

**“Statistics Means
Never Having To Say You’re
Certain”**

Creating a Student Centered Learning Environment

Deborah J. Rumsey

Mathematics and Statistics
Learning Center
Ohio State University

Important Questions

- How can you bring new teaching methods/ideas into your own classroom?
- How do make it bring out your best?
- What does it take to get students really involved?
- (How) can you have more fun teaching a statistics class?

What is the key to making a learning experience memorable?

- Learning to drive
 - Someone set it up
 - Told you/showed you
 - “Let me do it!”
- Art/craft
 - Tried it on your own
 - Made your own mistakes
- Interesting class
 - “I did it! Look at what I got!”

Your Statistics Class: Did (do) You...

- Ask your own questions
- Collect your own data
- “Let me do it!”
- See statistics as tools to answer “your” questions
- Learn what you needed to know when you needed to know it?
- “I did it! See what I got?”

What is Statistics?

- The business of asking and answering questions that use data as evidence.
- Whose question? Whose data? What answers?

How I Started in the Student Centered Learning Business

- Not another day explaining how to do a histogram!!
- Surfed the web
- Found McGwire/Sosa
- Made 50 copies
- Paired students up
- Let it roll

The Scenario: Week 1

- Select a ball player, and ask a question about him that is of interest to you.
- Identify which variable will help you answer that question.
- Organize the data from that variable to answer your question.
- Share your results with the rest of the class at the end of the hour.

What I Learned about Students

- It's amazing how much you don't have to tell them
- They are inquisitive, and creative
- They will work very hard - as long as they "buy into" the process
- It wasn't about ME
- There is more to data displays than a pie chart, bar graph and a histogram!

What Made this Work?

- Interesting scenario
 - Everyone was rowing in the same direction
 - Just enough structure
 - Rich data set
- Students took the lead
- My role changed
- Collaboration and idea exchange
- Now they want to know!
 - Follow-up discussions to fill in the details
 - In lieu of, not a supplement to, the lecture

Creating a Student Centered Learning Environment

- Set up: Investigation in a Relevant Context
- Statistics on a 'Need to Know' basis
 - Big Ideas and Common Threads
 - Discovery approach where possible
- Classroom Management
- Teacher/Student Training and Support
- Assessment

Finding a Relevant Context

- Find a rich data base
 - Lots of choices
 - Qualitative and quantitative variables
 - Interesting relationships
 - Not too messy
 - Know this data base
 - Watch for potentially sensitive situations
- Create scenarios
 - Same general context
 - Lots of choices
 - Some structure to stay on track

Examples: Smaller scale

- McGwire/Sosa data
 - Describe one player
 - Compare 2 players
 - Compare 2 variables
- Data and Story Library (DASL)
- Student survey
- “Well-known” data sets
- Cooperative Teaching Approach
- Proposed one-stop Resource Center

Examples: Larger scale

- Existing large databases
 - FERROT, U.S. Government
- Create your own data base
 - Planet X
 - Student survey to determine variables
 - Build in relationships between variables
 - Parameters known but not disclosed
 - Helps with course planning, grading
 - Better than “real” data in some ways

Statistics on a “Need to Know” basis

- Planet X: Height, Weight
- What was their next question?
 - How did they relate?
- What statistical topics are needed for that?
- Students’ path through statistics might not be what we assumed!
- Teach what they need to know, when they need to know it!

“Need to Know” Statistics in Your Classroom

- Keep a direct relationship with the investigations
- Guided activities/discussions for discovery of statistics
 - Team based question/answer
 - Real world applications
 - Instructor provides intro/wrap up and fills in the gaps
- Reference materials
 - How to Excel
 - Important formulas/concepts sheet
 - Organization is the key
- “Big Ideas and Common Threads”

Big Ideas

- What are the big ideas of statistics?
- Learning Objectives
- Examples
 - Sample results vary!
 - The variability in the population affects the variability of the sample mean.
 - Correlation does not automatically imply causation.
 - Garbage in = Garbage out

What is YOUR list of Big Ideas?

- What do you want them to walk away with?
- David Moore's learning objectives
- Be careful about language, terminology, formulas, notation, and the "beauty" factor
 - Distraction, loss of motivation
 - What standard deviation measures
 - How to calculate it (do you still use "that formula"?)

The Language of Statistics

- Sampling distribution of \bar{X}
- Z transformation
- Type I error
- Confidence coefficient
- Probability
- Histogram of sample means
- Change to standard units
- False alarm
- Number of standard errors
- Chance

Common Threads

- Build connections between ideas
 - Textbooks need to do better!
- Offer scenarios where the connections are more obvious
 - Scientific Method is not just for Day 1
 - Choose rich data bases that can be used throughout
 - Missions
- Ask yourself how each topic relates to past and future

Looking for Common Threads

- Is this really important for my students to know?
 - Is it something I just can't let go of?
- How does this relate to the "big picture?"
 - Are we ever going to use this later?
 - If no, it had better be worth it!
- Do we really need to know this NOW?
- Will this help students answer 'their' questions?
- Can I sell this?

How Accurate is Your Sample Mean?

- Describe your sample
- Sample results vary!
- Report the accuracy level of your results.
 - What affects the accuracy of the sample mean?
 - The population mean, sd, and my sample size affect it—how?
 - How to put it all together as a measurement
 - Central Limit Theorem
- Margin of Error
- CI and H tests are not far behind

Traditional Approach

- Descriptive statistics for a sample
- Population distributions
 - Binomial distribution
 - Z distribution
 - Probability that $X > 10$, $X \geq 10$, $X < 10$ (μ known)
- Sampling distribution of \bar{X}
- Central Limit Theorem
 - Probability that $\bar{X} > 10$, etc.
- Confidence Intervals
- Margin of Error

Where/How do these topics fit in?

- Binomial distribution
- Normal distribution – Probability problems
- “Sampling distribution of X-bar”
- Central Limit Theorem
- CI and H tests about p
- Two population means, matched, independent
- Two population proportions
- Small samples

Do Big Ideas and Common Threads and a Relevant Context Work?

- Build statistics in a natural way
- No more “dog and pony show”
- Students ask me questions about statistics
- I get to discuss the bigger issues
- I can ask more of the ‘real’ questions
- Students are able to communicate ideas
- More likely to retain the knowledge?

Facilitating Student Centered Learning in Your Classroom

- Classroom management
- Assessment
- Teacher training and support
- Student training and support

Classroom Management

- Daily agenda
- Clear expectations and policies
- Teams of students and teachers
 - Maximize class time
 - Build team skills
- Classroom layout
- Role of instructor
- Keep it Real
 - Always provide a relevant context
 - Don't have them do something for no good reason!

Assessment

- “Mission” reports
- Teamwork
 - Teammate and self evaluation
 - How well did the team work together?
- In-class activities
 - “Missions”
 - Question/answer team activities
 - “Stop and check” points
 - Include on exams/minute papers
- Daily question/minute paper
- Exams
 - Teams?
 - Learning objectives: big ideas/common threads
 - Apply to new situations
 - Communication of ideas

Teacher Training and Support

- Buy into the philosophy
- Understand the goals, expectations
- Less lecturing: ask don't tell
- Designing/using student centered activities
- Learning facilitator: a bigger role
- Teamwork
- Working the room
 - Opening/Closing
 - Stopping and Starting
 - Handling student questions/problems
 - Keeping them focused
 - Engaging vs monitoring
- Organization and Preparation

Student Training and Support

- Teamwork
 - Resources
 - Yourself
 - Teammate
 - Tablemates
 - Instructor
- Have excellent resources and reinforce their use
- Remind them what the goals are
- Make class time valuable
- Teach and reinforce preparation and organization
- Be fair but firm

Final Thoughts

- Learning Statistics should capture the “let me do it” and “see what I did” attitude.
- Teaching statistics should draw out your personal style, and your deeper knowledge of the subject.
- A Student Centered Learning Environment can allow for both of these goals to be accomplished.