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	AVERAGE		ABSOLUTE			
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March	15.1	7.7	22.9	-2.3	3.2	98.8
April	184	10.5	27.6	0.3	2.8	83.4
May	23.5	15	33.9	7	2	63.5
June	27.6	19	36.9	8.9	1.7	50.1
July	30.1	21.1	38.6	12.5	1	30.7
August	29.7	20.8	38	11.4	1.4	43
September	25.7	17	33.4	6	3.9	118
October	21.7	13.6	28.9	5.4	2.6	80.4
November	17	9.5	26	-1.8	4.9	146
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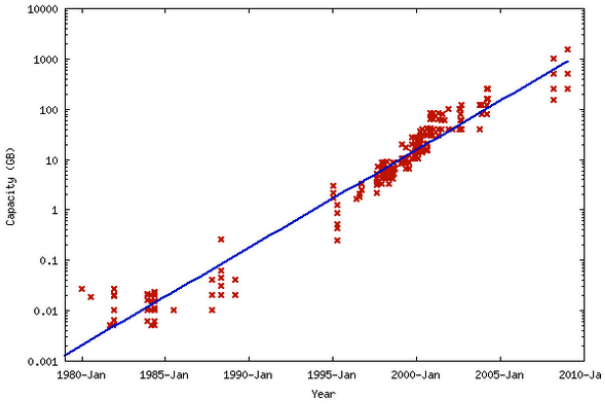

Mean Absolute Deviation in Sixth Grade??? Don't Get MAD!

Ellen Metzger
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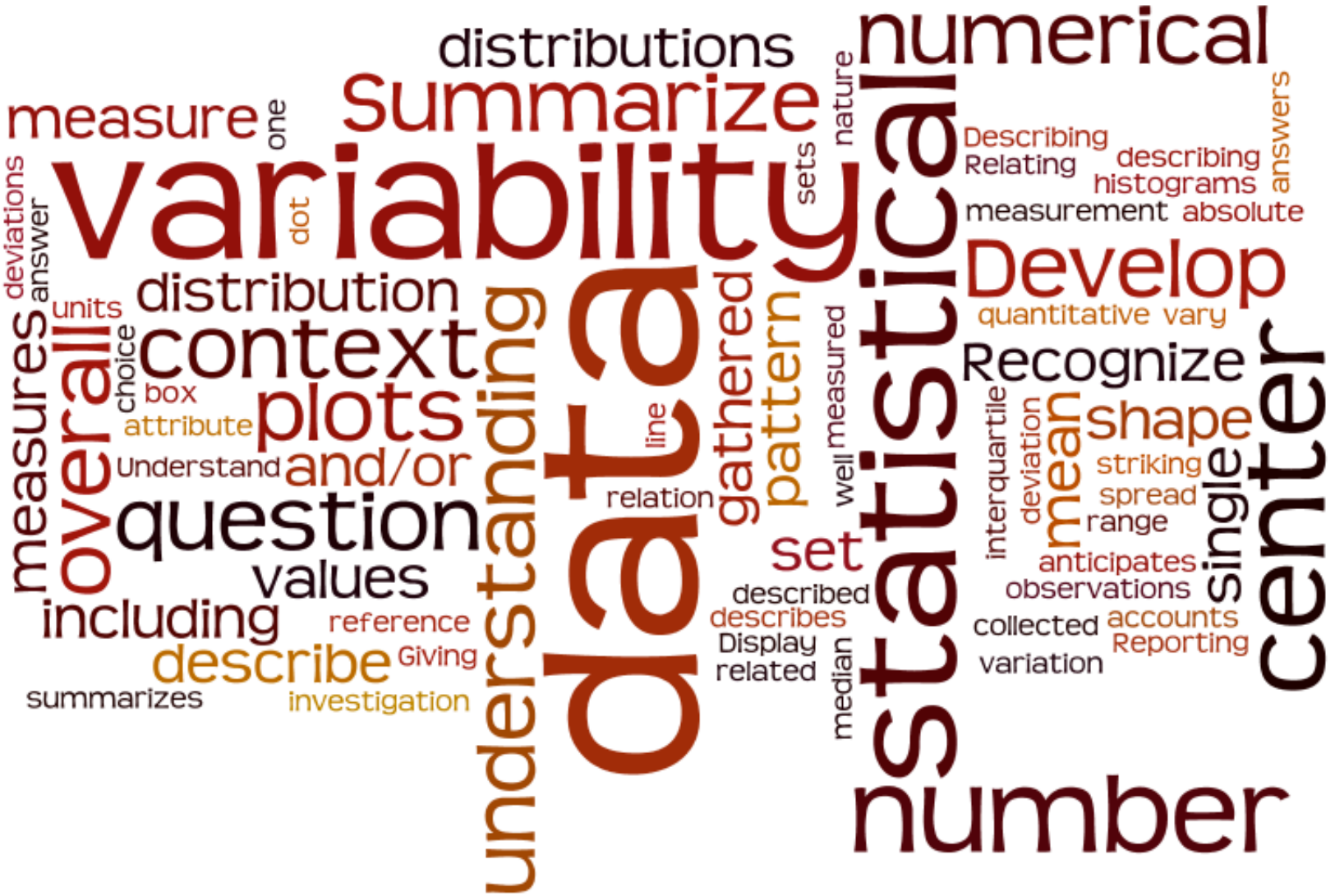
NCTM Boston
April 16, 2015

Does MAD make you mad?

- Responses to changes in statistics (CCSS)
  - There never used to be so much statistics in middle school math
  - The writing committee must have had too many overzealous statisticians in it
  - I never learned this myself
  - This is not in our textbook
  - This is too hard
  - What is the point of this?

Grade 6 Statistics CCSS



6th Grade Statistics

- Recognizing that a statistical question anticipates variability in data
- Summarizing and describing a data set
  - Measures of Center
  - Measures of Spread/Variability
  - Overall Shape, Cluster, Skew, Outliers
  - Displaying Data (dot plots, box plots, histograms)

Grade 7 Statistics CCSS

7th Grade Statistics

- Using random sampling to draw inferences about a population
- Comparing two populations
  - Overlap
  - Differences in centers
  - Differences in variability

7.SP.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities measuring the difference between the centers by expressing it as a multiple of a measure of variability.

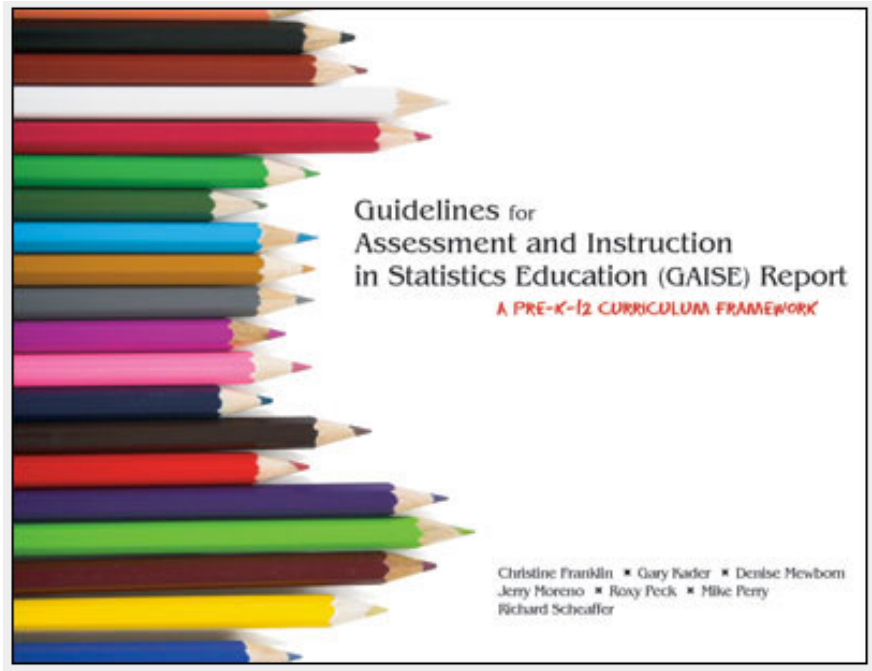
Grade 8 Statistics CCSS

8th Grade Statistics

- Patterns of Association in Bivariate Data
- Scatterplots -- Lines of best fit
- Two-way frequency tables

GAISE

- *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A PreK–12 Curriculum Framework.*



GAISE

- 2007 (pre-CCSS) – informed CCSS
- Levels A, B, and C roughly correspond to elementary, middle, and secondary, but are based on experience, not age.
- Emphasizes the importance of the investigative process:
  - Formulate a question
  - Design a plan to collect data
  - Analyze collected data
  - Interpret the analysis with respect to question

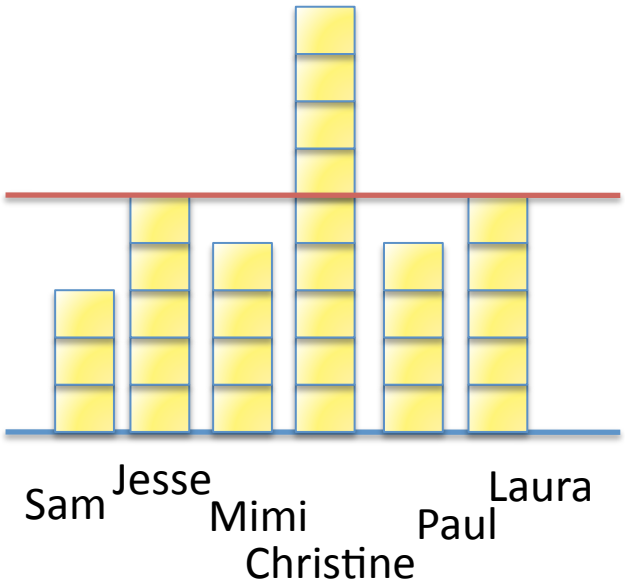
Small numbers MAD activity

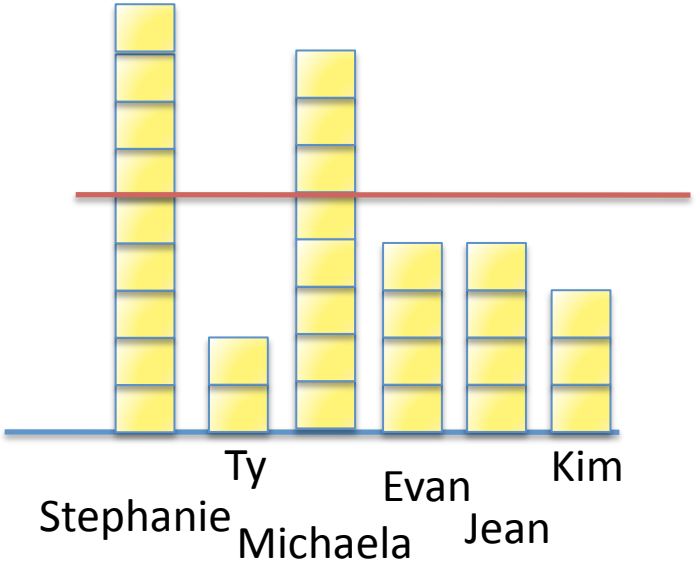
- 1. Write down the number of letters in your first name on a sticky note
- 2. Work together to find what the “fair share” is in your group (if you shared all of the letters fairly among those in your group).
- 3. How could we quantify which group is closest to fair?

Two Sample Groups

Sam's Group	Stephanie's Group
Sam Jesse Mimi Christine Paul Laura	Stephanie Ty Michaela Evan Jean Kim
30 letters total	30 letters total
Fair Share (mean) = 5	Fair Share (mean) = 5

Which Group is Closer to Fair?





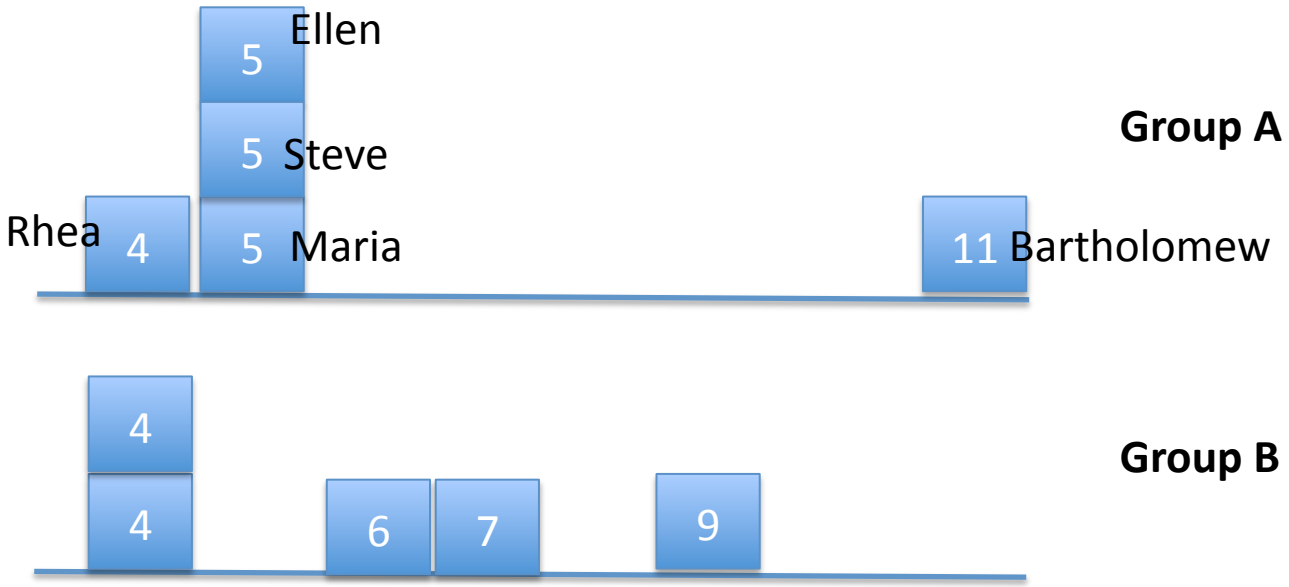
How many moves does it take to share evenly?

- Sam's Group: 4
- Stephanie's Group: 7

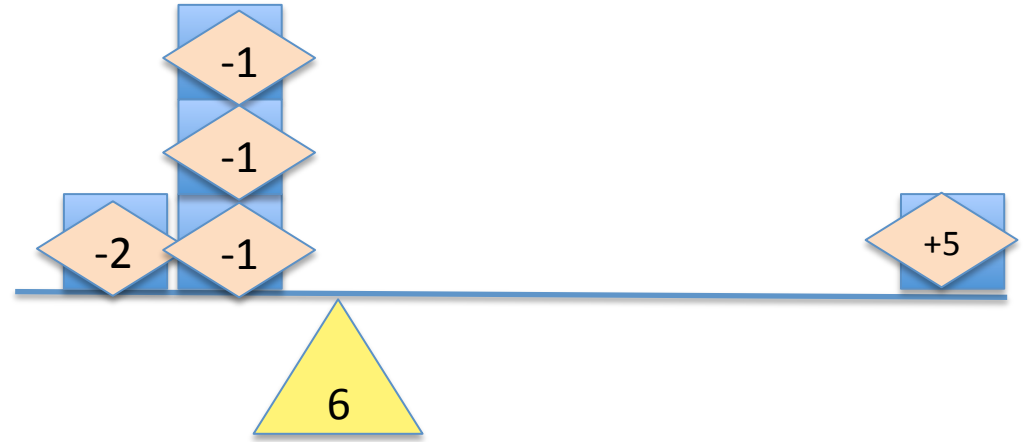
Sam's group is closer to fair share.

Which data set is closer to fair?

- Group A: 4, 5, 5, 5, 11 -- fair share is 6
- Group B: 4, 4, 6, 7, 9 -- fair share is 6

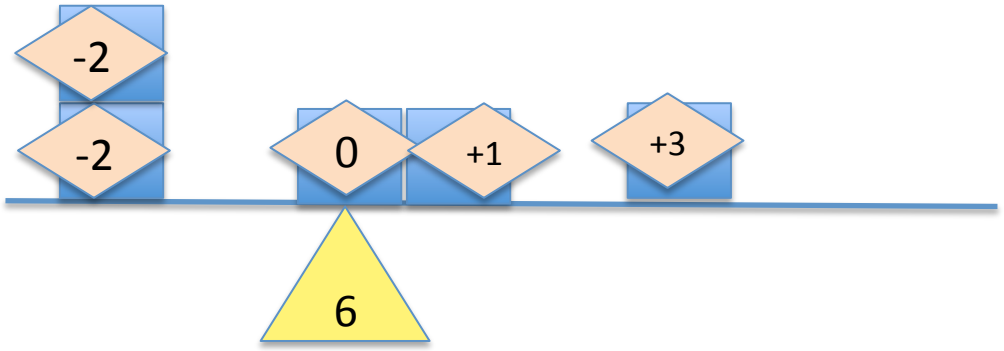


Mean as a Balance Point and Deviations from the Mean



Group A

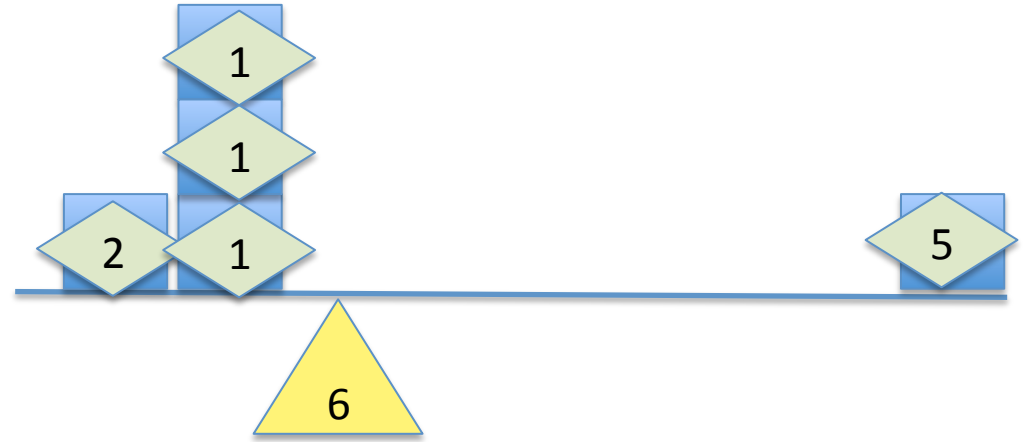
-2 + -1 + -1 + -1 + 5 = 0



Group B

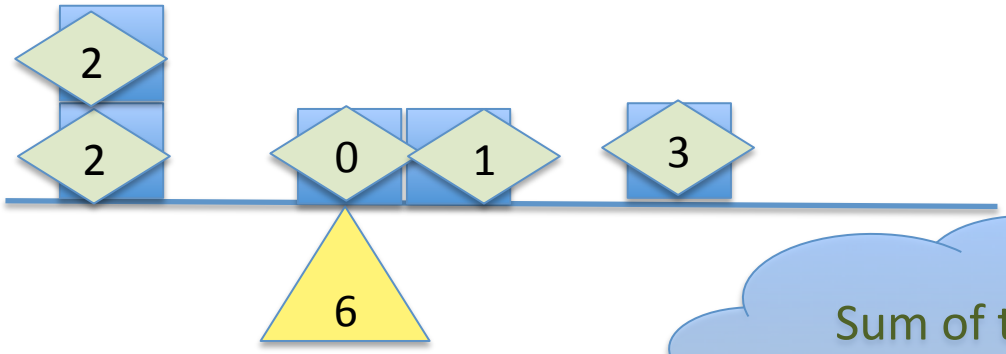
-2 + -2 + 0 + -1 + 3 = 0

Mean as a Balance Point and Absolute Deviations from the Mean



Group A

2 + 1 + 1 + 1 + 5 = 10



Group B

2 + 2 + 0 + 1 + 3 = 8

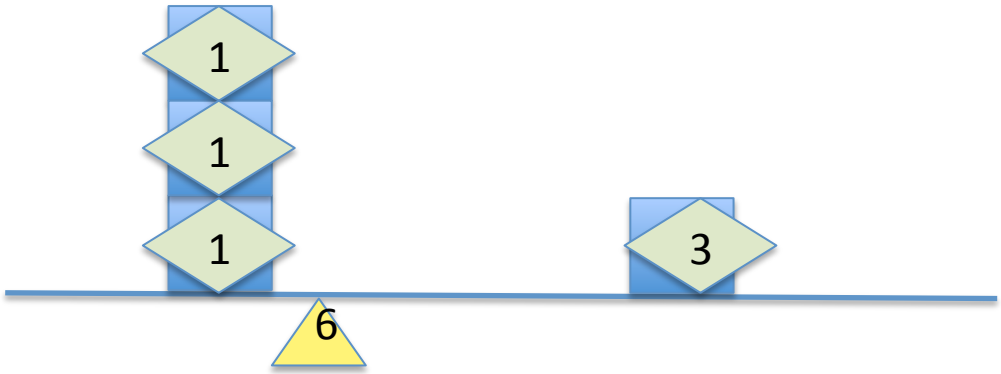
Sum of the Absolute Deviations: SAD

Why not just use the SAD?

- If the SAD (Sum of the Absolute Deviations) can tell us which group has data that is more spread out and which group has more clustered data, why don't we just use SAD?

What if the groups are different sizes?

- Group C: 5, 5, 5, 9 -- fair share is 6
- Group D: 4, 5, 5, 6, 6, 6, 7, 9 -- fair share is 6



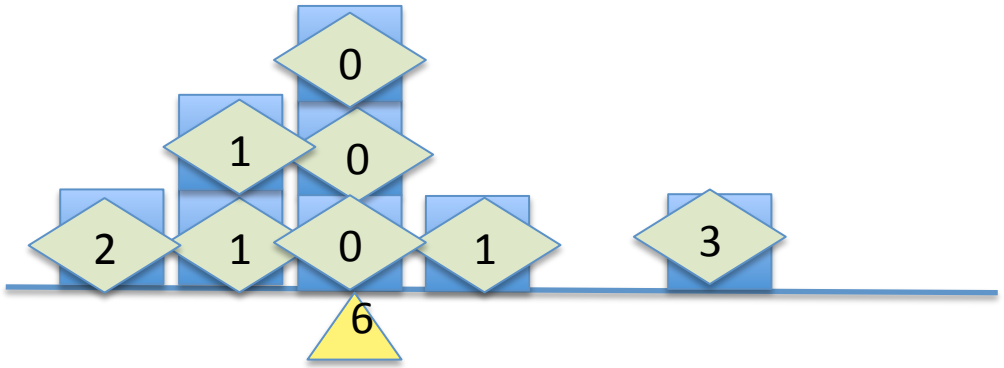
Group C

1 + 1 + 1 + 3 = 6

SAD = 6

6 ÷ 4 = 1.5

MAD = 1.5



Group D

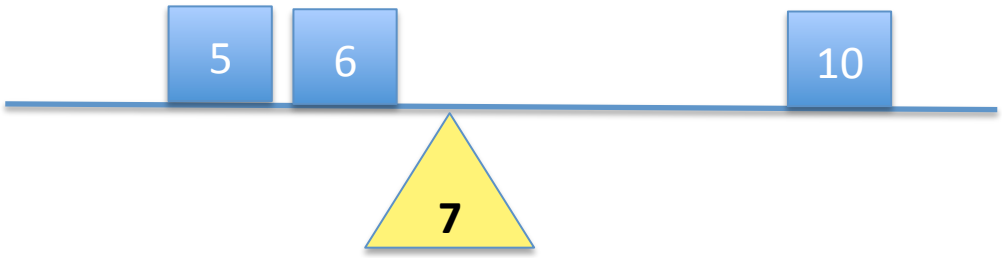
2 + 1 + 1 + 0 + 0 + 0 + 1 + 3 = 8

SAD = 8

8 ÷ 8 = 1

MAD = 1

MAD with Different Sized Groups and Different Means



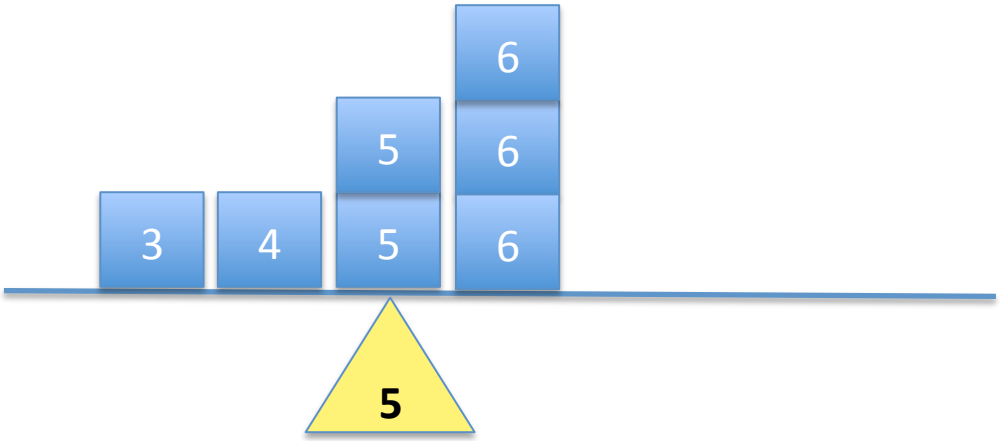
Group E

What is the SAD?

SAD = 6

6 ÷ 3 = 2

MAD = 2



Group F

What is the SAD?

SAD = 6

6 ÷ 8 = .75

MAD = .75

Bridging the Gap

Between Common Core State Standards and Teaching Statistics

- NCTM and American Statistical Association
- Great activities tagged to CCSS standards

How Fast Can You Sort Cards? 6.SP. 1-5 and 7.SP.3
Data Spreadsheet

2012, Pat Hopfensperger, Tim Jacobbe, Deborah Lurie, and Jerry Moreno

Examples of Statistics Projects

- K-4 Science Share Data (Grades 6-8)
  - Tongue Rolling and Gender, Height and Footlength
- Density Project (Math/Science Grade 8)
  - Dot plot of mass versus volume of various substances
- Salary Project (Grade 6)

The Salary Project

- Launch: Questions about Salary
- Assigning Jobs
- Google Form Data Collection
- Spreadsheets
- Data Displays (Histograms and Box Plots)
- Subsamples, Comparisons

Sample Salaries

Personal home and care aides: $20,000	Air traffic controllers: $107,000
Landscaping workers: $25,000	Astronomers: $103,000
Manicurists and pedicurists: $22,000	Construction managers: $93,000
Dental assistants: $34,000	Art directors: $92,000
Massage therapists: $40,000	Marine engineers: $79,000
Police, fire and amb. dispatchers: $36,000	Radiation therapists: $77,000
Law clerks: $42,000	Computer programmers: $75,000

Source: National Compensation Survey 2012

Assigning Jobs

- Group 1: Randomly assigned jobs
- Group 2: Students chose jobs
- Group 3: Teacher assigned jobs

How Close to Fair?

- Look at the salaries in your group.
- Is the salary distribution fair? How fair?
- Which group do we think has more fairly distributed salaries?
- How might we figure out which group has more fairly distributed salaries?

Activities

- Figure out the mean salary of your group.
- Figure out how far each salary is from the mean salary.
- Find the SAD and the MAD.
- Display data in histogram
- Make 5 point summary and box plot.
- Discuss differences among three sections.
- Subsamples
- Assessment

Twenty Spins (random samples)–

Grade 7

Color	Count
Blue	7
Yellow	13
Cyan	0

Color	Count
Blue	5
Yellow	13
Cyan	2

Color	Count
Blue	6
Yellow	14
Cyan	0

Color	Count
Blue	7
Yellow	12
Cyan	1

Color	Count
Blue	6
Yellow	13
Cyan	1

Color	Count
Blue	4
Yellow	15
Cyan	1

What do you think the spinner looks like?

Data generated from http://illuminations.nctm.org/adjustablespinner/

Twenty Spins (random samples)–

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Cyan	1

Color	Count
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Yellow	13
Cyan	1

Color	Count
Blue	4
Yellow	15
Cyan	1

Out of 120 total spins, count of landings on blue 7 + 5 + 6 + 7 + 6 + 4 = 35

35 ÷ 120 = approx. 0.29167 or about 30%

Illuminations Spinner

Number of spins: 20 | Spin | Skip to End | Reset

Number of spins so far: 20

Color	Count	Experimental %	Theoretical %
Blue	6	30.0%	30.1%
Yellow	13	65.0%	64.9%
Cyan	1	5.0%	5.0%

%

Pointing to: Yellow

Number of sectors: 3

What I Hope You Take Away

- Data is all around us, and we need to make sure students are data-literate.
- Without context, data is boring, but it can be very interesting in context. Questions are key.
- Some statistic concepts that sound very complicated are really not so hard.
- Keep looking for ways to foster connections among disciplines and with real world.

Resources for Teaching Statistics

- *Guidelines for Assessment and Instruction in Statistics Education (GAISE) PreK-12*, Alexandra, VA, American Statistical Association, 2007.
- "Progressions for the Common Core State Standards in Mathematics: 6-8 Statistics", common core writing team
- North Carolina Public Schools "Unpacking standards"
  - http://www.ncpublicschools.org/docs/acre/standards/common-core-tools/unpacking/math/7th.pdf
- Pat Hopfensperger, et al (2012) American Statistical Association and NCTM *Bridging the Gap between Common Core State Standards and Statistics Education*
- Gurl, Theresa, et al, *Implementing the Common Core State Standards through Mathematical Problem Solving Grades 6-8*, Reston, Va. NCTM 2013, chapter 4.

More Resources for Teaching Statistics

- Krader, Gary D. “Means and MADs”, *Mathematics Teaching in the Middle School*, NCTM, March 1999, vol 4, no. 6. pp. 398-403.
- Krader, Gary D. and Jim Mamer, “Statistics in the Middle Grades: Understanding Center and Spread”, *Mathematics Teaching in the Middle School*, NCTM, August 2008, vol 14, no. 1. pp 38-43.
- Franklin, Christine A. and Denise S. Mewborn, “Statistices in the Elementary Grades: Exploring Distributions of Data”, NCTM *Teaching Children Mathematics*, August 2008, pp 10-16.

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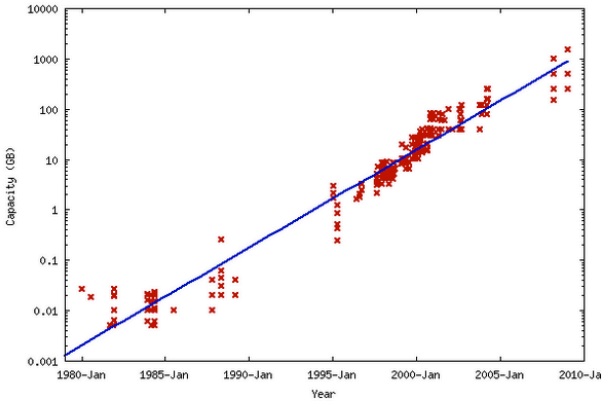

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