Welcome!

STATS 2020: Re-envisioning Intro Stats for a New Generation

Applying GAISE in Practice
November 22, 2019

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***Guidelines for Assessment and Instruction in Statistics Education**

How much do you know about GAISE ?

How much do you know about the GAISE report?

Nothing whatsoever - that's why I'm here!	**A**
A tiny bit. Knew it had something to do with Stat Education.	**B**
Read some of it once upon a time.	**C**
Quite familiar; can judge consistency with [my] course	**D**

Today's Plan:

Nuts and Bolts of GAISE

What ?

Who?

Where?

When?

Why?

Then a little more what and how, and finally an activity to demonstrate…

Nuts and Bolts about GAISE

Guidelines for Assessment and Instruction in Statistics Education.

What: Goals and Recommendations for teaching statistics. Then it gives piles of examples.

Nuts and Bolts about GAISE

Guidelines for Assessment and Instruction in Statistics Education.

Who: American Statistical Association (ASA)

with AMATYC endorsement

Where: Fully available on the web (via ASA) !

Just google "GAISE" and you'll get to it!

www.amstat.org/files/pdfs/GAISE/GaiseCollege_Full.pdf

Nuts and Bolts about GAISE

Guidelines for Assessment and Instruction in Statistics Education.

When: 2016

1992

The "Cobb Report" published in an MAA Volume "Heeding the Call for Change"

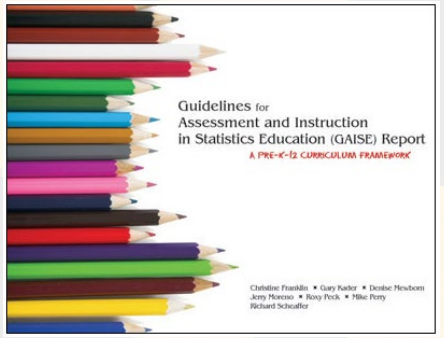
2003:

ASA funded development of Guidelines

Introductory College Statistics - 2005

Revised, 2016

PreK-12 Curriculum - 2007



Nuts and Bolts about the GAISE College Reports

Guidelines for Assessment and Instruction in Statistics Education.

Who: American Statistical Association (ASA)
with AMATYC endorsement

Really – *who*?

2016 Committee:

Robert Carver (Stonehill College), Michelle Everson, co-chair (The Ohio State University), John Gabrosek (Grand Valley State University), Nicholas Horton (Amherst College), **Robin Lock** (St. Lawrence University), Megan Mocko, co-chair (University of Florida), **Allan Rossman** (Cal Poly – San Luis Obispo), Ginger Holmes Rowell (Middle Tennessee State University), **Paul Velleman** (Cornell University), Jeffrey Witmer (Oberlin College), and Beverly Wood (Embry-Riddle Aeronautical University)

[Original] 2005 writing team:
Martha Aliaga, **George Cobb**, Carolyn Cuff, **Joan Garfield** (chair), Rob Gould, **Robin Lock**, Tom Moore, **Allan Rossman**, Bob Stephenson, **Jessica Utts**, **Paul Velleman**, Jeff Witmer

Nuts and Bolts about GAISE

Guidelines for Assessment and Instruction in Statistics Education.

Why: Generally a need to cement and disseminate the ideas from statistics education movement that took off in the 90s.

Changes in Content and Enrollment Trends in Stats Education over Decades

Nuts and Bolts about GAISE

Guidelines for Assessment and Instruction in Statistics Education.

Why: Generally a need to cement and disseminate the ideas from statistics education movement that took off in the 90s.

Changes in Content and **Enrollment Trends** in Stats Education over Decades

College Enrollment: Introductory Statistics at Two-Year colleges as percent of Calculus Enrollments*:

Year	1966	1970	1980	1990	2000	2010
Percent	10	19	27	52	74	Over 100

High School, AP Statistics exam takers**:

Year	1997	1998	1999	2000	2004	2015
Exam-takers	7500	15000	25000	35000	>65000	Near 200,000

* '66, 70, 80, 90 from http://jse.amstat.org/v1n1/cobb.html and '00 and '10 from https://www.amstat.org/asa/files/pdfs/GAISE/GaiseCollege_Full.pdf, p. 28.

** 1997-2000 numbers from GAISE, 2005 report, p. 7; 2004, 2015 numbers from GAISE, 2016, p. 29

Nuts and Bolts about the GAISE

Guidelines for Assessment and Instruction in Statistics Education.

Why: Generally a need to cement and disseminate the ideas from statistics education movement that took off in the 90s.

Changes in Content and **Enrollment Trends** in Stats Education over Decades

Early on: 1992 "Cobb Report":

1. Emphasize Statistical Thinking
2. More Data and concepts, Less Theory and fewer recipes
3. Foster active learning

More recently, pertaining to "revising" College Report from 2005 to 2016…

1. Attend to "changes in…statistics education and statistical practice since 2005"
2. Informed by outreach to stat education community and by stat education literature

→ **Re-upping of 2005 recommendations**

GAISE College Report 2016

Table of Contents:

https://www.amstat.org/asa/files/pdfs/GAISE/GaiseCollege_Full.pdf

2016 GAISE Report recommendations:

1. Teach **statistical thinking**.
2. Focus on **conceptual** understanding.

WHAT

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.

HOW

2016 GAISE Report recommendations:

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.

WHAT

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.

HOW

"Realistic Expectations while setting Aspirational Goals":

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.

WHAT

HOW

Pages 12-23: Each recommendation is explained and followed by a bulleted list of "Suggestions for teachers."

Substantially expanded and revised from '05

1. Teach statistical thinking.

Why this recommendation?

- **Teach statistics as an investigative process of problem-solving and decision-making.**

An analogy to a class in carpentry…

In week 1 of the carpentry course (statistics) , we learned to use various kinds of planes (summary statistics). In week 2, we learned to use different kinds of saws (graphs). Then, we learned about using hammers (confidence intervals). Later, we learned about the characteristics of different types of wood (tests). By the end of the course, we had covered many aspects of carpentry (statistics).

But I wanted to learn how to ***build a table*** *(collect and analyze data to answer a question) and I never learned how to do that.* (GAISE 2016, p. 13)

Suggestions for Topics that Might be Omitted from Introductory Statistics Courses

- Probability theory
- Constructing plots by hand
- Basic statistics
- Drills with z-, t-, $\chi 2$, and F-table
- Advanced training on a statistical software program.

Suggestions for Topics that Might be Omitted from Introductory Statistics Courses

- **Probability theory** – *"GAISE goals and recommendations can be met **without** [basic probability and rules about random variables, with binomial as special case]"*
- Constructing plots by hand
- **Basic statistics** – brief coverage suggested as review, due to place that statistics now plays in Common Core SS, e.g., pie charts, scatter plots, histograms, means, medians
- **Drills with z-, t-, $\chi 2$, and F-table:** *"These skills are no longer necessary and do not reflect modern statistical practice. Apps that perform the lookup (not limited to a finite list of df values) [are ubiquitous]…This shift makes it unnecessary to examine students on their ability to use these tables, so they can usually be dispensed with on exams."*
- Advanced training on a statistical software program.

GAISE in practice…

"Statistics can be thought of as the science of **learning from data**, so the context of the data becomes an integral part of the problem-solving experience" (p. 17)

An Activity to demonstrate some GAISE what's and how's in action…

Investigation: Pick Two Cubes

Consider the game of chance:

- Put four cubes in a bag, 2 of one color, and 2 of another color.
- Two cubes get pulled out without looking.
- If they are the **same**, one player wins, and if they are **different**, the other player wins.
- *It does not matter who pulls the cubes!*

Investigation: Pick Two Cubes Game

Is the game *fair*?

Are the two cubes equally likely to come up same color as they are to come out different colors?

What do you predict?

How can we investigate this?

Collect data – all groups collect the same way. How so?

- Groups of 2 or 3: Play a **game** of **10 rounds**, recording "same" or "different" for each pull. *Mix well between rounds!*
- At the end of a game, find the **proportion** of "same" color outcomes.
- Play two or more games of 10.

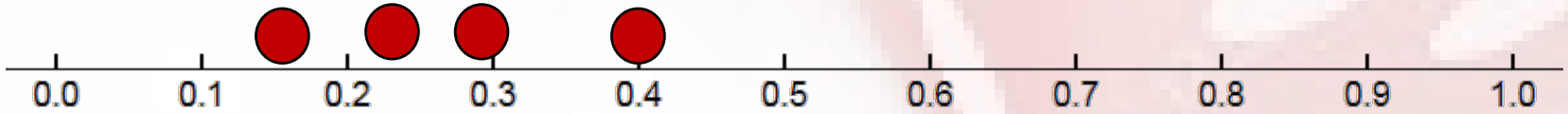
Investigation: Pick Two Cubes Game

- **What's the variable of interest each time we pull out of the bag?**
- **For a 10-round game, focus on the proportion of a particular outcome.**

Revisit your prediction– is it a fair game? Why?/Why not?

Proportion of "same color" pulls in a **10**-round game

How might we expect these distributions to compare?



Proportion of "same color" pulls in a **20**-round game

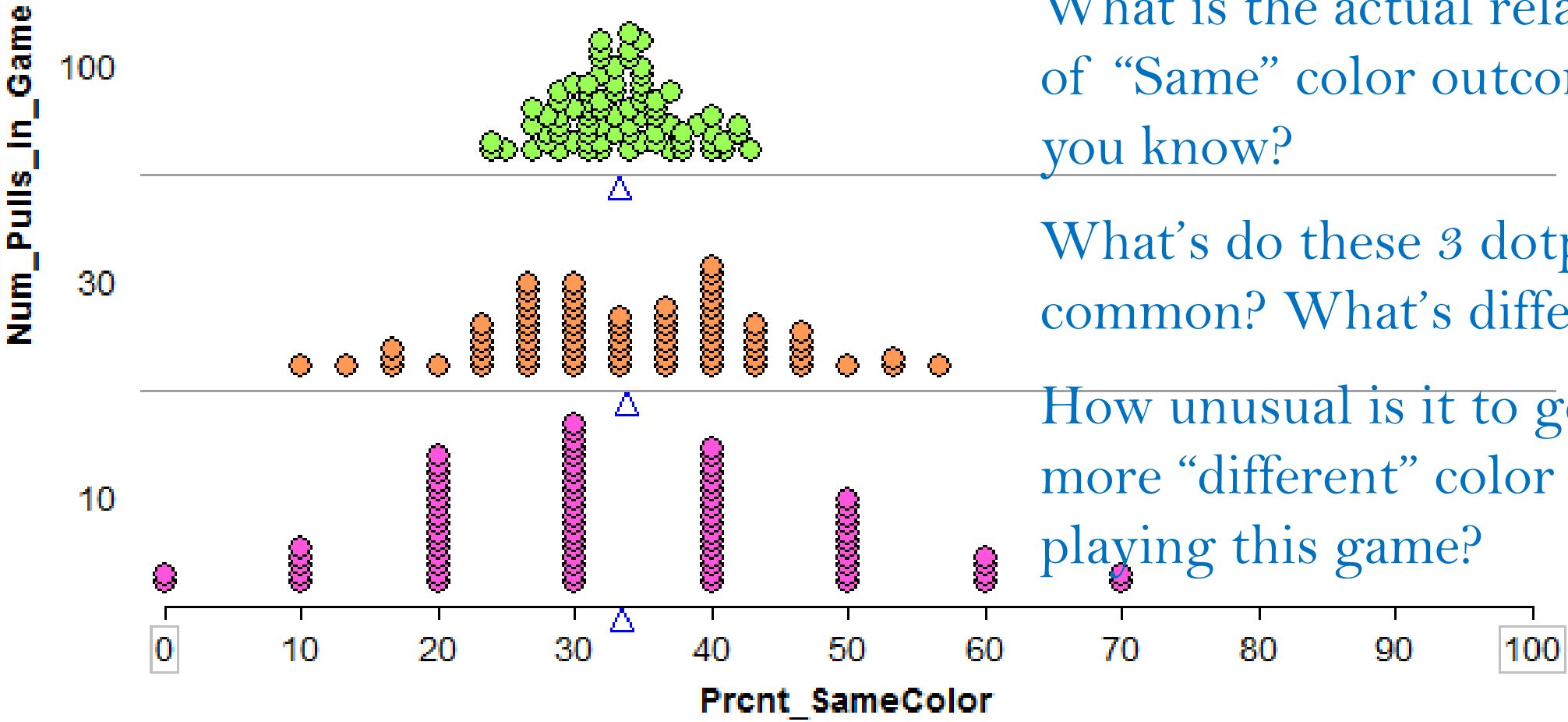
Wish we had loads more data, don't you?

How can we do that?

Simulations!!

Investigation: Pick Two Cubes Game
A computer simulation…

GreenYellow 2, 2 average_Stat2020.tp



Main take-aways:

What is the actual relative frequency of "Same" color outcome? How do you know?

What's do these 3 dotplots have in common? What's different?

How unusual is it to get 50% or more "different" color cubes when playing this game?

https://www.dropbox.com/sh/3s53tjwrxulhqnl/AADU-FRZQfZrPEjHePCoR4XUa?dl=0

Investigation: Pick Two Cubes Game

Straight outta GAISE…

Recommendation 1: Teach statistical thinking

Teach statistics as an **investigative process** of problem-solving

- "Discuss the research question that guided the study, the collection and the analysis of the results…"
- "Begin most examples…classifying variables as categorical or quantitative, and consider… use of random sampling…"
- "Use technology…to explore and visualize data …"

Recommendation 2: Focus on conceptual understanding

- "View the primary goal as to discover and apply concepts."

Which concepts would you say were covered?

W H A T

Investigation: Pick Two Cubes Game

Straight outta GAISE…

Recommendation 3: Integrate real data w/context and purpose

- "Use real data…to enliven class."
- "Use data with a context as the catalyst for exploration, generating the questions, and informing interpretations."

Recommendation 4: Foster Active Learning

- "Consider student need for physical exploration prior to use of computer simulation."
- "Encourage predictions from students about results… before analyzing data"

Recommendation 5: Use technology to explore concepts and analyze data

- "Perform simulations to illustrate abstract concepts"

HOW

Investigation: Pick Two Cubes Game

Straight outta GAISE…

From Appendix C: Desirable Characteristics of Class Activities, p. 43-45

- **Data Relevance** – real data collected in real-time by students to answer a question (if only arguably compelling)
- **Design Decisions and Data Collection** – Students helped design method of collection
- **Teamwork** – Employed both to collect data and think/pair/share ideas about what will happen or why things are happening

Go forth, mine GAISE, then *mind* GAISE!

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