

# Past, Present, and Future: the Theory of Everything

Jack Rotman

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# Goals ...

- PAST:  
Understand where ‘college mathematics’ has been
- PRESENT:  
Appreciate the forces acting on college mathematics
- FUTURE:  
Develop a (shared) vision of where WE might want to take college mathematics
- Work towards a “Theory of Everything”

# Connecting: Past ↔ Future

- “Memories are the key not to the past, but to the future.” (Corrie Ten Boom)
- “We are made wise not by the recollection of our past, but by the responsibility for our future.” (George Bernard Shaw)
- “People don't realize that the future is just now, but later.” (Russell Brand)

- 
- **It's the Mathematics, silly!**
  - **The question is: WHAT is important to US?**

# Start with “Now” ... 2018 !

- Minimization of Dev Math: smaller footprint for developmental mathematics
- Avoid College Algebra
- Trend I: Co-requisite remediation (footprint size=0) → “place ‘em all in college math”
- Trend II: Pathways (smaller footprint for sub-populations) → “no algebra for non-STEM”
- **Trend III: Replace  $n$  traditional courses with  $(n-a)$  modern courses (smaller footprint for all)**
- *Everybody is an expert (even college presidents and boards of trustees)*

# **Poll: Which option do you prefer?**

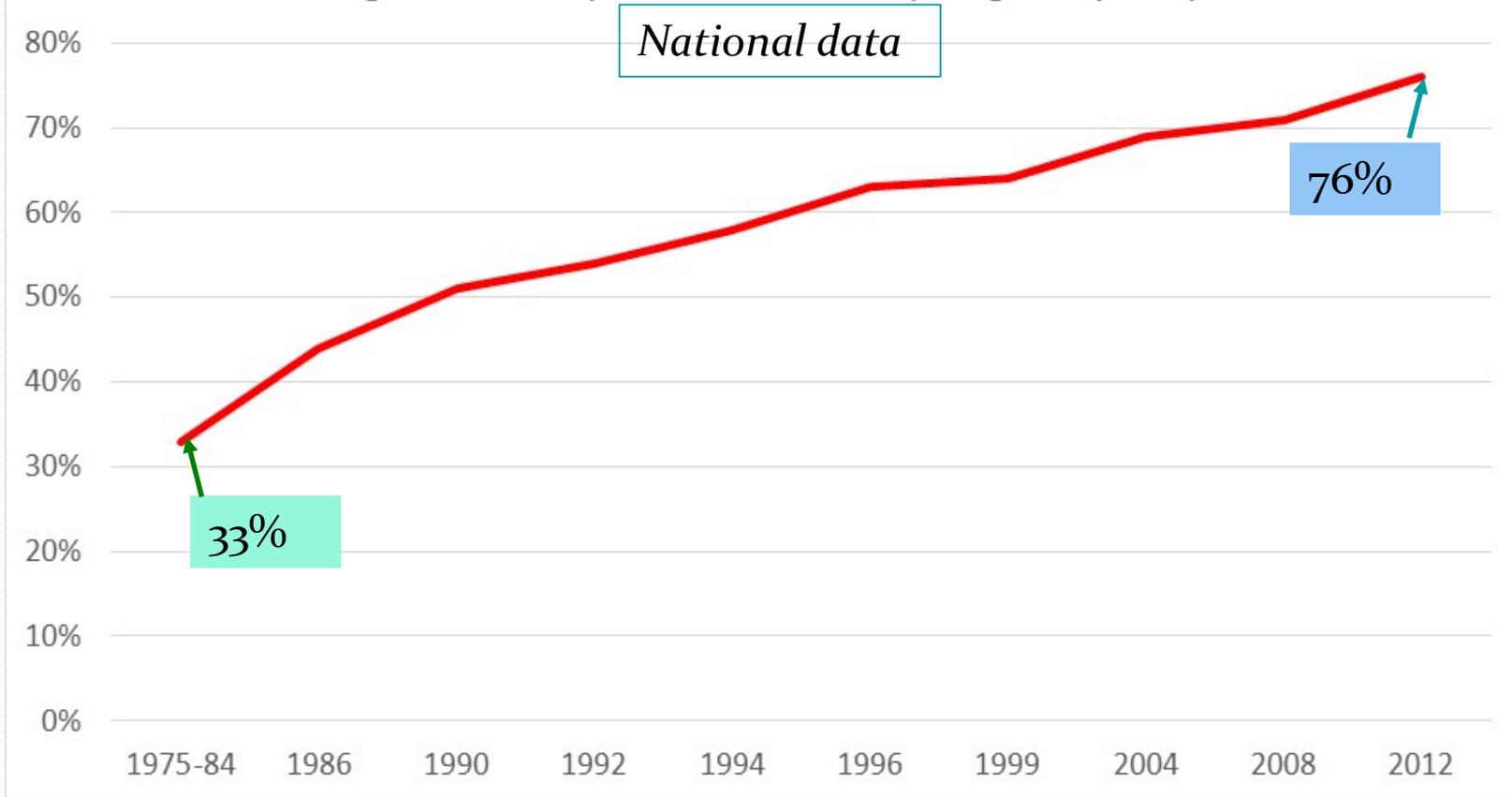
- **I: Corequisite remediation**
- **II: Pathways**
- **III: Replace traditional courses**
- **IV: None of these**

# College Mathematics 1975: Dev Math Origins

- Developmental mathematics completed the college-prep mathematics from high school, for those who had not done so
- “High school” mathematics cloned
- **Rationale:** Get students ready for College Algebra or equivalent

# Dev Math made some sense in 1975

Algebra II Completion over time (at age 17 years)



Almost all current high school graduates have completed an Algebra II experience that is an approximation to the Common Core standards.

# College Algebra 1975: The Transition to Calculus ...

- Commonly done by “**College Algebra**” followed by “**Pre-calculus**”
- **College Algebra** usually based on a descendent of general education within a liberal arts framework (see Suzuki “College Algebra in the 19<sup>th</sup> Century”)
- **Pre-calculus** focused on trigonometry
- Some content actually related to preparing students for calculus. *i.e. ... most was not!*
- That preparation conceptualized within traditional engineering programs

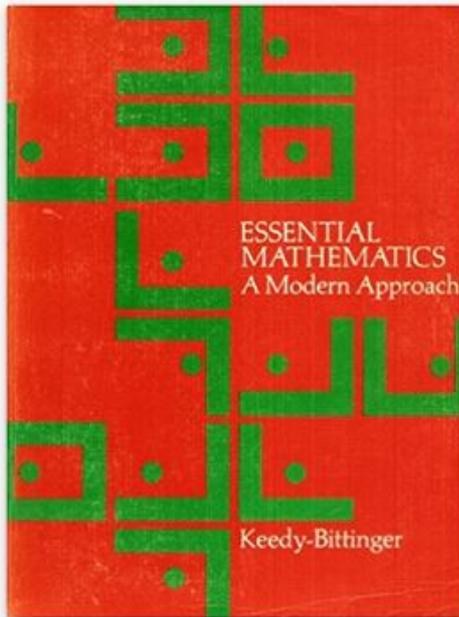
# College Math Courses ... 1975

- Basic Math (<8<sup>th</sup> grade)
- Pre-Algebra (8<sup>th</sup> grade)
- Beginning Algebra (9<sup>th</sup> grade)
- Intermediate Algebra (11<sup>th</sup> or 10<sup>th</sup> grade)
- Some had Geometry (10<sup>th</sup> or 11<sup>th</sup> grade)
- College Algebra (copied from a 1955 copy of ...) and “Pre-Calculus” (aka “Trigonometry”)
- Calculus (physics/engineering: “Thomas”)

# What we tried then (1975)

- Dev Math: Workbooks
- Programmed instruction books  
and specialized learning machines
- Audio tapes
- Books in 3 colors
- It was all about the **materials**

# A sample ...



## Essential Mathematics: Modern Approach Paperback – Import, December, 1972

by Mervin L. Keedy (Author), Marvin L. Bittinger (Author)

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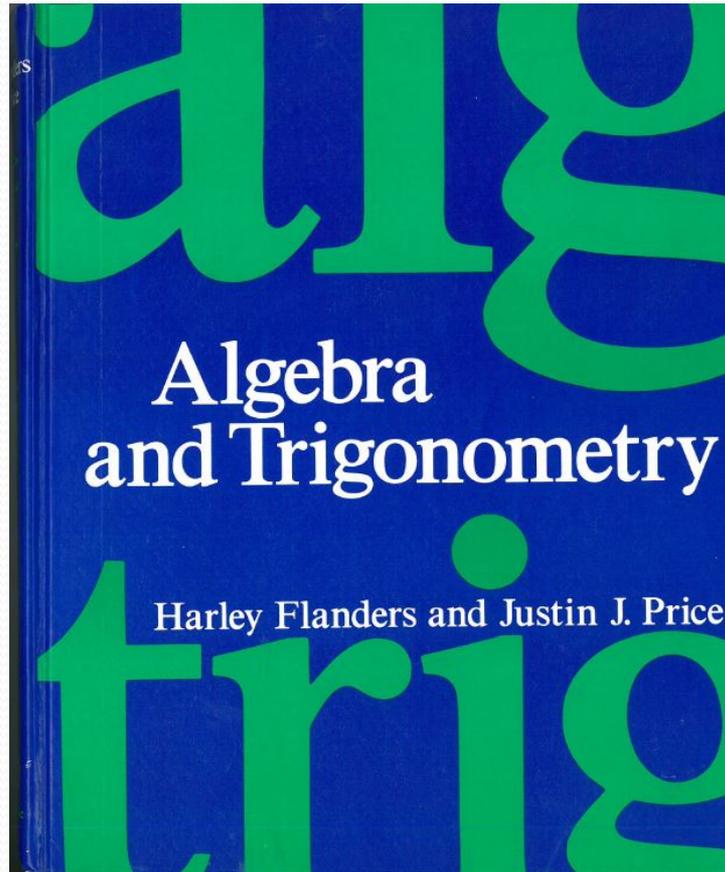
1 Used from \$49.99

This book contains a treatment of arithmetic, algebra, and trigonometry, and an appendix on the slide rule. The text adapts to either review or first time coverage and is designed mainly for a junior college audience with no prerequisites necessary. Practical application is emphasized throughout, with a minimum of words used to explain concepts; this stress on demonstration over description is especially helpful for remedial students. Of particular interest is the textbook page with wide margins intended for exercises a feature that creates an opportunity for student reinforcement and eliminates the cost of an extra workbook.

“Slide Rule” was the computing device of the era.

“Minimum of words” was a goal in many textbooks of the day – especially in dev math.

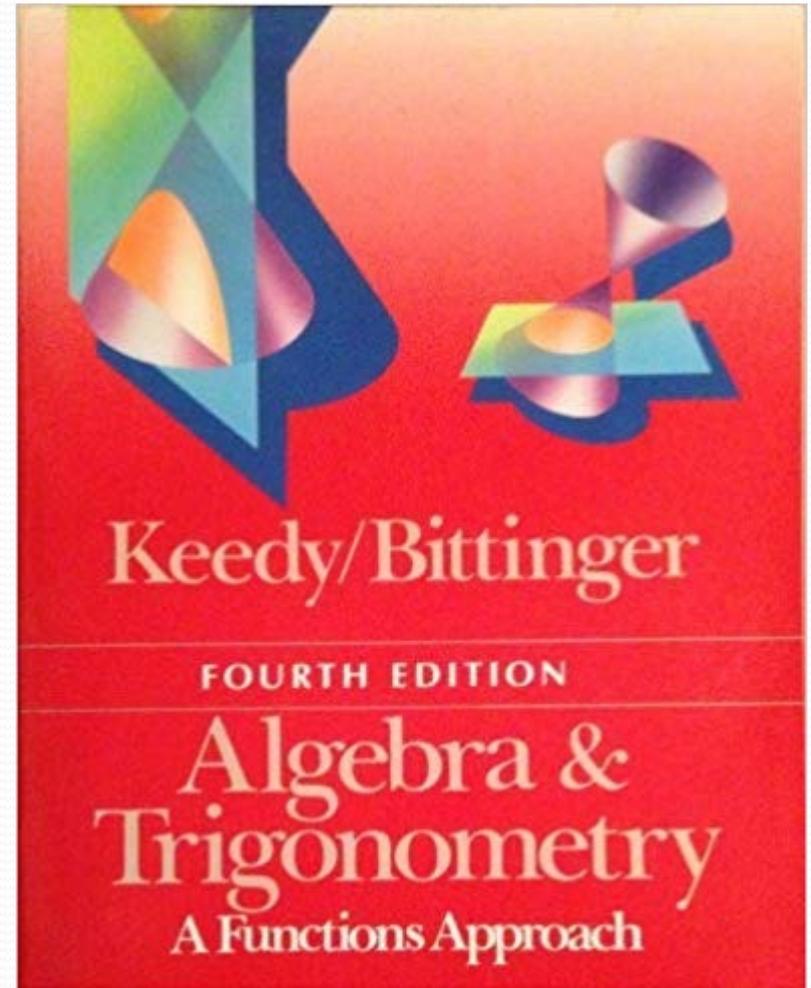
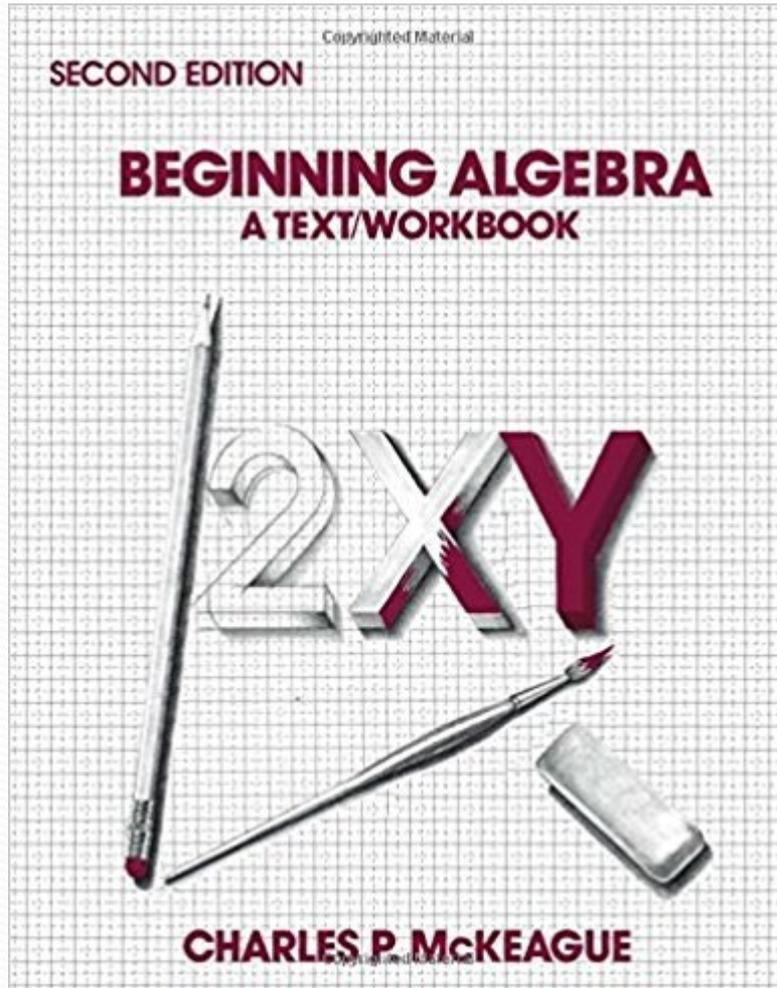
Another ... a bit unusual



# The 1980's: Regressive Content

- The Ban of Calculators
- Low pass rates meant “let’s add another course!” [or add more credits]
- Dev Math: Regression towards the “Basics” (skills, procedures)
- College Level Math: Double-down on symbol manipulation and ‘difficult’ problems

# Samples from the 1980's:



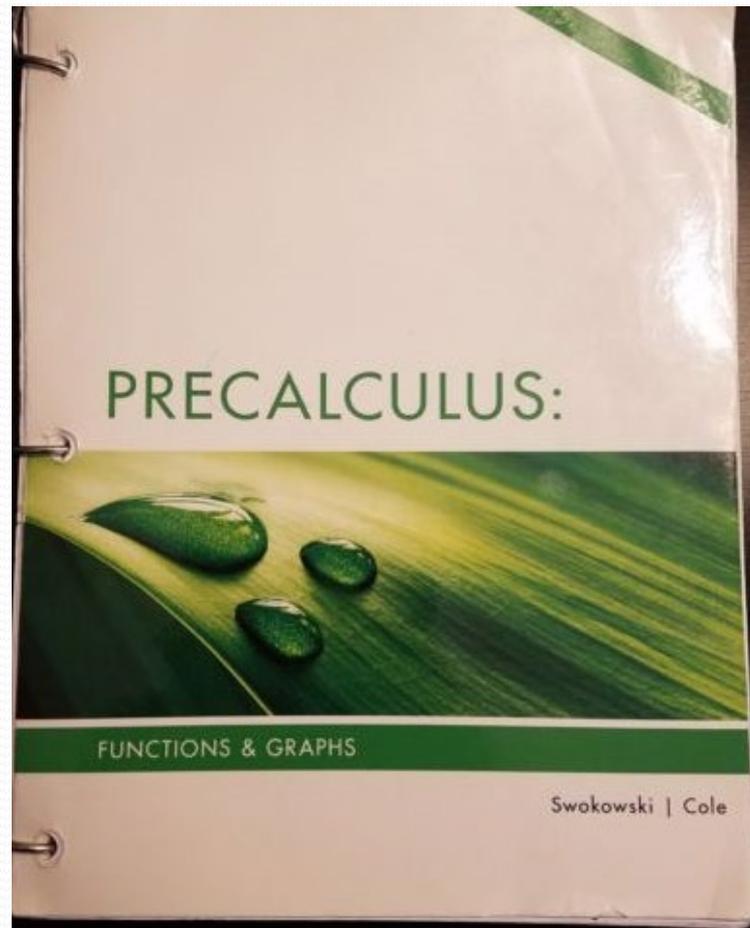
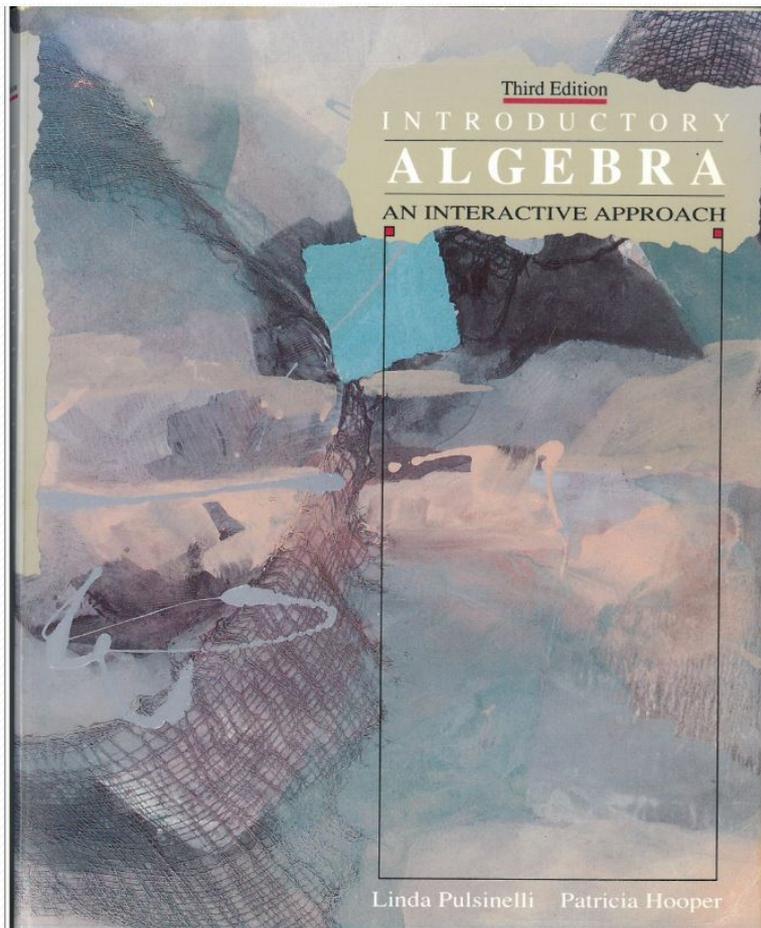
# Professional Guidance 1980s

- AMATYC was too young
- MAA did not address anything before calculus (CUPM 1981)
  - Calc II: *“An early introduction of numerical methods.” [pg. 20]*
- NCTM was very active in K-12 curriculum (Standards 1989)
- No directionality established for college mathematics

# The Early 1990s

- NCTM Standards: Major ... small changes for us
- Graphing calculators ... all or nothing  
[Most of us did 'nothing']
- First messages: needed changes (as in “Common Vision” & “Mathematical Sciences 2025”)
- Dev Math still focused on: old curriculum, getting students ready for College Algebra
- College Algebra & Precalculus: solutions by definition

# Samples from early 1990s



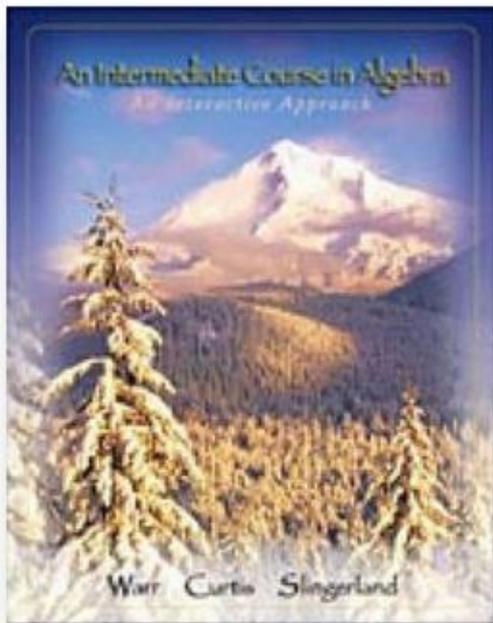
# The Late 1990s

- Pockets of reform and revolution:  
Focus on writing textbook(s); some grant based
- Supported by AMATYC Standards (1995) and NCTM standards (though not by ‘us’)
- Presentations at AMATYC and affiliates
- “AMATYC Right Stuff”
- Some efforts were similar to current “Option III”:  
Replace traditional math courses with modern courses

# One of the 1990s Reform Books

## An Intermediate Course in Algebra: An Interactive Approach (with InfoTrac) / Edition 1

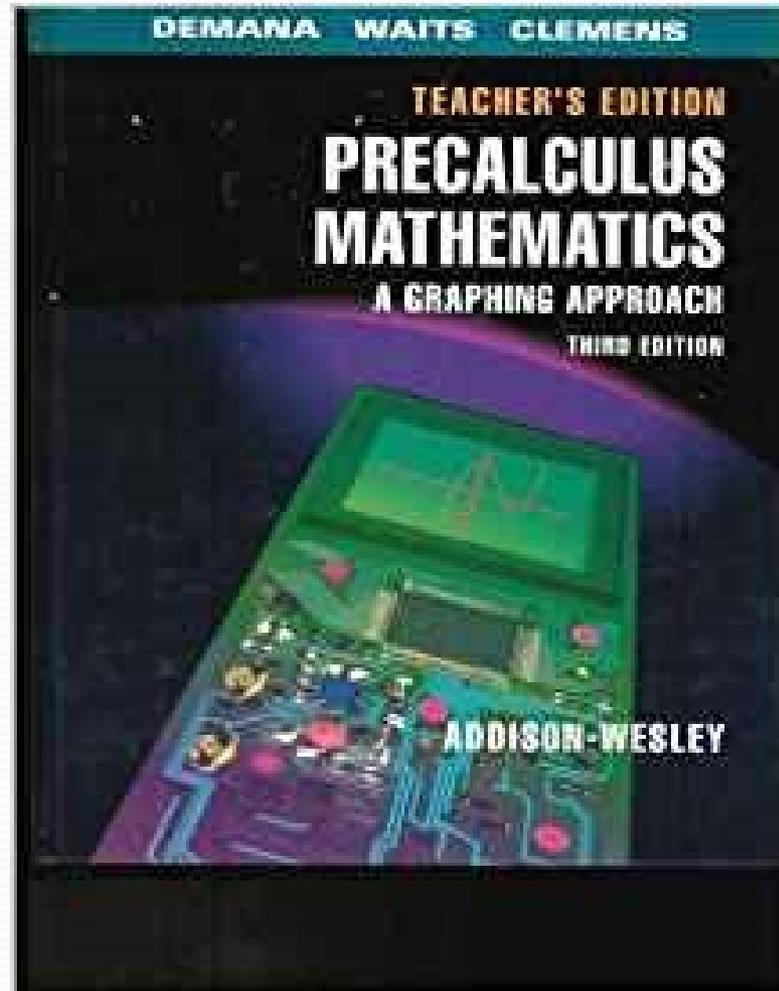
by Alison Warr, Cathy Curtis, Penny Slingerland



ISBN-10: 0534436730

*“This book was written to address the challenge of the NCTM and AMATYC Standards and technology integration in the classroom. The authors address the standards using a variety of methods, including Numerical, Graphical, and Algebraic Models; Guided Discovery Activities; Problem Solving; Technology; Collaborative Learning.”*

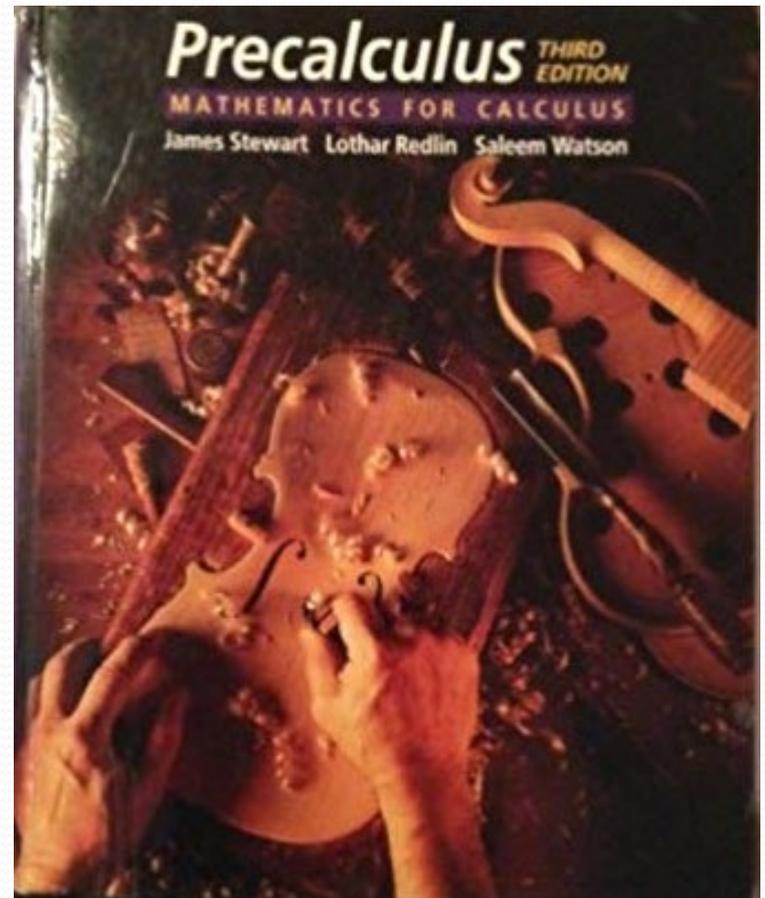
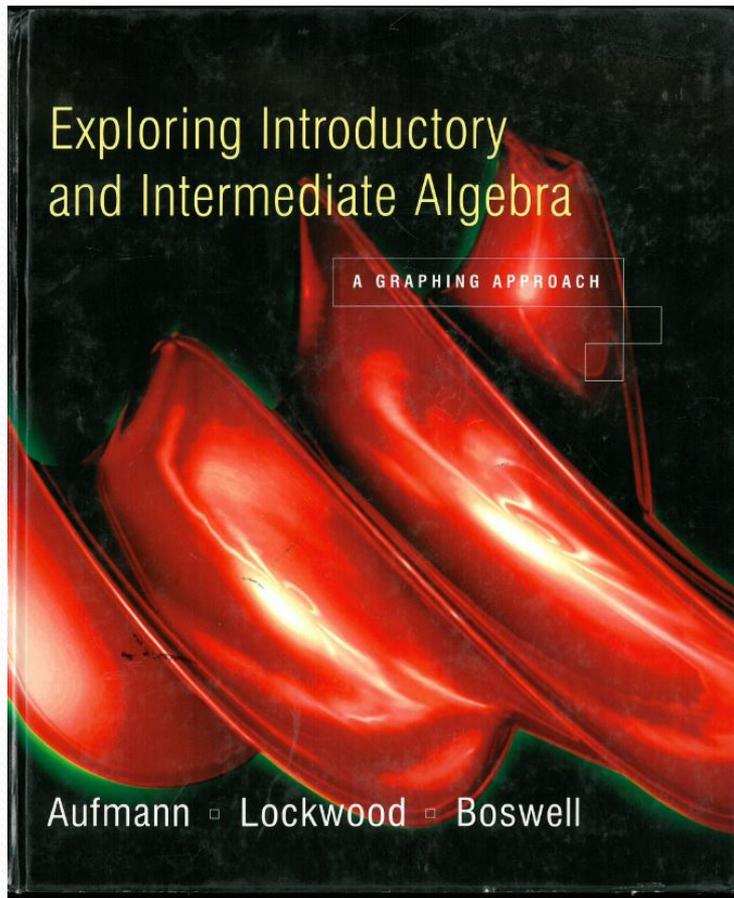
# Another Reform book (sort-of)



# 2000 to 2009

- Publishers ... Consolidation; “Print” still king
- Digital as supplement
- Focus on commonly used content
- Reduction in reform books
- Separate and unequal: graphing calculator sometimes integrated; most avoid GC
- Few of us thought of anything besides College Algebra as a “target”

# Text samples ... 2004



Next:

## AMATYC Standards, Act 2

- Beyond Crossroads (2006)
- Process as a Focus (“Improvement Cycle”)
- Curriculum addressed more in 1995 document
- **Implicit acceptance of status quo (the out-of-date remediation structure)**
- **Policy influencers ... began to be interested in developmental mathematics**

# 2000-2009: NCAT

- The National Center for Academic Transformation
- Course Redesign using Technology as the all-purpose solution: Emporium; Modules
- Skills ... old content
- Efficiency
- Isolated from the work of the profession

# College Algebra:

## The Ultimate Piñata



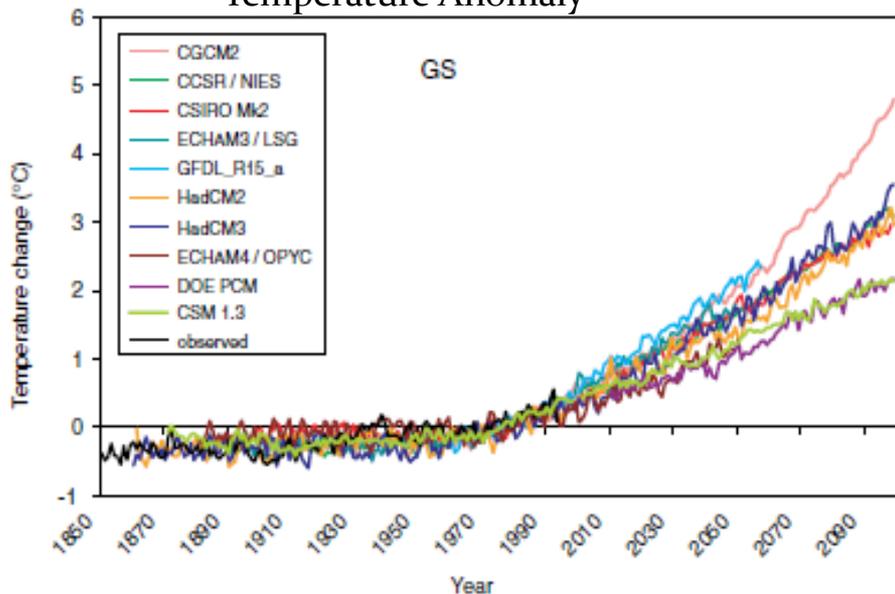
- The “reforms” (AMATYC, MAA) tended to create a general education course for non-calculus needs
- Evidence of a problem: pre-calculus as an impediment to success in calculus I (Sonnert/Sadler)
- Most dev math ‘reforms’ have been done on the back of “avoid college algebra”
- What is important to US ... do we want to enable a STEM path for many, or restrict the path to the privileged few?

# It's still the Mathematics!

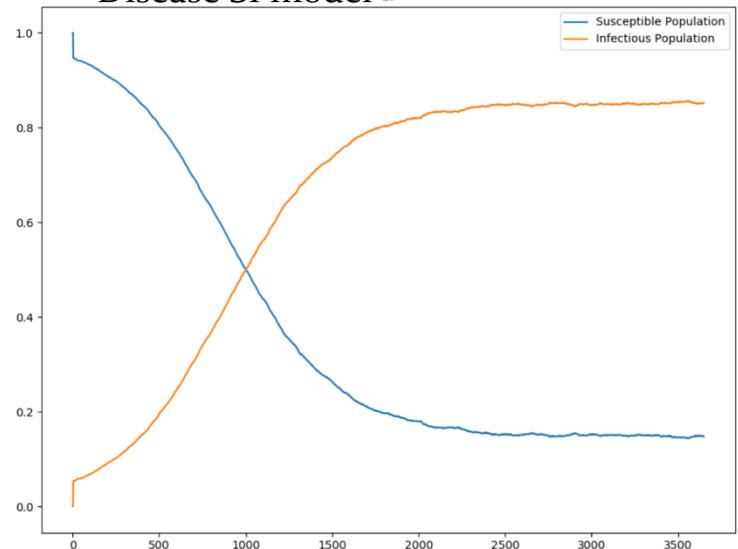
### Income inequality, USA, 1970-2014



### Temperature Anomaly



### Disease SI model $S_I$



# The Role of 2010

- Carnegie Foundation: Quantway™ and Statway™
- Dana Center: Foundations of Mathematical Reasoning
- AMATYC New Life: Mathematical Literacy, and Algebraic Literacy
- The “joyful conspiracy” (Uri Treisman)
- We began thinking about other college math courses (besides ‘college algebra’)

# No Longer Hidden

- Prior to 2010, dev math operated under the radar
- Until ... Policy influencers painted a dismal picture of our work
- Policy influencers sought to disrupt the continuity in the profession
- Specific solutions “sold” to college and system leaders (presidents, provosts) bypassing faculty
- Focus on non- (or anti-) College Algebra

# Professional Guidance ... Heard anything about Precalculus?

- AMATYC and MAA have not provided direction about the curriculum before calculus
- However, the latest CUPM document (2015) has a great chapter on the Calculus sequence
- A novel design for pre-calculus: the Dana Center STEM Path
- A general benchmark: the MAA “Calculus Readiness” test



Back to the  
present ...

# Minimization I: **Co-Requisites**

## Dev Math Footprint=0

- Co-requisite remediation as the all-purpose solution
- Focus on Statistics & Liberal Arts Math (or QR)
- “The data is in ... co-requisite remediation works”
- “We can’t a group of students for which it does not work.” If it sounds too good to be true ... is it?
- **College algebra de-valued; get done with math!**

# Minimization II: **Pathways!!**

## New and Old Dev Math Courses

- Pathways: Math Literacy replaces 1 or 2 algebra courses **for SOME students**
- Students needing statistics or quantitative reasoning (aka “non-STEM”) arithmetic courses often still required;
- “STEM” students generally see the same old curriculum (**obsolete stuff**)  
**The ‘best’ math students get the worst courses.**
- *Algebra Avoidance as institutional policy*

# Minimization III: **Replacement**

## New Math Courses

- **Mathematical needs: converge for almost all students at the Math Literacy level**
- Eliminate arithmetic (and pre-algebra)
- Intermediate Algebra is not appropriate today:  
Need “Algebraic Literacy” (**reasoning, models, etc**)
- **Supports STEM-bound as well as ‘other mathematics’** (stat, QR, etc)
- Supports upward mobility (mid- and high-skill technical programs)

# STEM ... Pre-Calculus and Calculus courses

- Too many courses ... antiquated content
- Effective preparation would focus on reasoning, communication and analysis
- Professional resources exist for this work; our commitment is needed
- **Modern courses will open up “STEM Dreams” for many more of our students**

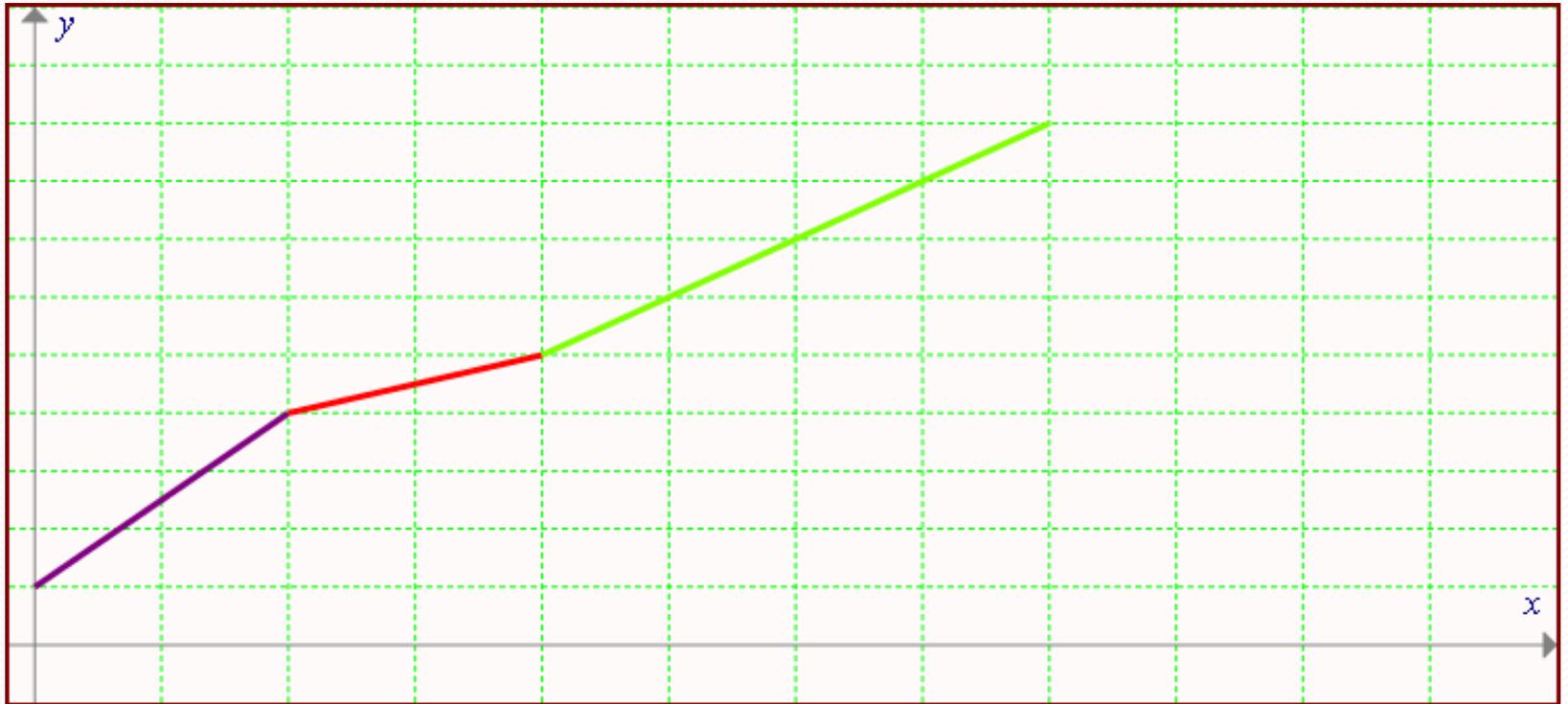
See:

MAA CUPM 2015, “The Calculus Sequence”

National Academy Press, “The Mathematical Sciences in 2025”

MAA, “Common Vision for Undergraduate Mathematical Sciences Programs in 2025”

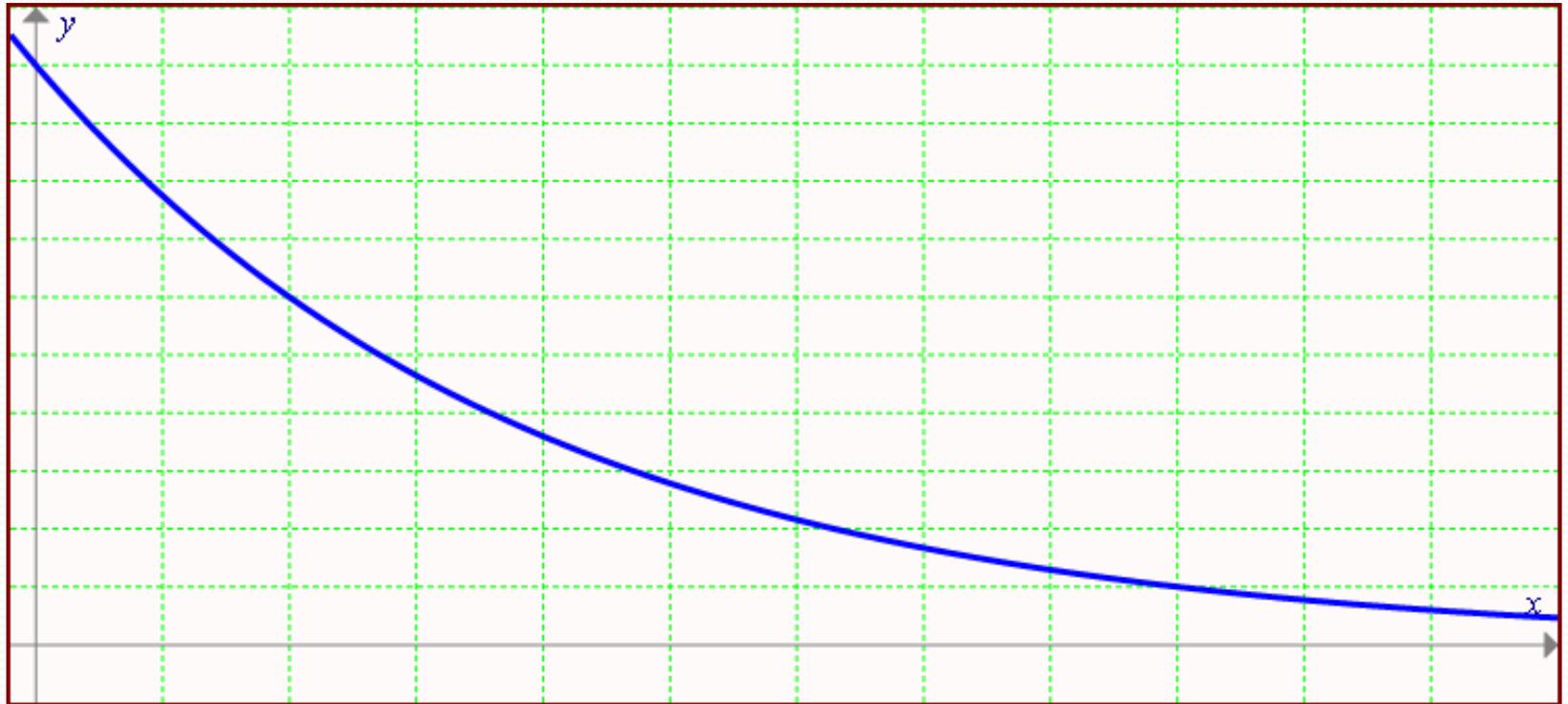
# What WE see



“More developmental courses leads to more students being ‘ready!’”

# What THEY see

*“They” refers to policy influencers ... such as Complete College America, Jobs for the Future, and others.*

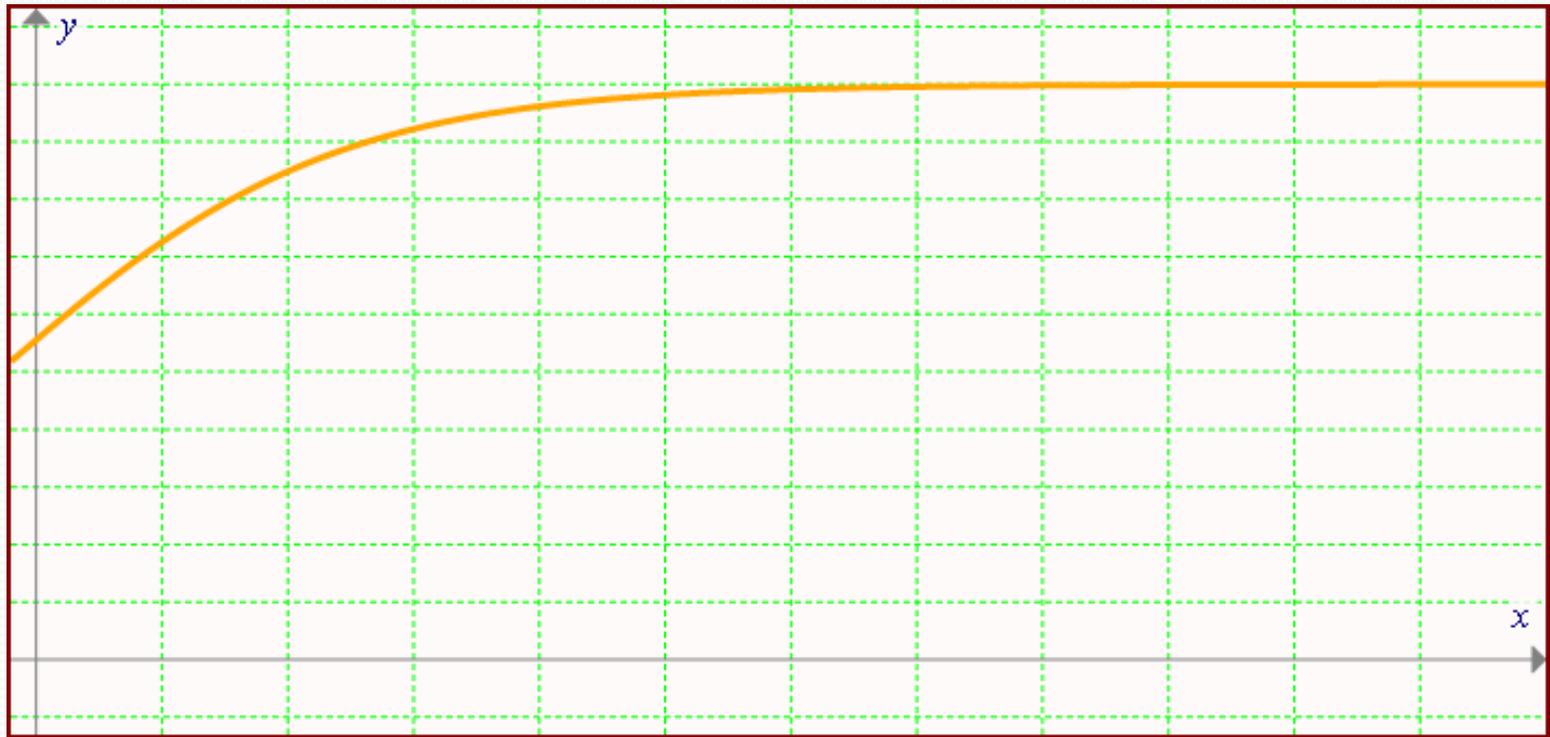


**“More developmental courses means most students are blocked from completion!”**

# Winning the Debate ....

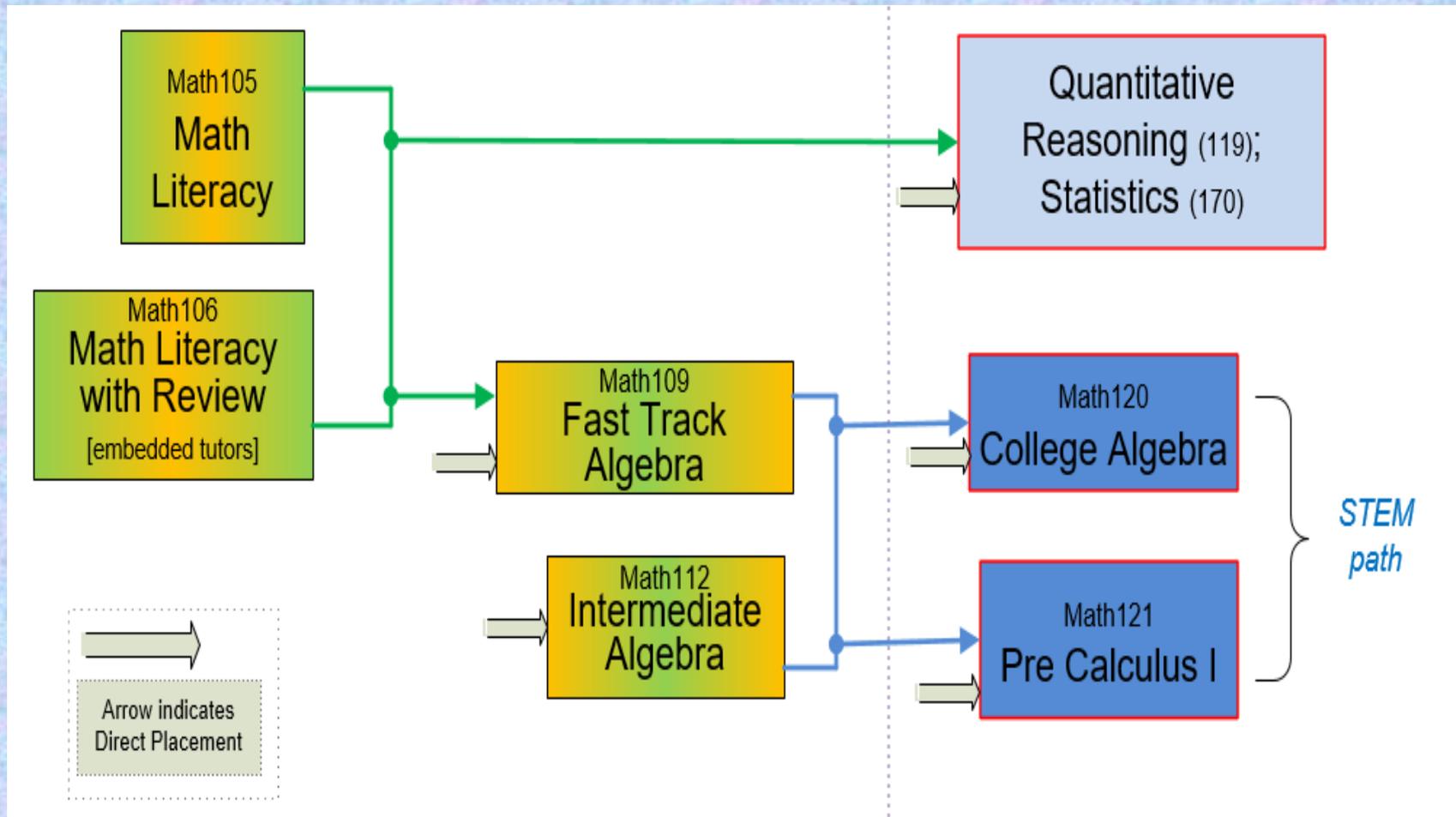
- Exponential decay is stronger: we can not WIN this argument
- Change the debate: Stop using the labels “remedial”, “developmental” and “college algebra”
- Good mathematics ... for all students
- Articulate a positive message about effective & modern preparation courses that we can show lead to success in ALL fields (not just non-STEM)
- Such as: **One (at most) pre-college prep course for 90% of students**

# Our Future



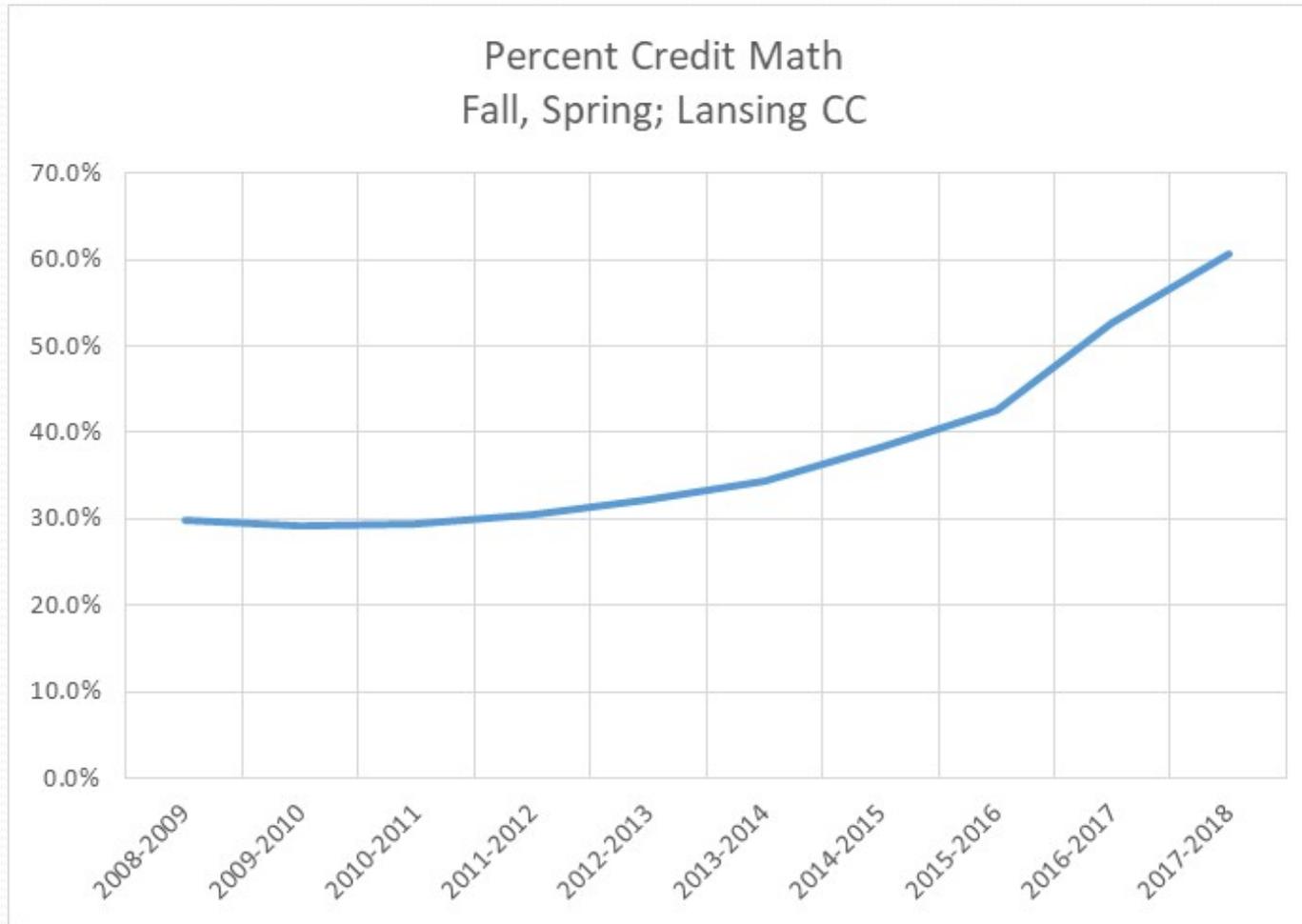
**“One course gets 90% of students ready for success in college!”**

# What this looks like: Lansing CC



*60% of current enrollment is in credit courses (up from 30%).*

# Credit course enrollment (math)



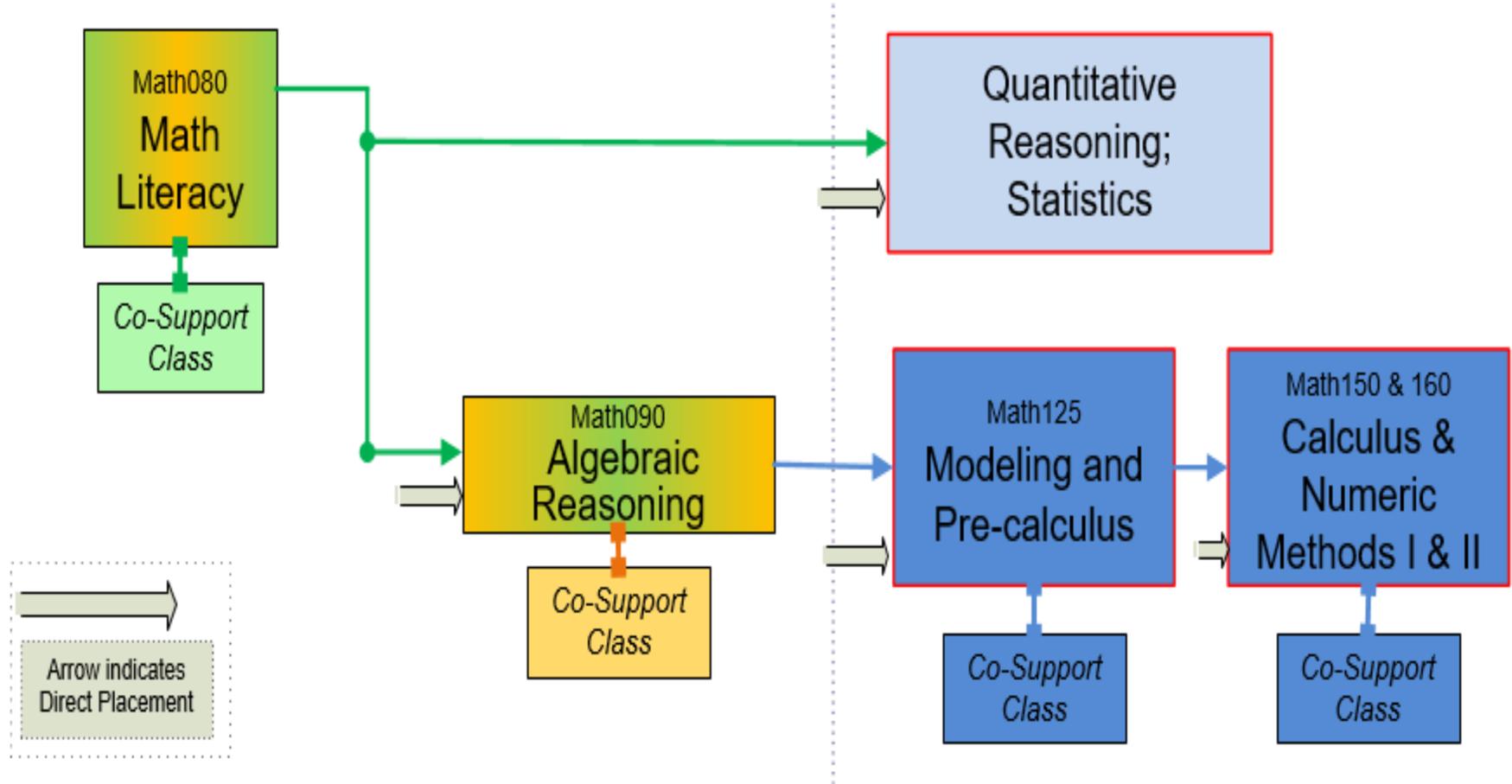
Curricular changes resulted in a doubling of this rate

**Poll: Is this a reasonable goal ...**

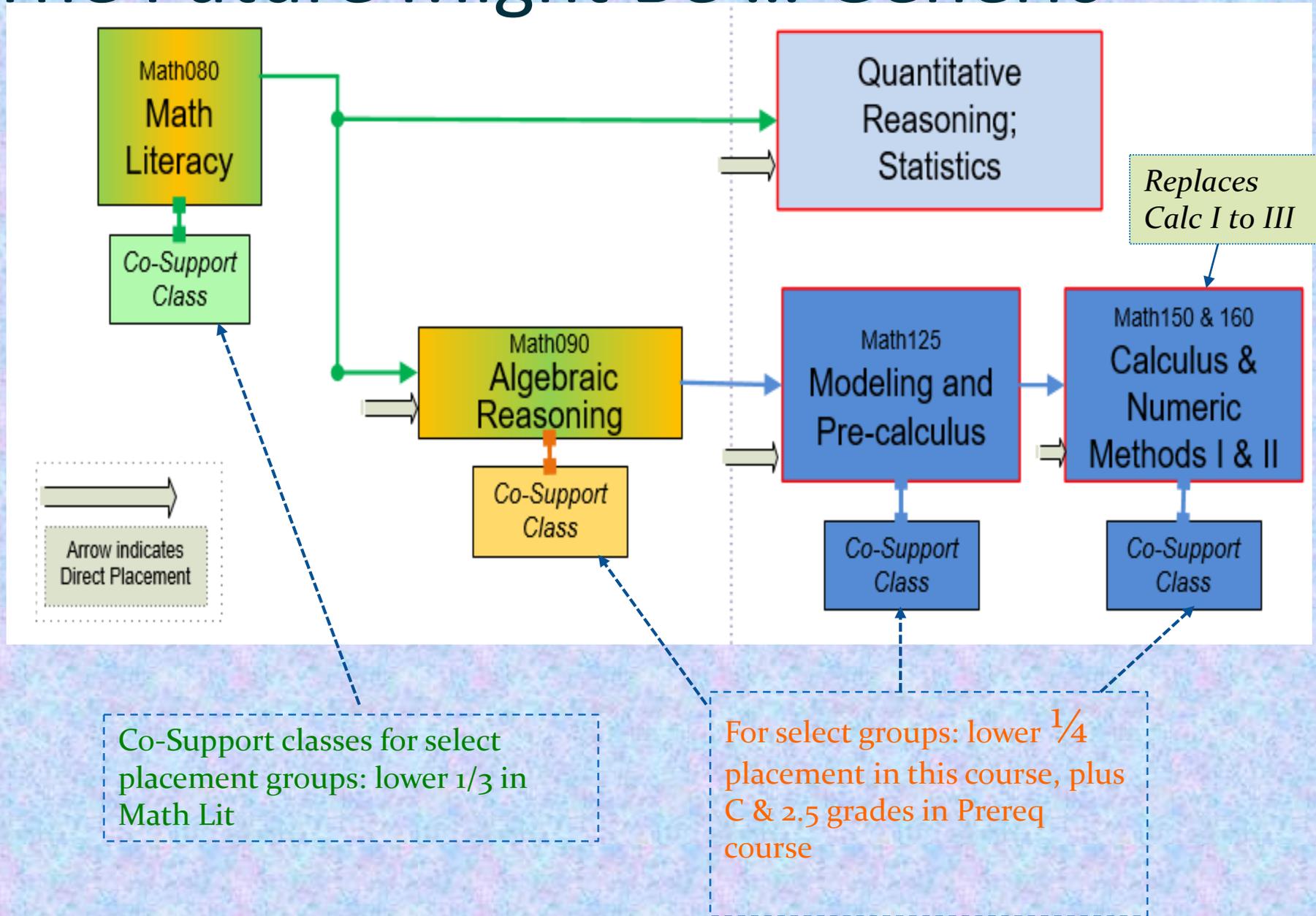
**One course (at most) gets 90%  
of our students ready for  
College mathematics?**

- I: Yes
- II: No

# The Future Might Be ... Generic



# The Future Might Be ... Generic



# Where are we headed?

- All traditional developmental math courses will be gone within 5 years; several forces ensure that
- College algebra should be replaced 'today'
- We can build effective calculus preparation, in fewer courses compared to traditional courses
- **It's still about the mathematics!!**

# Closing

- Focus on what is important to us
- Progress is more important than change
- College math courses must reflect contemporary K-12 education (not the 1970s)
- Professional standards as the basis for our curriculum
- **We do not need to surrender the STEM path**

Jack Rotman

[rotmanj@lcc.edu](mailto:rotmanj@lcc.edu)

[www.devmathrevival.net](http://www.devmathrevival.net)