Teaching Statistics: A Bag of Tricks

Andrew Gelman
Department of Statistics and Department of Political Science
Columbia University

3 June 2005
Examples, demos, drills, projects
Getting it to happen
Challenges and struggles
Themes

- Active learning of statistics
- Tricks for getting students involved: examples, demos, drills, projects
- Actually doing it
- Challenges and struggles
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- Discuss practical issues
- Open questions
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Active learning

- Working in groups
- Skills vs. concepts
- Motivating students to work hard and think hard
- Lots of educational research (see refs in our book)
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Some examples

- Interspersed throughout the course
- Earnings and height
- Vietnam war
- Grading on a curve
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Examples

. regress earn height

Source | SS    df       MS
-------+------------------------------ F(  1, 1377) = 137.21
Model  | 4.8773e+10   1  4.8773e+10  Prob > F = 0.0000
Residual | 4.8948e+11  1377  355470204 R-squared = 0.0906
-------+------------------------------ Adj R-squared = 0.0900
Total  | 5.3826e+11  1378  390606004 Root MSE = 18854

Number of obs = 1379

earn | Coef.  Std. Err.   t    P>|t|     [95% Conf. Interval]
-------+--------------------------------------------------
height | 1563.138   133.4476  11.713  0.000     1301.355   1824.92
_cons  | -84078.32   8901.098  -9.446  0.000    -101539.5  -66617.15

. graph earn yhat height, connect(.s) symbol(Oi) xlabel ylabel

▶ Graph the regression line and the data (consistent with the Stata output)
Earnings and height example

- Graphs on graph paper and on the blackboard
- How did it feel to make the graphs?
- How did it feel to work in pairs?
- What skills are the students learning?
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Guess the results, for respondents in each education category, and fill out this table (the two numbers in each column should add up to 100%):

<table>
<thead>
<tr>
<th>Adults with:</th>
<th>Grade school education</th>
<th>High school education</th>
<th>College education</th>
<th>Total adults</th>
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<tbody>
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<td></td>
<td></td>
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</tr>
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Examples: grading on a curve

- How to assign grades?
- What are some possible systems? What is best?
- What are your goals?
- How could you design a study and gather evidence to decide what grading system to use?
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- Relevance
  - Surveys and experiments on topics of interest (e.g., beauty and student evaluations)
  - For probability examples: boy and girl births, not tricky dice games, poker hands, etc.
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- Candy
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Demonstrations: principles

- Clear instructions
- Working in pairs
- Debriefing afterward: connect to statistical topics
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- Easy questions
- Involve all the students
- Don’t make it a lecture [story from our t.a.]
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Projects

- Data collection, data analysis
- Can they study something relevant to their own interests?
- Struggles
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Not doing it

- Teachers love these demos but don't actually use them!
- Why?
  - Limited class time
  - Awkwardness of trying something new, losing control
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What we do

- "Covering the material"
  - Students learn by doing homeworks
  - Rely on the textbook—the students will rely on it anyway!
  - Give students tips on how to do well on exams
- Active learning in class
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  - 1 demo and 1 drill per lecture
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Struggles: demos and games

- Scatterplot charades
  - My example
  - Students' examples?

- Phone book sampling
Struggles: demos and games

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KASSOMBOLA——KATZ  509

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<tr>
<th>Name</th>
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<tr>
<td>KATOPIS Theodore</td>
<td>212 249-3047</td>
</tr>
<tr>
<td>KATOVITZ Michael</td>
<td>212 929-9511</td>
</tr>
<tr>
<td>KATOWSKY Marc</td>
<td>212 706-2855</td>
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<tr>
<td>KATRAGADDA Sireesha</td>
<td>212 532-6457</td>
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<td>KATRANCI Eili</td>
<td>212 722-1951</td>
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<td>KATRI Edmond</td>
<td>212 588-0118</td>
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<td>212 741-0174</td>
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<td>212 333-5811</td>
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<td>212 288-7739</td>
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<td>212 987-2902</td>
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<td>Victor 75 West St</td>
<td>212 385-1686</td>
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<td>212 628-9512</td>
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<td>Moshe &amp; Rivka 117 W17</td>
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<td>212 222-3669</td>
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<td>212 749-8386</td>
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<td>A 25 Av</td>
<td>212 533-9692</td>
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<td>A 148 10 Av</td>
<td>212 366-6467</td>
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<td>A D 433 W21</td>
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Phone book sampling

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Phone book sampling

First digits of addresses

First digits of telephone numbers
Real and fake coin flips

00111000110010000100 01000101001100010100
00100010001000000001 11101001100011110100
00110010101100001111 01110100011000110111
11001100010101100100 10001001011011011100
10001000000011111001 01100100010010000100

Lie detection

Role playing
Struggles: demos and games

- Real and fake coin flips
  - 00111000110010000100
  - 01000101001100010100
  - 00100010001000000001
  - 11101001100011110100
  - 00110010101100001111
  - 01110100011000110111
  - 11001100010101100100
  - 10001000000011111001
  - 01100100010010000100
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00110010101100001111 0110100011000110111
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- Lie detection

- Role playing
Struggles: group projects

- Lots of ideas . . .
- . . . but student projects are usually disappointing
- Struggles
Struggles: group projects

- Lots of ideas . . .
- . . . but student projects are usually disappointing
- Struggles
  - The topic
  - Data collection
  - Data analysis
  - Working together
Struggles: group projects

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Putting it all together

- Integrating drills, hwks, exams, and lecture material
- Goal: a more teacher-friendly (and student-friendly) package
- Integrate examples, demos, drills, and supplementary material
- Just the good stuff—no "filler"
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Concluding thoughts

- Sharing teaching tips
- Where to put your teaching effort
- Connections to empirical research?
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