

Student Growth:

Graphing, Calculating, and Interpreting Rate of
Improvement data

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Your presenters

- **Caitlin S. Flinn**, Ed.S., is a Nationally Certified School Psychologist at Eastern Lancaster County School District. She is working toward her doctoral degree in school psychology at Indiana University of Pennsylvania. Her main interests include response-to-intervention, systems-level change, rate of improvement, and data analysis teams.
- **Andrew E. McCrea**, M.S., NCSP, is Director of Pupil Services at Lower Dauphin School District and is a Ph.D. candidate in the Educational Leadership program at Penn State University. Andy's experience focuses on implementing student growth methodologies in the public school setting.

Getting to Know You

- Current Role in regard to Rtl models, specific learning disability identification
- How do you determine “growth?”
 - Measures
 - Analysis
- What are the pros and cons of these approaches?

In Analogy...

- Diet example (concept and applied info)
- Value Added example (know limitations of tools)
- Research Heavy: should know the why & why not
- Easy Application: should know how

Workshop Overview

- Rate of improvement (RoI) Background and Definitions
- RoI in the Context of an RTI System
- Establishing a Need for Consistency and for Quantifying RoI
- Graphing and Calculating RoI for Individual Students
- Applying RoI: Operationalizing Adequate & Inadequate Growth

Learning Objectives

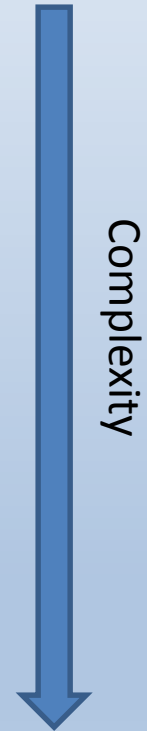
- Participants will
 - Review the research on interpreting student growth using CBM
 - Learn how to use Excel to calculate a rate of improvement (RoI) statistic
 - Learn how student growth fits into educational decision-making

Big Picture

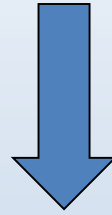
- Why is this important???
- Accountability Movement
- School Improvement/Reform
- Instruct – Measure – Instruct model
- Specific Learning Disability

Accountability Movement

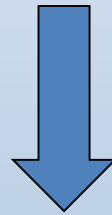
- Accountability often = quantitative analysis
- Level 1 Quantitative analysis = Level
 - Proficiency levels, Grades, etc.
 - Has content been learned?
 - Generally Summative
- Level 2 Quantitative analysis = Growth
 - Rate of Improvement, PVAAS, etc.
 - Is content being learned?
 - Generally Formative



School Improvement/Comprehensive School Reform

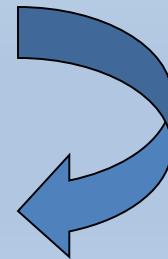


Response to Intervention Model



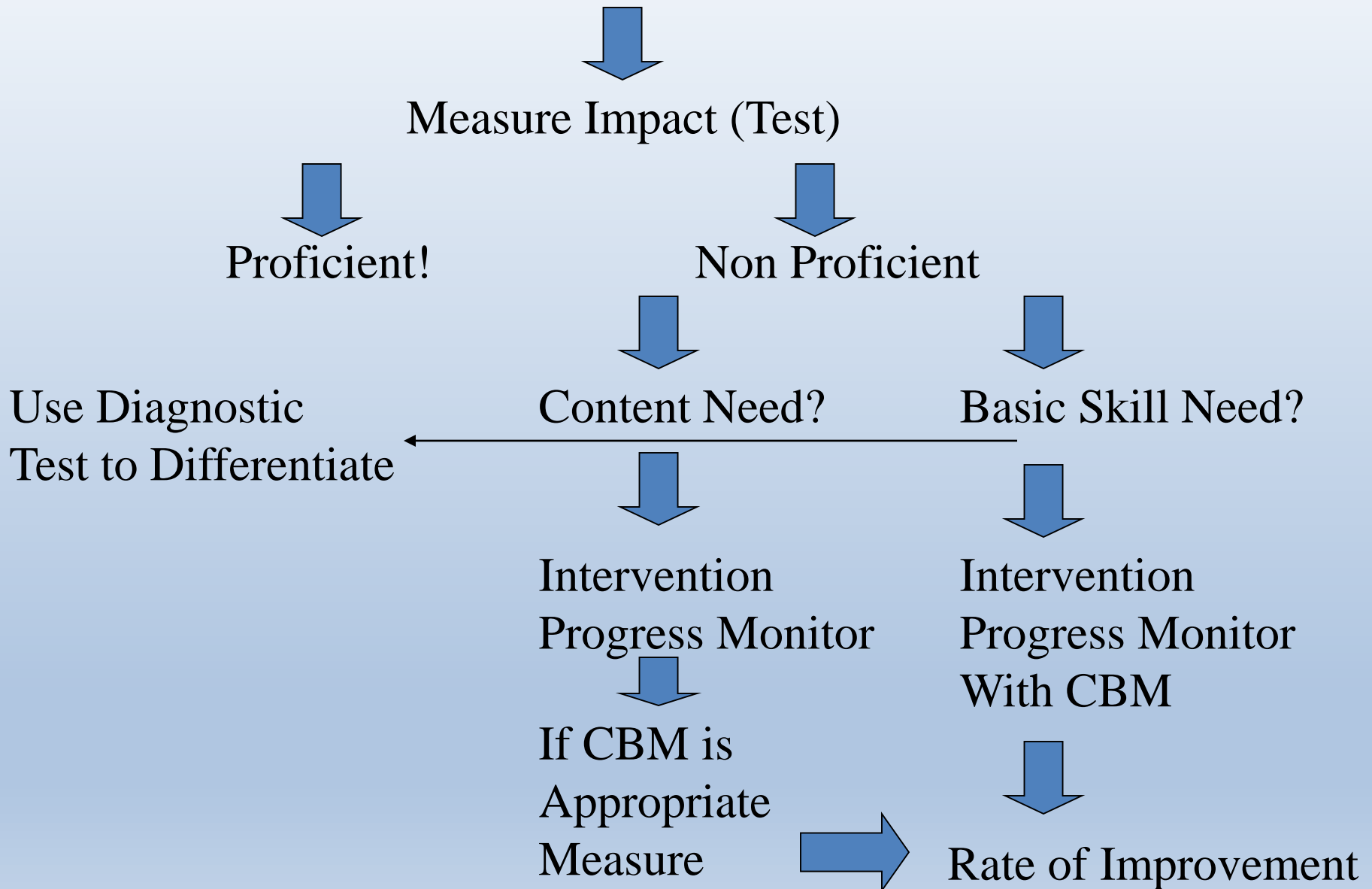
Dual Discrepancy: Level & **Growth**

Rate of Improvement

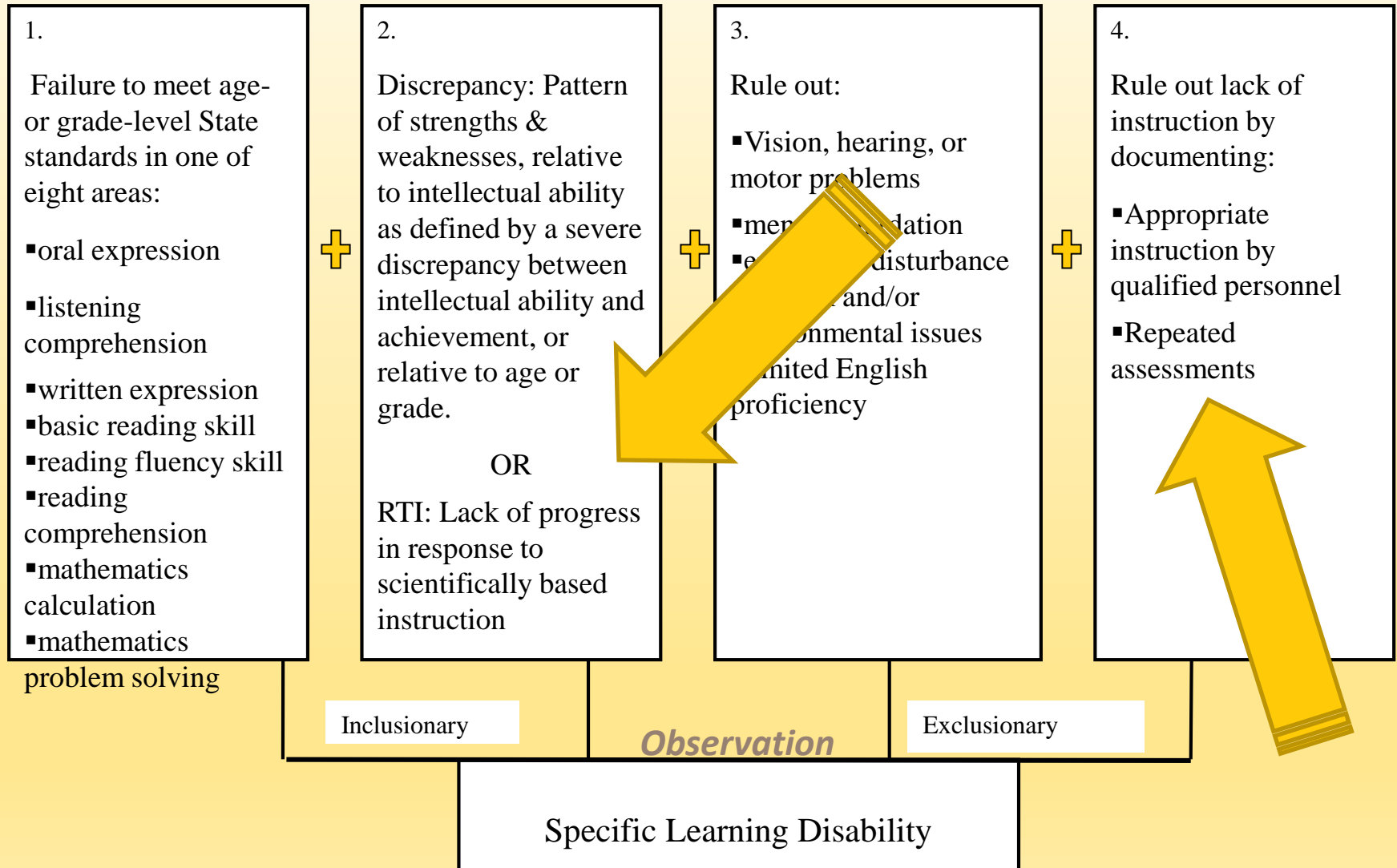


Instruct – Measure – Instruct model

Classroom Instruction (Content Expectations)



Where RoI Fits into SLD



Background and Definitions

RATE OF IMPROVEMENT

Defining Lack of Progress

in response to scientifically based instruction

- ...that *is* the question!
- First – Define Progress...
- Progress Monitoring: Continuous progress monitoring of student performance and use of progress monitoring data to determine intervention effectiveness and drive instructional adjustments, and to identify/measure student progress toward instructional and grade-level goals. (PA)
- Progress = Rate of Improvement (ROI)

Rate of Improvement

- Growth, progress, learning
- Algebraically: slope of a line
- Slope: the vertical change over the horizontal change on a Cartesian plane. (x-axis and y-axis graph)
 - Also called: Rise over run
 - Formula: $m = (y_2 - y_1) / (x_2 - x_1)$
 - Describes the steepness of a line (Gall & Gall, 2007)

Rate of Improvement

- Finding a student's rate of improvement means determining the student's learning
- What are some ways you are currently using to determine a student's learning?
 - Looking at CBM data, are the scores improving?
 - Looking at where the student is performing compared to their aimline (goal) on a graph
 - Creating a line that fits the data points – line of best fit, trendline

A Word on Measurement

- Reliability: consistent results
 - Error: every measure is an estimate of some sort.
- Validity: testing what we think we're testing?

Why use CBM?

- What are the benefits of CBM?
- Measures basic skills – general outcome measures
- Technically adequate – reliable and valid
 - National Center on Response to Intervention (2011)
- Progress monitoring tools chart:
<http://www.rti4success.org/progressMonitoringTools>
- Quick to administer
- Sensitive to growth
- Alternate forms / repeatable
- Standardized
- Represented well in educational research
- Linked to instruction and intervention

Advances in Measurement, Future of CBM??

- AIMSweb
- MAP, CDTs, STAR
- How Rol is crunched will become easier
- How Rol is analyzed/used will remain complex

Skills Measured with Rol

- Oral Reading Fluency
- Reading Comprehension
- Early Literacy Skills
- Spelling
- Written Expression
- Math Computation
- Math Concepts and Applications
- Early Numeracy
- Behavior*
- State Standards*

How Many Data Points?

- 10 data points are a minimum requirement for a reliable trendline (Gall & Gall, 2007)
- 7-8 is minimum for using the Tukey Method (Wright, 1992)
- 8-9 for stable slopes of progress in early writing (McMaster, 2011)
- Take-away: The more data points the more stable the slope (Christ, 2006; Hintze & Christ, 2004)

Results Summary

Dataset Quality Residual (ε_{ij}) =	Very Good 5							Good 10						
CBMs-R per Occasion	3	3	1	1	3	3	1	3	3	1	1	3	3	1
Schedule of Occasions	Pre-Post Mean	1 per month	1 per week	3x per week	1 per week	2x per week	5x per week	Pre-Post Mean	1 per month	1 per week	3x per week	1 per week	2x per week	5x per week
Number of Weeks ^a														
2														
4														
6 ^a														
8				●	●	●	●						○	○
10 ^a	●	●	●	●	●	●	●						●	●
12	●		●	●	●	●	●				●	●	●	●
14 ^a	●	●	●	●	●	●	●			○	●	●	●	●
16	●		●	●	●	●	●			●	●	●	●	●
18 ^a	●	●	●	●	●	●	●	●	●	●	●	●	●	●
20	●		●	●	●	●	●	●		●	●	●	●	●

	Does not meet criteria
○	AUC .85 or above
●	AUC .85 or above + Validity .70 or above
●	AUC .85 or above + Validity .70 or above + Reliability .70 or above
●	AUC .85 or above + Validity .70 or above + Reliability .70 or above + RMSE .35 or below

Graphing Rol

- Speeches that included visuals, especially in color, improved recall of information (Vogel, Dickson, & Lehman, 1990)
- “Seeing is believing.”
- Useful for communicating large amounts of information quickly
- “A picture is worth a thousand words.”
- Transcends language barriers (Karwowski, 2006)
- Responsibility for accurate graphical representations of data

Our proposal for Rol

- To graph data responsibly!
- To find the line of best fit with CBM data
 - Simple linear regression
 - Ordinary least squares
- To quantify Rol
 - Using a trendline of CBM data, calculate slope

In the Context of an RTI System

RATE OF IMPROVEMENT

Components of RTI

PA Model www.pattan.net

- Standards aligned core instruction
- Universal screening
- Interventions of increasing intensity
- Research-based practices
- Progress monitoring
- Data analysis teaming
- Parental engagement

Dual Discrepancy Model

Fuchs & Fuchs (1998)

- Hallmark components of Response to Intervention
 - Ongoing formative assessment
 - Identifying non-responding students
 - Treatment fidelity of instruction
- Dual discrepancy model
 - Significantly below typically performing peers in **level** and **rate**

Caution!!!

- Rol for instructional decisions is not a perfect process, but is well-documented and researched.

Many sources of error to consider:

- Standard error of measurement for slope (Christ, 2006)
 - Ben Ditkowsky
www.measuredeffects.com
 - Downloads > Monitor with Confidence chart
- Reading passage variability (Ardoyn & Christ, 2009)
- Frequency of progress monitoring (Jenkins, Graff, & Miglioretti, 2009)

Many sources of error to consider (cont.):

- Progress monitoring off grade level (Silberglitt & Hintze, 2007)
- CBM for non-English speaking students (Farmer, Swanlund, & Pluymert, 2010)
- Difference in growth for benchmarks between fall and spring (Ardoyn & Christ, 2008; Christ, Silberglitt, Yeo, & Cormier, 2010; Graney, Missall, Martinez, & Bergstrom, 2009; Fien, Park, Smith, & Baker, 2010)
- Difference in growth depending on initial level of performance (Fien, et al., 2010; Good et al., 2010, Silberglitt & Hintze, 2007)

Expected Growth

By how much does the student need to improve?

- Fuchs, Fuchs, Hamlett, Walz, & Germann (1993)
 - Typical weekly growth rates in oral reading fluency and digits correct
- Silberglitt & Hintze (2007)
 - Examined weekly growth in R-CBM mediated by level
- Shapiro (2008)
 - Described challenging and ambitious goals for rates of improvement

Typical Growth: Is There Such a Thing?

- “...before adding a trend line, it is important to carefully consider whether the overall pattern in the data is consistent and linear across time, or whether another pattern (nonlinear, curvilinear) better explains the data.”

– *Hixson, Christ, & Bradley-Johnson (2008)*

Typical Growth: Is There Such a Thing?

- More growth from fall to winter than winter to spring for benchmarks (3x per year)
 - Christ & Ardoin (2008)
 - Christ, Silberglitt, Yeo, & Cormier (2010)
 - Fien et al. (2010)
- More growth from winter to spring than fall to winter
 - Graney, Missall, Martinez, & Bergstrom (2009)

DIBELS (6th Ed.) ORF Norms

	Fall to Winter	Winter to Spring
2 nd	<u>24</u>	22
3 rd	15	<u>18</u>
4 th	13	13
5 th	<u>11</u>	9
6 th	<u>11</u>	5

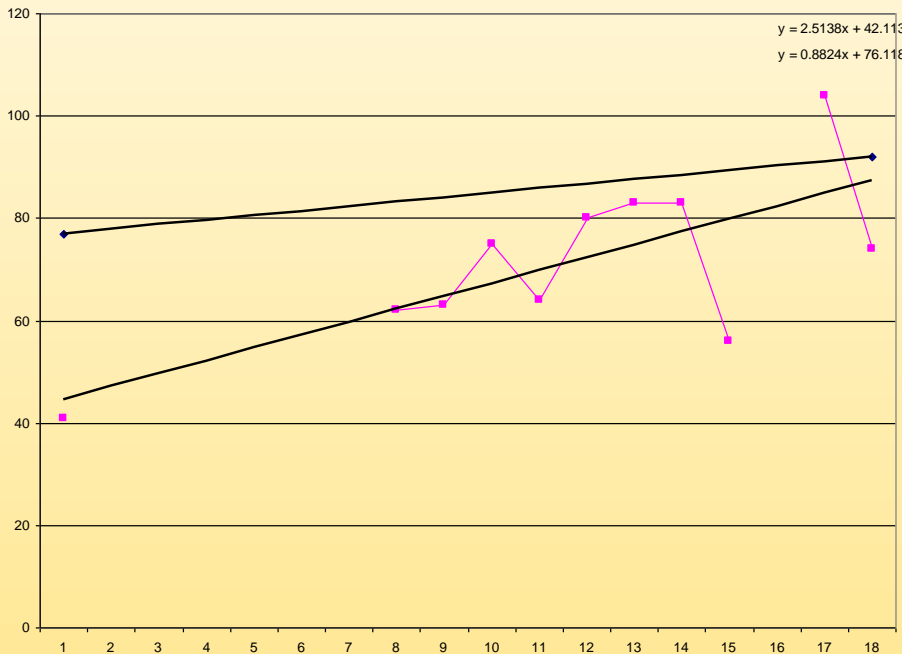


AIMSWeb Norms R-CBM



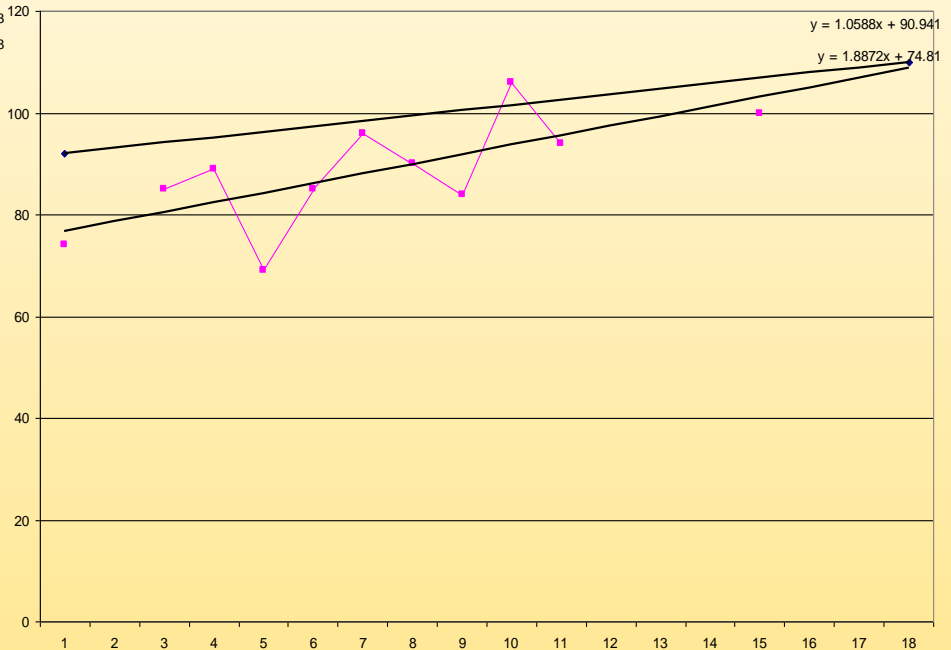
Based on 50 th Percentile	Fall to Winter	Winter to Spring
1 st	18	<u>31</u>
2 nd	<u>25</u>	17
3 rd	<u>22</u>	15
4 th	<u>16</u>	13
5 th	<u>17</u>	15
6 th	<u>13</u>	12

Typical Growth: Example 1



Benchmark ROI=0.88

Student SLOPE=2.5



Benchmark ROI=1.06

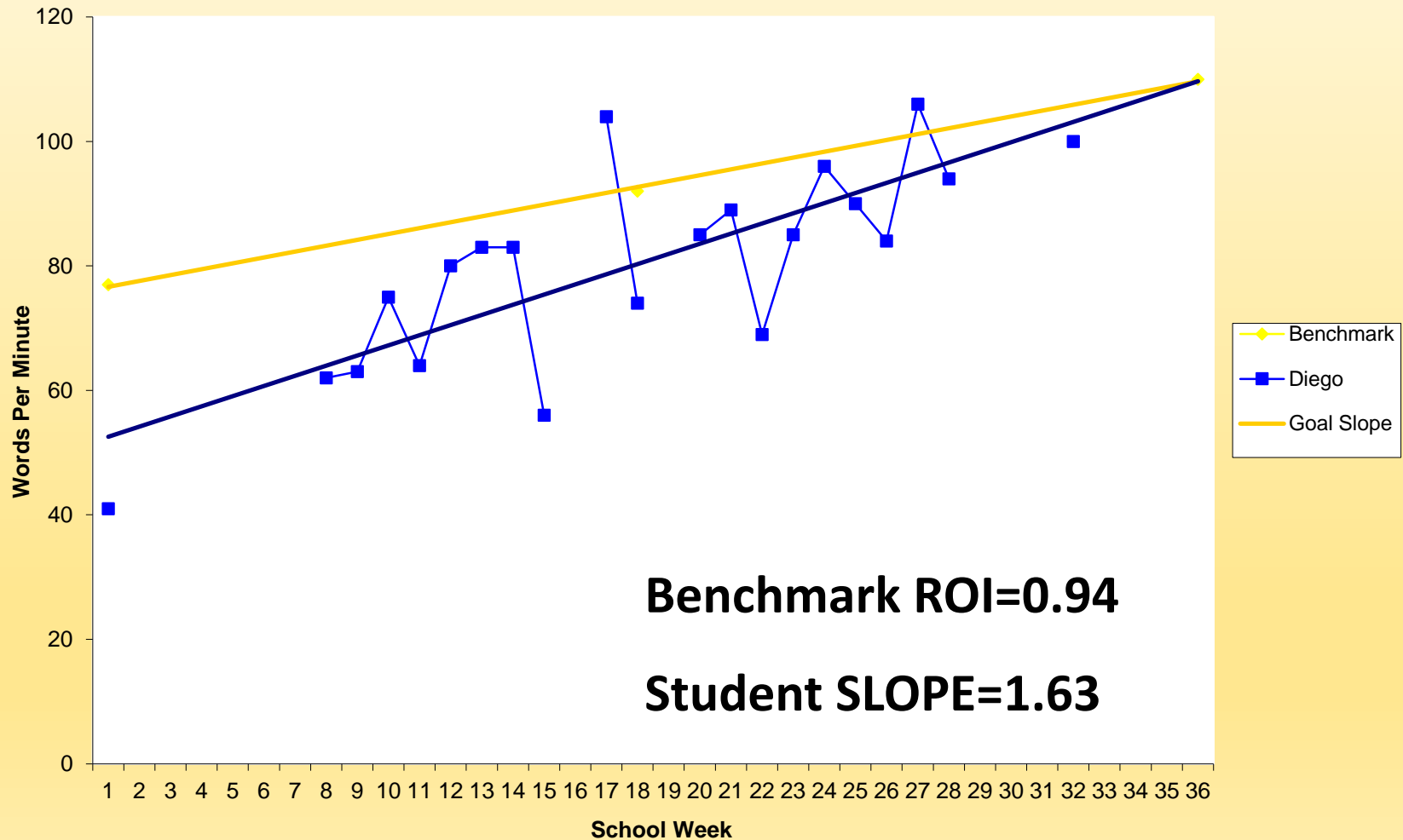
Student SLOPE=1.89

Typical Growth: Example 1

Diego's Progress

$$y = 0.9434x + 75.704$$

$$y = 1.6317x + 50.928$$



Typical Growth: Example 2

- Looked at Rate of Improvement in small 2nd grade sample
- Found differences in Rol when computed for fall and spring:
- Ave Rol for fall: 1.47 WCPM
- Ave Rol for spring: 1.21 WCPM

Typical Growth: Mediated by Level

- Fien, et al. (2010)
 - Different growth rates depending on beginning level
- Silberglitt & Hintze (2007)
 - Differences in growth rates depending on level
 - Lowest and highest deciles had least amount of growth

Good et. al., 2010

Growth Rate as Function of Level at BOY (2 nd Grade)					
		20th	40th	60th	80 th
Intensive	0 to 5	0.11	0.33	0.56	0.98
	6 to 15	0.40	0.70	1.05	1.53
	16 to 25	0.95	1.43	1.78	2.20
Strategic	26 to 34	1.30	1.73	2.06	2.43
	35 to 43	1.50	1.83	2.11	2.50

And for Quantifying Rol

ESTABLISHING A NEED FOR CONSISTENCY

Multiple Methods for Interpreting Growth

- “Statistical methods, such as ordinary least square regression can be used to calculate the slope or trend line... Visual analysis can also be used to estimate the general pattern of change across time.” p 2136
 - *Hixson, Christ, & Bradley-Johnson (2008)*

Multiple Methods for Interpreting Growth

QUALITATIVE APPROACHES

- Professional “Eye Ball” Approach
- Three Data-Point Decision Rule
- Split Middle
- Standard Celeration Chart
- Tukey Method

QUANTITATIVE APPROACHES

- Last Minus First
- Tukey Method “Plus” a statistic
- Split Middle “Plus” a statistic
- Linear Regression*

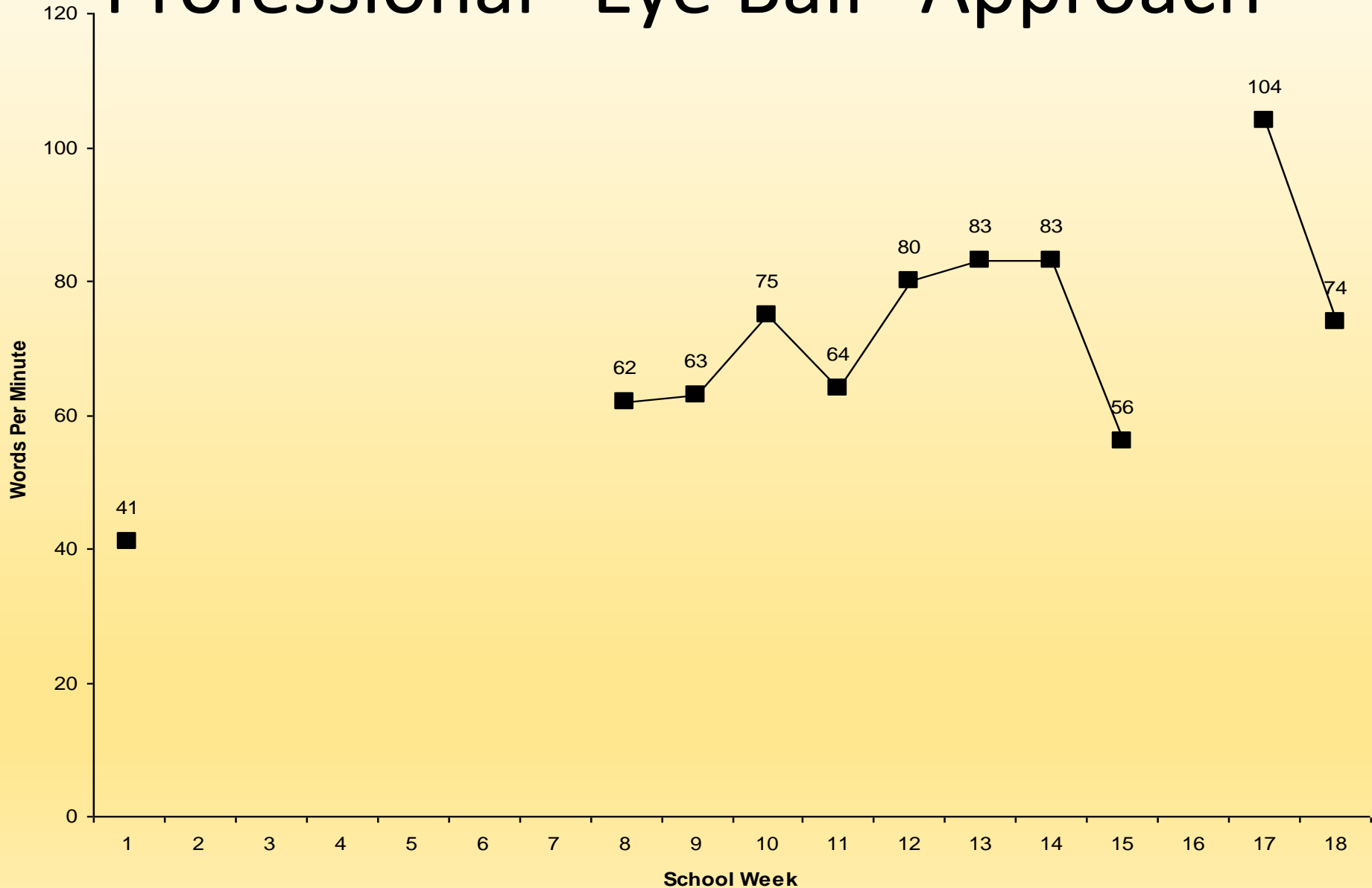
The Qualitative (Visual Inspection) Approaches



Professional “Eye Ball” Approach

- Are the data generally trending in a positive, negative, neutral manner?
- Where are the data points in relation to the goal or aimline (if available)?
- Is there variability among the data points?

Professional “Eye Ball” Approach



Professional “Eye Ball” Approach

PROS

- Easy to use, no calculations involved
- May lead to interesting discussions

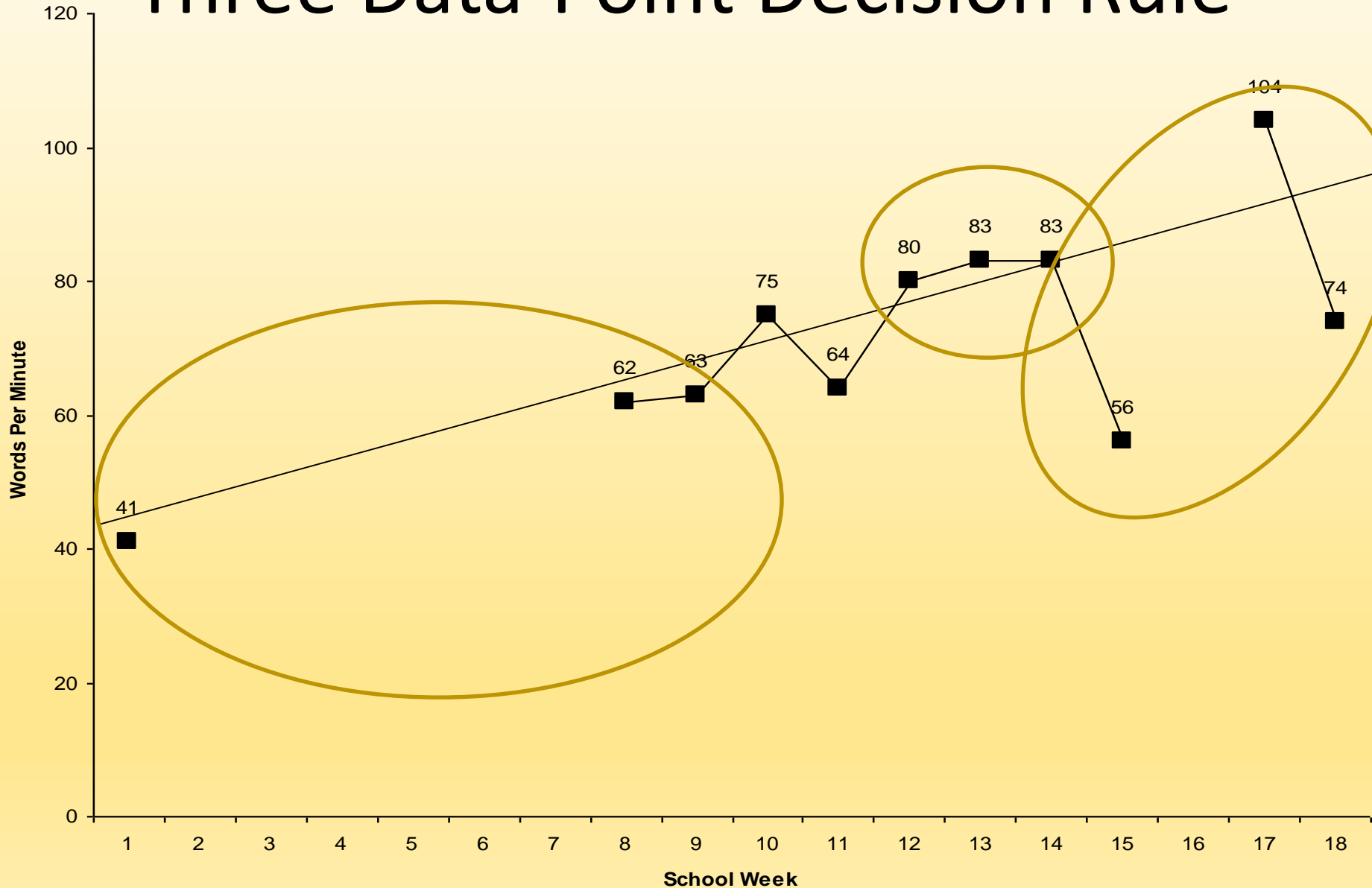
CONS

- Fairly subjective
- May lead to interesting discussions because there are multiple interpretations of the same data

Three Data-Point Decision Rule

- Requires an aimline
 - If three successive data points lie above the aimline, adjust the aimline upward
 - If three successive data points lie below the aimline, adjust the instructional intervention
 - If three successive data points lie around the aimline, make no changes
-
- (Wright, 1992)

Three Data-Point Decision Rule



Three Data-Point Decision Rule

PROS

- Easy to use
- Requires only an aimline and three data points
- No calculations or software needed, can complete by hand

CONS

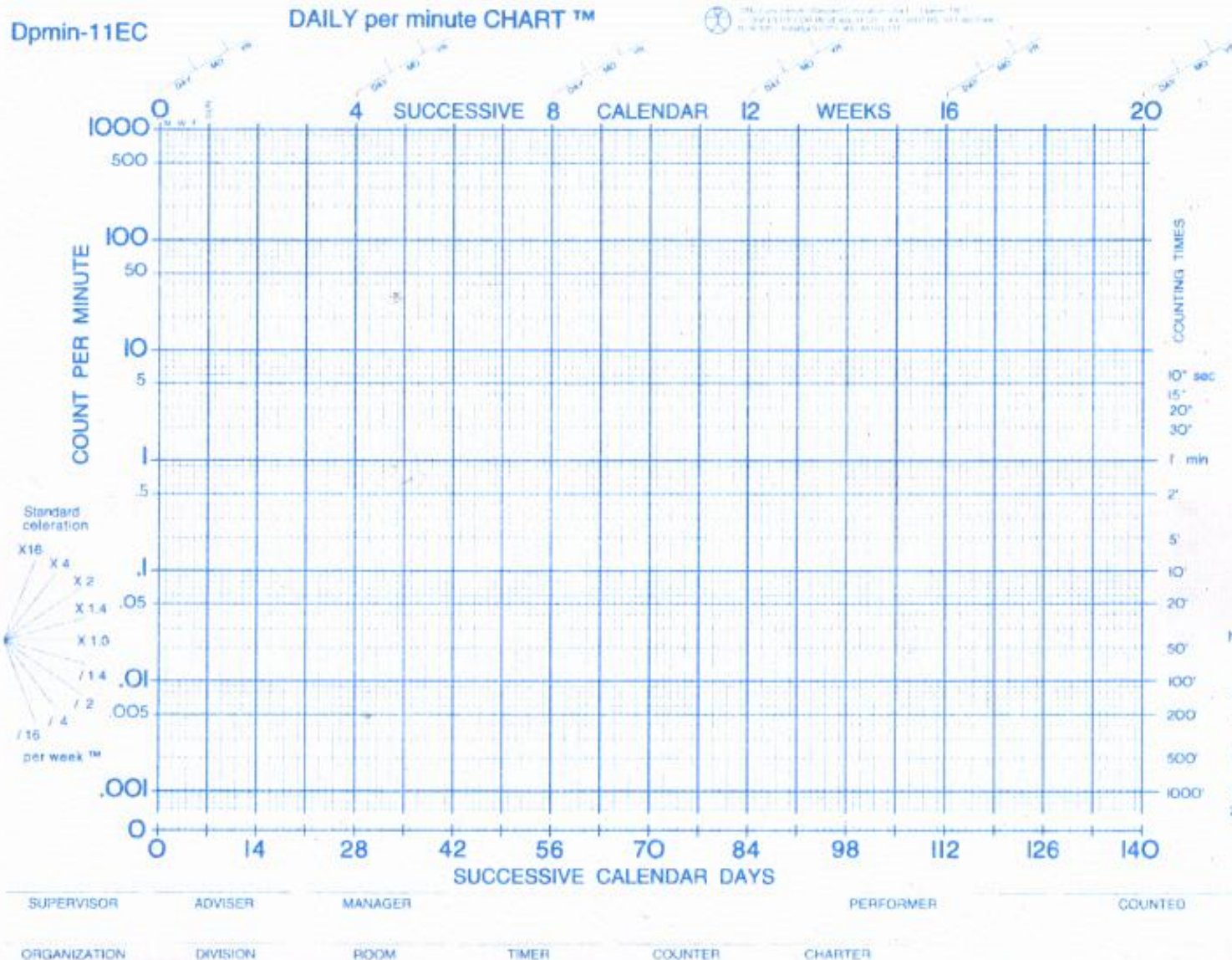
- Does not provide an RoI statistic
- Does not indicate a degree of growth
- Need to be good at drawing lines and accurately plotting data!
- Poor reliability of using an aimline

Standard Celeration Chart

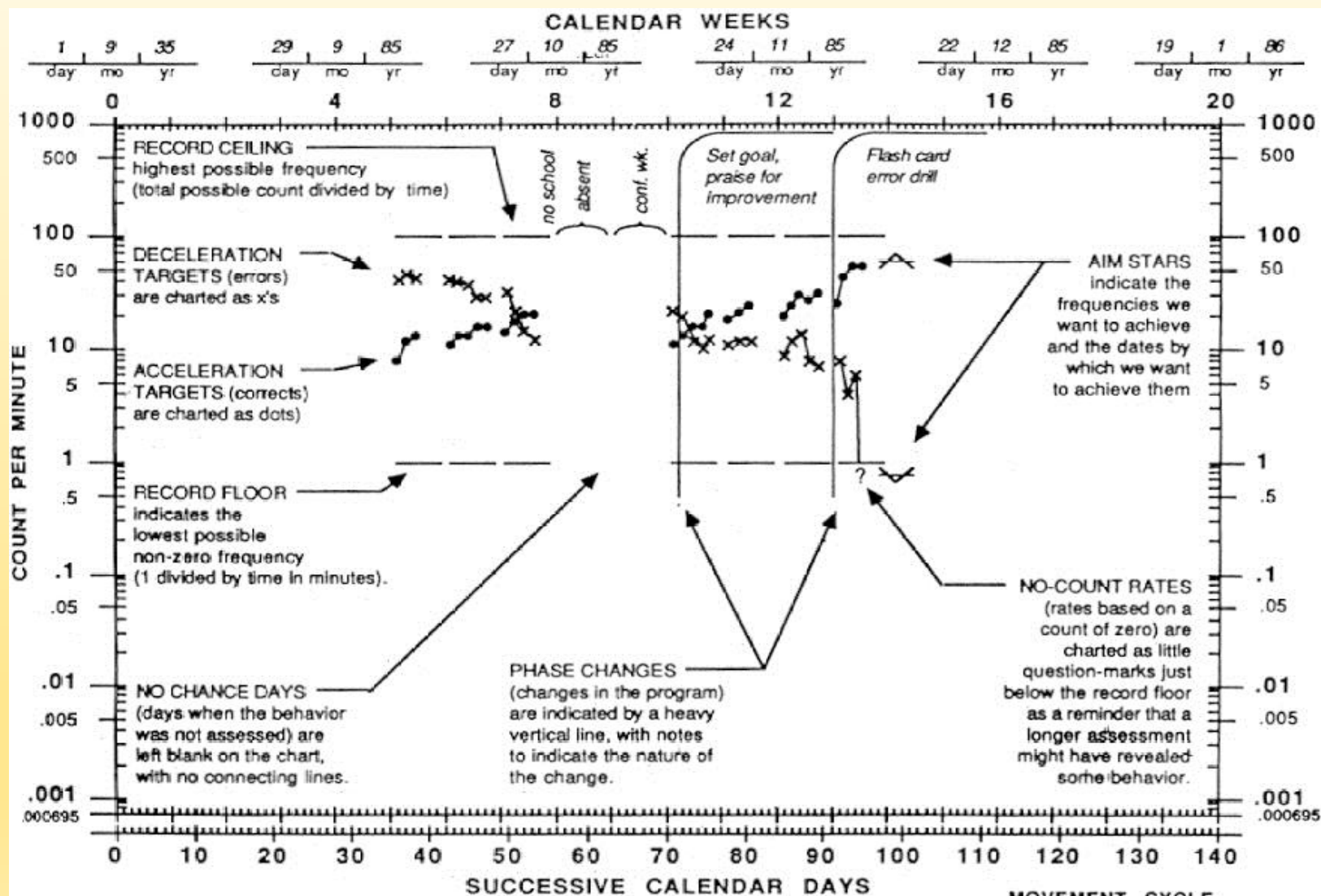
- Developed by Ogden Lindsley, precision teaching
- Ensures a standardization in the display of data
- Y-axis: set up on a multiply scale to accommodate behavior frequencies ranging from 1 per day to 1,000 per minute
- X-axis: set up on an add scale to accommodate 140 successive calendar days, which is about the equivalent of one school semester
- Mark multiple academic skills/behaviors on same graph
- Leave blank any days a skill wasn't measured

(White, 1986, p. 524)

Standard Celeration Chart



Standard Celeration Chart



UPERVISOR P.T. BEHAVIOR Lisa
 DIVISOR S.S. AGE 7 LABEL L.D. MANAGER R. Mundt
 QUANTER R. Mundt CHARTER R. Mundt NOTES 2nd grade

NAME IT Say Dolch Words, Preprimer - 1st grade
 COUNT WHEN correct when says word correctly,
error when say word incorrectly or pause for 5 seconds

Standard Celeration Chart

PROS

- Easy to use
- Can measure multiple academic behaviors (errors and corrects)
- Easy to share with students
- Charts about one semester at a time
- No software or calculations required
- Provides a degree of growth

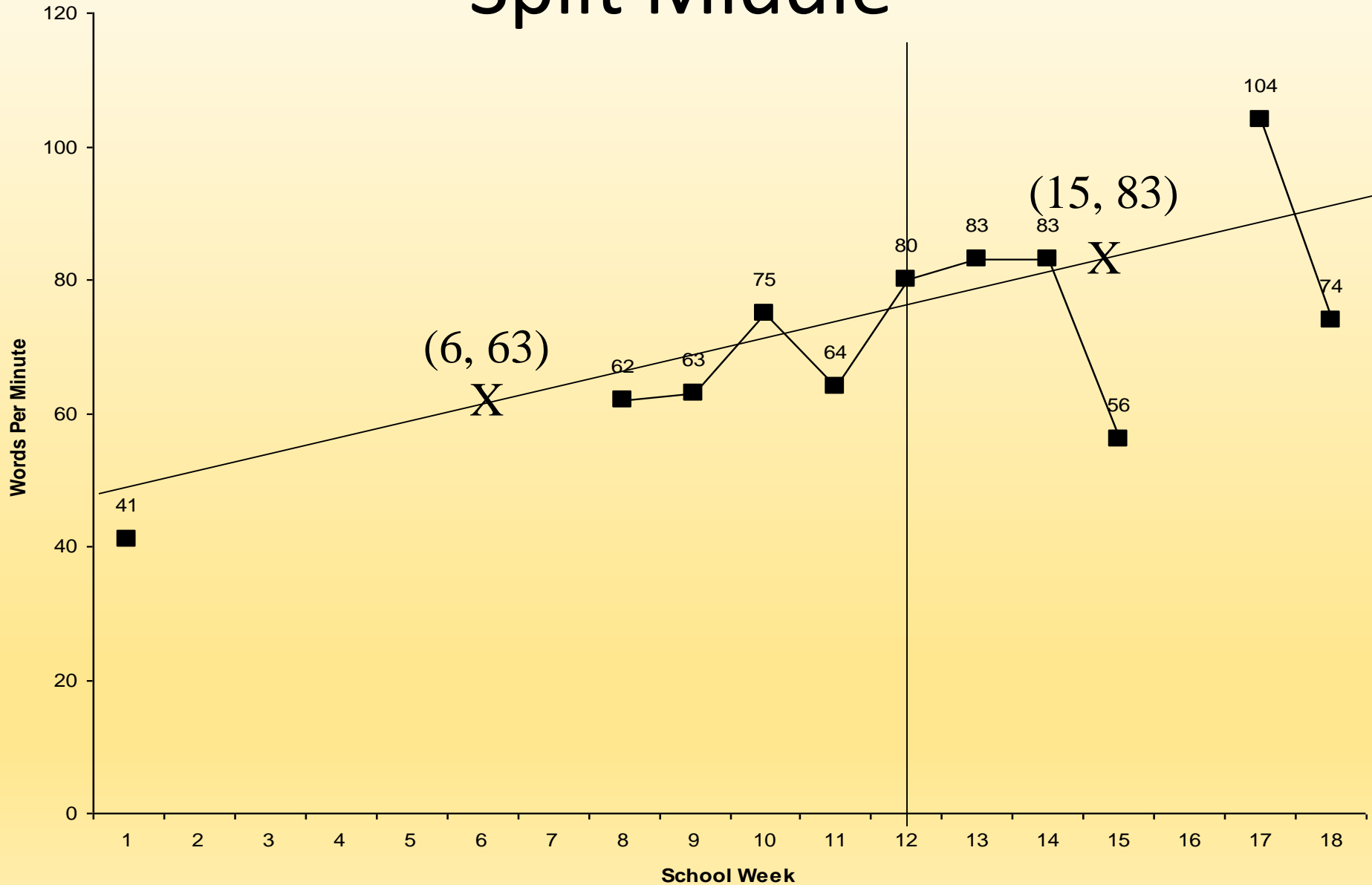
CONS

- Requires specific graph paper – one sheet per student
- And hand graphing

Split Middle

- Drawing a line through the two points obtained from the median data values and the median days when the data are divided into two sections.” (Shinn, Good, & Stein, 1989)
 1. Split the data points into two sections – if unequal, draw line on the middle data point.
 2. Find the middle/median data point in each section. This gives you the X-value.
 3. Figure out the median number of weeks in each section. This gives you the Y-value.
 4. Draw a line through those two coordinates.

Split Middle



Split Middle

PROS

- No calculations or software needed
- Can be done fairly easily by hand
- Provides a trendline to compare against an aimline (yes/no for acquisition of skill)
- Accounts for outliers
- Possible solution for different Rols between fall and spring

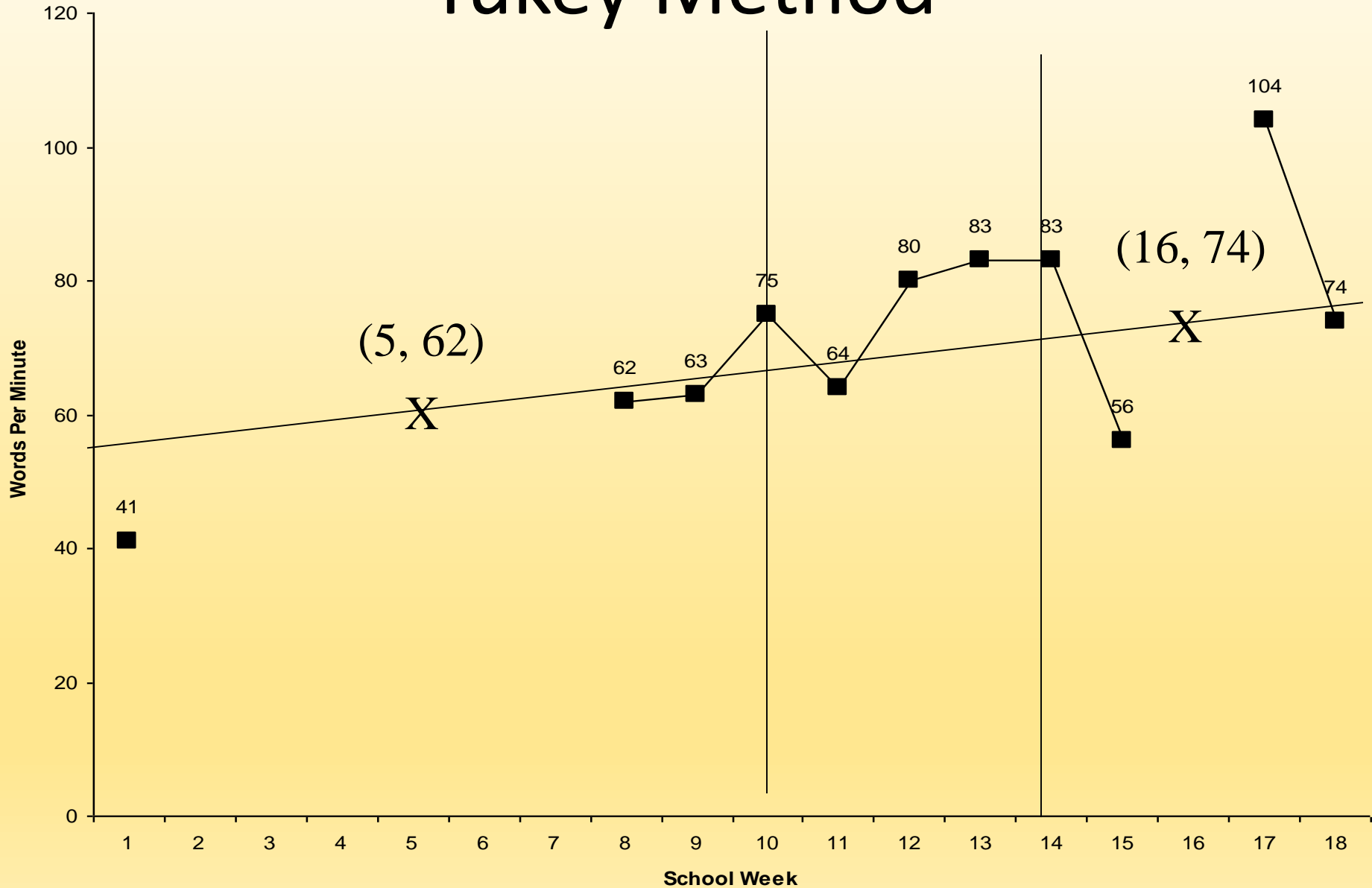
CONS

- Does not provide an Rol statistic
- Does not described degree of growth
- Need to have some training in finding the median score and week

Tukey Method

1. Count the number of data points on the graph.
2. Divide the graph into three approximately equal sections.
3. Ignore the middle section and focus on first and third section. Draw an X where the median data point in the first section meets with the median number of weeks in that section. Then do the same for the third section: Draw an X where the median data point meets with the median number of weeks in that section.
4. Draw a line through both Xs, extending to the ends of the graph to see an approximate rate of improvement, or trendline.

Tukey Method



Tukey Method

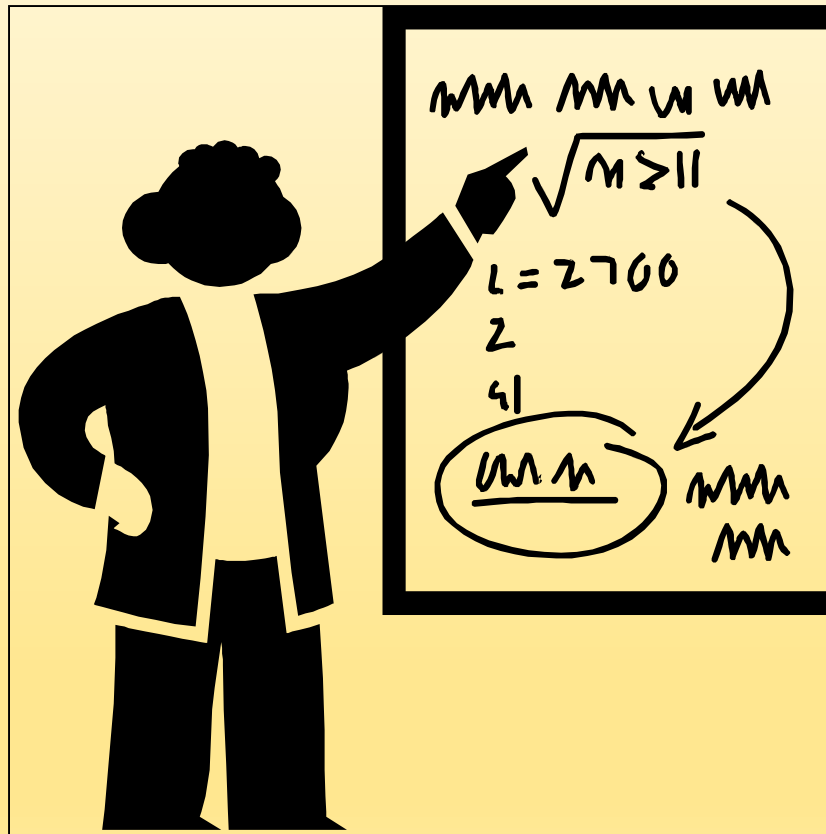
PROS

- No calculations or software needed, can be done fairly easily by hand
- Provides a trendline to compare against and aimline (yes/no for acquisition of skill)
- Accounts for outliers
- May be a solution to account for differences in performance b/t fall and spring Rol

CONS

- Ignores middle 1/3 of data
- Does not provide an Rol statistic
- Does not described degree of growth
- Need to have some training in finding the median score and week

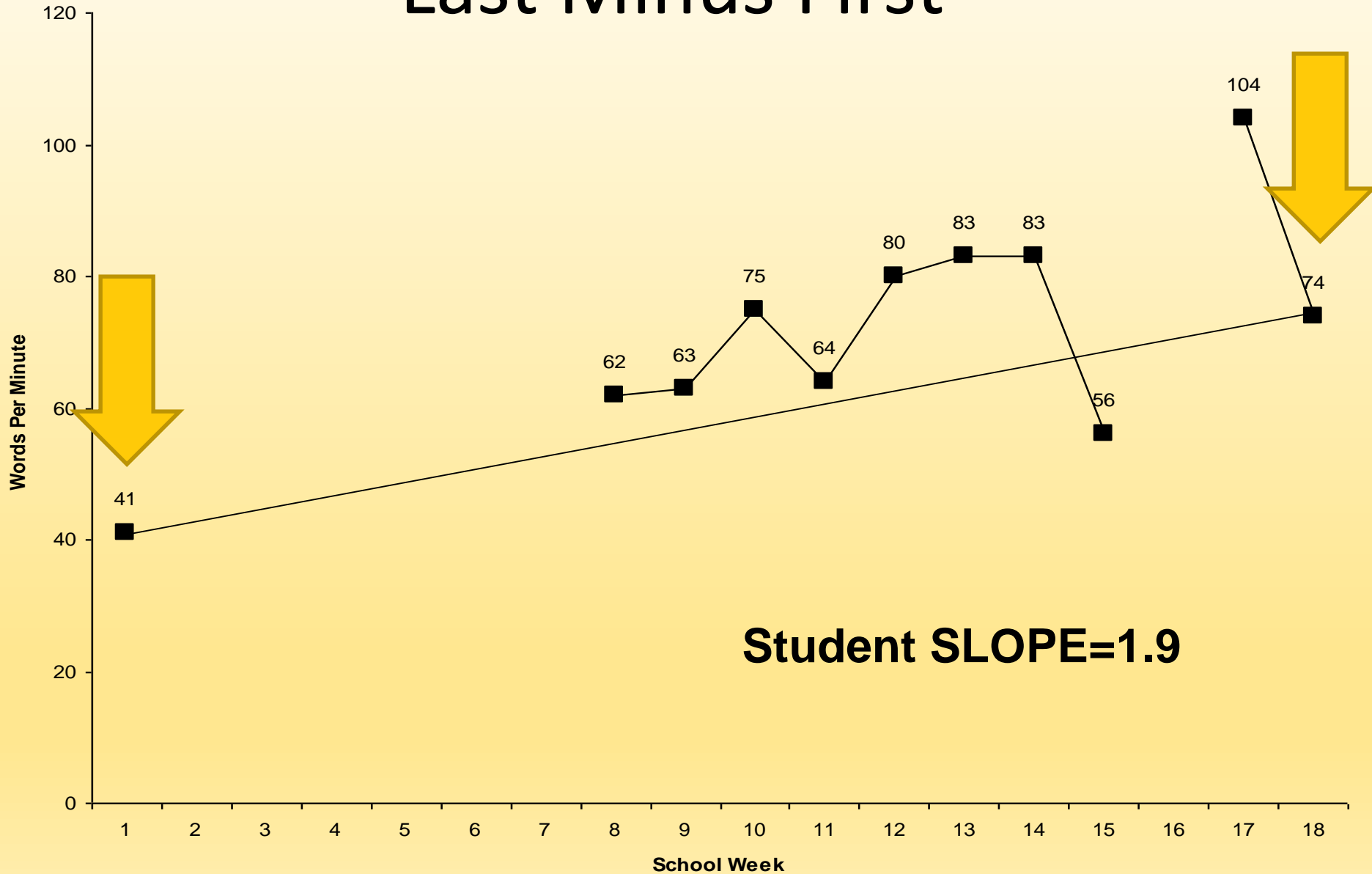
The Quantitative Approaches



Last Minus First

- Iris Center
- <http://iris.peabody.vanderbilt.edu/resources.html>
- Last data point minus first data point
- Divided by administration period minus first administration period
- $RoI = (Y2 - Y1) / (X2 - X1)$
- $RoI = (74 - 41) / (18 - 1)$
- $33 / 17 = 1.9$
- $RoI = 1.9$ words gained on average per week

Last Minus First



Last Minus First

PROS

- Provides a growth statistic and trendline
- Can compare trendline to aimline
- Easy to compute, software not necessary
- Can complete by hand

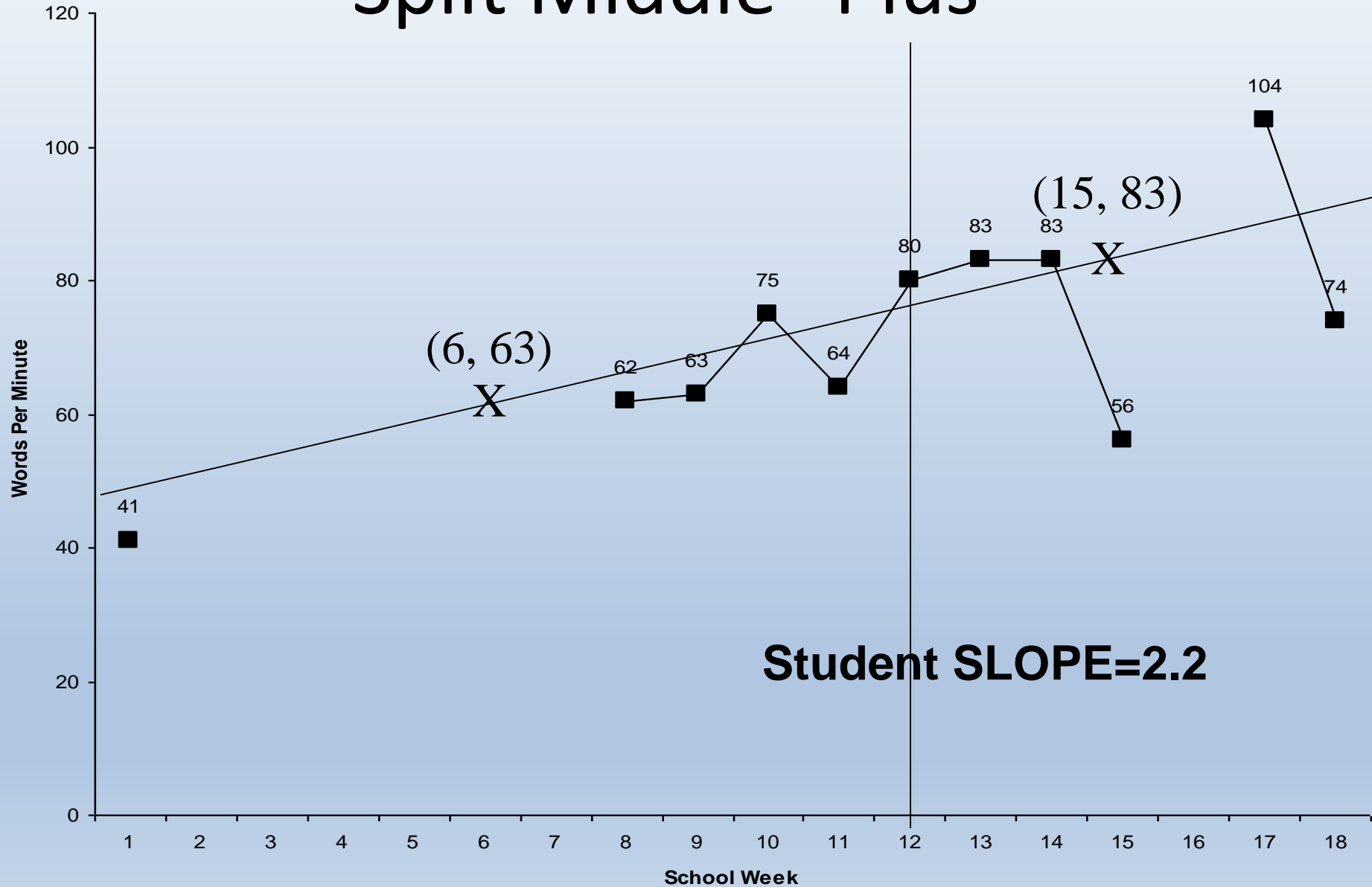
CONS

- Does not account for all data points
- Depends only on two data points
- Requires some simple math

Split Middle “Plus”

- Median point in 2nd section minus median point in 1st section
- Divided by median point in 2nd section minus median point in 1st section
- $RoI = (Y2 - Y1) / (X2 - X1)$
- $RoI = (83 - 63) / (15 - 6)$
- $20 / 9 = 2.2$
- 2.2 word correct gained on average per week

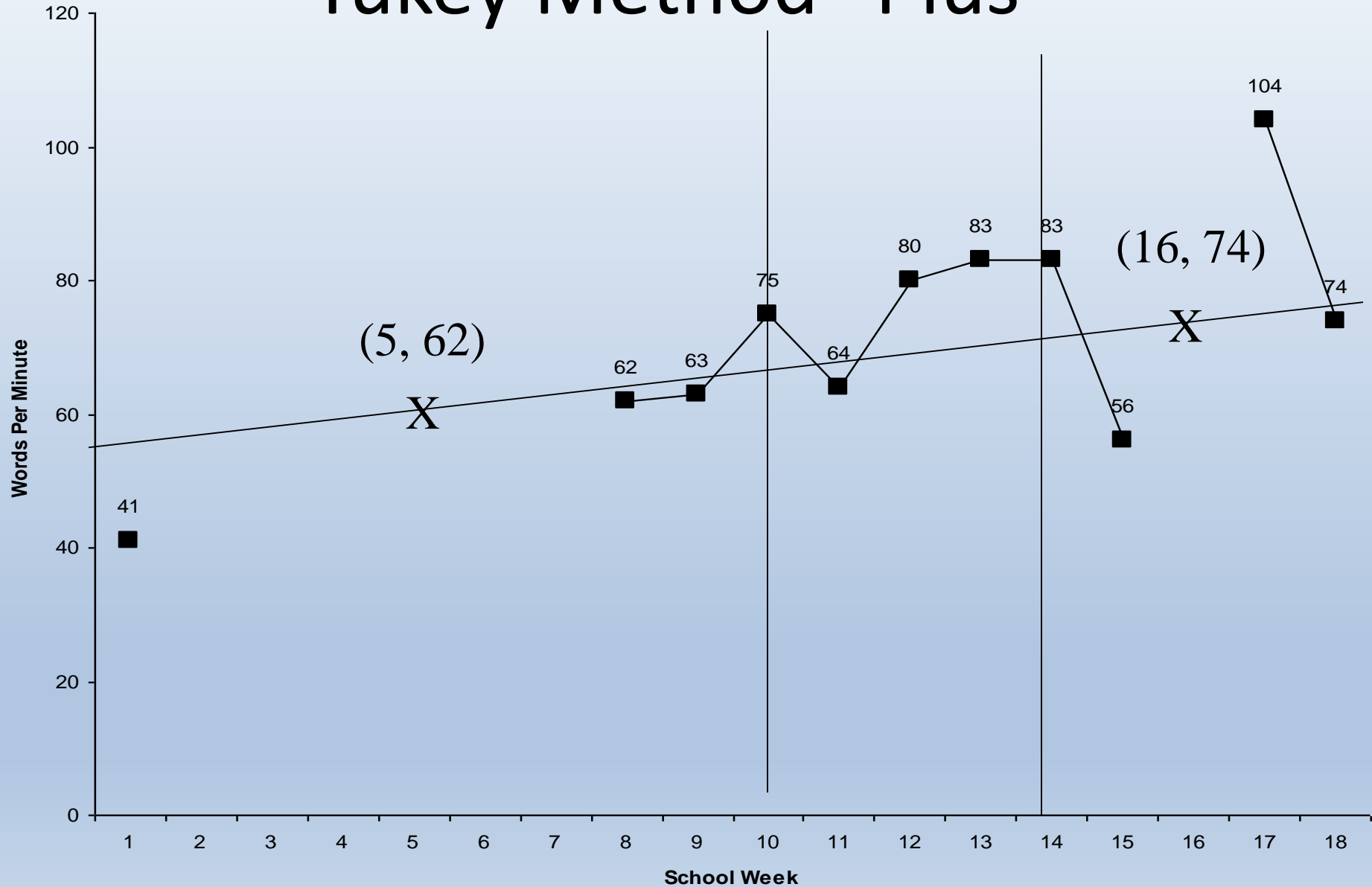
Split Middle “Plus”



Tukey Method “Plus”

- Median point in 3rd section minus the median point in 1st section
- Divided by the number of data points minus one
- $\text{Slope} = (74 - 62) / (16 - 5)$
- $12 / 11 = 1.1$
- 1.1 words correct gained on average per week

Tukey Method “Plus”



Split Middle & Tukey Method “Plus” a Statistic

PROS

- Provides an Rol statistic
- Provides a degree of growth
- Can be compared to aimline or growth of typically performing peers

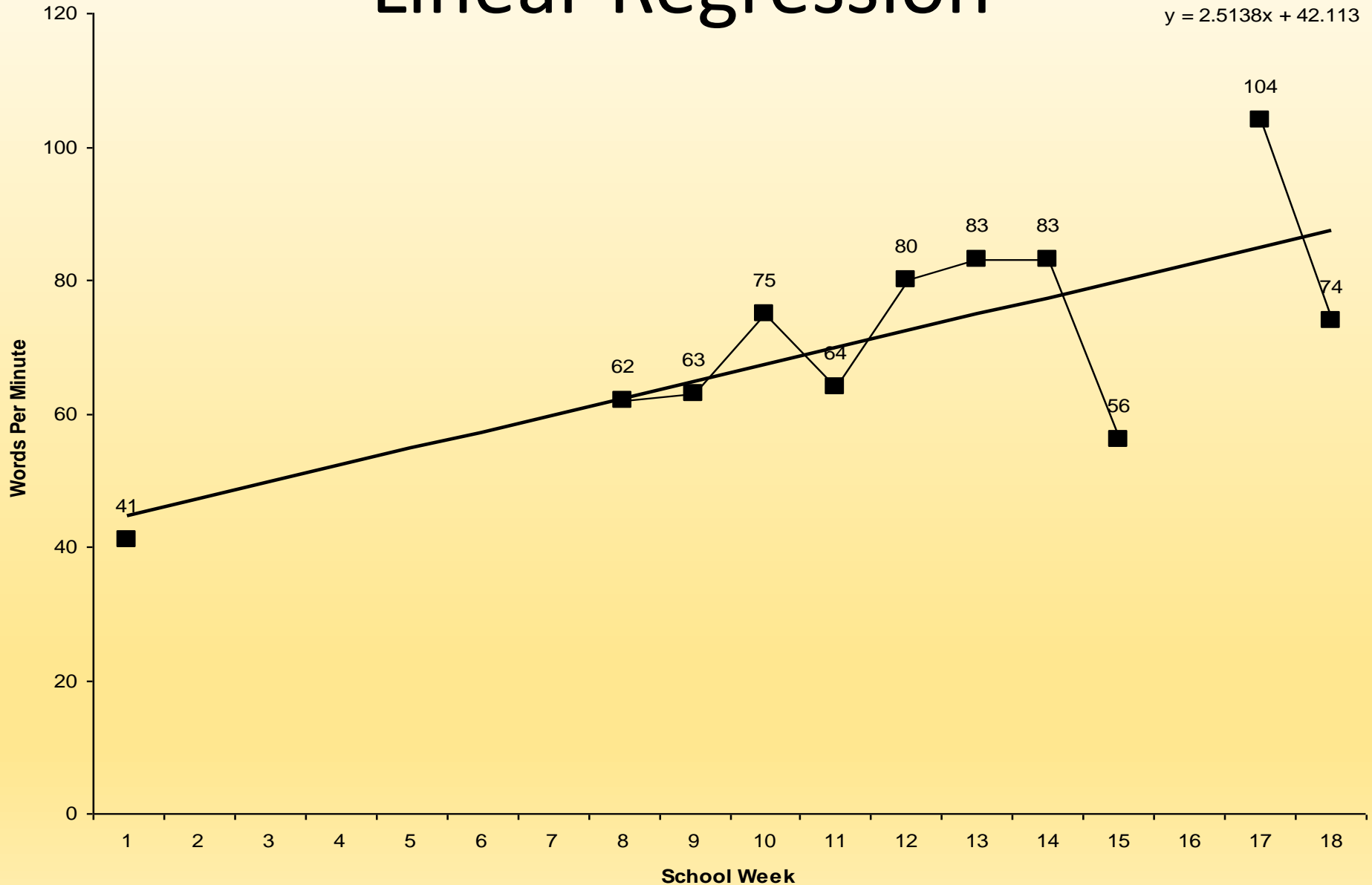
CONS

- Tukey “plus” does not consider all data points
- No empirical support for adding the statistic to the trendline
- Requires some math and knowledge of how to find the median

Linear Regression

- Used when there is some correlation between two types of data.
 - In this case: words gained (skill) per week (time)
- Most common type of regression used is least squares
- *A line of best fit* is calculated and drawn through the data points
- The line of best fit is the line with the minimum amount of error between the data point and the line (vertical deviation)

Linear Regression



Linear Regression

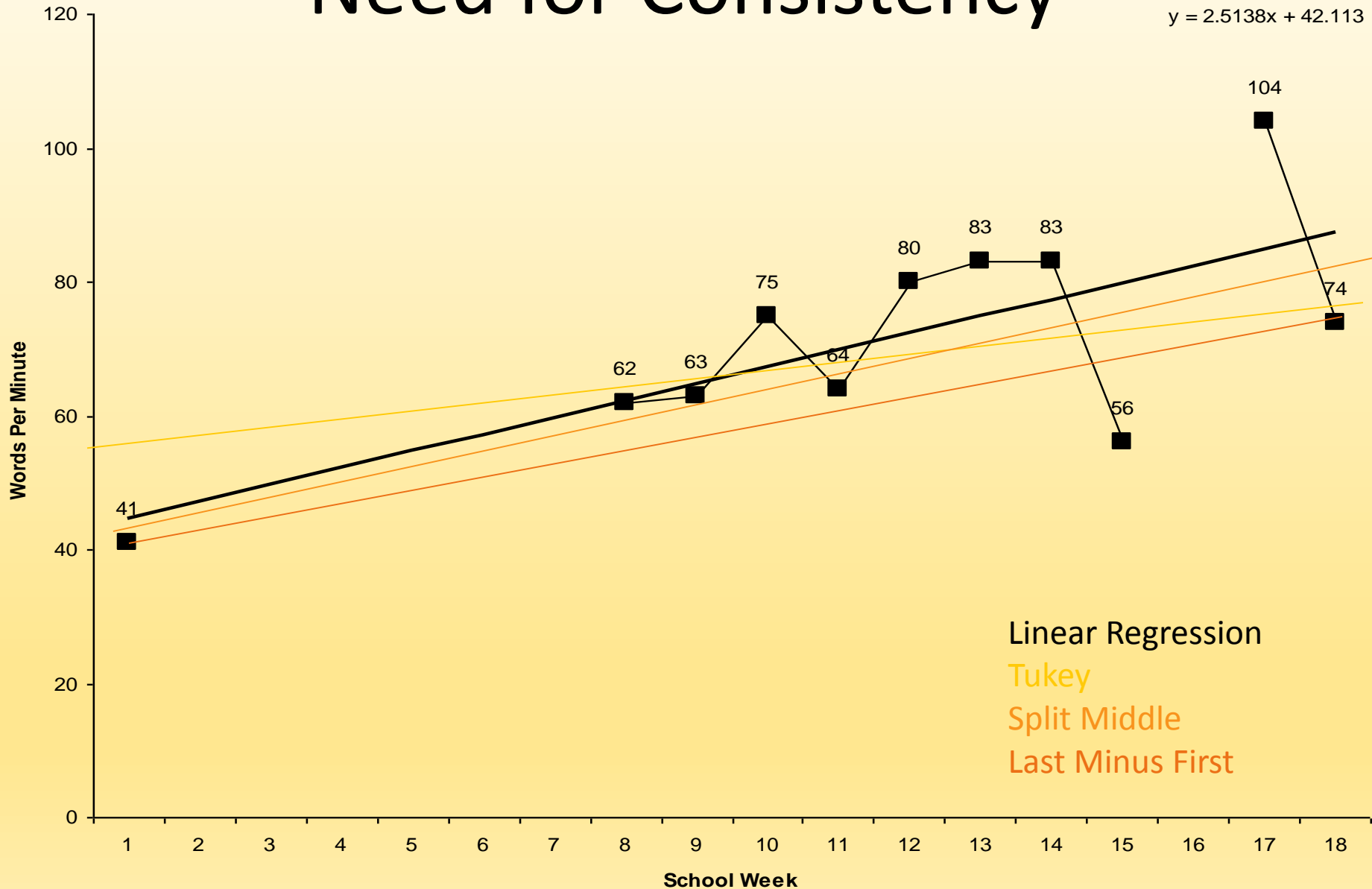
PROS

- Considers all data points
- Provides an Rol statistic and trendline that can be compared to aimline and Rol of typically performing peers
- Researchers use it to measure growth of CBM!

CONS

- Requires software/ computer for calculations
- Time consuming
- Need several data points
- Influenced by outlier data points

Need for Consistency



Need for Consistency

Method	Rate of Improvement
Qualitative Methods	?
Last Minus First	1.9
Tukey Method	1.1
Split Middle	2.2
Linear Regression	2.5

Need for Consistency

Method	RoI	After 18 Weeks
Qualitative Methods	?	?
Last Minus First	1.9	75.2
Tukey Method	1.1	60.8
Split Middle	2.2	80.6
Linear Regression	2.5	86

25 Words

Linear Regression

- “Student’s daily test scores...were entered into a computer program. The data analysis program generated slopes of improvement for each level using an Ordinary Least Squares procedure (Hayes, 1973) and the line of best fit.”
- “This procedure has been demonstrated to represent CBM achievement data validly within individual treatment phases (Marston, 1988; Shinn, Good, & Stein, in press; Stein, 1987).”

Shinn, Gleason, & Tindal (1989)

Literature Review: Rol and Linear Regression

- 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, 128-133.
- Deno, S. L., Fuchs, L. S., Marston, D., & Shin, J. (2001). Using curriculum based measurement to establish growth standards for students with learning disabilities. *School Psychology Review*, 30, 507-524.
- Good, R. H. (1990). Forecasting accuracy of slope estimates for reading curriculum based measurement: Empirical evidence. *Behavioral Assessment*, 12, 179-193.
- Fuchs, L. S., Fuchs, D., Hamlett, C. L., Walz, L. & Germann, G. (1993). Formative evaluation of academic progress: How much growth can we expect? *School Psychology Review*, 22, 27-48.

Literature Review: Rol and Linear Regression

- Jenkins, J. R., Graff, J. J., & Miglioretti, D.L. (2009). Estimating reading growth using intermittent CBM progress monitoring. *Exceptional Children*, 75, 151-163.
- Shinn, M. R., Gleason, M. M., & Tindal, G. (1989). Varying the difficulty of testing materials: Implications for curriculum-based measurement. *The Journal of Special Education*, 23, 223-233.
- Shinn, M. R., Good, R. H., & Stein, S. (1989). Summarizing trend in student achievement: A comparison of methods. *School Psychology Review*, 18, 356-370.

Why Are There So Many Ways to Demonstrate RoI?

- Ease of application
- Focus on Yes/No to goal acquisition, not degree of growth
- How many of us want to calculate OLS Linear Regression formulas (or even remember how)?

Problem with lack of Consistency

- If we are not all using the same model to compute Rol, we continue to have the same problems as past models, where under one approach a student meets SLD criteria, but under a different approach, the student does not.
- Without a consensus on how to compute Rol, we risk falling short of having technical adequacy within our model.

Feedback

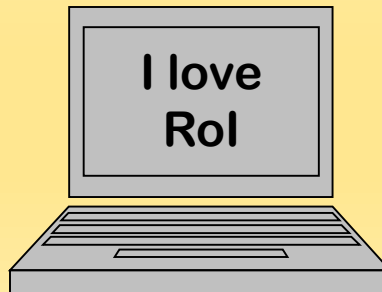
- What other method(s) are your schools using to measure growth?
- Have your thoughts on pros and cons changed?
- Considering your current growth analysis, are you sold on OLS LR?
 - If no, why not???

For Individual Students

GRAPHING AND CALCULATING ROI

Get Out Your Laptops!

Open Microsoft Excel



Fall to Winter

GRAPHING ROI FOR INDIVIDUAL STUDENTS

Setting up Your Spreadsheet

- In cell A1, type 3rd Grade ORF
- In cell A2, type 1st Semester
- In cell A3, type School Week
- In cell A4, type Benchmark
- In cell A5, type Student's Name Boots

	A	B	C
1	3rd Grade ORF		
2	1st Semester		
3	School Week		
4	Benchmark		
5	Boots		

Labeling School Weeks

- Starting with cell B3, type numbers 1 through 18 going across row 3 (horizontal).
- Numbers 1 through 18 represent the number of the school week.
- You will end with week 18 in cell S3.

[illegible]

Labeling Dates

- Note: You may choose to enter a date for the school week across row 2 for easy identification.
- We leave out the week of Thanksgiving break and Winter Break

	A	B	C	D	E
1	3rd Grade ORF				
2	1st Semester	8/29/2011	9/5/2011	9/12/2011	9/19/2011
3	School Week	1	2	3	4
4	Benchmark				
5	Boots				

Entering Benchmarks

- Our example is using DIBELS 6th Ed. 3rd Grade ORF Benchmarks.
- You would enter the benchmarks for fall and winter of whatever grade level for which you are graphing rate of improvement here.
- In cell B4, type 77 for the fall benchmark.
- In cell S4, type 92 for the winter benchmark.

	A	B	
1	3rd Grade ORF		
2	1st Semester	8/29/2011	9/
3	School Week	1	
4	Benchmark	77	
5	Boots		

	R	S	
	1/9/2012	1/16/2012	
	16	17	18
		92	

Entering Student Data

- Enter the following numbers, going across row 5, under the corresponding week numbers.
- Week 1 – 41
- Week 8 – 62
- Week 9 – 63
- Week 10 – 75
- Week 11 – 64
- Week 12 – 80
- Week 13 – 83
- Week 14 – 83
- Week 15 – 56
- Week 17 – 104
- Week 18 – 74

	A	B	C	D	E	F	G	H	I	J
1	3rd Grade ORF									
2	1st Semester	8/29/2011	9/5/2011	9/12/2011	9/19/2011	9/26/2011	10/3/2011	10/10/2011	10/17/2011	10/24/2011
3	School Week	1	2	3	4	5	6	7	8	9
4	Benchmark	77								
5	Boots	41							62	63

CAUTION



- If a student was not assessed during a certain week, leave that cell **blank**
- Do **not** enter a score of zero (0) if a student wasn't assessed during a certain week. The program will read the 0 as being a score (e.g., zero words correct per minute) and skew your trendline!

K	L	M	N	O	P	Q	R	S
10/31/2011	11/7/2011	11/14/2011	11/28/2011	12/5/2011	12/12/2011	12/19/2011	1/9/2012	1/16/2012
10	11	12	13	14	15	16	17	18
								92
75	64	80	83	83	56		104	74

Graphing the Data

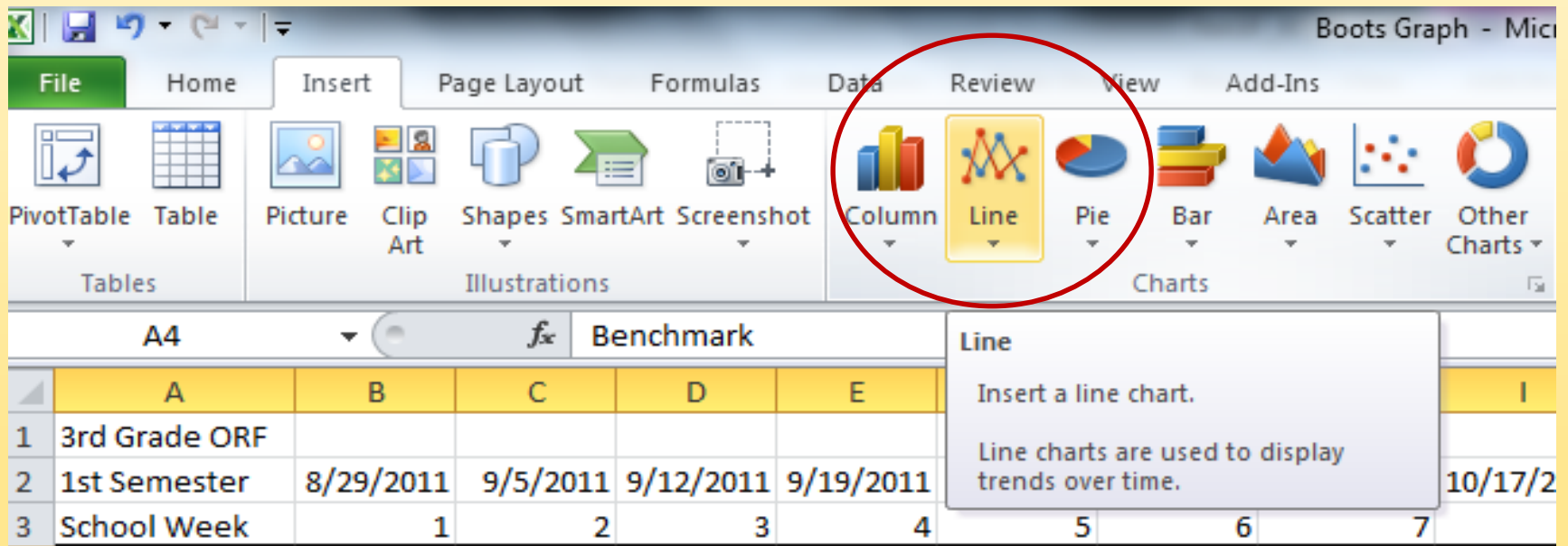
- Highlight cells A4 and A5 through S4 and S5
- Click Insert from your top row

A4					
fx Benchmark					
	A	B	C	D	
1	3rd Grade ORF				
2	1st Semester	8/29/2011	9/5/2011	9/12/2011	9/1
3	School Week	1	2	3	
4	Benchmark	77			
5	Boots	41			

A4					
fx Be					
	A	B	C		
1	3rd Grade ORF				
2	1st Semester	8/29/2011	9/5/2011		
3	School Week	1	2		
4	Benchmark	77			
5	Boots	41			
6					

Graphing the Data

- Find the icon for Line



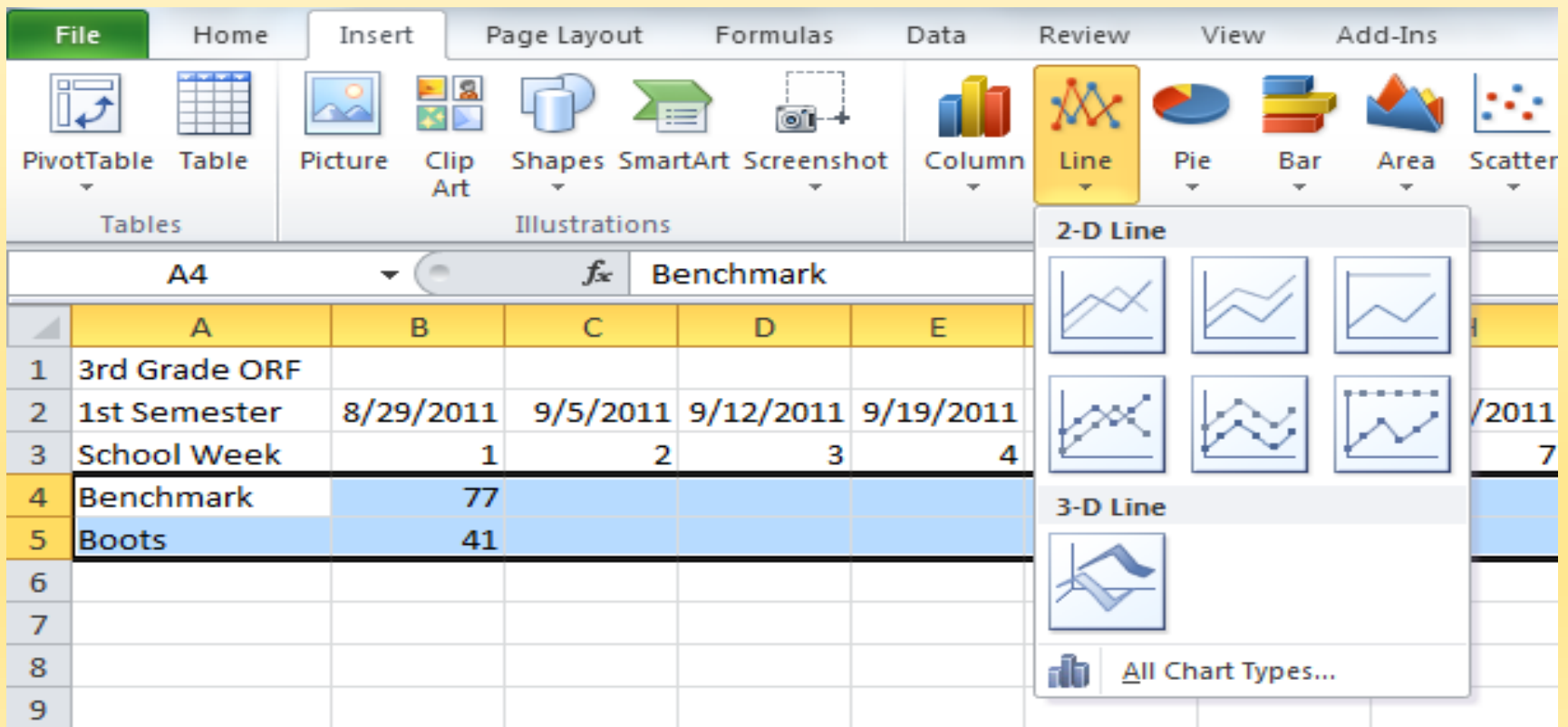
The screenshot shows the Microsoft Excel interface with the 'Insert' tab selected. The 'Charts' group is visible, and the 'Line' chart icon is highlighted with a red circle. A tooltip for the 'Line' chart is displayed, stating: 'Insert a line chart. Line charts are used to display trends over time.'

The spreadsheet data is as follows:

	A	B	C	D	E	
1	3rd Grade ORF					
2	1st Semester	8/29/2011	9/5/2011	9/12/2011	9/19/2011	10/17/2011
3	School Week	1	2	3	4	5

Graphing the Data

- Click the arrow below it to show options

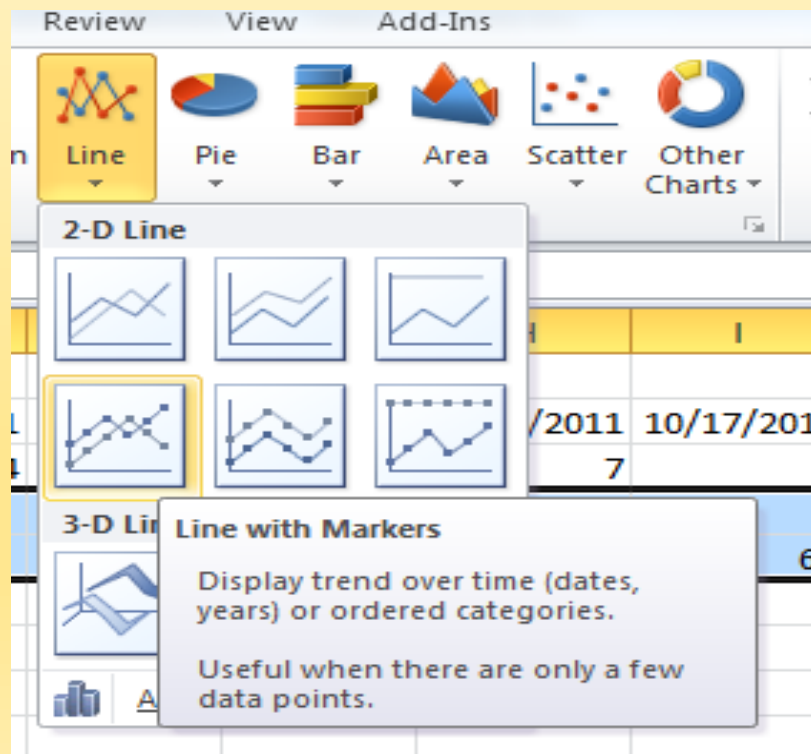


The screenshot shows the Microsoft Excel ribbon with the 'Insert' tab selected. The 'Line' chart icon is highlighted, and its dropdown menu is open, displaying various line chart options. The background spreadsheet contains the following data:

	A	B	C	D	E
1	3rd Grade ORF				
2	1st Semester	8/29/2011	9/5/2011	9/12/2011	9/19/2011
3	School Week	1	2	3	4
4	Benchmark	77			
5	Boots	41			
6					
7					
8					
9					

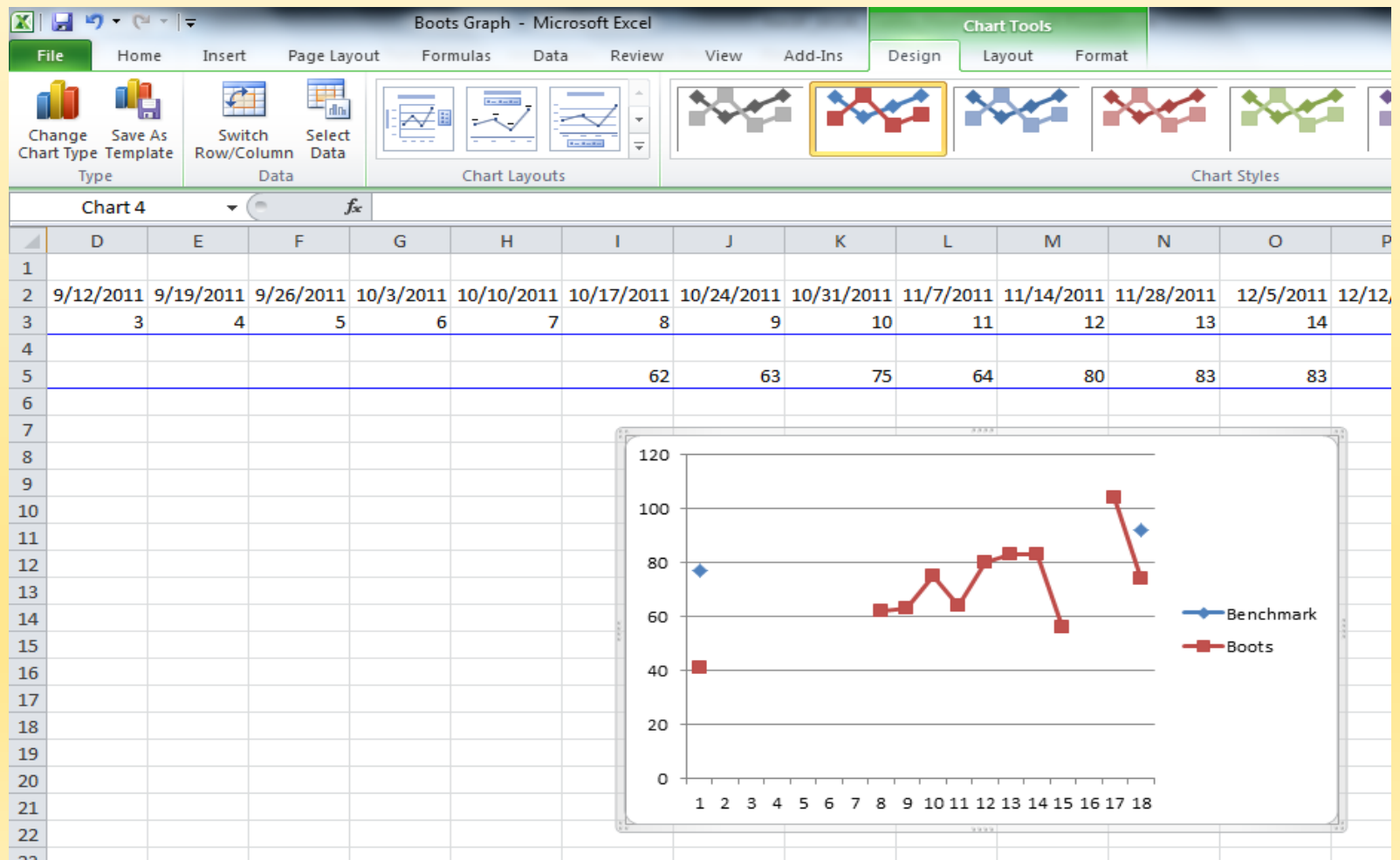
Graphing the Data

- 6 graphics appear for 2-D Line graphs
- Choose “Line with Markers”



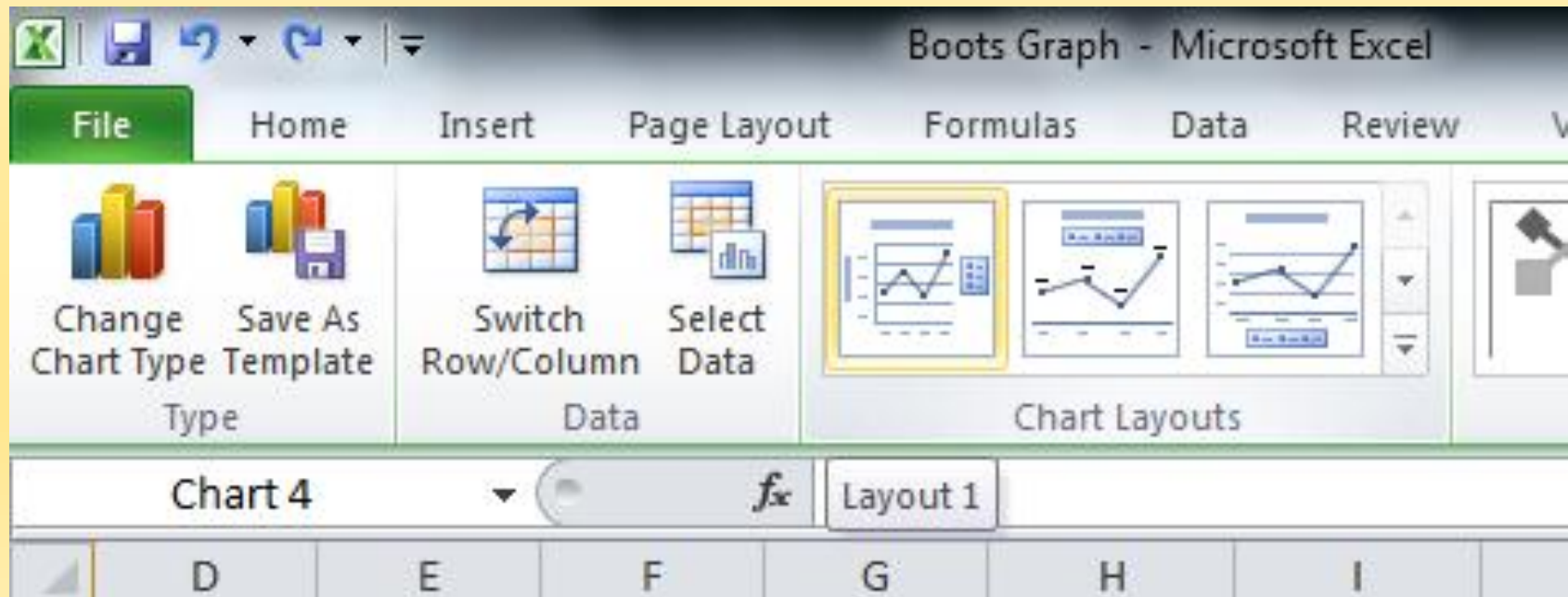
Graphing the Data

- Your graph will appear



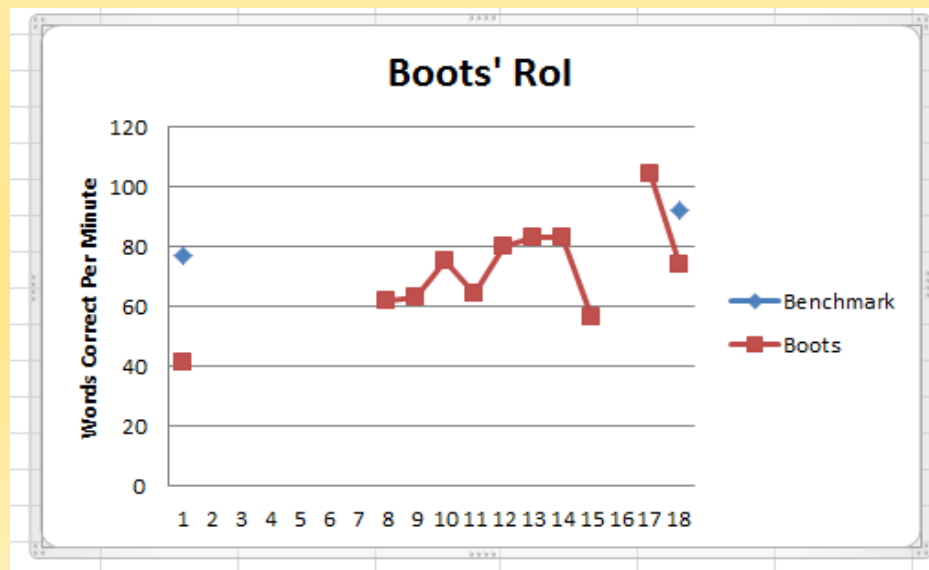
Graphing the Data

- To change your graph labels, click on your graph
- Your options appear in the top row
- Click on one of the Chart Layouts



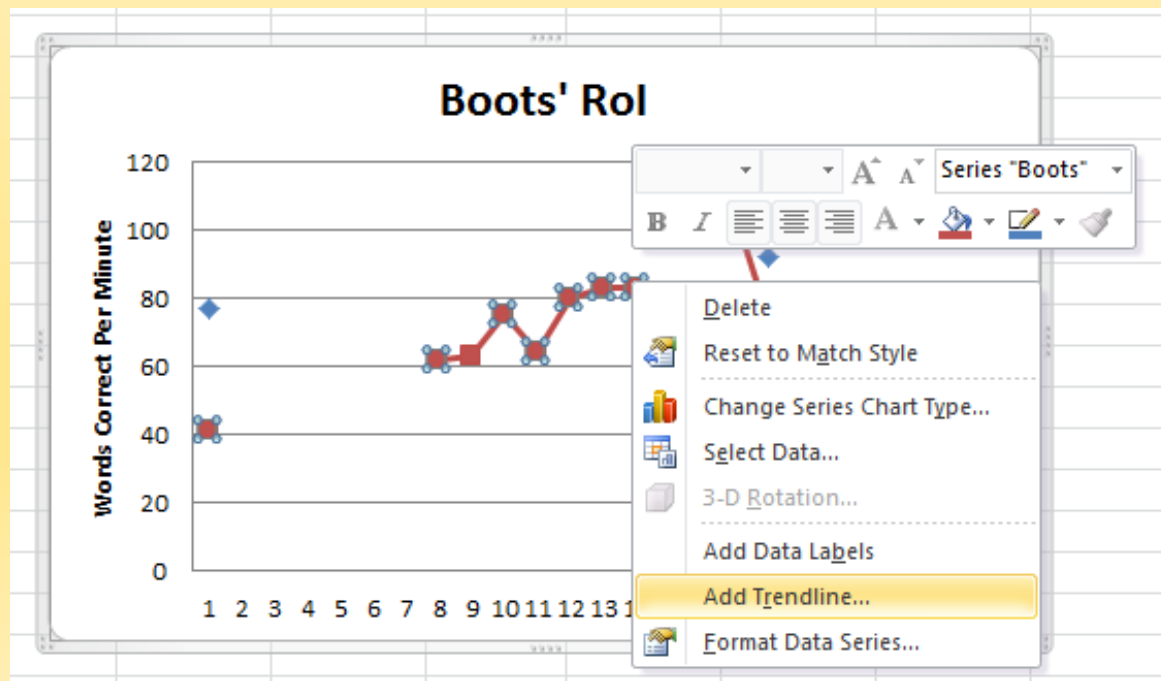
Graphing the Data

- Your chosen layout is applied to the graph
- By clicking on the labels (Chart Title, etc.) you can edit them
- Y-Axis is words per minute
- X-Axis is number of school weeks



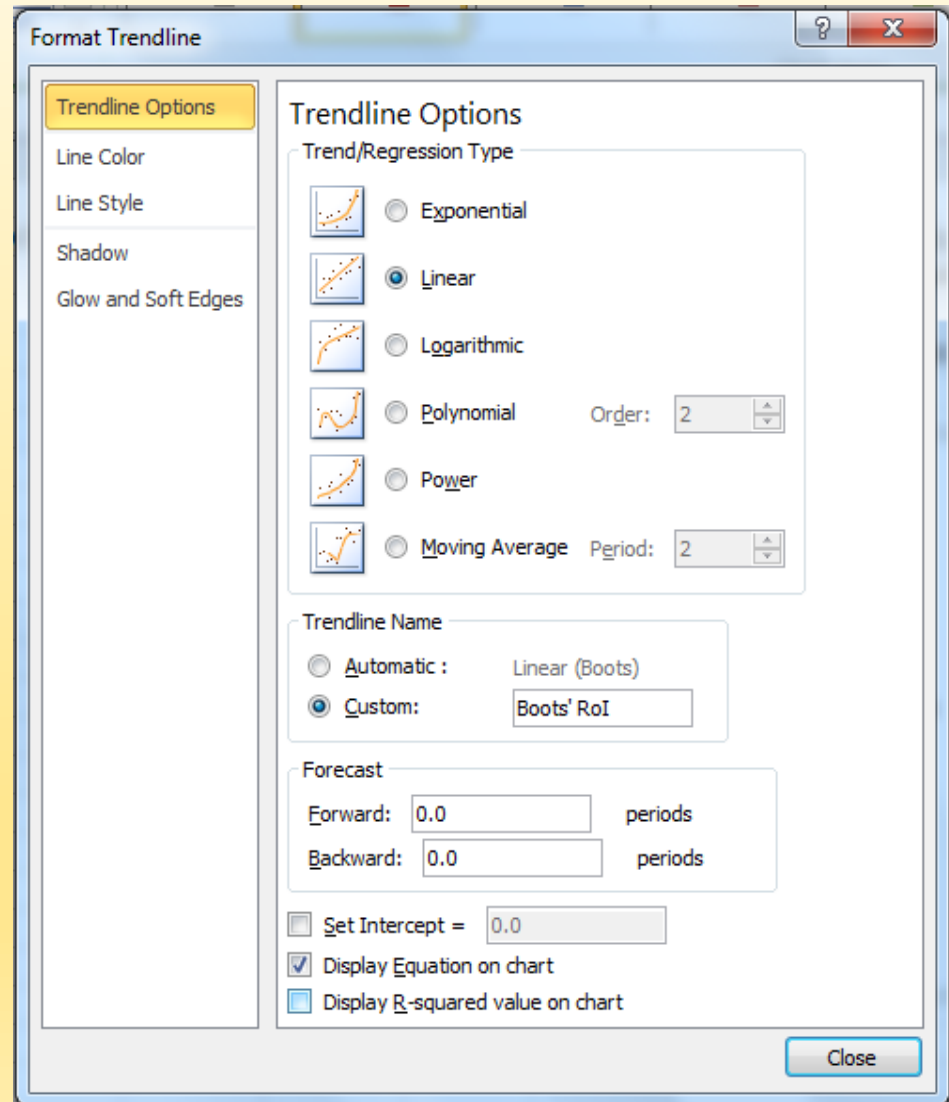
Graphing the Trendline

- Right click (Mac – control click) on any of the student data points.
- From the drop-down menu that appears, click on “Add Trendline”



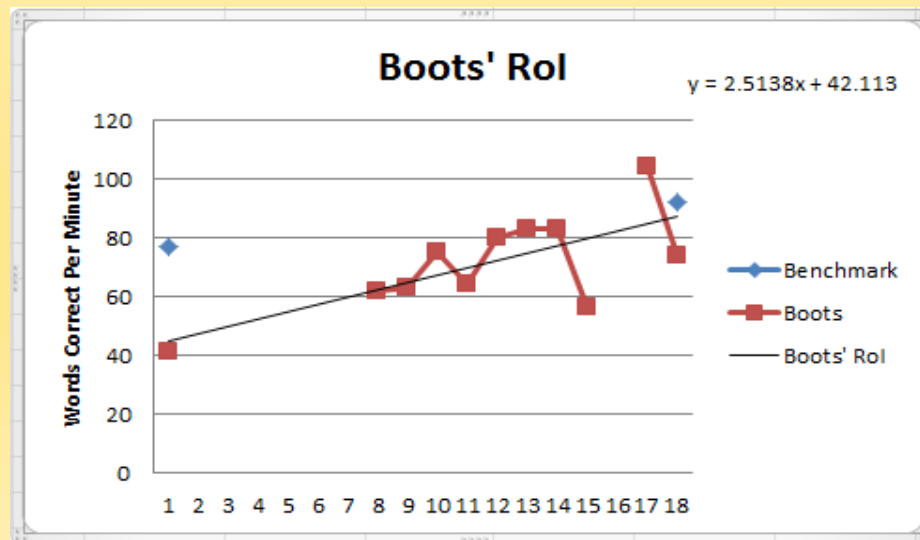
Graphing the Trendline

- On that menu, choose “Linear”
- To label your trendline, choose “Custom” and type in RoI, or Boots’ Progress
- Further down on that menu, check the box next to “Display Equation on Chart”



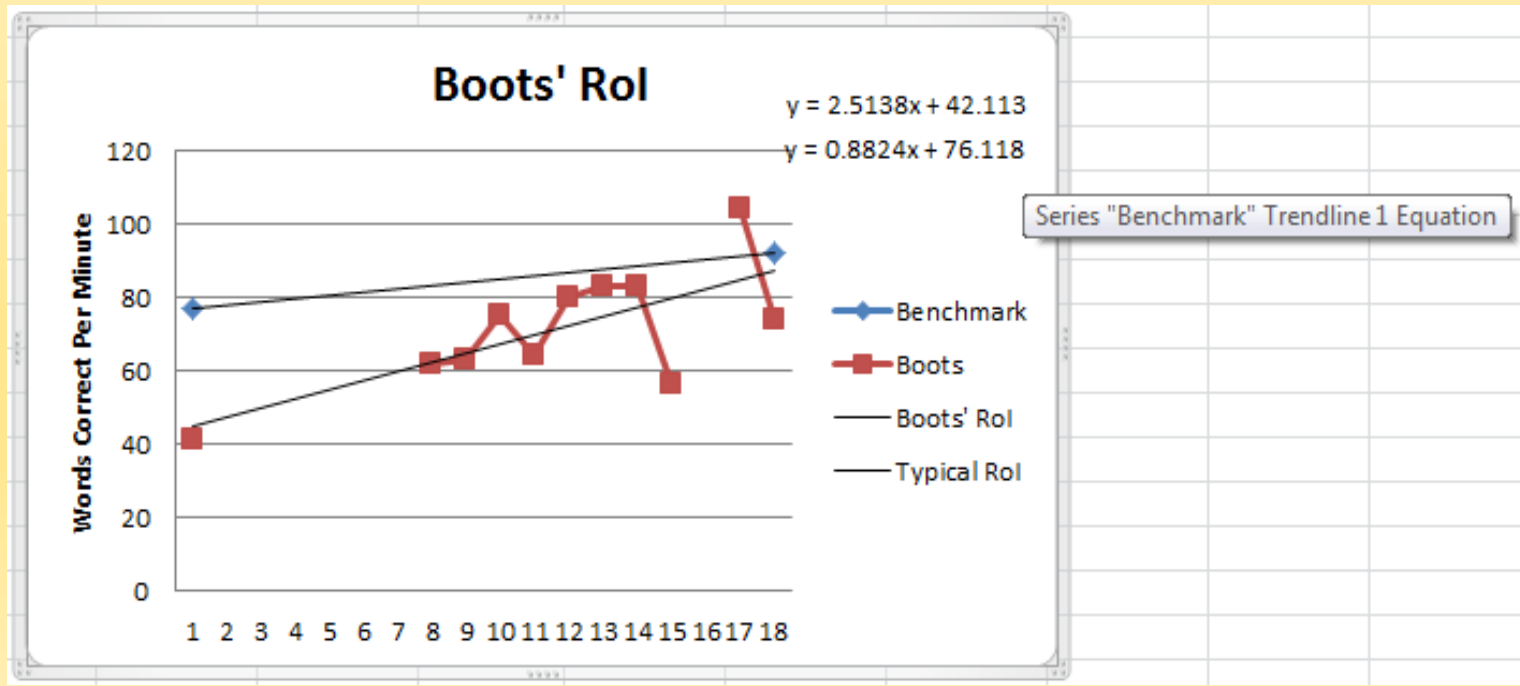
Graphing the Trendline

- Click on “Close”
- Your trendline should appear on your graph
- An equation will also appear on your graph
- You can relocate the trendline by clicking on it and dragging it to a new place



Graphing Typical Rol

- You can repeat the same procedure by clicking on one of the benchmark data points
- Suggestion: Label this trendline Typical Rol
- Move this equation under the first



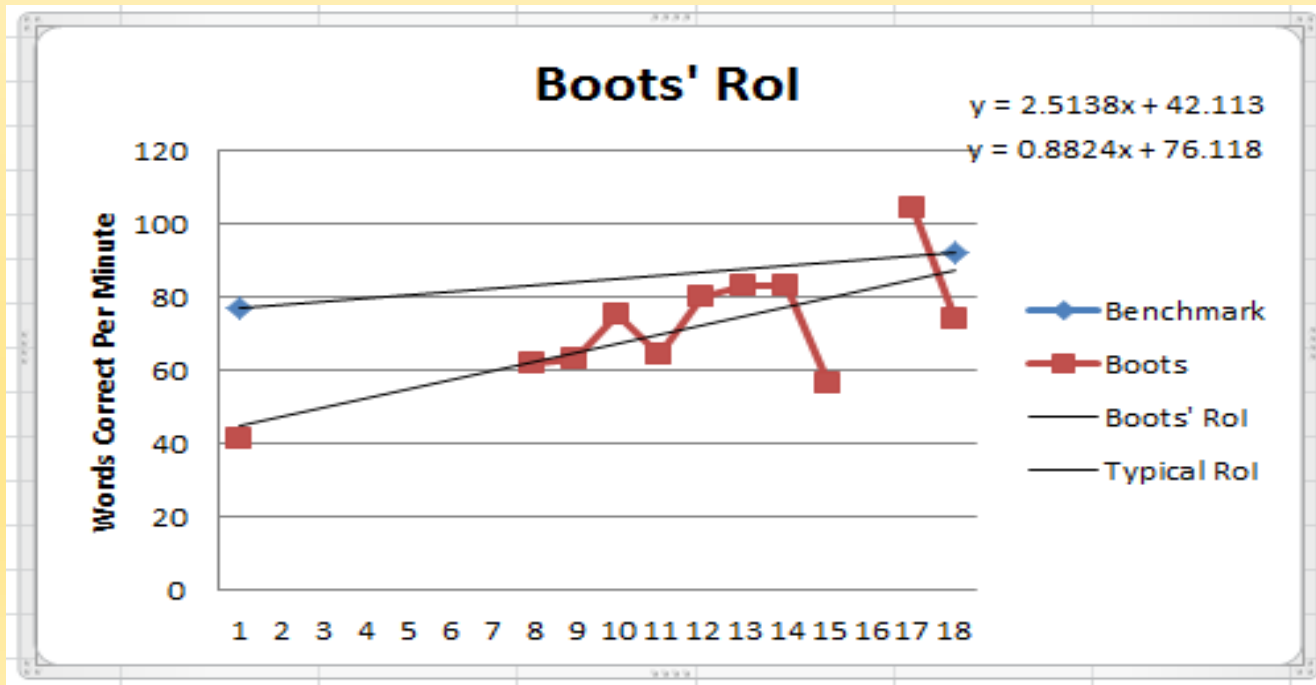
Understanding the Equation

- $Y=2.5138x +42.113$
- What does it mean?
- 2.513 is the average words per week the student is gaining based on the given data points
- 42.133 is where the trendline crosses the Y-Axis

- $Y=0.8824x +76.118$
- 0.8824 is the average words gained per week for typically performing peers in 3rd grade for oral reading fluency

Understanding the Graph

- Discuss with your neighbor:
 - How is this student progressing?
 - What is the student's Rol compared to the typical Rol?



Adding More Data Points

- To add additional data points to the graph (e.g., if you are doing ongoing monitoring) once you've already created the graph, simply enter those data in row 5 under the corresponding school week.
- *You don't have to re-create the graph each time you add a data point!*

Note...

- The typical Rol can change depending on where (which week) you enter the benchmark scores on your chart.
- Suggestion: Enter the benchmark scores based on when your school district completes their benchmark administration for the most accurate description of expected student progress.

Calculating Needed RoI

Calculating Typical RoI

Calculating Student RoI

PROGRAMMING EXCEL

FIRST SEMESTER

Quick Definitions

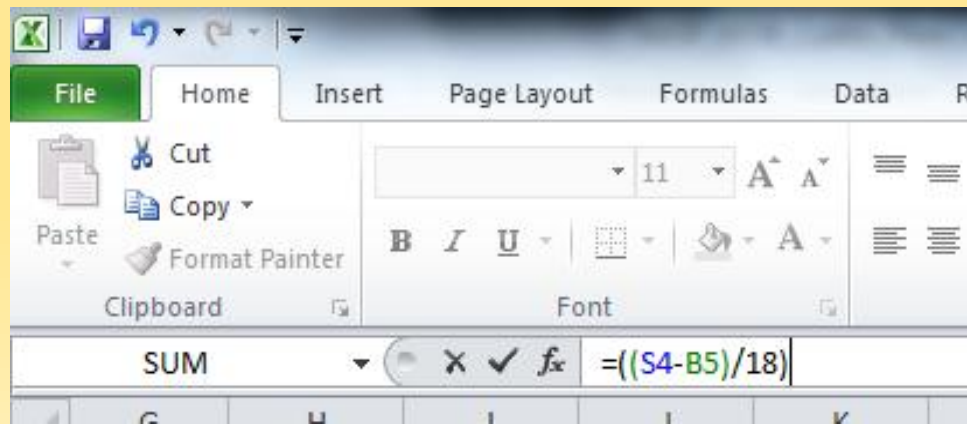
- Needed Rol
 - The rate of improvement needed to close the achievement gap
- Typical Rol
 - The rate of improvement of typically performing peers according to the norms
- Student Rol
 - The actual rate of improvement at which the student is achieving based on available data points

Calculating Needed Rol

- In cell T3, type Needed Rol
- Click on cell T5

S	T
1/16/2012	
18	Needed Rol
92	
74	

- In the *fx* line at the top of the worksheet, type this formula **$=((S4-B5)/18)$**
- Then hit enter/return



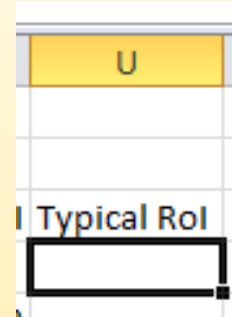
Calculating Needed Rol

- Your result in cell T5 should read: **2.833...**
- This formula subtracts the student's actual beginning of the year (BOY) benchmark from the expected middle of the year (MOY) benchmark, then divides by 18 for the first 18 weeks

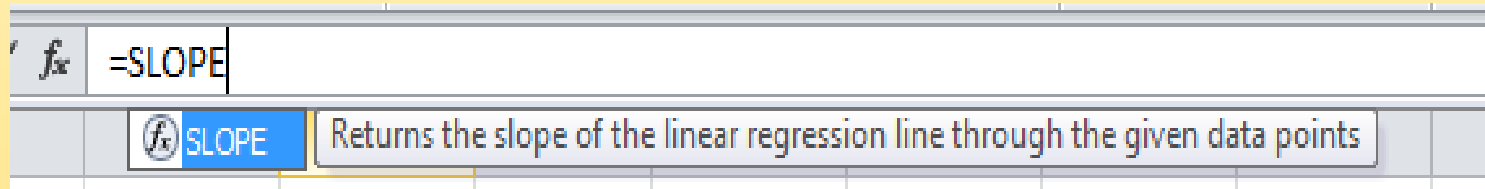
	T
9/2012	
18	Needed Rol
92	
74	2.83333333

Calculating Typical Rol

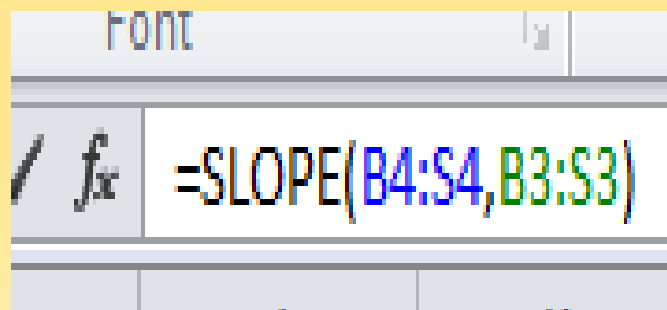
- In cell U3, type Typical Rol
- Click on cell U4



- In the *fx* line at the top of the sheet, type this formula **=SLOPE(B4:S4,B3:S3)**



- Then hit enter



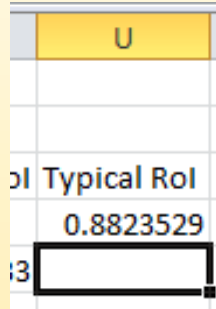
Calculating Typical Rol

- Your result should read: 0.8825...
- This formula considers 18 weeks of growth according to the benchmark data – or – typical change (growth) expected per week in the target skill.

U
Typical Rol
0.8823529

Calculating Student Rol

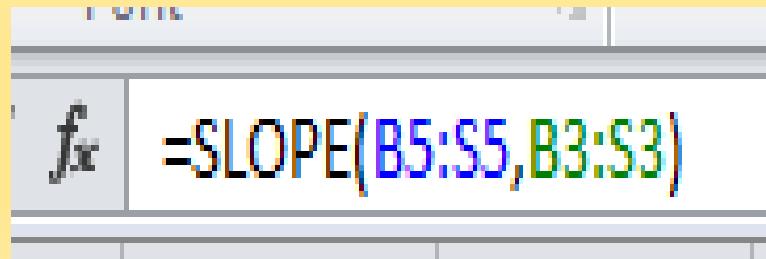
- Click on cell U5



U
Typical Rol
0.8823529

- In the *fx* line at the top of your sheet, type this formula **=SLOPE(B5:S5,B3:S3)**

- Then hit enter



Calculating Student Rol

- Your result should read: 2.5137...
- This formula considers 18 weeks of student data (as long as you have a few data points) and provides an average growth or change in skill acquisition per week.

	U
ol	Typical Rol
	0.8823529
33	2.5137652

Feedback

- Got it?

When to use what we just did!

- Excel method fits well with DIBELS, easyCBM, or other CBM probe data
- AIMSweb uses OLS LR within software to graph student results

Operationalizing Adequate & Inadequate Growth

APPLYING ROI



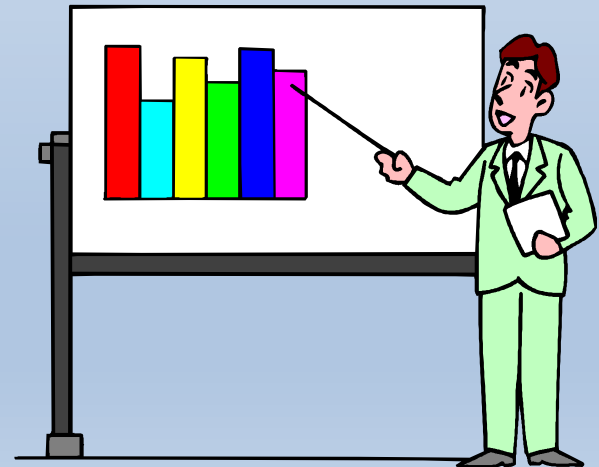
Data Resources @ National Center on RtI

- Screening Tools Chart
 - <http://www.rti4success.org/screeningTools>
- Progress Monitoring Tools Chart
 - <http://www.rti4success.org/progressMonitoringTools>

**You have a student growth rate...
... now what?**

Ground (make relative) the Data

- 1) To what will we compare our student growth data?
- 2) How will we set goals?



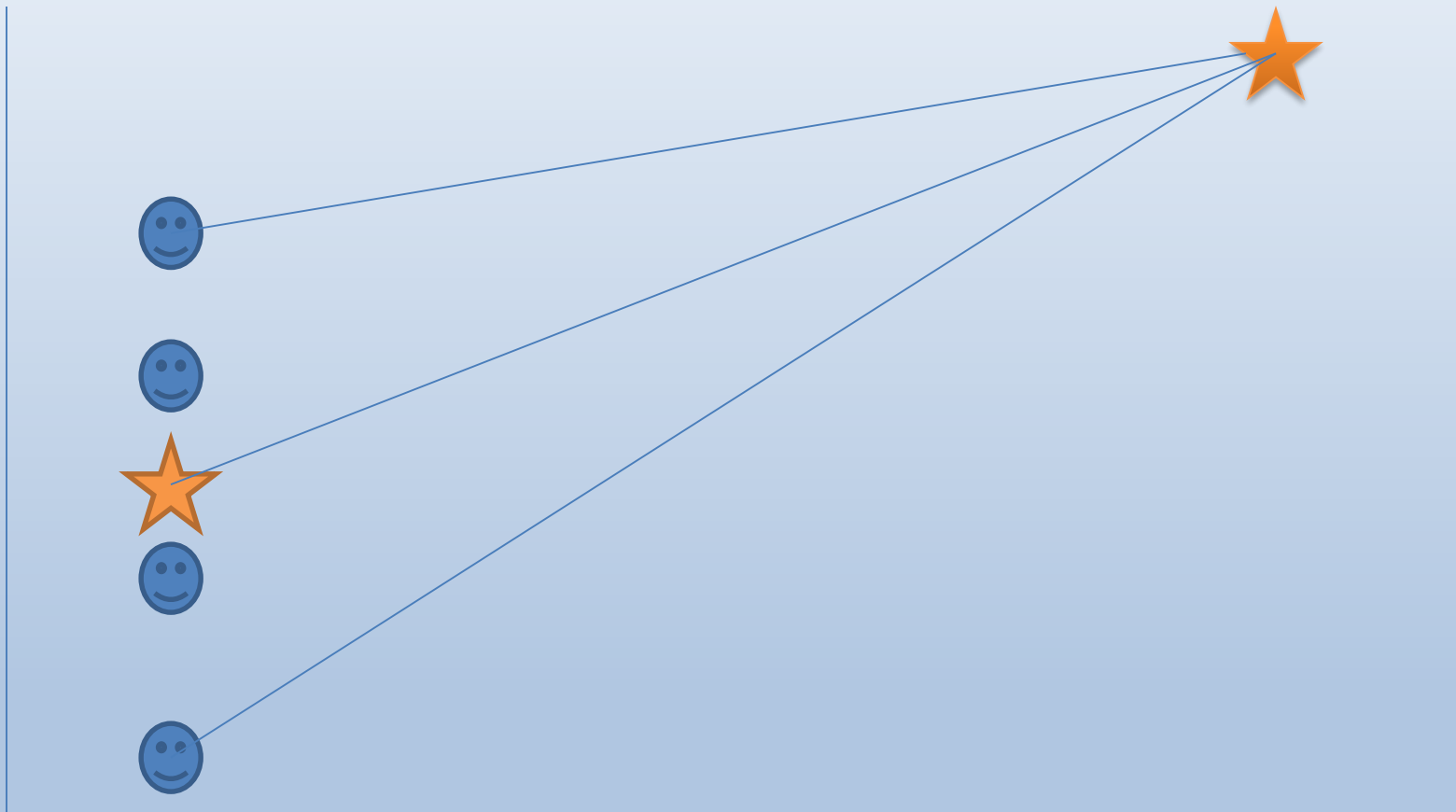
Multiple Ways to Look at/Compare Growth

- Needed Growth
- Expected Growth & Percent of Expected Growth
- Growth Toward Individual Goal

Needed Growth

- Difference between student's BOY (or MOY) score and benchmark score at MOY (or EOY).
- Example: MOY ORF = 10, EOY benchmark is 40, 18 weeks of instruction ($40-10/18=1.67$). Student must gain 1.67 wcpm per week to make EOY benchmark.

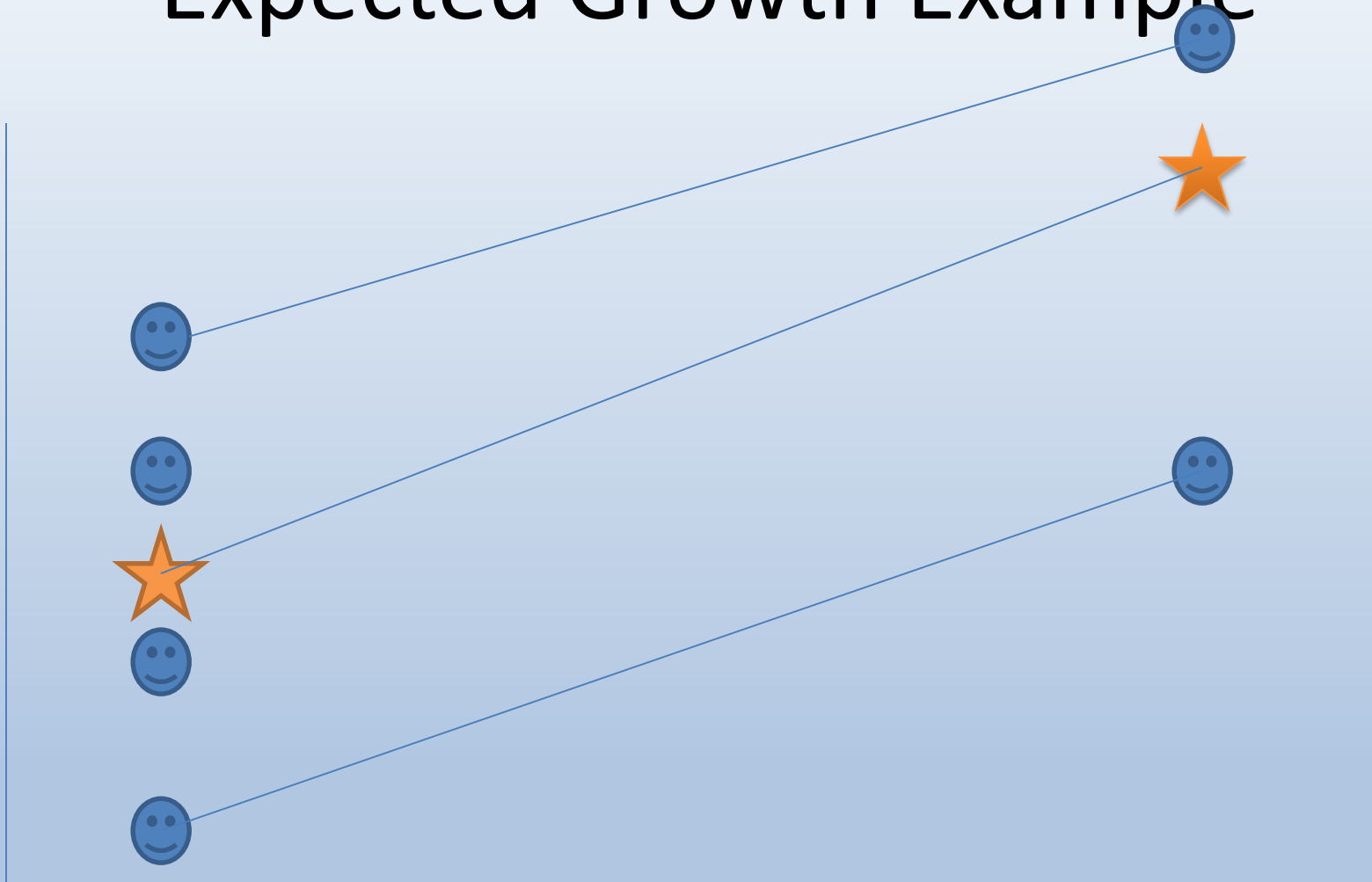
Needed Growth Example



Expected Growth

- Difference between two benchmarks.
- Example: MOY benchmark is 20, EOY benchmark is 40, expected growth $(40-20)/18$ weeks of instruction = 1.11 wcpm per week.

Expected Growth Example



Looking at Percent of Expected Growth

	Tier I	Tier II	Tier III
Greater than 150%			
Between 110% & 150%			Possible LD
Between 95% & 110%			Likely LD
Between 80% & 95%	May Need More	May Need More	Likely LD
Below 80%	Needs More	Needs More	Likely LD

Individual Goal

- Growth Toward Individual Goal*

*Best Practices in Setting Progress Monitoring
Goals for Academic Skill Improvement
(Shapiro, 2008)

From Where Should Benchmarks/Criteria Come?



Oral Reading Fluency Adequate Response Table

	Realistic Growth	Ambitious Growth
1st	2.0	3.0
2nd	1.5	2.0
3rd	1.0	1.5
4th	0.9	1.1
5th	0.5	0.8

Digit Fluency Adequate Response Table

	Realistic Growth	Ambitious Growth
1st	0.3	0.5
2nd	0.3	0.5
3rd	0.3	0.5
4th	0.75	1.2
5th	0.75	1.2

Local Benchmarks

- Appears to be a theoretical convergence on use of local criteria (what scores do our students need to have a high probability of proficiency?) when possible.
 - Hintze & Silberglitt (2005)
 - McGlinchey & Hixson (2004)
 - Shapiro, Keller, Lutz, Santoro, & Hintze (2006)
 - Silberglitt, Burns, Madyun, & Lail (2006)
 - Stage & Jacobsen (2001)
 - Stewart & Silberglitt (2008)

If Local Criteria are Not an Option

- Use norms that accompany the measure (DIBELS, AIMSweb, etc.).
- Use national norms.

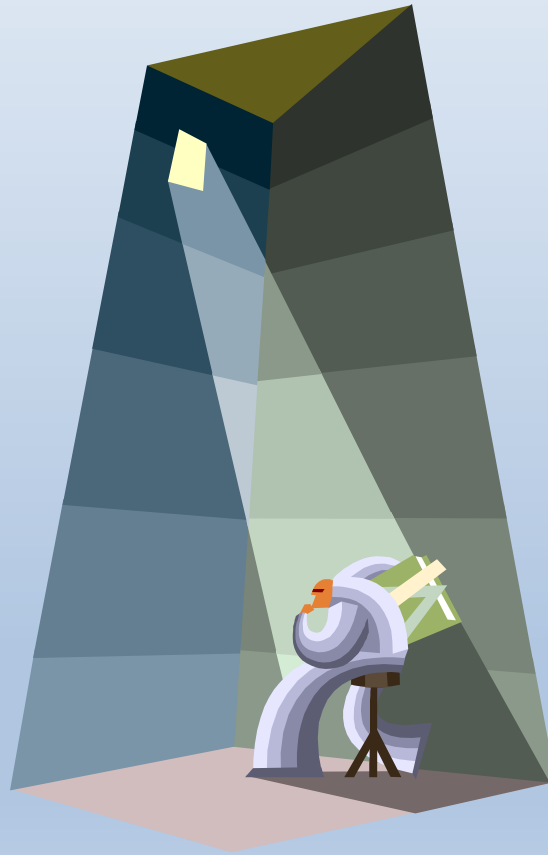
Making Decisions: Best Practice

- Research has yet to establish a blue print for 'grounding' student Rol data.
- At this point, teams should consider multiple comparisons when planning and making decisions.

Making Decisions: Lessons From the Field

- When tracking on grade level, consider an Rol that is 100% of *expected* growth as a minimum requirement, consider an Rol that is at or above the *needed* as optimal.
- So, 100% of expected and on par with needed become the limits of the range within a student should be achieving.

Is there an easy way to do all of this?



Oral Reading Fluency																			
	01/15/09	01/22/09	01/29/09	02/05/09	02/12/09	02/19/09	02/26/09	03/05/09	03/12/09	03/19/09	03/26/09	04/02/09	04/09/09	04/16/09	04/23/09	04/30/09	05/07/09	05/14/09	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Needed Rol*
Benchmark	68																	90	1.29
Aiden	61					40				52		60		71				95	1.61
Ava	49				43	49		77		57		54		87				92	2.28
Noah	49				48		45	69		61		54						84	2.28
Olivia	65					49				57		70		79				83	1.39
Liam	55					53				36		54		70				83	1.94
Hannah	59				54		64	69		52		60						82	1.72
Gavin	64					40				67		68		84				79	1.44
Grace	53					48				46		60		74				79	2.06
Oliver	50				44	46		68		51		51		57				78	2.22
Peyton	63					50				47		58		75				77	1.50
Josh	49				38	49		55		48		36		67				77	2.28
Riley	42				49		54	69		67		50						76	2.67
Mason	53					53				50		64		60				74	2.06
Zoe	34				38		42	68		55		51						58	3.11
Ian	41				31		45	49		47		30						46	2.72
Faith	29				36	35		36		36		29		45				44	3.39
David	30				23	44		52		43		19		63				38	3.33
Alexa	18				19	25		33		33		23		28				37	4.00
Hunter	23				23		24	48		38		32						34	3.72
Caroline	28				20	28		40		37		19		25				30	3.44

* Needed Rol based on difference between week 1 score and Benchmark score for week 18 divided by 18 weeks

** Actual Rol based on linear regression of all data points

Benchmarks based on DIBELS Goals

Expected Rol at Benchmark Level

Oral Reading Fluency Adequate Response Table

	Realistic Growth	Ambitious Growth
1st Grade	2.0	3.0
2nd Grade	1.5	2.0
3rd Grade	1.0	1.5
4th Grade	0.9	1.1
5th Grade	0.5	0.8

(Fuchs, Fuchs, Hamlett, Walz, & Germann 1993)

	1/14/2011	1/121/2011	1/28/2011	5/14/2011	Needed Rol	Actual Rol	%of Expected Rol
	1	2	3	18			
Benchmark	68			90		1.29	
Student	22		27	56	3.78	1.89	147%

Access to Spreadsheet Templates

- <http://rateofimprovement.com/roi/>
 - Click on Downloads
- Update dates and benchmarks.
- Enter names and benchmark/progress monitoring data.

What about Students not on Grade Level?



Determining Instructional Level

- Independent/Instructional/Frustrational
- Instructional often b/w 40th or 50th percentile and 25th percentile.
- Frustrational level below the 25th percentile.
- AIMSweb: Survey Level Assessment (SLA).

Setting Goals off of Grade Level

- 100% of expected growth not enough.
- Needed growth only gets to instructional level benchmark, not grade level.
- Risk of not being ambitious enough.
- Plenty of ideas, but limited research regarding Best Practice in goal setting off of grade level.

Possible Solution

- Weekly probe at instructional level for sensitive indicator of growth.
- Monthly probes (give 3, not just 1) at grade level to compute Rol.
- Goal based on grade level growth (more than 100% of expected).

We had a student growth rate...
... now we have something to which
we can compare...
... now what?



What do we do when we do not get the growth we want?

- When to make a change in instruction and intervention?
- When to consider SLD?

When to make a change in instruction and intervention?

- Enough data points?
- Less than 100% of expected growth.
- Not on track to make benchmark (needed growth).
- Not on track to reach individual goal.

When to consider SLD?

Continued inadequate response despite:

- Fidelity with Tier I instruction and Tier II/III intervention.
- Multiple attempts at intervention.
- Individualized Problem-Solving approach.
- Evidence of dual discrepancy...

Variations & Innovations

- Examples from schools & districts



05/14/09	Needed RoI*	Actual RoI**	% of Expected RoI	Dual Discrepancy?
18				
90		1.29		
95	1.61	2.17	167%	Keep On Truckin
92	2.28	2.76	213%	Keep On Truckin
84	2.28	2.01	156%	
83	1.39	1.50	116%	
83	1.94	1.58	122%	
82	1.72	1.20	93%	
79	1.44	1.66	129%	
79	2.06	1.76	136%	
78	2.22	1.45	112%	
77	1.50	1.12	87%	
77	2.28	1.62	125%	
76	2.67	1.76	136%	
74	2.06	1.17	91%	
58	3.11	1.44	111%	
46	2.72	0.24	19%	BIG PROBLEMS
44	3.39	0.75	58%	BIG PROBLEMS
38	3.33	0.79	61%	BIG PROBLEMS
37	4.00	0.94	73%	BIG PROBLEMS
34	3.72	0.75	58%	BIG PROBLEMS
30	3.44	0.02	2%	BIG PROBLEMS

Growth Criteria	
	>125%
	85% - 125%
	<85%

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Oral Reading Fluency																					
2		Fall Base								end M1												
3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Needed Rol*	Actual Rol**	% of Expected Rol
4	Benchmark	70																	86		0.94	
5	A	76				94	56	54			91	87	108	101	98				105	0.56	2.49	265%
6	C	72				95	80	68			89	88	103						76	0.78	0.50	53%
7	D	71				104	88	82			107	98	117		120				82	0.83	1.37	146%
8	E	65				89	68	65			106	81	115	105	109				86	1.17	2.32	246%
9	F	62				98	62	71			77	88	96	69					90	1.33	1.24	132%
10	G	62				86	86	71			78	93							90	1.33	1.36	144%
11	H	60				100	83	60			92		110						57	1.44	0.04	4%
12	I	60				77	74	68			95	86	99						90	1.44	2.08	221%
13	K	57				69	78	72			96	60	100						36	1.61	-0.68	-73%
14	L	56				88	65	71			75								82	1.67	1.11	118%
15	M	53				76	56	50			74	68							85	1.83	1.76	187%
16	N	53				86	56	68			86	59	97						87	1.83	1.89	201%
17	O	50				85	75	63			90	72	86						23	2.00	-1.37	-145%
18	P	46				67	50	38		67	45		71						84	2.22	2.12	225%
19	Q	45				75	67	62			84	67							100	2.28	2.79	297%
20	R	42				64	48	42			67	39	52	63	45				92	2.44	1.78	189%
21	S	23	25	38	56	38	19	27			36	41	21	26					47	3.50	0.37	39%
22	T	13	26	33	30	42	37	29			49	31	55	24					72	4.06	2.18	231%
23	U	12	15	26	16	19	18	8			32	18	25	14					77	4.11	2.33	248%
24	T	13	26	33	30	42	37	29	#N/A	#N/A	49	31	55	24	#N/A	#N/A	#N/A	#N/A	72	4.06	#N/A	#N/A

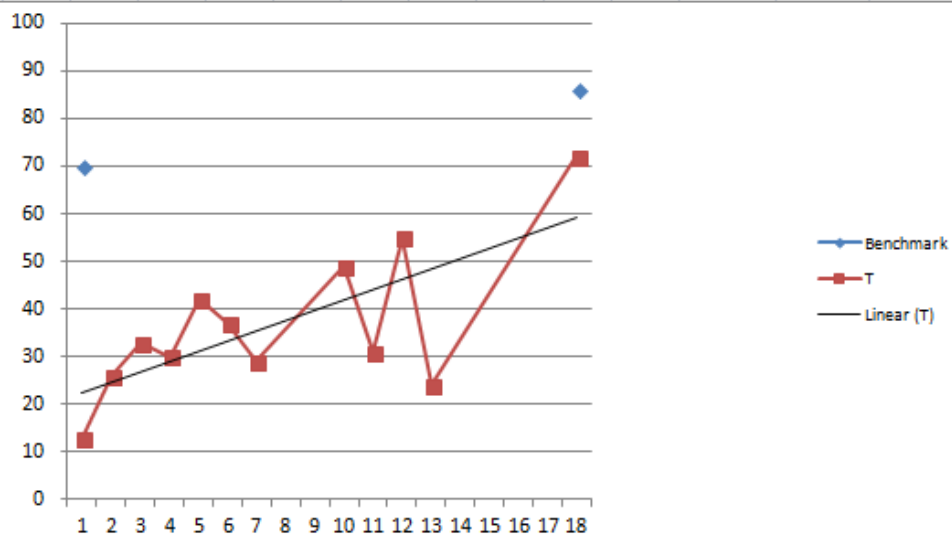
* Needed Rol based on difference between week 1 score and Benchmark score for week 18 divided by 18 weeks

** Actual Rol based on linear regression of all data points

Oral Reading Fluency Adequate Response Table

	Realistic Growth	Ambitious Growth
1st Grade	2.0	3.0
2nd Grade	1.5	2.0
3rd Grade	1.0	1.5
4th Grade	0.9	1.1
5th Grade	0.5	0.8

(Fuchs, Fuchs, Hamlett, Walz, & Germann 1993)



Laura Lent, Staff Development & Training Specialist
Lancaster-Lebanon IU 13

ROI CHART INNOVATIONS

Research Foundations

- Work of Dr. Edward Shapiro, Lehigh University
- Article: *Best Practices in Setting Progress Monitoring Goals for Academic Skill Improvement*
- **Golden Nugget:** Set goals at instructional level to capture greatest sensitivity in response to intervention
- Work of Dr. Ted Christ, UMN and Dr. Scott Ardoin, U of Georgia
- Various studies on technical adequacy of CBMs
- **Golden Nugget:** Many data points needed to create a slope that accounts for variance in passages
- Work of Drs. Lynn and Doug Fuchs of Vanderbilt University
- **Golden Nugget:** “Dual Discrepancy” of both gap and slope allows for multidimensional decision-making

Progress Monitoring @ Instructional Level for T2/T3

- **Rationale:**
- If assessed at instructional level, student's response or non-response to intervention is more authentic than if measuring one or two levels above at grade level.
- **Process:**
- Using percentile cut scores, find instructional level at between the 25th and 50th percentile with adequate accuracy (>93% accuracy).
- Once the goal of 50th percentile scores has been achieved, the student can begin on a new PM schedule at the next level up until grade level is instructional level.

Application to ROI Charts

- **Growth:**
 - Captured by charts through “percent of expected” column
 - Criterion referenced “zones” of low risk, some risk, at risk as determined by Tigard-Tualatin SD OR
- **Achievement:**
 - Captured by individual data points
 - Color-coded by individual cell

Chart Example: Growth Coding Only

Oral Reading Fluency																					
	09/07/12	09/14/12	09/21/12	09/28/12	10/05/12	10/12/12	10/19/12	10/26/12	11/02/12	11/09/12	11/16/12	11/23/12	11/30/12	12/07/12	12/14/12	12/21/12	12/28/12	12/28/12	Needed Rol*	Actual Rol**	% of Expected Rol
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
DN 25th-50th	51																	75		1.41	
Snow White	52	54	55	57	59	54	62	67	71										1.28	2.10	149%
Zippy Car	63	65	66	70	71	68	73	76	75										0.67	1.55	110%
John Doe	70	67	72	75	71	77	73	78	77										0.28	1.08	77%
Jane Doe	72	72	75	73	75	78	80	77	80										0.17	1.03	73%
Simon Saiz	53	62	67	73	79	68	63	66	70										1.22	1.12	79%
																			1.17	#DIV/0!	#DIV/0!

- Note: Last 3 students are “red” for ROI...yet, have hit the goal or exceeded it on multiple occasions...**

Chart Example:

Growth & Achievement Coding

Oral Reading Fluency																					
	09/07/12	09/14/12	09/21/12	09/28/12	10/05/12	10/12/12	10/19/12	10/26/12	11/02/12	11/09/12	11/16/12	11/23/12	11/30/12	12/07/12	12/14/12	12/21/12	12/28/12	12/28/12	Needed Rol*	Actual Rol**	% of Expected Rol
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
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Jane Doe	72	72	75	73	75	78	80	77	80										0.17	1.03	73%
Simon Saiz	53	62	67	73	79	68	63	66	70										1.22	1.12	79%
																			4.17	#DIV/0!	#DIV/0!
																			4.17	#DIV/0!	#DIV/0!

- The color coding of the cells mitigates the “problem” with aimlines or the variance created by differing baseline scores moving to the same goal.

Limitations

- CBM data is only one form of assessment
- Only correlates around .5-.6 with high stakes assessment
- Other forms of data need to be collected and triangulated in order to best interpret a student's response to intervention.
- “Be smarter than the Excel sheet!” –Koser.

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Thank You!