, Section on Statistical Education*. Alexandria, VA: American Statistical Association.