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Statistics and Informatics Education in the U.S.

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A green light to greatness.

analysis of statistics education

1. Journal for Research in Mathematics Education (JRME) – Highest ranked US journal in mathematics education
2. Search included 2008-2018 –
   - Why? Common Core State Standards adopted by 42 states in 2010.
3. Search term(s) – statistics
4. Originally 140 articles
5. Reviewed each article for key words to see if exclusively statistics education
6. 140 articles reduced to 5 articles
7. 3 articles remained: 1 article omitted for referring to statistical analysis used in mathematics education research and 1 omitted for focus on student interest

Results

- Lyn D. English, & Jane M. Watson. (2016). Development of Probabilistic Understanding in Fourth Grade. *Journal for Research in Mathematics Education, 47*(1), 28-62. doi:10.5951/jresematheduc.47.1.0028
- Randall E. Groth. (2015). Working at the Boundaries of Mathematics Education and Statistics Education Communities of Practice. *Journal for Research in Mathematics Education, 46*(1), 4-16. doi:10.5951/jresematheduc.46.1.0004
- Jennifer Noll, & J. Michael Shaughnessy. (2012). Aspects of Students' Reasoning About Variation in Empirical Sampling Distributions. *Journal for Research in Mathematics Education,43*(5), 509-556. doi:10.5951/jresematheduc.43.5.0509

Groth (2015) – Shared spaces between mathematics and statistics education

Common Core State Standards-Mathematics – NGA & CCSSO, 2010

- Not until high school is there student choice to determine attributes to study for a situation (e.g. measuring highway safety)
- Grade 6 variability is introduced but lacks what types to be studied
- K-5 statistics content found in measurement and data focused on mathematics skills (e.g. producing specific types of graphs to solve specific math problems)

Note: US does not have national standards but the CCSS-M is close. See Eddy & Richardson (2011) for the historical development to accept the CCSS.

Guidelines for Assessment Instruction in Statistics Education Report – Franklin et al., 2007

- Early experiences in defining measures (e.g. define *word*)
- Learning trajectory for understanding variability (measurement, natural, and induced)

Note: GAISE uses levels A,B, & C versus grade levels and ages similar to van Hiele's levels of geometric thinking of experience over age

GAISE 2016 College Report

Recommendations updated from 2005 Report

1. Teach statistical thinking
   - Teach statistics as an investigative process of problem-solving and decision-making.
   - Give students experience with multivariable thinking.
2. Focus on conceptual understanding.
3. Integrate real data with a context and purpose.
4. Foster active learning.
5. Use technology to explore concepts and analyze data.
6. Use assessments to improve and evaluate student learning.

Note: Red is new

Why the Gaise 2016 College report Matters

Below is a highlight of some of the reasons.

- More students are studying statistics
- Students exposed to statistical thinking in grades 6-12 (Adoption of CCSS-M in 2010)
- Availability of data has made statistics more relevant
- Data Science includes statistics and computer science
- Innovations in statistical inference

CCSS-Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

CCSS-M - High school: modeling

Modeling links classroom mathematics and statistics to everyday life, work, and decision-making. Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data. (NGA & CCSSO, 2010, p. 72)

English & Watson (2016) – Probability understanding in 4th grade

- Empirical study of 4th graders in Australia
- Purpose: Investigated students' development in understanding the relationship of experimental estimates of probabilities based on relative frequencies and the theoretical probabilities of tossing one or two coins

- CCSS-M 2010
  - Grade 6 – statistical variability
  - Grade 7 – random sampling to draw inferences
- References Carpenter et al. (1981) reporting on results from the National Assessment of Educational Progress (NAEP) - predicting the probability of heads after flipping one coin then two heads after flipping one coin twice.

Noll & Shaughnessy (2012) – Lattice as instructional tool

Lattice as an instructional tool teaching statistics (e.g. student reasoning for Sampling Distribution for understanding concept of variability) – originally included three levels of reasoning in the following progression:

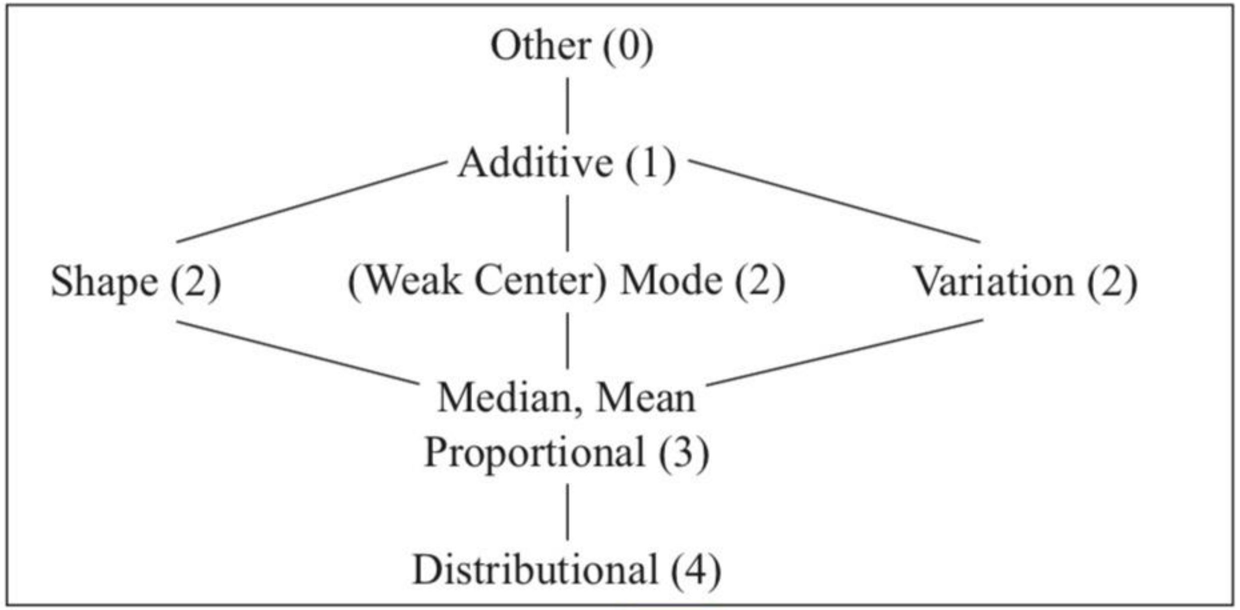
Additive-dependence on frequency information

Proportional - percentage and relative frequencies and flexibility between population and sample proportions

Distributional – "integrate multiple aspects of sampling distributions (e.g. center, shape, and variability) when making predictions about, or when estimating population proportions, from a sampling distribution

Revised conceptual Lattice

Noll & Shaughnessy, 2012, p.523



Informatics Education

- Included as option in University coursework – for example UNT Health Informatics (https://informationscience.unt.edu/health-informatics)
- Not formally required as part of course work in k-12 education
- International Society for Technology in Education (ISTE) – Standards for students (https://www.iste.org/standards/for-students)
- Texas Essential Knowledge and Skills – Technology Applications (http://ritter.tea.state.tx.us/rules/tac/chapter126/index.html)

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Thank you

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