Rate of Improvement: Why, How, What Does it Mean?

EDWARD S. SHAPIRO, PH.D.

UNIVERSITY CONSULTANT TO THE PENNSYLVANIA RESPONSE TO INSTRUCTION AND INTERVENTION INITIATIVE

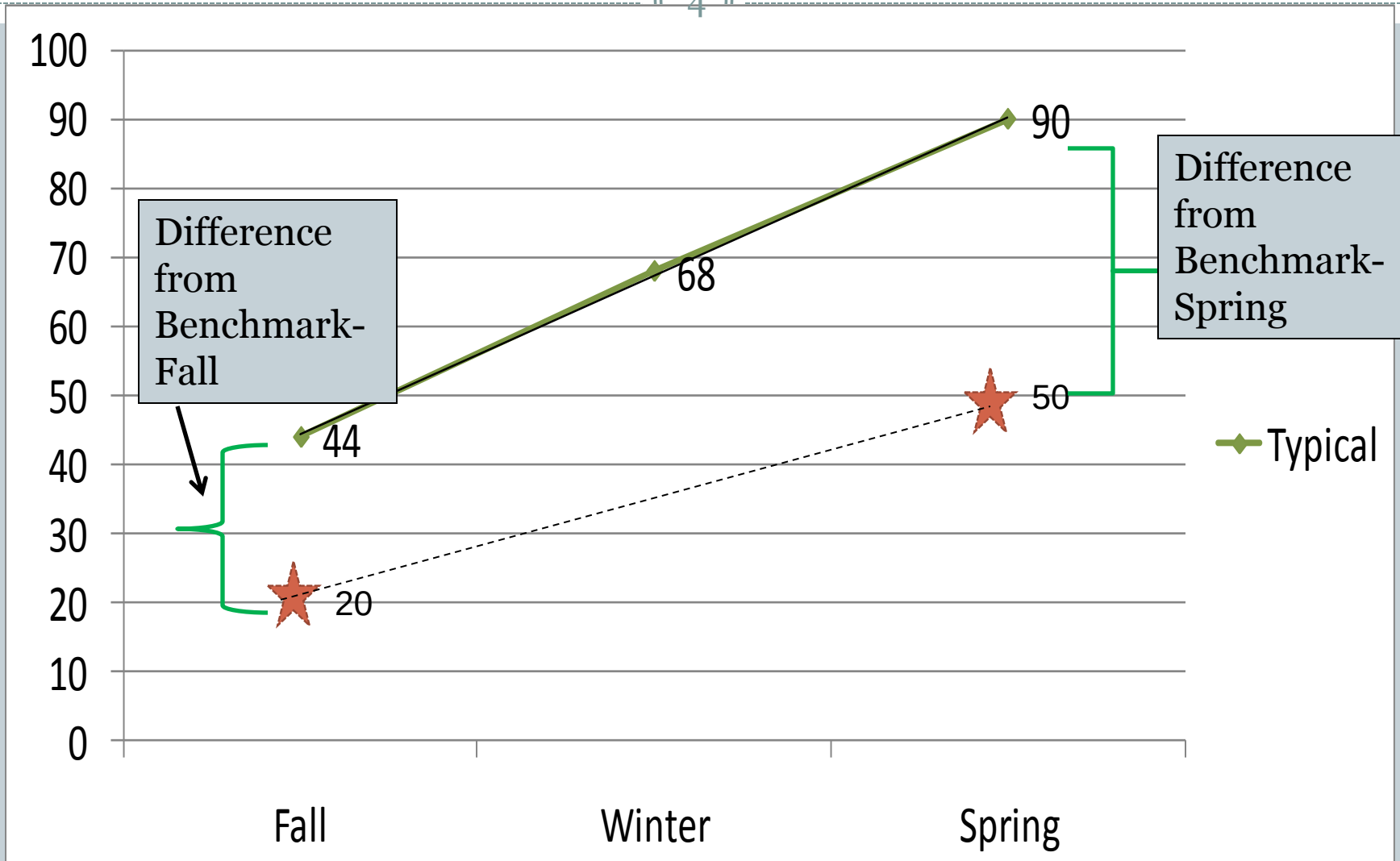
Why ROI?

- RTII is about identifying whether a student responds or does not respond to instruction and intervention
- Key assumption – fidelity of core instruction and intervention must be strong for ROI to have meaning
- Requires determining a student's **Rate** of Response to Instruction and Intervention
- Determining Response involves two key items against peer expectations:
  - How LOW?
  - How SLOW?

How Low?

- How Low = Level
  - How different is the student from their peers in terms of reaching the expected **benchmark scores**?
- Benchmark Scores
  - Cut scores that mark predicted low risk category
  - Represent the **minimum** score students should achieve
  - National vs local benchmarks

Grade 2 Student – How Low?



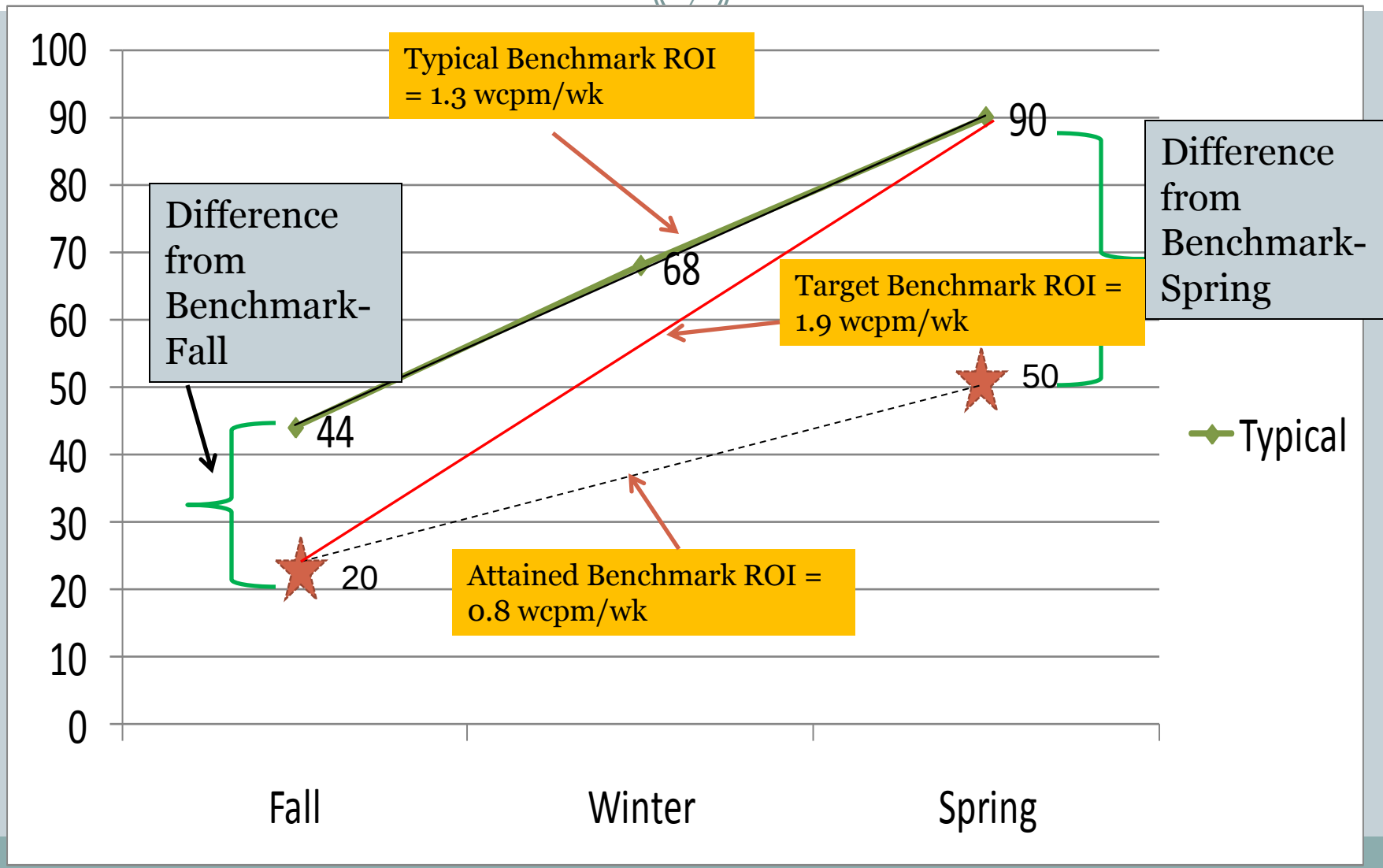
Grade 2- How Slow? Or Rate of Improvement (ROI)

- How Slow?
  - How different is the student from their peers in terms of the **Rate of Improvement** for expected **benchmark scores**?
  - How different is the student from their peers in terms of the **Rate of Improvement** for **progress monitoring** scores?
- ROI = Change Over Time
- Important Terms
  - Typical ROI = From benchmark to benchmark
  - Target ROI = From starting score of student to benchmark of typical benchmark
  - Attained ROI =From starting score of student to ending score of student

ROI Benchmark Calculations

- Benchmark Scores (DIBELS 6th ed) – Grade 2
  - Typical ROI
    - From 44 to 90 in 36 weeks = 90 – 44/36 = 1.3 wcpm/week
  - Target ROI
    - From 20 to 90 in 36 weeks = 90 – 20/36 = 1.9 wcpm/wk
  - Attained ROI
    - From 20 to 50 in 36 weeks = 50 – 20/36 = 0.8 wcpm/week
- DIBELS ROI

Grade 2 Student – How Slow? Benchmark ROI



Benchmark ROI Interpretation
Gap Analysis

- Student needs to move at a rate about 40% faster than typical student's rate to close the gap.
- Student is moving at a rate about 40% slower than typical students rate.
- Gap between the student and what is expected has gotten larger, student is NOT responding to instruction and intervention.

Example- Calculate Benchmark ROI

- Grade 3 DIBELS (6th ed) Benchmark

Fall	77
Winter	92
Spring	110

- Grade 3 Attained Scores

Fall	40
Winter	56
Spring	71

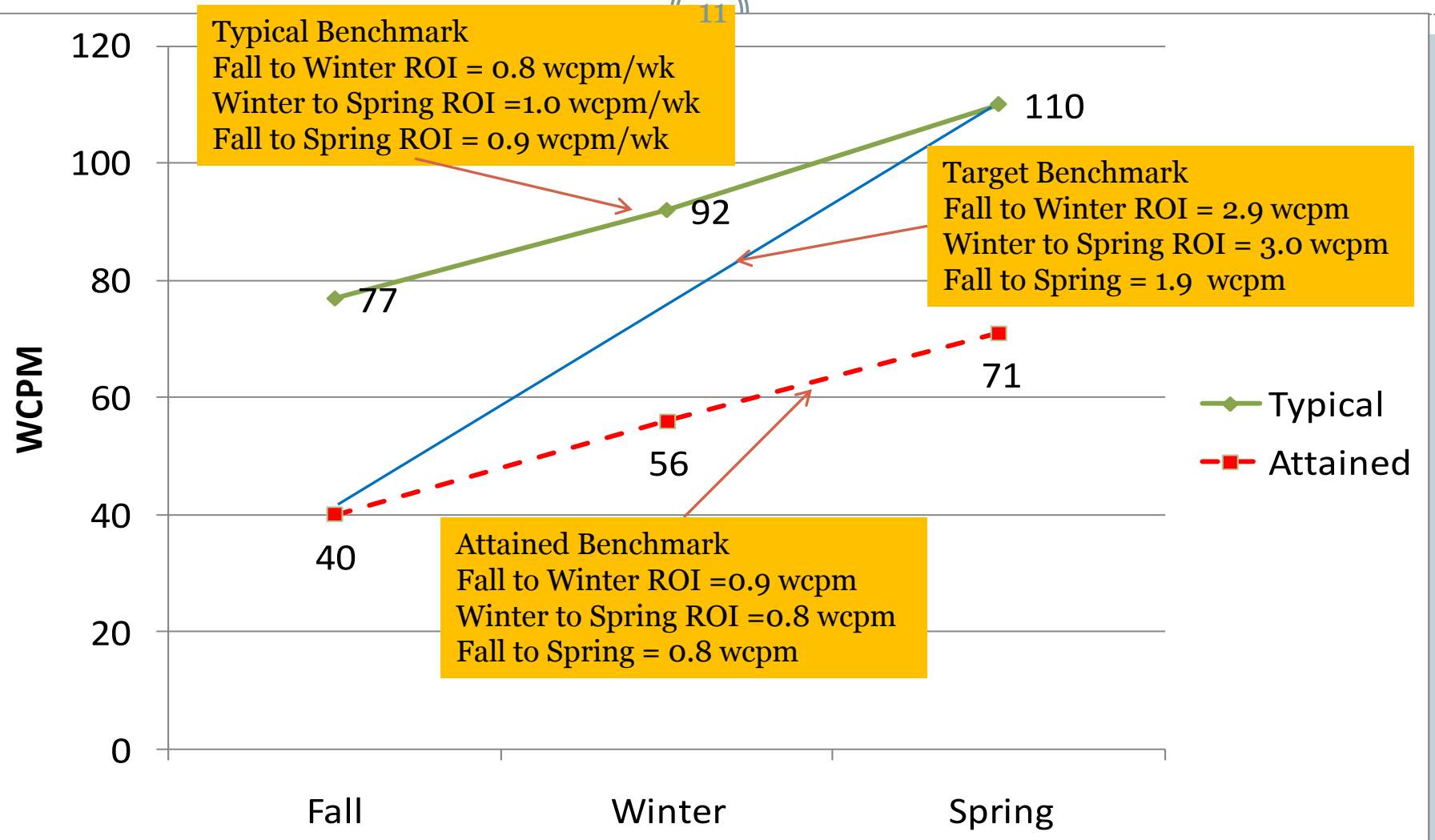
- Calculate Typical ROI, Target ROI, Attained ROI
  - Fall to Winter
  - Winter to Spring
  - Fall to Spring

Results- Benchmark ROI

- Typical ROI
  - Fall to Winter (92 – 77)/18 = 0.8 wcpm/wk
  - Winter to Spring (110- 92)/18 = 1.0 wcpm/wk
  - Fall to Spring (110 –77)/36 = 0.9 wcpm/wk
- Target
  - Fall to Winter (92 – 40)/18 = 2.9 wcpm/wk
  - Winter to Spring (110- 56)/18 = 3.0 wcpm/wk
  - Fall to Spring (110 –40)/36 = 1.9 wcpm/wk
- Attained ROI
  - Fall to Winter (56 – 40)/18 = 0.9 wcpm/wk
  - Winter to Spring (71 - 56)/18 = 0.8 wcpm/wk
  - Fall to Spring (71 – 40)/36 = 0.9 wcpm/wk

- Student moving at same rate as peers but at low level.
- Student NOT closing the gap between themselves and peers.

Graphic Results



Progress Monitoring in RtII

- Key to data based decision making
- Use PM data as basis for continue tiered instruction, increase goals, change instruction
- Use PM data as basis for potential consideration down the road for eligibility decisions

Key Terms in ROI Progress Monitoring

- TYPICAL Rate of Improvement (ROI)
  - Expected rate of progress of students from benchmark to benchmark
- TARGET Rate of Improvement
  - Rate of improvement from the starting point of the student's benchmark to the next benchmark point
- ATTAINED Rate of Improvement
  - Rate of improvement (slope) actually attained by the student in progress monitoring

Rationale: Why Worry about Rate of Improvement in PM?

- We need to accelerate students who lag behind
- We want to use a systematic and scientific process to set goals rather than just use “educated guesses”.

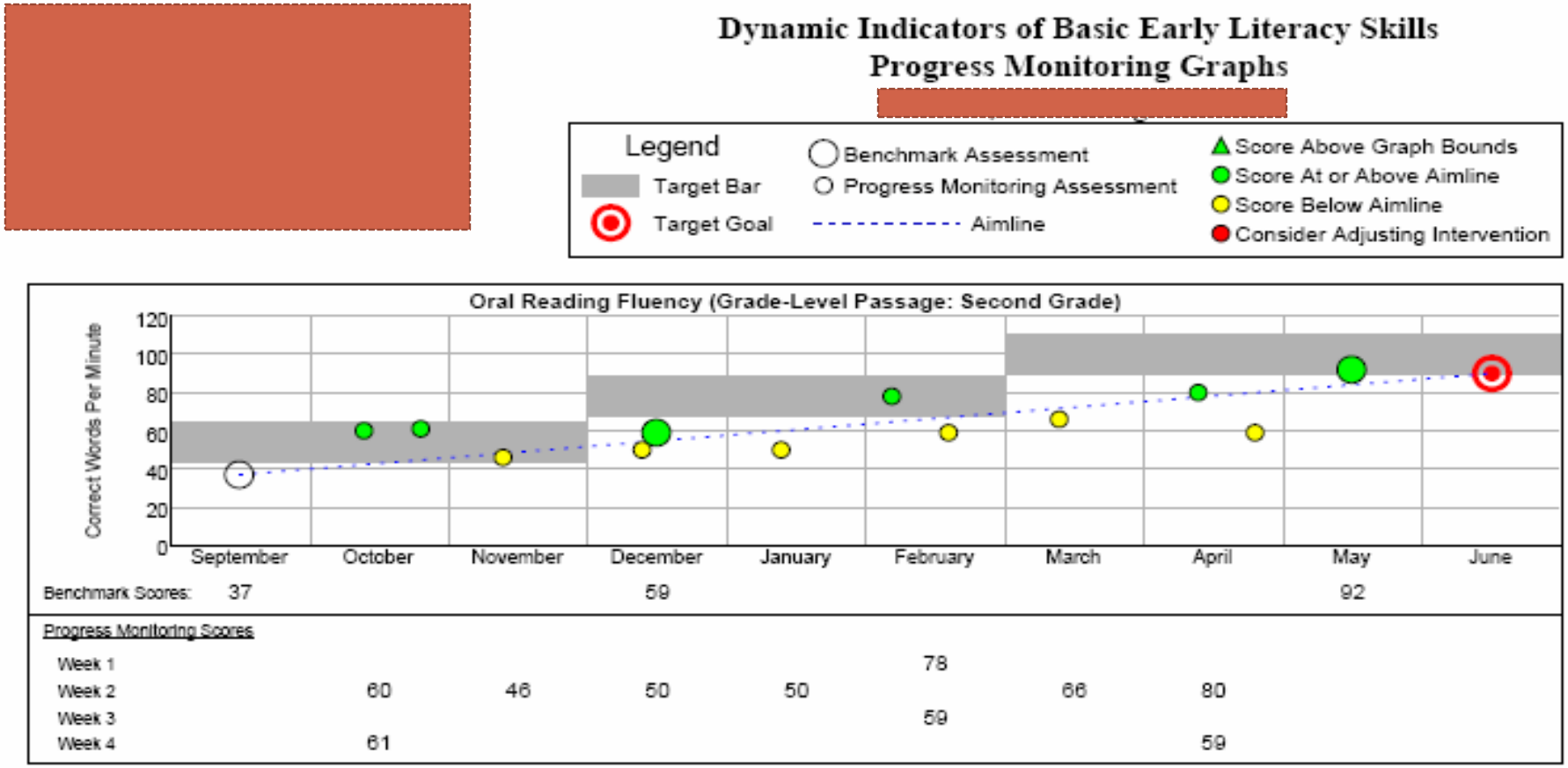
Calculating ATTAINED ROI for Progress Monitoring

- Three Main Ways to calculate
  - Two point ROI
  - Modified two point ROI
  - Ordinary Least Squares (OLS) calculation

Two Point Attained ROI Calculation

- Similar to Benchmark ROI
- Use the starting and ending point of the data set
- Use the number of weeks across which progress monitoring is collected
- Example –Note that student scores on Benchmark Assessment Probes are being used here as starting and ending points
  - Ending point = 92
  - Starting point= 37
  - ROI = 92 – 37/36 weeks = 1.5
- Tool Available
  - Iris Vanderbilt

What does it look like graphically?



Advantage/Disadvantage with Two Points Attained ROI Calculation

Advantages

- Simple to calculate
  - By calculator
  - Use of Slope calculator
- Easy to understand

Disadvantages

- Very vulnerable to single outliers
  - If last data point was 60 instead of 92, ROI would be =0.7
  - "End of school year drop"
  - If first data point was 60 instead of 37, ROI would be = 0.9
  - "Beginning of school year motivation"
- Does not account for entire set of PM data
- May prefer a more precise method high stakes diagnostic decision making

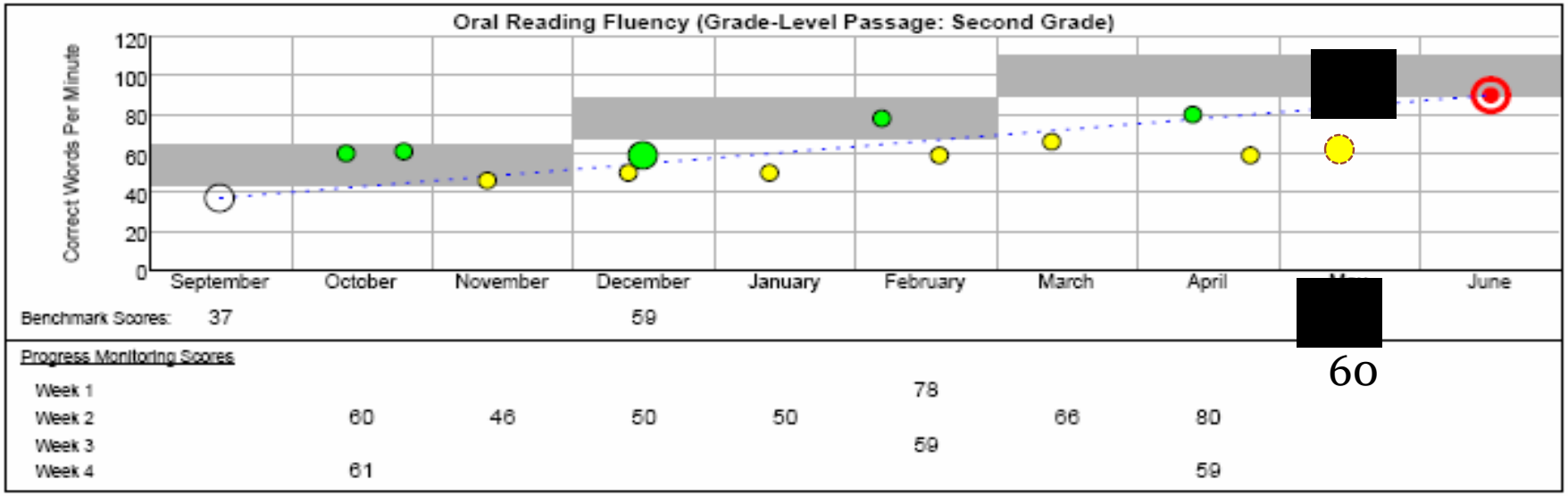
Outlier Data Point at End

[redacted]

Dynamic Indicators of Basic Early Literacy Skills
Progress Monitoring Graphs

[redacted]

Legend
Target Bar
Target Goal
Benchmark Assessment
Progress Monitoring Assessment
Aimline
Score Above Graph Bounds
Score At or Above Aimline
Score Below Aimline
Consider Adjusting Intervention



Progress Monitoring Scores

Week 1					78		
Week 2	60	46	50	50		66	80
Week 3					59		
Week 4	61						59

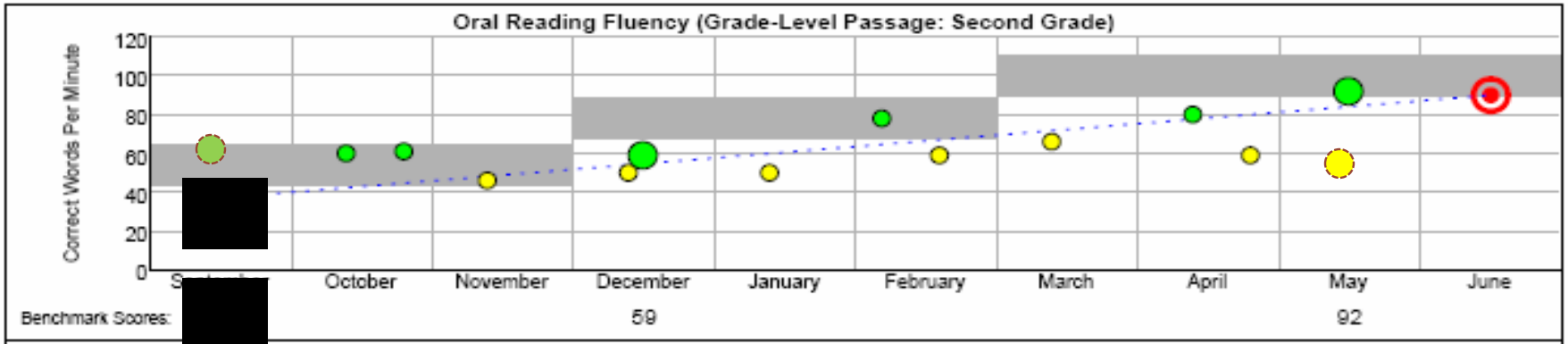
Outlier Data Point at Beginning

[redacted]

Dynamic Indicators of Basic Early Literacy Skills
Progress Monitoring Graphs

[redacted]

Legend
Target Bar
Target Goal
Benchmark Assessment
Progress Monitoring Assessment
Aimline
Score Above Graph Bounds
Score At or Above Aimline
Score Below Aimline
Consider Adjusting Intervention



Benchmark Scores: [redacted] 59 92

Progress Monitoring Scores

Week 1					78			
Week 2	60	60	46	50	50		66	80
Week 3					59			
Week 4		61						59

[redacted] 60

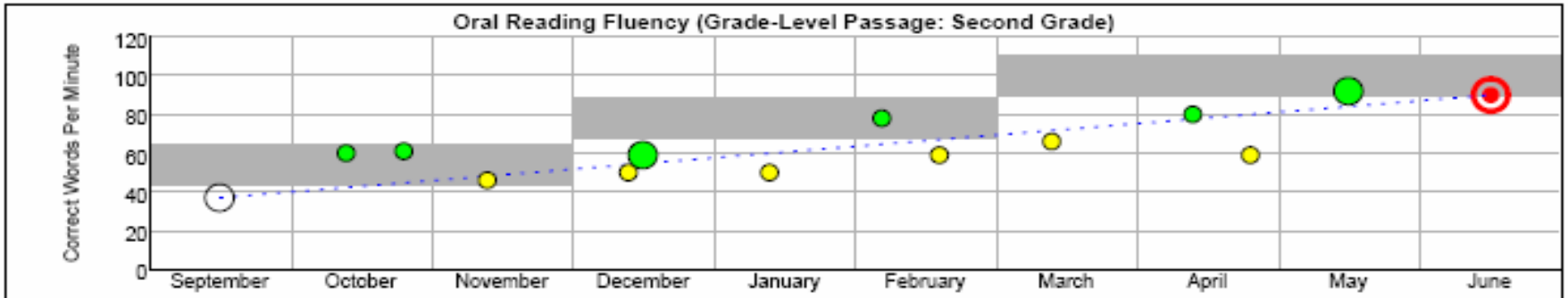
Modified Two Point Solution

- Use MEDIAN (Middle) score first 3 data points
- Use MEDIAN (Middle) score last 3 data points
- Calculate the two point ROI
  - Median first 3 = 60
  - Median last 3 = 80
  - ROI = 80- 60/36 = 0.6

What does it look like graphically?

Dynamic Indicators of Basic Early Literacy Skills
Progress Monitoring Graphs

Legend
- Target Bar
- Target Goal
- Benchmark Assessment
- Progress Monitoring Assessment
- Aimline
- Score Above Graph Bounds
- Score At or Above Aimline
- Score Below Aimline
- Consider Adjusting Intervention



Benchmark Scores:	37			59				92	
Progress Monitoring Scores									
Week 1					78				
Week 2	60	46	50	50		66	80		
Week 3					59				
Week 4	61						59		

Median = 60

Median = 80

Advantage/Disadvantage with Modified Two Point Attained ROI Calculation

Advantages	Disadvantage
• Controls for outliers at beginning of year • Controls for outliers at end of year • Simple to calculate • Use of slope calculator	• Does not take into account the entire set of PM data • May prefer a more precise method high stakes diagnostic decision making

Advanced Topic in ROI Calculation
OLS Calculation of ROI

Ordinary Least Squares (OLS) Attained ROI Calculation

- Uses linear regression
  - Mathematical process for establishing the straight line that cuts through all the data points
  - Establishes the LINEAR TREND in the data
- Takes into account ALL data points in the series
- Requires mathematical calculation best left to software to do!
- Some commercial software (AIMSweb) does it for you.
- Some commercial software (DIBELS) gives you the ability to do it.
- EXCEL can do it! (But you need a moderate level of EXCEL comfort level)

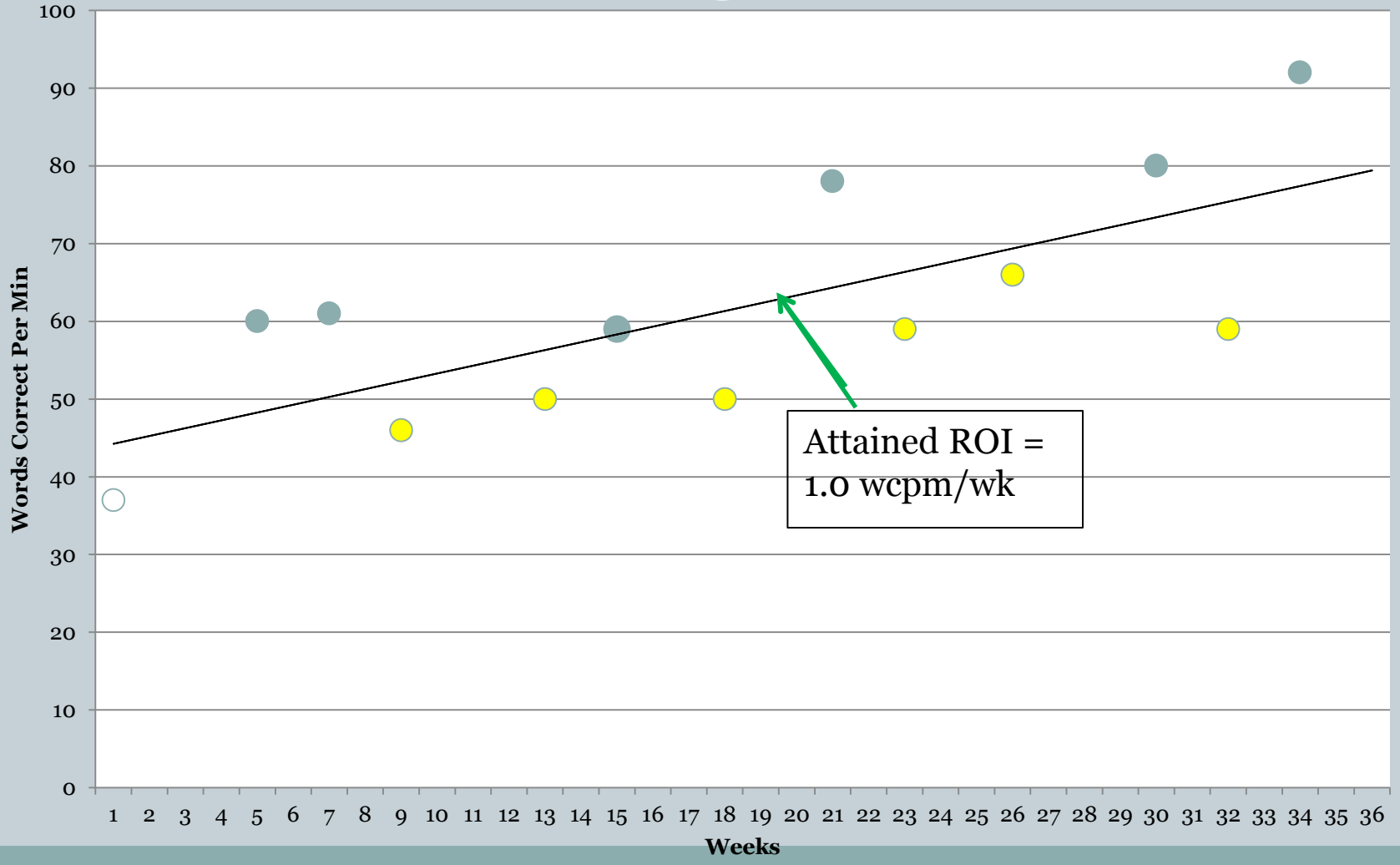
OLS Calculation of Attained ROI

- Spreadsheet must be set up to do this
- Demonstration here is with an established spreadsheet using the same DIBELS data
- Demonstrate using spreadsheet
  - y = bx + a

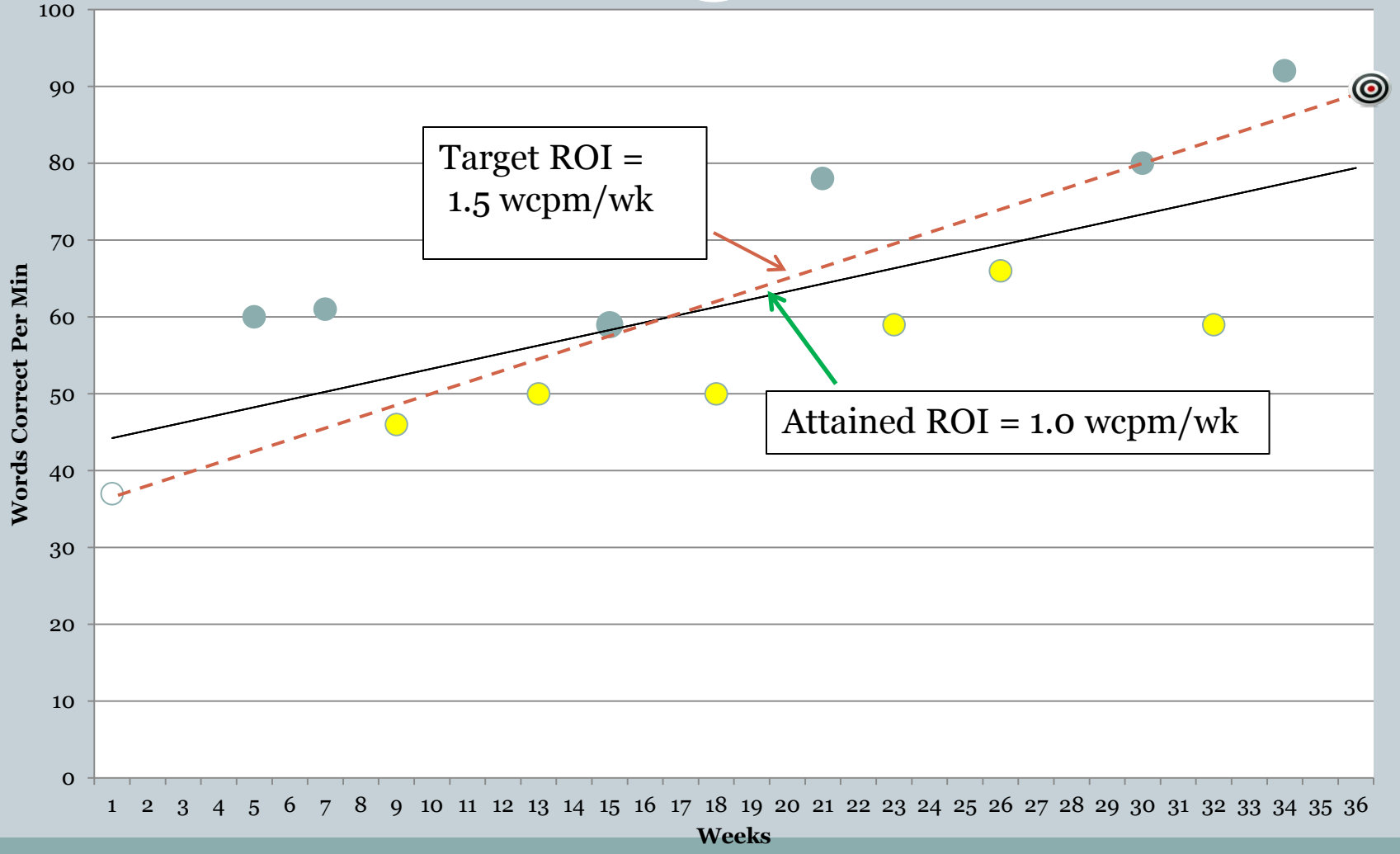
Rate of Improvement (Slope)

- Excellent resource for OLS Calculation
  - Caitlin Flinn, Andrew McCrae, Mathew Ferchalk
  - http://sites.google.com/site/rateofimprovement/

OLS Calculation with DIBELS Data



OLS Calculation with DIBELS Data



Let's Compare Calculations

- Typical ROI = 90-44/36 = 1.3
- Targeted ROI = 90 – 37/36= 1.5
- Attained ROI
  - Two Point Calculation = 1.6
  - Modified Two Point Calculation = 0.6
  - OLS Calculation = 1.0
- Different approaches result in different outcomes
- Recommended approach in literature is OLS

Interpreting Outcomes

- Attained ROI (what did the student actually do?)
- Target ROI (what rate of progress did they need to make to close the gap?)
- Typical ROI (what would a student starting at benchmark do ending at benchmark?)
- Our Example
  - Typical = 1.3 wcpm/week
  - Target ROI = 1.5 wcpm/week
  - Attained ROI = OLS method = 1.0
- Interpretation
  - Student is moving at a rate that is not as fast as their target (the gap is not closing), but they are moving at a rate slightly under the expected rate of performance.
  - Responder or non-responder?

Discrepancy or GAP Analysis in RTII

Discrepancy or GAP Analysis in RTII

- How low?
  - How far from the expected benchmark is the student at the point of referral?
- How slow?
  - How slow is the rate of progress of the student compared to their peers at the point of referral?
- Discrepancy or Gap Analysis
  - Simple mathematical way of expressing how low and how slow.

Gap Analysis

- Discrepancy between expected and attained performance translated into empirical value
  - Divide performance at point of referral to the expected benchmark performance of same age/grade peers
  - Can be done for both benchmark assessments and rate of improvement

How low is low?
How slow is slow?

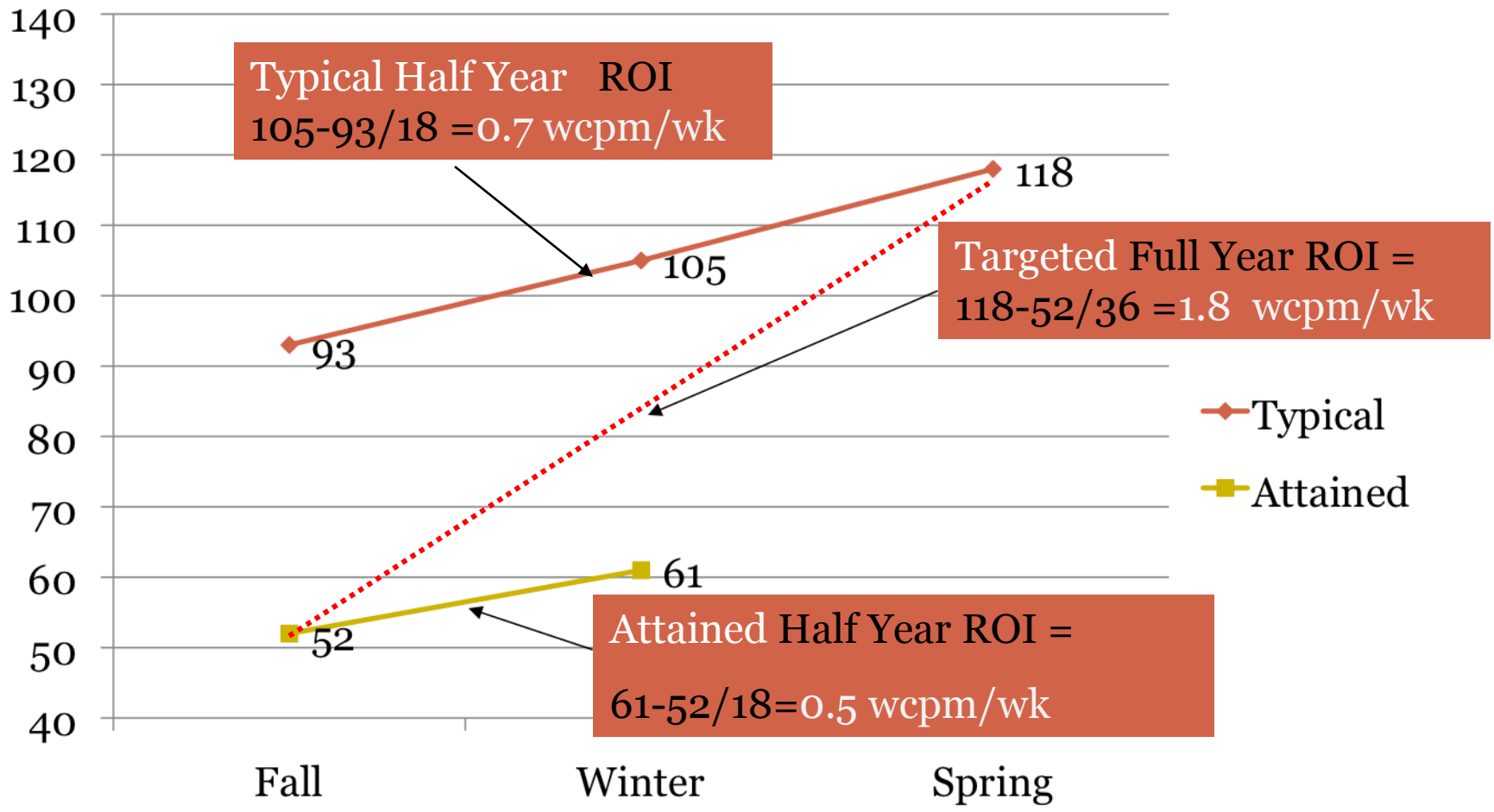
How deficient does the student need to be to qualify?

- There is not a research consensus on this issue at this time.
- Note that there never was a research consensus on the extent of the ability-achievement discrepancy.
- Continues and will always be a team decision
- Discrepancy analysis can add to the decision
- No state guidelines on the level of rate of discrepancy, it's a team decision based on many data sources.
- District might think about their own internal consistency across schools within the district.

Example

- 4th grade student
- Referred at mid-year (use half year ROI)
- Benchmarks for 4th grade
  - Fall = 93
  - Winter = 105
  - Spring = 118
- Student's Scores on Benchmark Assessment Probes
  - Fall = 52
  - Winter = 61

Grade 4 Student



Calculation of Discrepancy of Gap Analysis of DIBELS Benchmarks at point of referral (18 months)

	Gr 4
Typical ROI	0.7
Target ROI	1.8
Attained ROI	0.5
Level Discrepancy Analysis (How low?) Performance Against Typical	Benchmark /Attained = discrepancy % expected performance = 100- [benchmark –attained/benchmark]
ROI Benchmark Discrepancy Analysis (How slow?)- Rate Against Target (did the gap close?)	Targeted ROI/Attained ROI = discrepancy % targeted growth = 100- [Targeted ROI–Attained ROI/Targeted ROI]
ROI Discrepancy Analysis- (How slow?) Against Typical (did the gap close)	Typical ROI/Attained ROI = discrepancy % typical growth = 100- [Typical ROI–Attained ROI/Targeted ROI]

Do the Calculations

Answers - Discrepancy of Gap Analysis

Benchmarks for 4th grade
Fall = 93
Winter = 105
Spring = 118

Student's Scores on Benchmark Assessment Probes
Fall = 52
Winter = 61

Typical ROI = 0.7

Targeted ROI = 1.8

Attained ROI = 0.5

Calculation	Gr 4	Answers
Level Discrepancy Analysis (How low?) (winter data)	Discrepancy = Benchmark /Attained	1.7 = 93 /52
Performance Against Typical (winter data)	% expected performance = 100 - [benchmark –attained/benchmark]	58% = 100 – ((105 – 61)/105)
ROI Benchmark Discrepancy Analysis (How slow?)	Discrepancy = Targeted ROI/Attained ROI	3.6 = 1.8/0.5
Rate Against Target (did the gap close?)	% targeted growth = 100 - [Targeted ROI–Attained ROI/Targeted ROI]	28% = 100 – ((1.8 – 0.5)/1.8)
ROI Discrepancy Analysis- (How slow?)	Discrepancy = Typical ROI/Attained ROI	1.4 =0.7/0.5
Against Typical (did the gap close?)	% typical growth = 100 - [Typical ROI–Attained ROI/Targeted ROI]	89% = 100 – ((0.7 - 0.5)/1.8)

Answers
Data from Analysis of DIBELS Benchmarks

	Gr 4
Typical ROI (half year)	0.7
Target ROI (full year)	1.8
Attained ROI (half year)	0.5
Level Discrepancy Analysis (How low?) Against Typical	1.7x 58% of typical performance
ROI Benchmark Discrepancy Analysis (How slow?)- Against Target (did the gap close?)	2.8x 28% of targeted growth
ROI Discrepancy Analysis- (How slow?) Against Typical (did the gap close)	1.4x 72% of typical growth rate

Interpretation

- How low?
  - Student is far from what is expected, making 58% of the performance expected for a 4th grader
- How slow?
  - Student is not making progress against their target, making only 28% of expected growth
  - Student is moving at a rate just under what is expected of typical 4th graders (moving at 89% of typical)
- Student would probably meet criteria for consideration because of how low, and lack of closing the gap, even though their rate of improvement against typical 4th graders is not that much behind.

Guidelines for Decision Making

- Examples from Derry Area SD
- Used to guide decisions toward evaluation consideration

Interpretation Example- Derry Area SD

Is the student's progress slow?	Core Only	Core + Up to 20 minutes *(Classroom Based Flexible Groups – Tier 1*	Core + Up to 45 Minutes of Supplemental Intervention *(Standard Protocol –Tier 2)*	Core + 45 Minutes of Supplemental Intervention *(Standard Protocol – Tier 3)*
More than 150% of expected rate of growth				
110 – 150% of expected rate of growth				Possibly MDE (See below**)
95 – 110% of expected rate of growth				Consider MDE
81 – 95% of expected rate of growth	May Need More Support	May Need More Support	May Need More Support	Consider MDE
80% or less of expected rate of growth	Needs More		Needs More	Consider MDE
	Needs More		Needs More	Consider MDE

Advanced Topics in ROI/Resources

- ROI of TYPICAL students is greater fall to winter than winter to spring
- ROI should be calculated to the half year mark separately (fall to winter; winter to spring)
- ROI decisions regarding SLD determination must use grade level progress monitoring outcomes
- ROI decisions regarding outcomes of instruction can be either instructional level or grade level
- Excellent resource
  - Caitlin Flinn, Andrew McCrae, Mathew Ferchalk
  - http://sites.google.com/site/rateofimprovement/

IRIS Center
Slope Calculator

To find the Rate of Improvement or Slope calculator on the IRIS Center's web site following the directions below.

1. Go to IRIS Center home page – http://iris.peabody.vanderbilt.edu
2. Click on 'Resources'
3. Click on 'Assessment(includes Progress Monitoring)'
4. Click on 'Modules (8)'
5. Click on 'RtII (part 2): Assessment'
6. Click on 'Perspectives and Resources' – scroll to the bottom of that page to find the Slope Calculator. Directions for use of the calculator are also available.

Advanced Topics in ROI/Resources

- Ardoin, S. P. & Christ, T. J., (2009). Curriculum-based measurement of oral reading: Standard errors associated with progress monitoring outcomes from DIBELS, AIMSweb, and an experimental passage set. *School Psychology Review, 38(2),* 266-283.
- Ardoin, S. P., & Christ, T. J. (2008). Evaluating curriculum-based measurement slope estimates using data from triannual universal screenings. School Psychology Review, 37(1), 109-125.
- Christ, T. J. & Silberglitt, B. (2007). Estimates of the standard error of measurement for curriculum-based measures of oral reading fluency. *School Psychology Review, 36(1),* 130-146.
- Christ, T. J., & Hintze, J. M. (2007). Psychometric considerations when evaluating response to intervention. Handbook of response to intervention: The science and practice of assessment and intervention. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden, *Handbook of response to intervention: The science and practice of assessment and intervention,* (pp. 93-105). New York, NY, US: Springer.
- Christ, T. J. (2006). Short-term estimates of growth using curriculum-based measurement of oral reading fluency: Estimating standard error of the slope to construct confidence intervals. *School Psychology Review, 35(1),* 128-133.