PEDAGOGY AND RESULTS OF

The Math You Need, When You Need It

math tutorials for students in introductory geoscience

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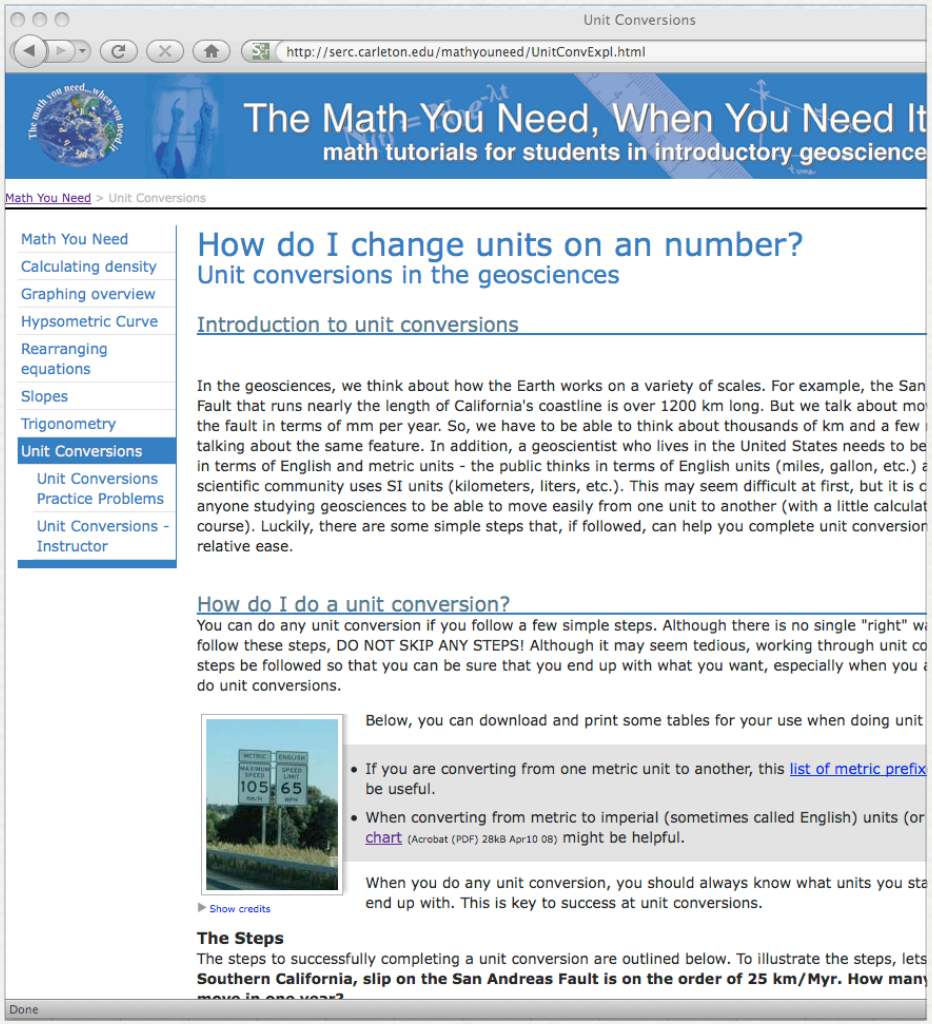
"MATHPATCH"

- Developed by Baer and Burn
- A separate 1 credit class taught first F2F, then online.
- Initial results showed 14% increase in retention, higher course grades, and increase in quantitative content for some faculty.
- Move to online was co-incident with sharp drop in use, even when required.

PHASE 1: WEBSITE & PILOTS



- The structure of the websites provide a rich learning environment for students to build their quantitative skills.
- Each module/topic has three main parts:
  - instruction
  - practice
  - assessment

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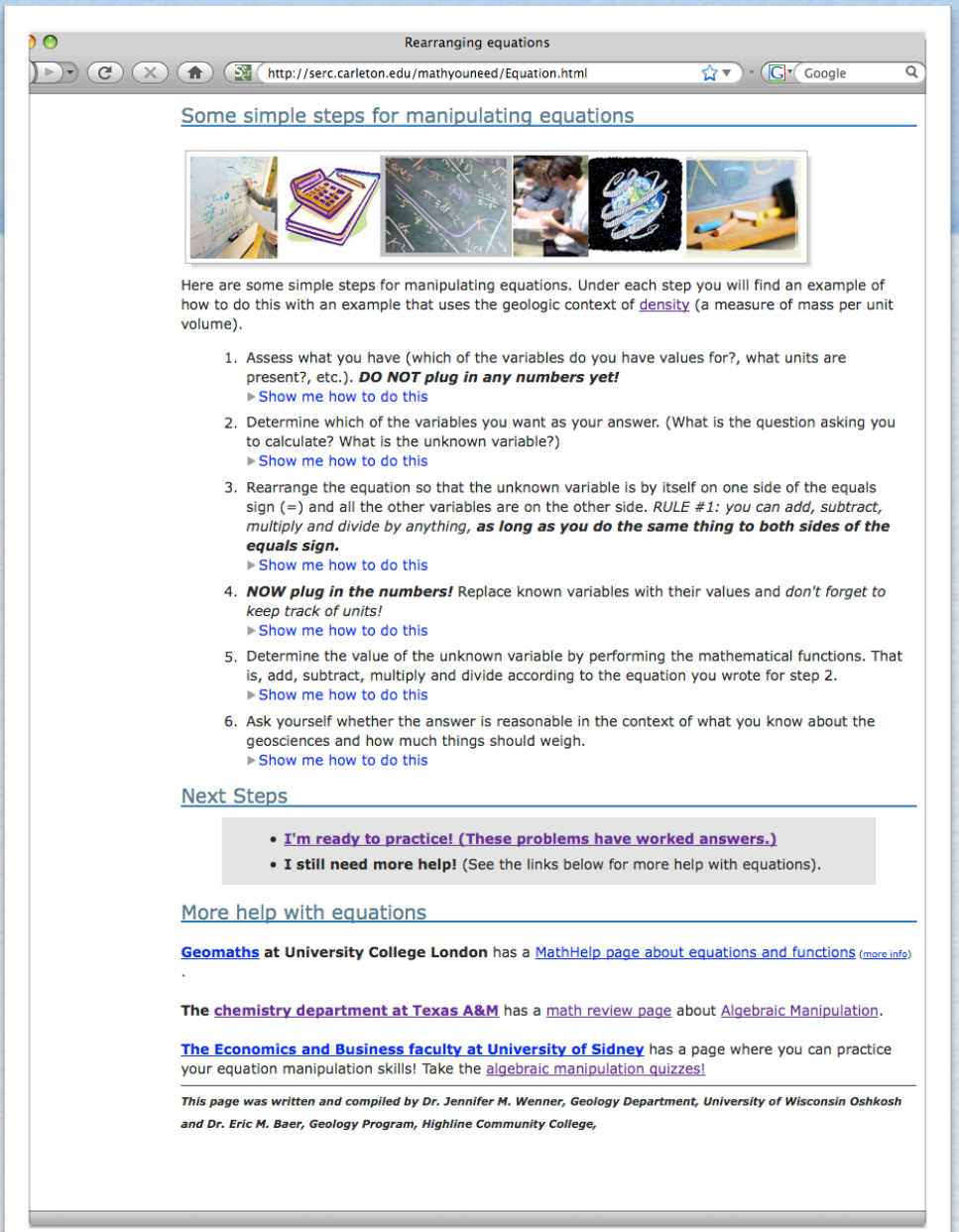
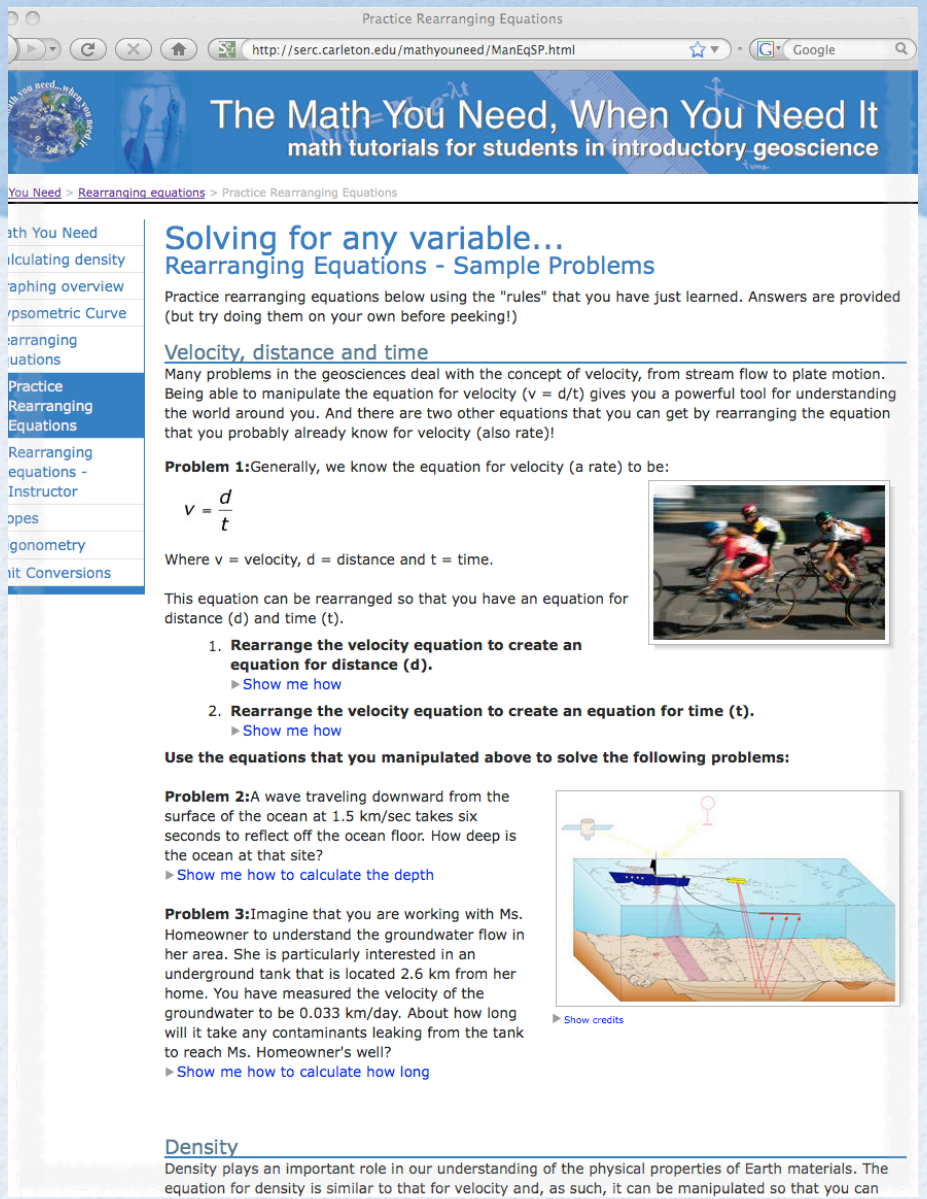
INSTRUCTION

Each module:

- begins with an explanation
  - How does it fit in the geosciences?
  - Why should I?
- includes a step-by-step process for solving problems
- Ends with link/help



PRACTICE



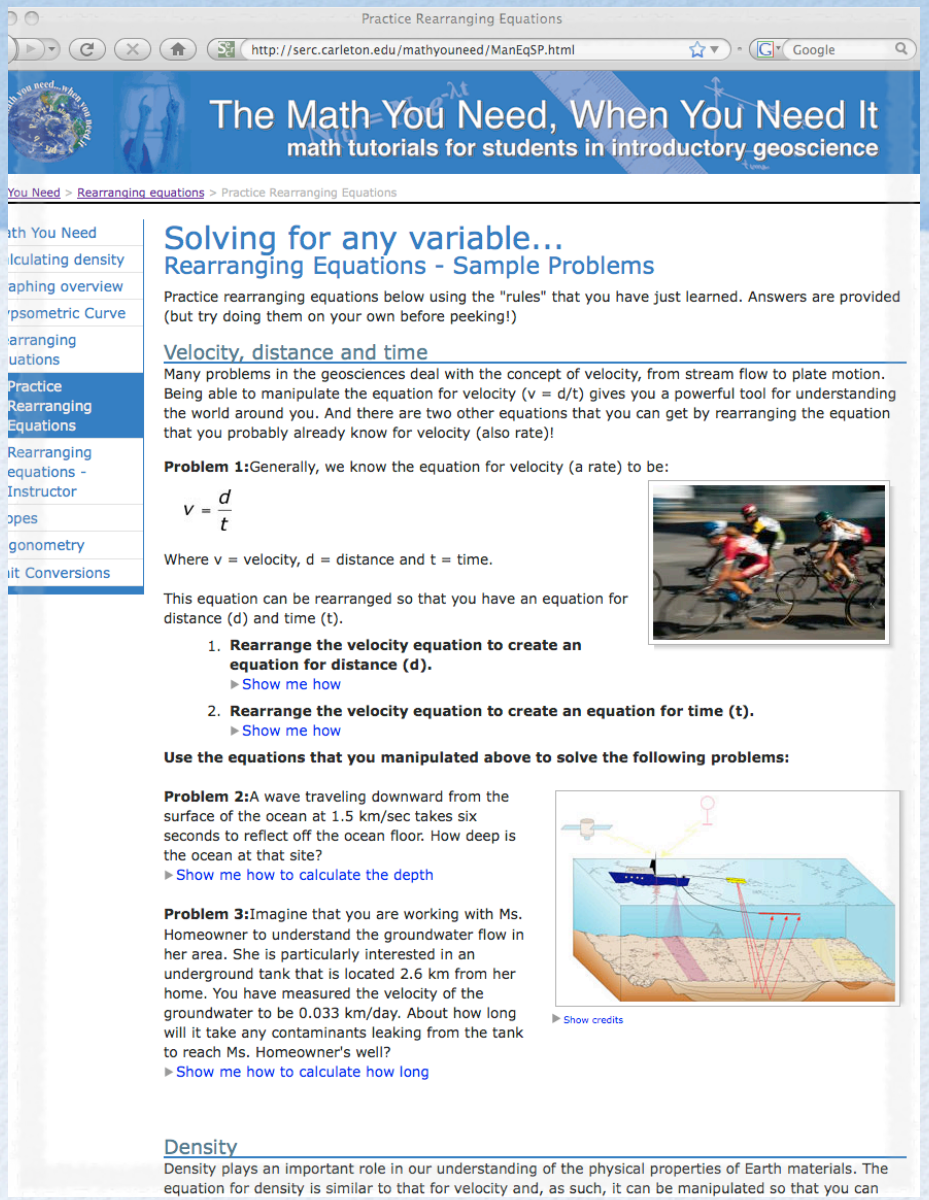
Each practice page:

- has multiple contextual examples
  - reinforces importance
  - repetition promotes transfer
- Examples are solved using step-by-step instructions.
- Ends with link to quiz

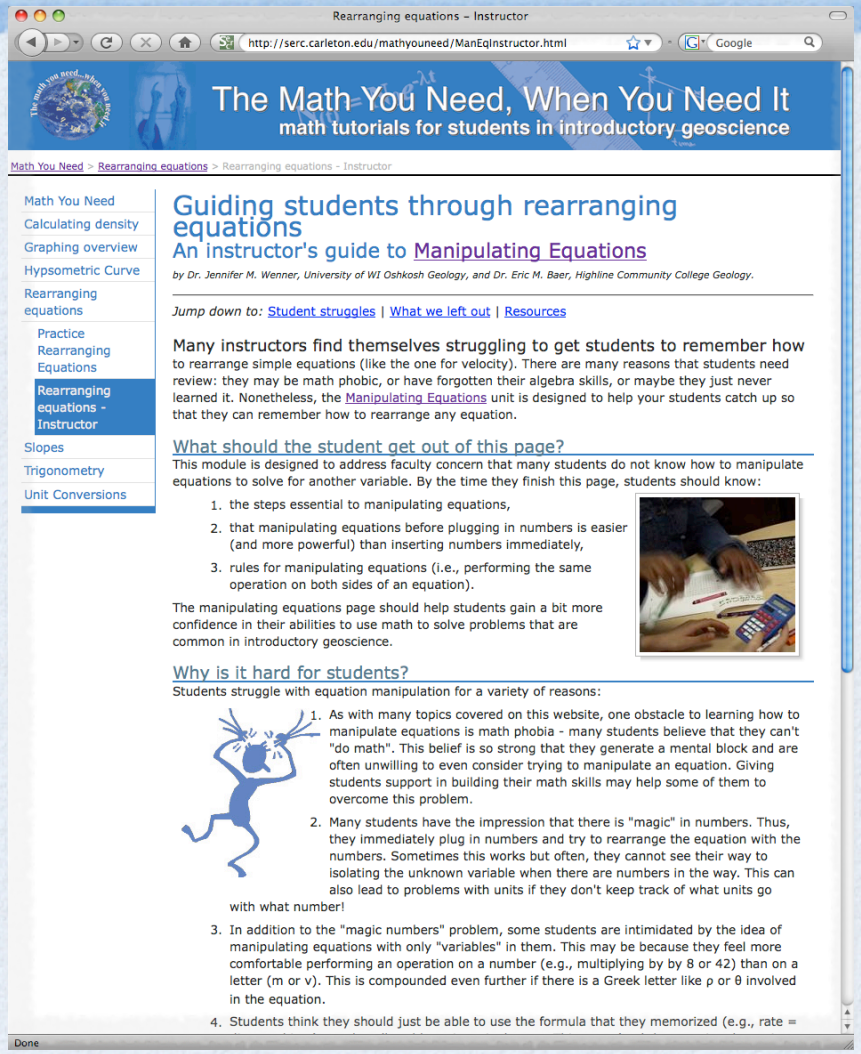
ASSESSMENT

Link from practice page:

- WAMAP
  - designed for mathematics
- Wide variety of options for quizzes (students can get feedback after due date)
- Self grades



INSTRUCTOR PAGE



- What you should expect from this module
- why it's hard for students
- what we left out
- outside resources

PILOT RESULTS

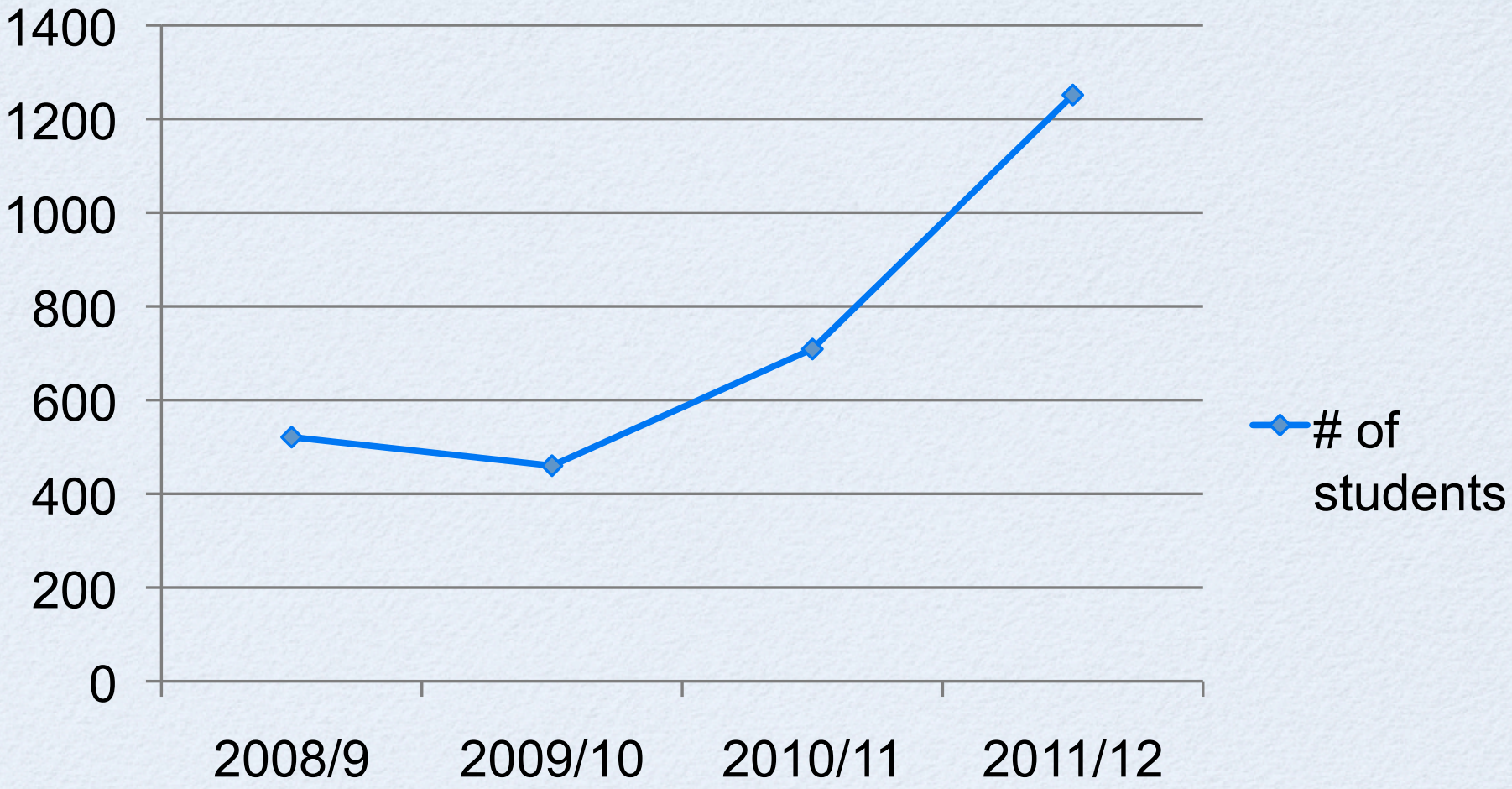
School/Course	Semester/quarter offered	number of students	post-test attempts	completion rate	Average pre-post change
UWO Physical Geology	Fall sem 2008	154	1	90%	28
UWO Physical Geology	Spring sem 2009	166	unlim.	95%	42
UWO Physical Geology	Spring sem 2010	164	unlim.	84%	28
UWO Environmental Geology	Fall sem 2008 §	180	1	67%	19
HCC Physical Geology	Fall qtr 2008 §	5	1	40%	-33
HCC Physical Geology	Spring qtr 2009	10	1	80%	18
HCC Physical Geology	Fall qtr 2009	5	1	60%	-13
HCC Physical Geology	Spring qtr 2010	19	1	83%	-13

PHASE II EXPANSION

Phase I (2006-9)	Highline Community College				University of Wisconsin Oshkosh		
2009/10	Adams State		Fort Lewis College		McHenry County College		
2010/11	Rochester CTC	Illinois Valley CC	Hofstra University	SUNY Geneseo	Trinity College	Boston University	Cal Poly Pomona
2011/12	California Univ. (PA)	Patrick Henry CC	Fitchburg State	Wake Tech C.C.	Ursinus	Linn-Benton CC	
	U. Maine Farmington	Austin CC	SUNY Oneonta	Los Angeles Valley CC	North Hennepin CC	Bergen CC	
	CSU East Bay	Central Wyoming Coll.					

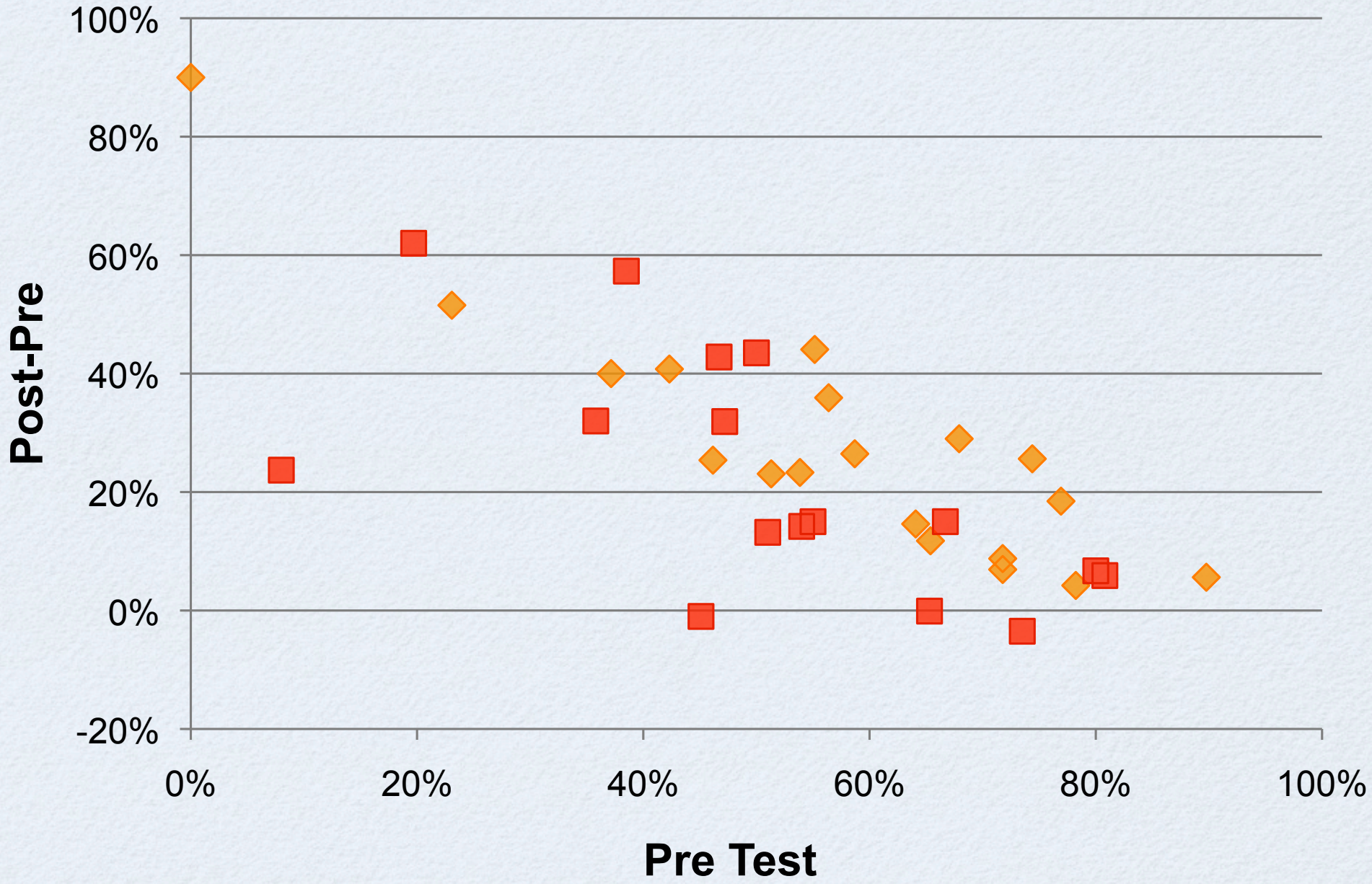
PHASE II EXPANSION (2011/12)

STUDENTS USING TMYN



Who are we helping?

- The most underprepared students?
- The students on the borderline?
- Students who would pass but not excel?
- Students at the top of the class?
- No one?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Post-Pre
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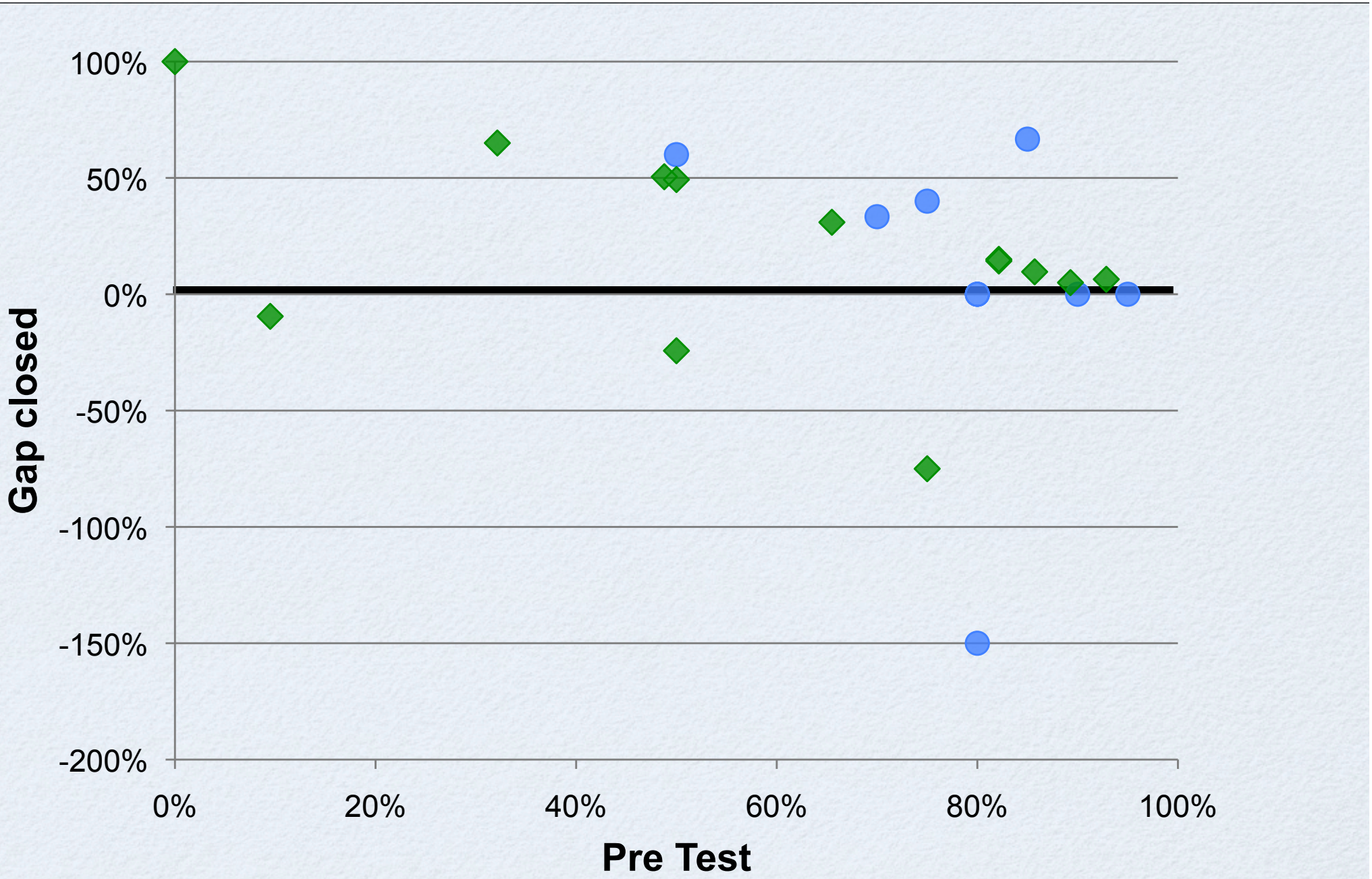
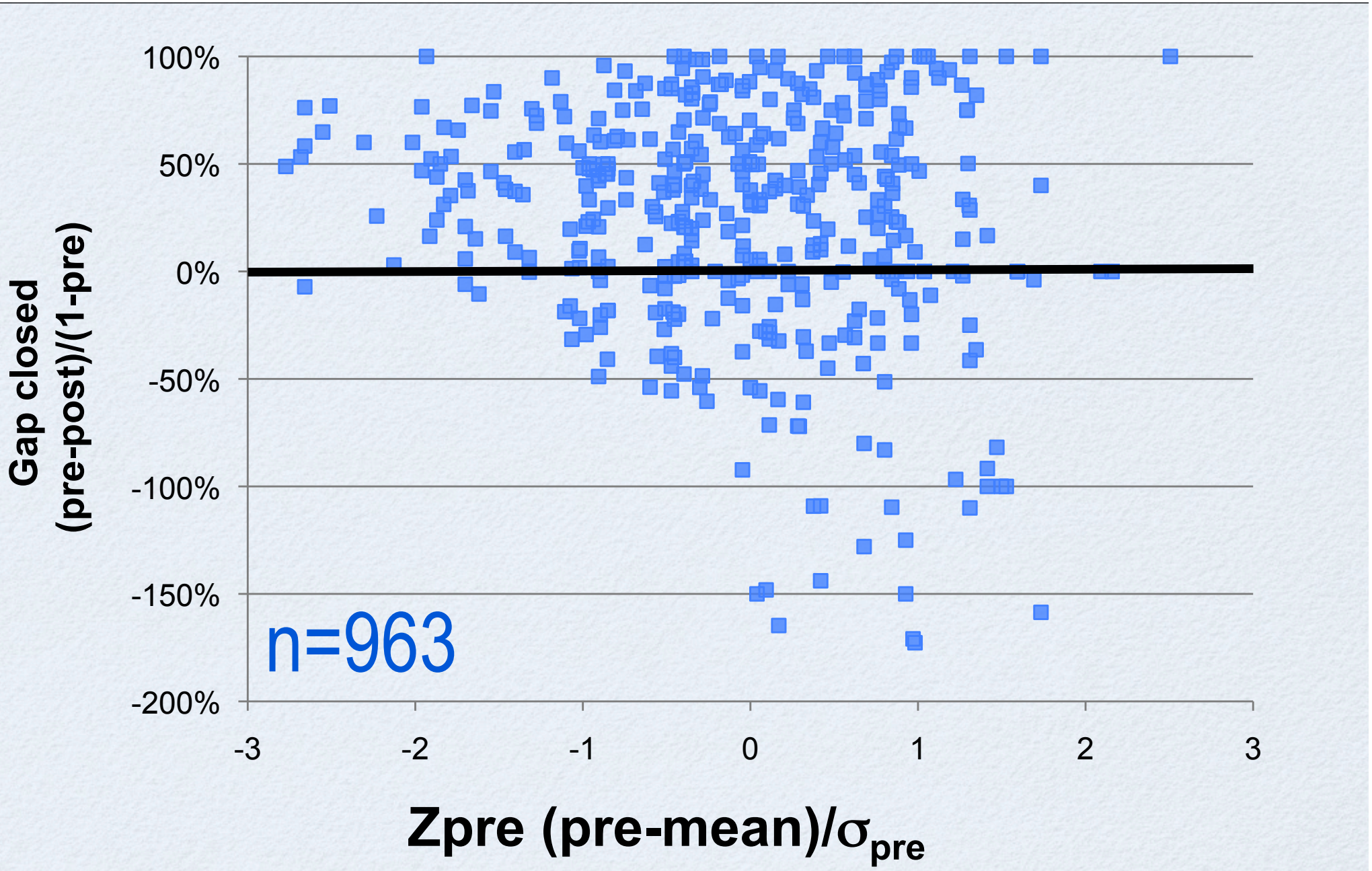
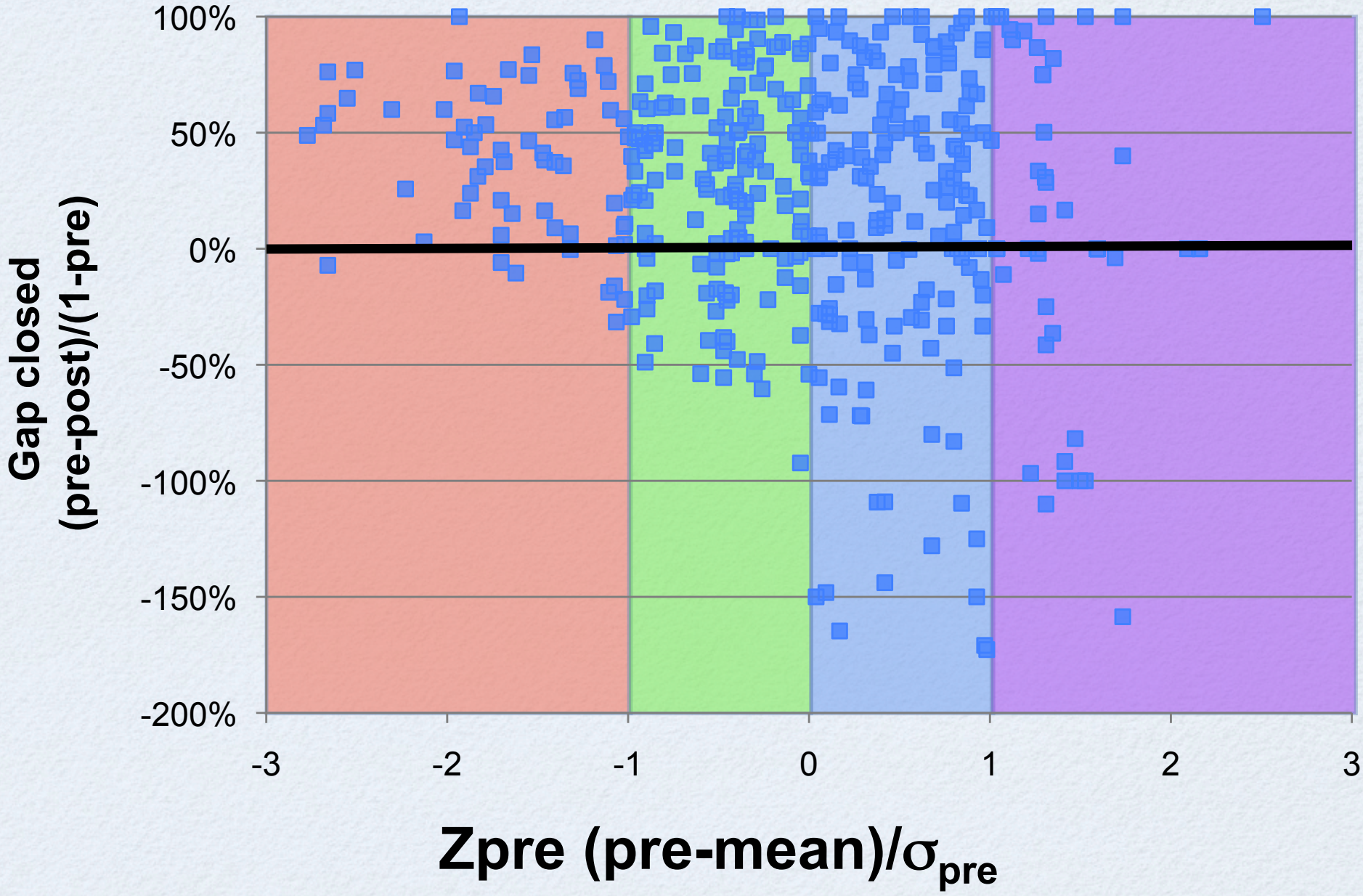
Pre Test



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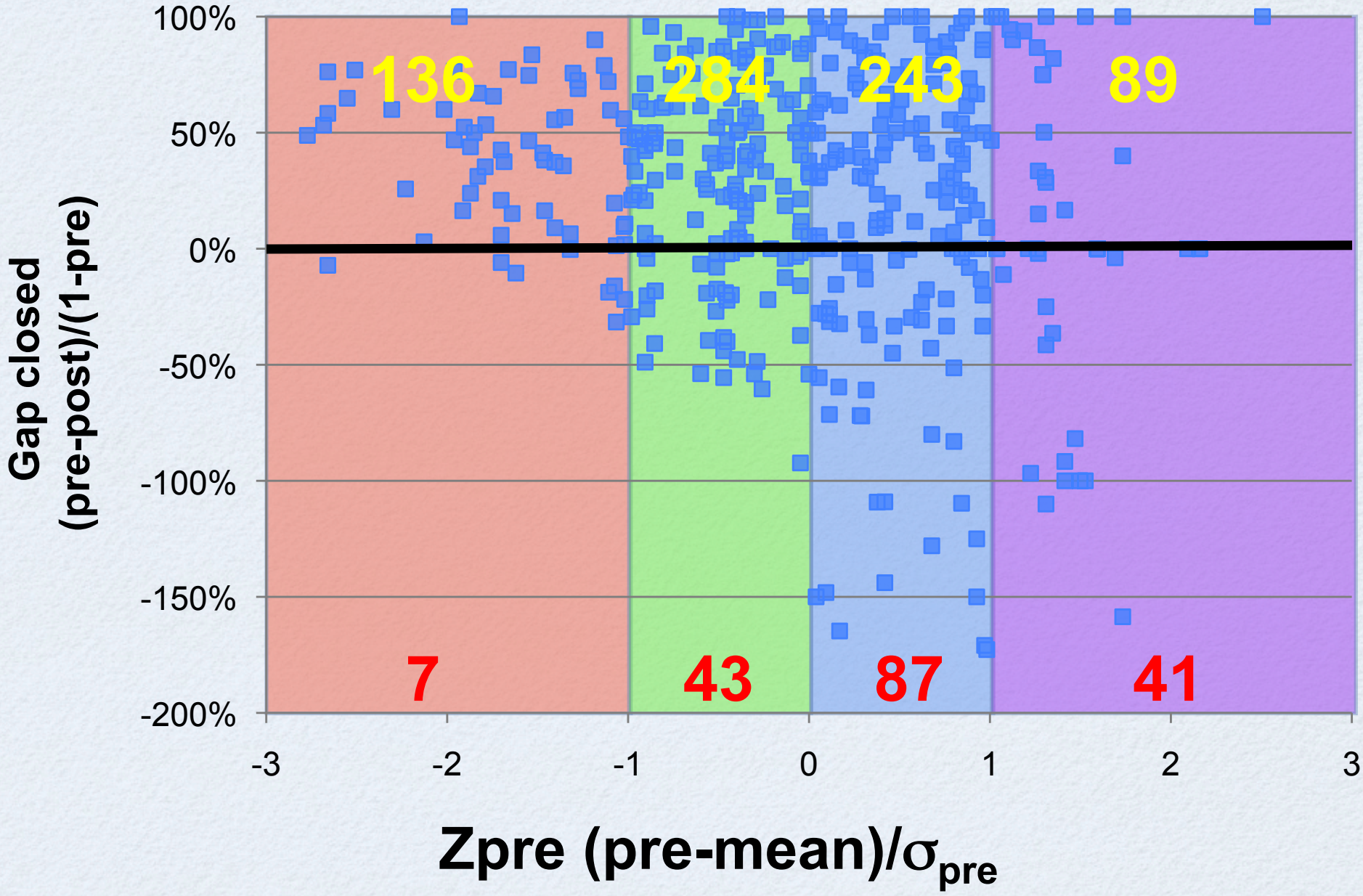
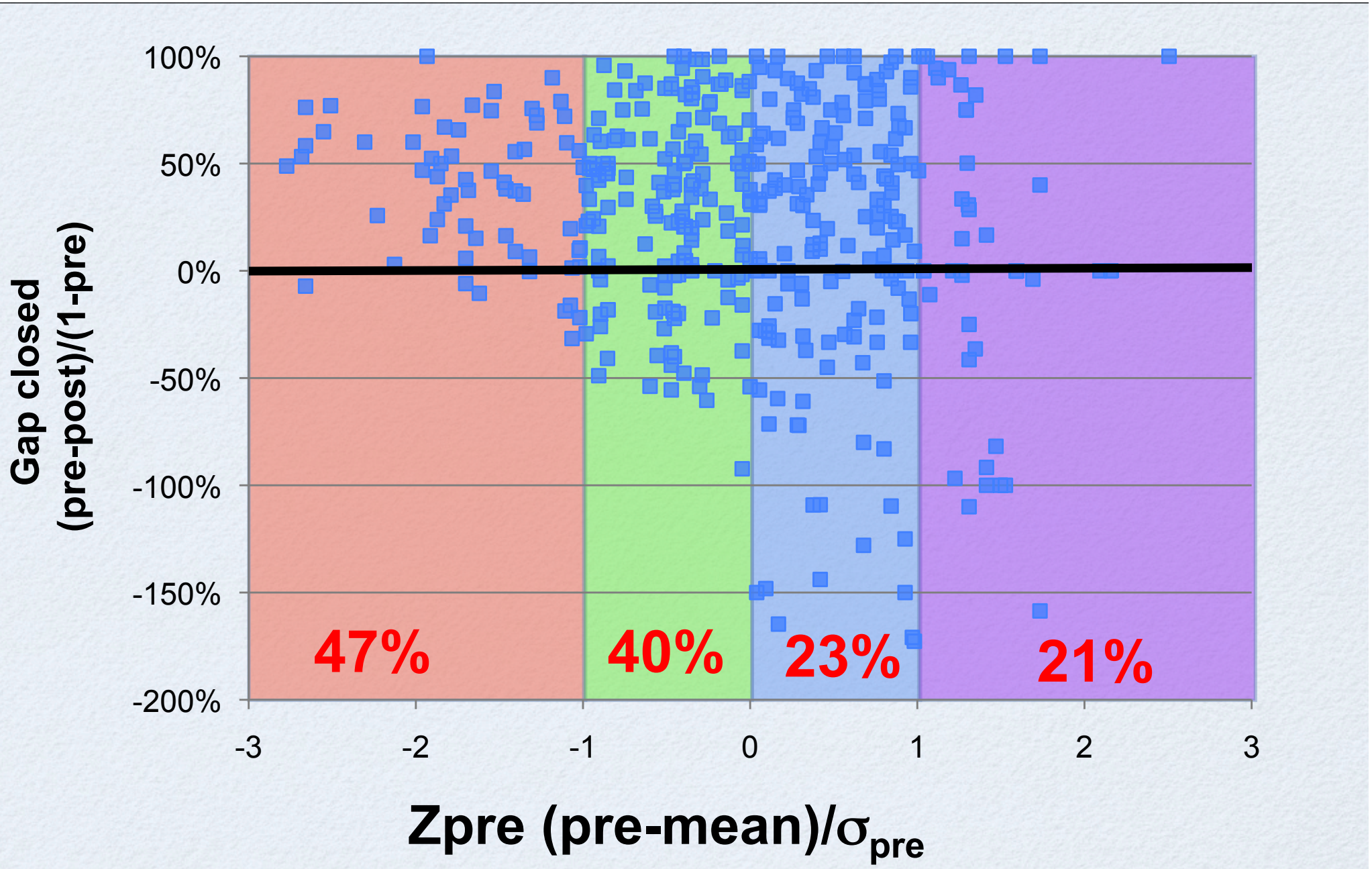
-50%
-100%
-150%
-200%
-3
-2
-1
0
1
2
3
Gap closed
(pre-post)/(1-pre)
Zpre (pre-mean)/σpre


100%
50%
0%
-50%
-100%
-150%
-200%
Gap closed
(pre-post)/(1-pre)
136
284
243
89
7
43
87
41
-3
-2
-1
0
1
2
3
Zpre (pre-mean)/σpre


100%
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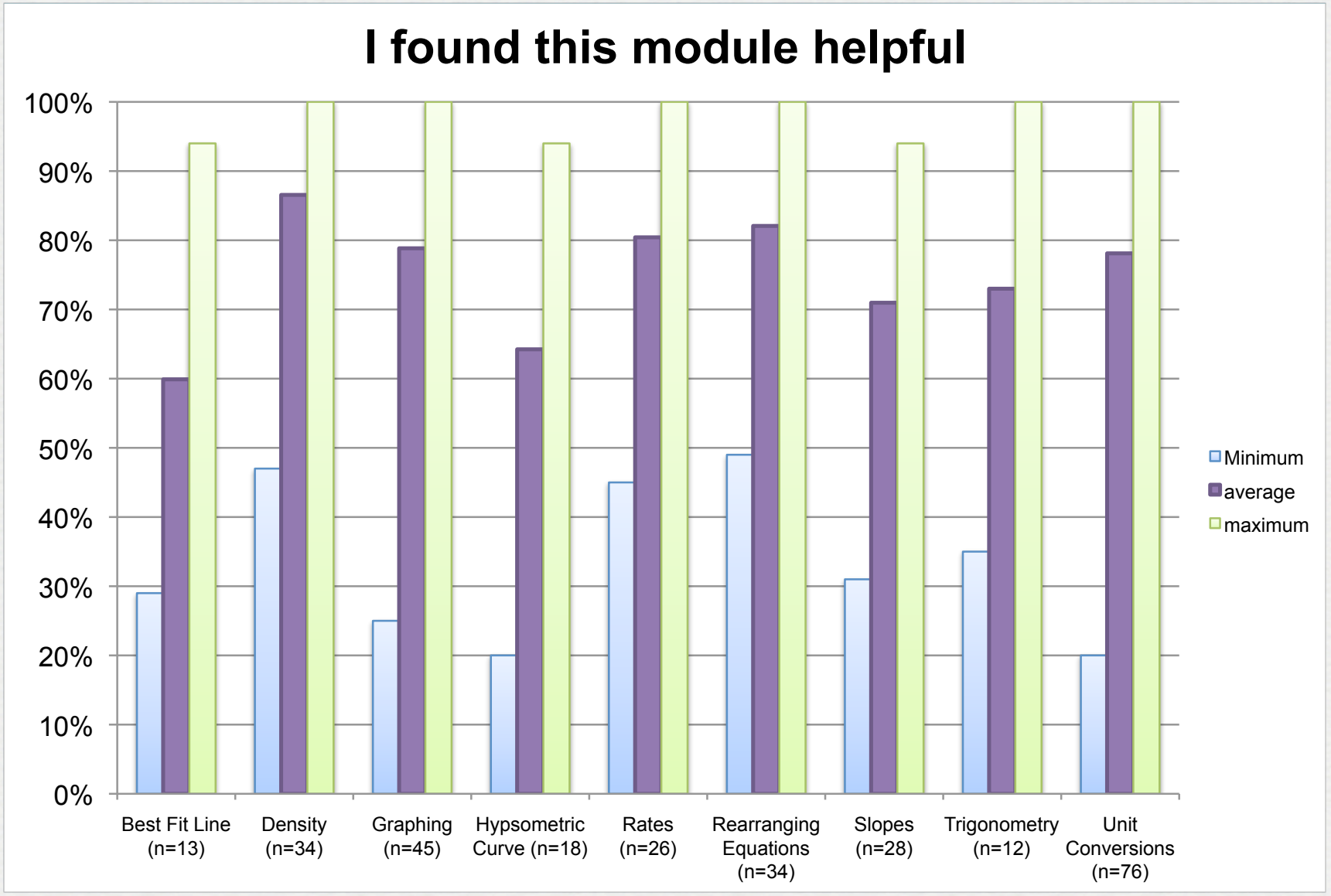
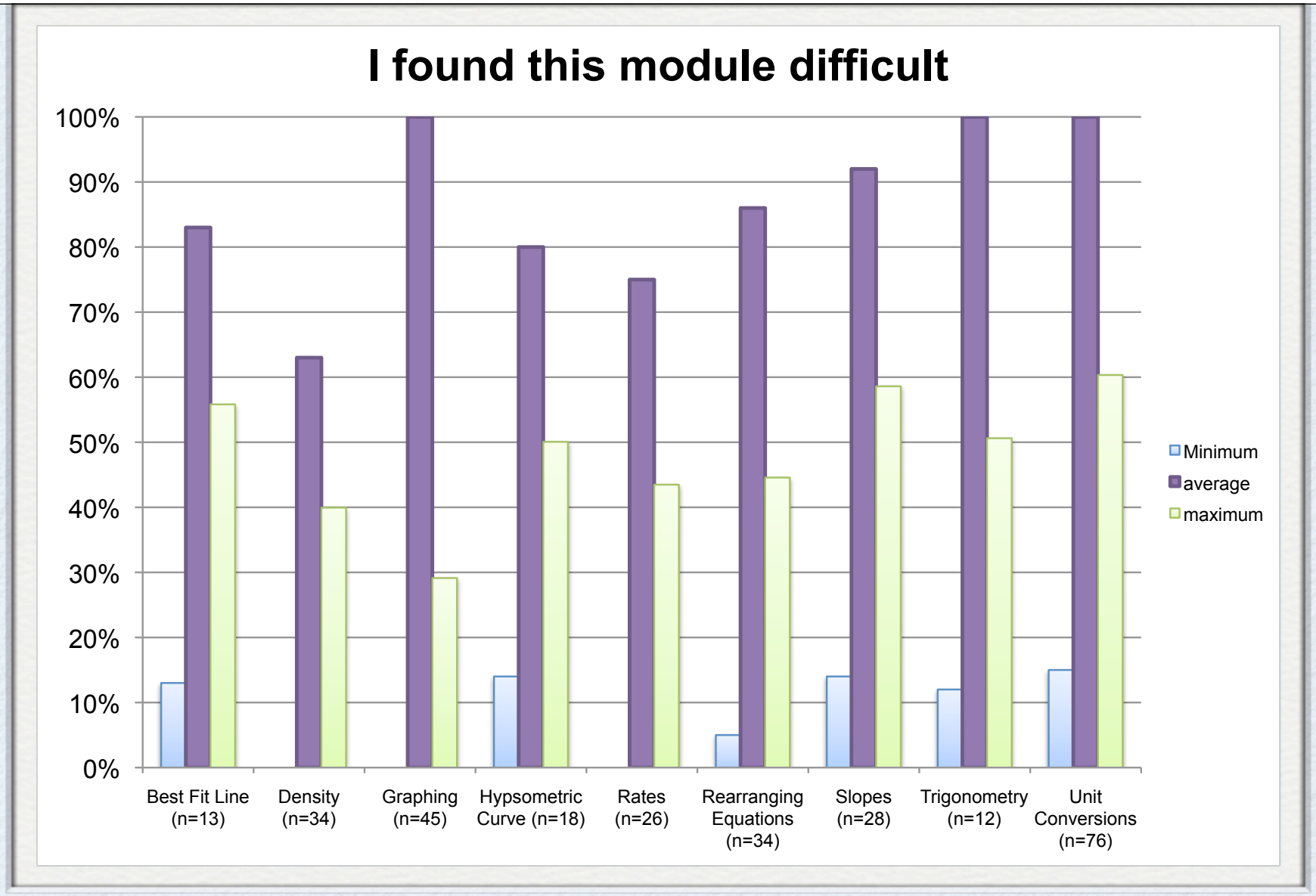
-50%
-100%
-150%
-200%
Gap closed
(pre-post)/(1-pre)
47%
40%
23%
21%
-3
-2
-1
0
1
2
3
Zpre (pre-mean)/σpre



HELPFULNESS


I found this module difficult
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Best Fit Line (n=13)
Density (n=34)
Graphing (n=45)
Hypsometric Curve (n=18)
Rates (n=26)
Rearranging Equations (n=34)
Slopes (n=28)
Trigonometry (n=12)
Unit Conversions (n=76)
Minimum
average
maximum

DIFFICULTY

Students...struggle with manipulating trig equations and dealing with mapscales... despite pre-calculus being a pre-requisite for the course.

I was enthusiastic about being able to return to SOME numbers work, which I had largely dropped from my course...having a WIDELY varied student population meant that I would spend a large portion of lab time helping some students with simple calculations, not geoscience.

The course is focused on collecting, plotting, analyzing and interpreting data...In discussing challenges...it became apparent...that some were struggling...because they had not mastered basic quantitative skills. Their unfamiliarity...with basic operations and quantitative skills was preventing them from completing assignments that they understood conceptually and/or geologically.

RESPONSES TO WHY TMYN IS NEEDED...

Absolutely. [S]tudents did much better on mass balance calculations and... human impacts due to development and pollution. I have not been able to address these concepts in a quantitative way in the past. But... rely[ing] on students to work through math basics on their own outside of class time gave us more flexibility to address these interesting and valuable topics [in class].

Yes. In past years I have largely glossed over all math except for reading graphs and calculating density. Having students calculate rates added significantly to [the topics of] mass wasting and tectonics.

I don't think I increased the quantitative aspect, but using the modules allowed me to maintain it at the level I wanted rather than reducing the quantitative part of it.

DID YOU INCREASE THE QUANTITATIVE CONTENT OF YOUR COURSE?

CONCLUSIONS

- Students use it
- Students learn
- Students like it
- Faculty like it!

THIS WORKSHOP

- Learn about what works
- Talk about strategies with like minded folks
- Design your own implementation
- Choose appropriate modules for your course
- Leave here ready to use it in your class