“Statistics Means Never Having To Say You’re Certain”
Creating a Student Centered Learning Environment

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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
- Art/craft
- Interesting class

- Someone set it up
- Told you/showed you
- “Let me do it!”
- Tried it on your own
- Made your own mistakes
- “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 X-bar
- 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 $X>10$, $X\geq10$, $X<10$ ($\mu$ known)
• Sampling distribution of $X$-bar
• Central Limit Theorem
  – Probability that $X$-bar $>10$, 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.