## Objective
What are the impacts on student attitudes and performance of offering proficiency-based grading and the option of assignment resubmission?

## Inspiration/Model
Young Women’s Leadership Charter School of Chicago (www.ywls.org)
- Opened in 2000
- Highest graduation rate of non-selective schools
- 100% of class of 2005 attending college

## Experimental Design
- Two sections of introductory statistics (for non-majors)
- Same instructor, same material, back-to-back class periods
- First year students are somewhat randomized
- Control Group
  - Numeric Grading
  - Weekly homework, 2 exams, final exam
- Experimental Group
  - Proficiency Grading
  - Assignment Resubmission
  - Weekly homework and quizzes, final exam

## Learning Objectives
- 19 learning objectives defined. Examples include:
  - Summarize quantitative data with stem-and-leaf plots, histograms
  - Calculate and interpret linear regression equation
  - Use the z-table to calculate percentiles for standard normal distribution
  - Used to clarify course goals
  - Used by students to identify problem areas
  - Used by instructor in assessment design

## Proficiency Grading
- Three tiered proficiency-grading system
  - Not proficient (NP) – minimal understanding
  - Proficient (P) – grasped major concepts
  - High Performance (HP) – (almost) flawless

## Assignment Resubmission
- Students not achieving proficiency (“NP”) could resubmit
  - HW: same problem, due one week later
  - Quizzes: new problem, taken one week later

## Results

### Class Summary
<table>
<thead>
<tr>
<th></th>
<th>Exp</th>
<th>Con</th>
<th>Diff</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total n</td>
<td>26</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drop</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analytic n</td>
<td>26</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>67%</td>
<td>65%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>65%</td>
<td>75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st-year</td>
<td>50%</td>
<td>70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts Major</td>
<td>88%</td>
<td>80%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Course Evaluations
- Experimental group said (on a 5 point scale):
  - Goals of course were clearer (4.91 vs. 4.71)
  - Better interaction with students (4.87 vs. 4.56)
  - Requires harder work (4.13 vs. 3.88)
  - More fair grading (4.57 vs. 4.00)
  - WORSE at explaining material (4.48 vs. 4.72)

### Course Surveys
- Due to engaging with material?
  - Students who resubmitted did better
  - Evaluation on course objectives allows students and instructor to better assess learning

### Final Exam Summary

<table>
<thead>
<tr>
<th></th>
<th>Exp</th>
<th>Con</th>
<th>Diff</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>74.2</td>
<td>83.4</td>
<td>-9.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Median</td>
<td>78.5</td>
<td>88.5</td>
<td>-10.0</td>
<td>0.04</td>
</tr>
</tbody>
</table>

### Learning Objectives
- 19 learning objectives defined.
- Examples include:
  - Summarize quantitative data with stem-and-leaf plots, histograms
  - Calculate and interpret linear regression equation
  - Use the z-table to calculate percentiles for standard normal distribution
  - Used to clarify course goals
  - Used by students to identify problem areas
  - Used by instructor in assessment design

## Effect by Ability

<table>
<thead>
<tr>
<th>Math Ability</th>
<th>High</th>
<th>Mod</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS Math GPA</td>
<td>3.07</td>
<td>3.42</td>
<td>0.02</td>
</tr>
<tr>
<td>Math SAT</td>
<td>612</td>
<td>645</td>
<td>0.11</td>
</tr>
</tbody>
</table>

**Percent Resubmission:**
- % of all NPs resubmitted
- N2P = (NP + N2P)

**NP = Not Proficient**
- P = Proficient

**N2P = Proficient on 2nd attempt**
- % of all Ps originally NP
- N2P / (N2P + P)

## Final Exam Summary

<table>
<thead>
<tr>
<th></th>
<th>Exp</th>
<th>Con</th>
<th>Diff</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>74.2</td>
<td>83.4</td>
<td>-9.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Median</td>
<td>78.5</td>
<td>88.5</td>
<td>-10.0</td>
<td>0.04</td>
</tr>
</tbody>
</table>

### but They Differed by Math Ability

<table>
<thead>
<tr>
<th></th>
<th>Exp</th>
<th>Con</th>
<th>Diff</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>74.2</td>
<td>83.4</td>
<td>-9.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Median</td>
<td>78.5</td>
<td>88.5</td>
<td>-10.0</td>
<td>0.04</td>
</tr>
</tbody>
</table>

### Delayed Proficiency (% of all Ps originally NP)

<table>
<thead>
<tr>
<th></th>
<th>Exp</th>
<th>Con</th>
<th>Diff</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>74.2</td>
<td>83.4</td>
<td>-9.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Median</td>
<td>78.5</td>
<td>88.5</td>
<td>-10.0</td>
<td>0.04</td>
</tr>
</tbody>
</table>

### Exam Score

**Final Exam = 52 + 39 %resub (p=0.003)**
- No Ns (r=1) > 100%

**Final Exam = 53 + 38 %resub (p=0.001)**
- No Ns excluded

**Final Exam = 44 + 46 %resub (p=0.001)**
- Weighed by N-N2P

**Summary – doesn’t matter how you achieved proficiency, same net effect**

## A Parting Quote...
If you would attain to what you are not yet, you must always be displeased by what you are. For where you are pleased with yourself there you have remained: keep adding, keep walking, keep advancing.
~ Saint Augustine

## Contact Information
Michael A. Posner, Ph.D.
Assistant Professor of Statistics
Department of Mathematical Sciences
Villanova University
michael.posner@villanova.edu
610-519-5016

Funding for this project was provided by The Math Science Partnership of Greater Philadelphia through a grant from The National Science Foundation.