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Data Workshop: Two Tools for Analysis in Improvement Science

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In this session…

Data and analytic tools used in improvement journeys

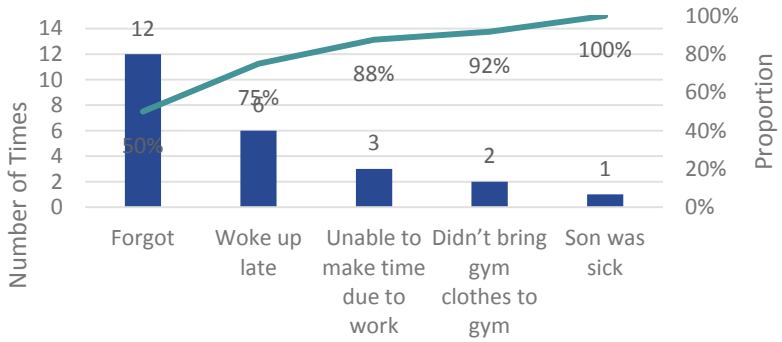
1. Identifying a problem within a system
2. Understanding variation in performance

This session will focus on hands-on improvement data work

Some of the Tools used in Improvement Efforts

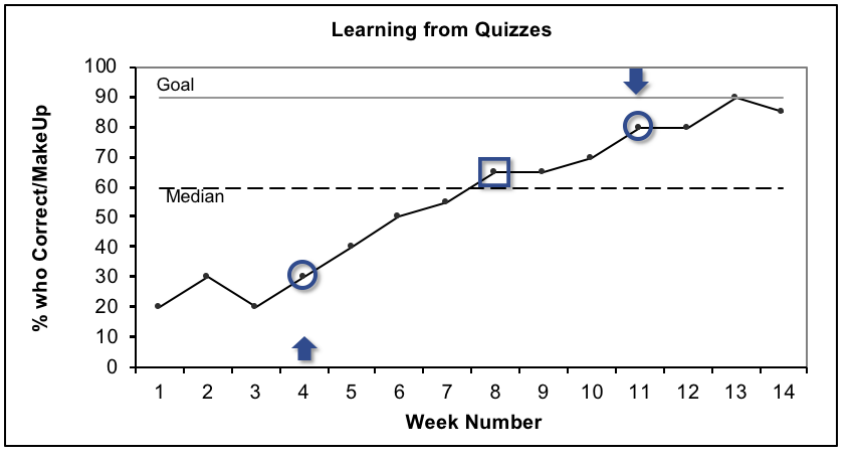
1. Identifying a problem within a system

   a. Pareto graphs



2. Understanding variation in performance

   b. Run charts



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Types of Analysis in Improvement Work

- Discuss with your neighbor the types of analysis you've encountered in improvement work

One Tool for Focusing on the Problem: Pareto Graphs

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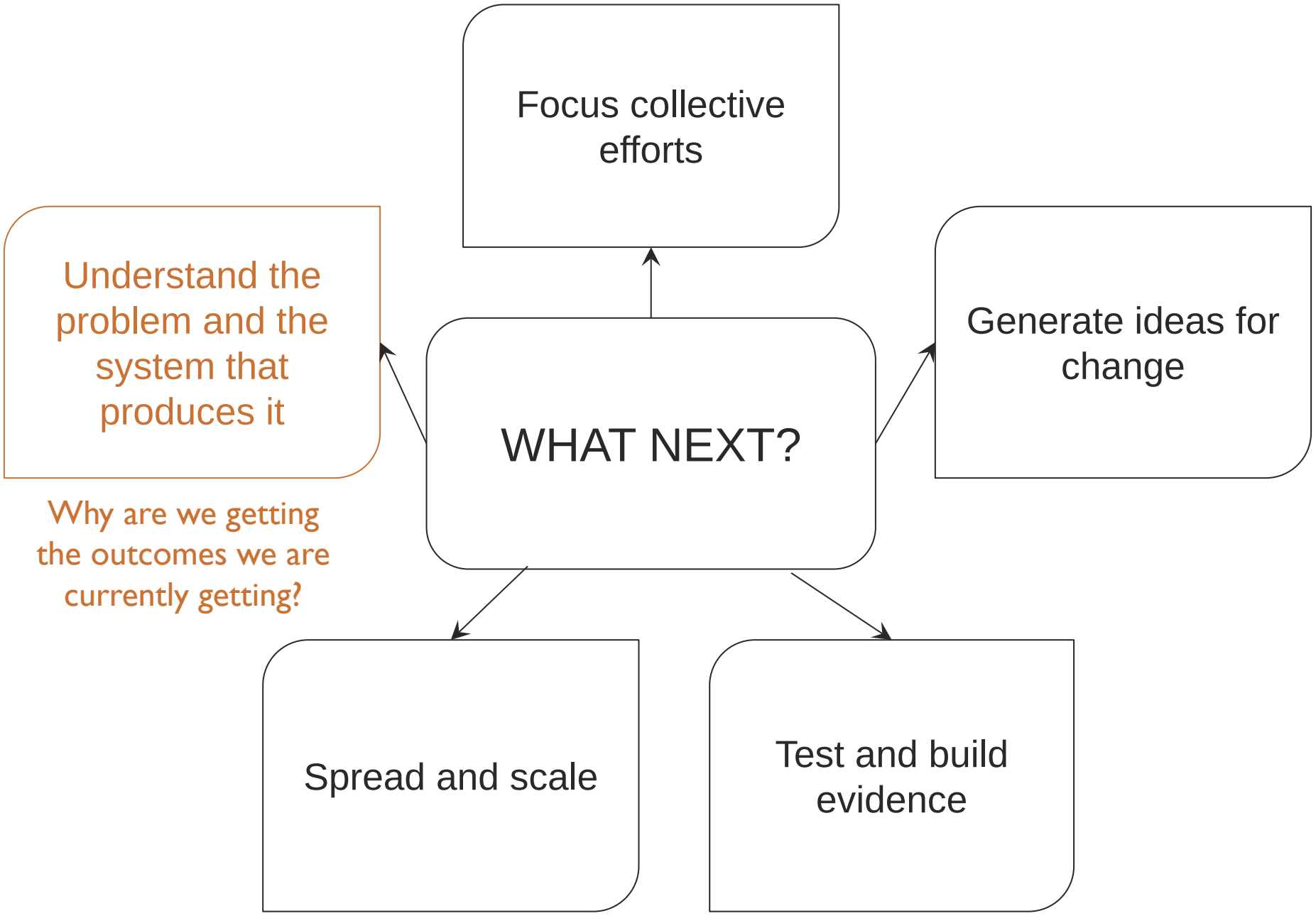

Developmental Math is a Hurdle for Students

60%

of freshman entering community colleges are assigned to developmental math.

Only

20%

of those students continue on to pass a required college level math class.

500,000 STUDENTS

in every cohort will never complete the developmental math requirement.

= 10,000 students

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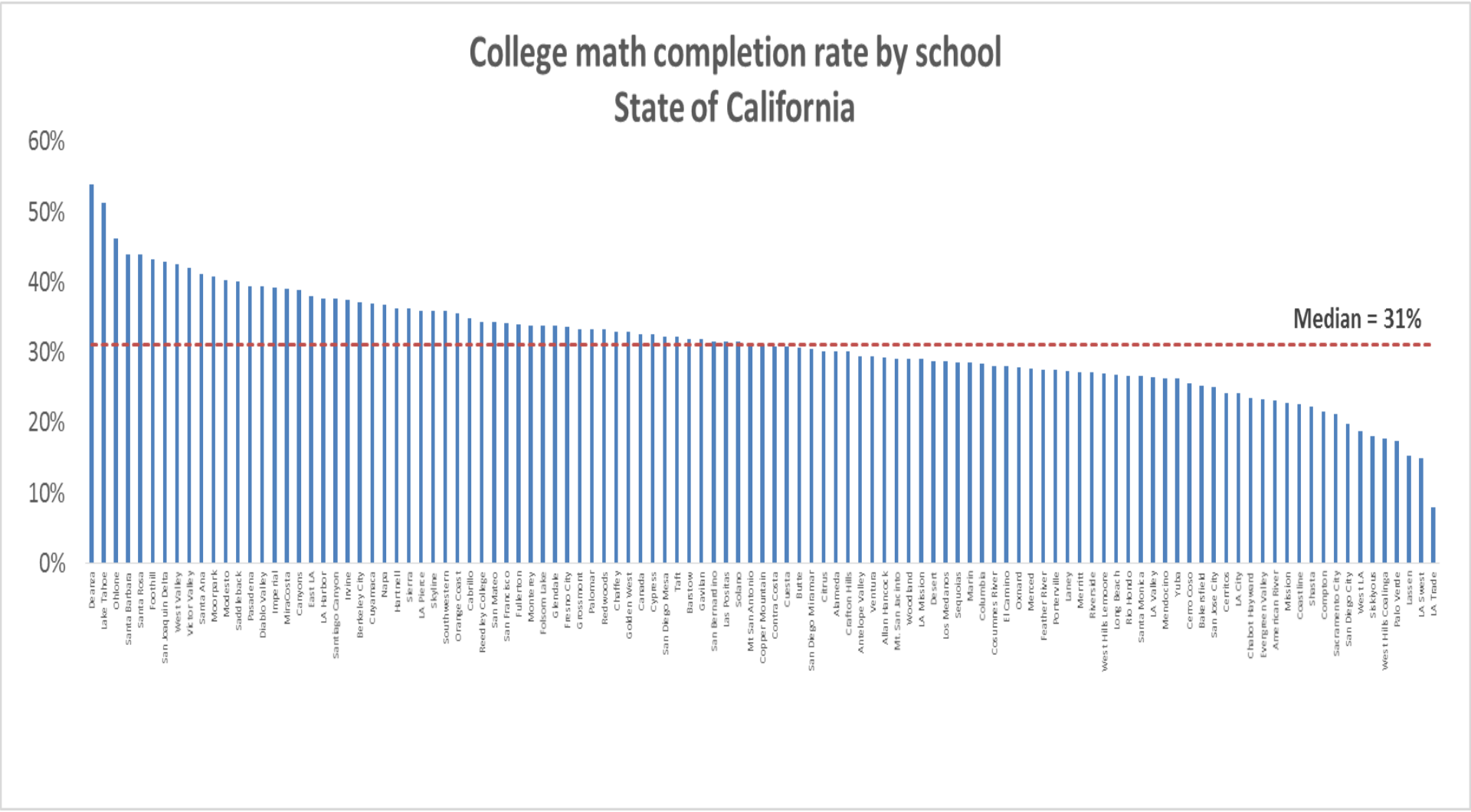
Improvement principle

Every system is perfectly designed to get exactly the results that it gets

Improvement principle

Attending to Variation



2008 cohort
6 year completion rate

Variation in Performance

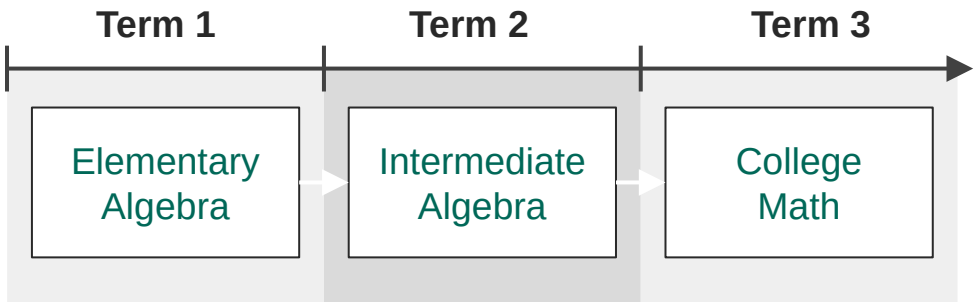
WHY?

Every system is perfectly designed to get exactly the results that it gets

Why are we getting the outcomes we are currently getting?

Course placement | **Registration** | **Advising** | **Out of class supports**

High School Math



Transfer requirements

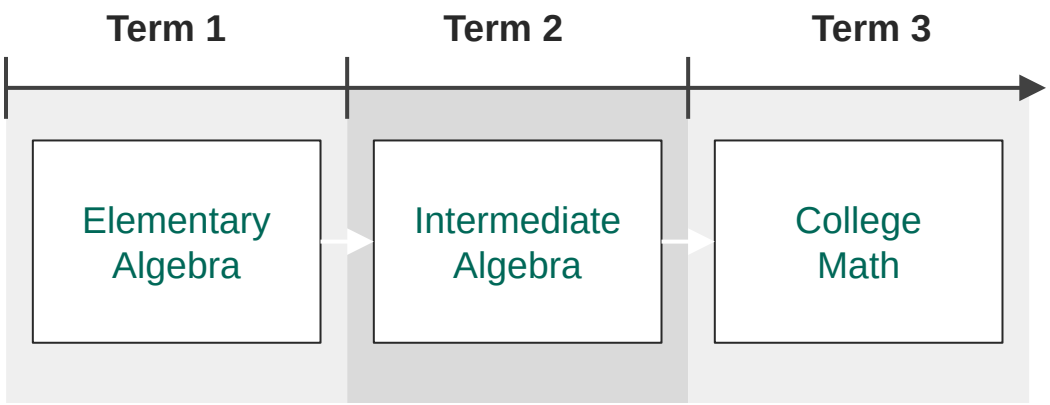
Student beliefs about learning math

$$(x-1)\left(x+3+\frac{3}{x-1}\right)=\left(\frac{4-x}{x-1}\right)(x-1)$$
$$(x-1)(x+3)+3=4-x$$
$$x^2+2x-3+3=4-x$$
$$x^2+3x-4=0$$
$$(x-1)(x+4)=0$$

Faculty beliefs about learning math

Hiring of faculty | **Faculty assignment** | **Available data** | **Incentives** | **Resources**

Lets dig in a little bit



Where do we lose students?

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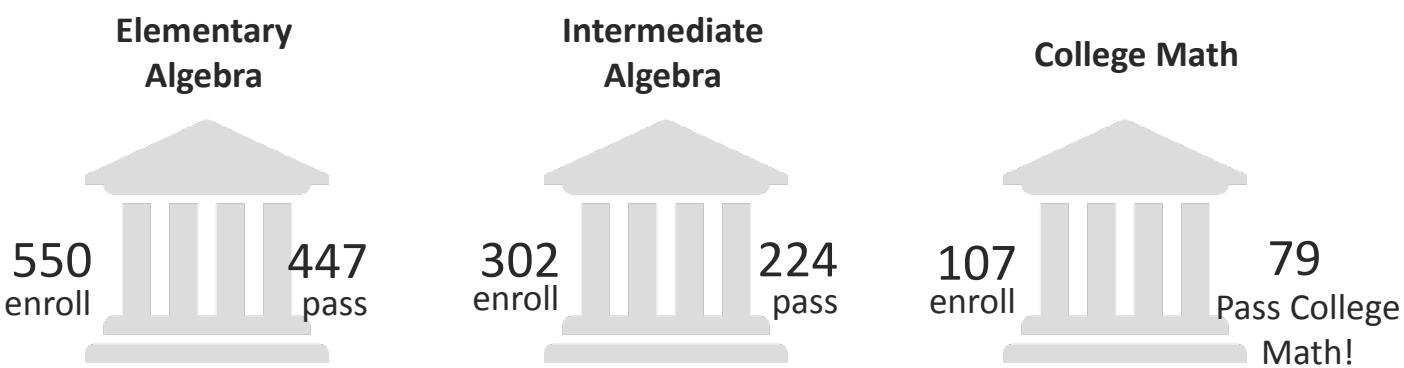
Where do we lose students?

Fall 2009 cohort, 1 college

742

Incoming students that place 2 levels below college level math



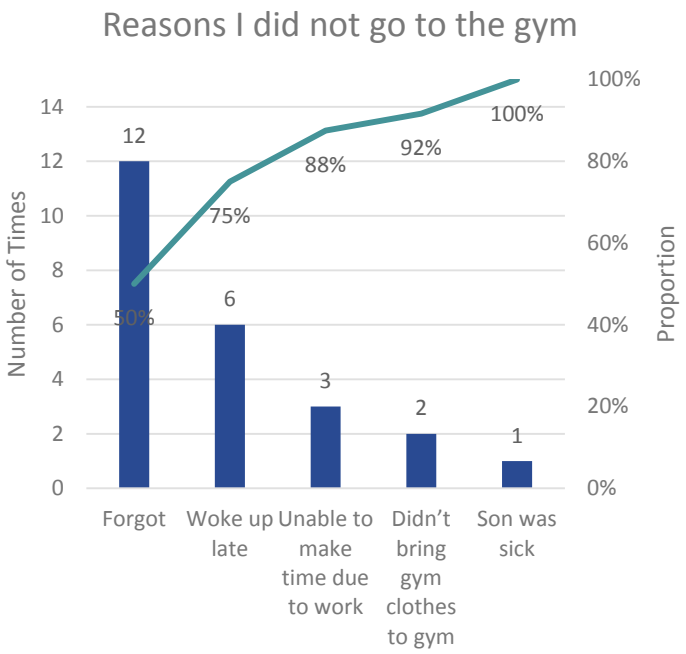
2 years later

Pareto principle

An Example of Visualizing the Pareto Principle

- Reasons why I did not go to the gym in the last two months…

Reasons I did not Exercise In December	Number of Times	Proportion
Forgot	12	50%
Woke up late	6	75%
Unable to make time due to work	3	88%
Didn’t bring gym clothes to gym	2	92%
Son was sick	1	100%



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Activity: Creating a Pareto Graph

In groups of 3 or 4 people:

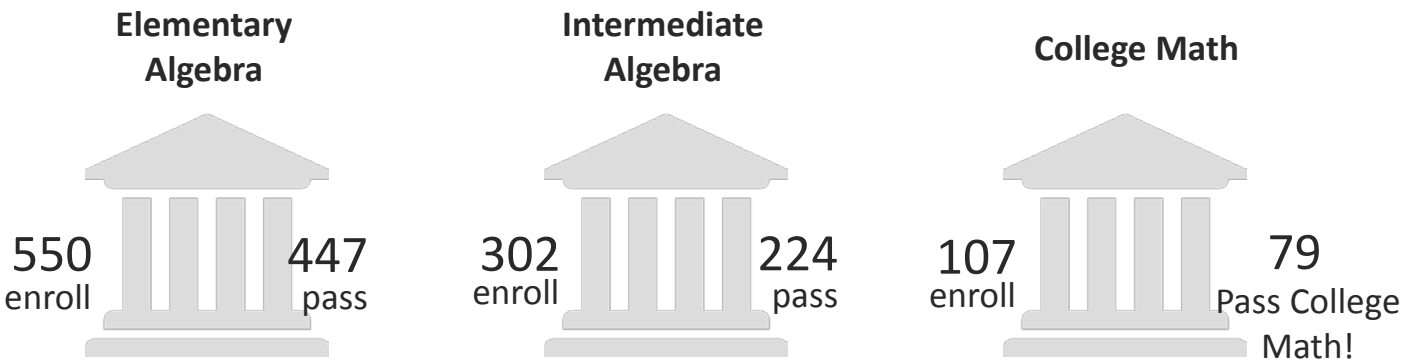
1. Identify LOSS POINTS in the developmental math sequence using the data provided
2. Create an ordered bar graph on the x/y axis sheet
3. Draw in proportion line (using the second y-axis)

Where do we lose students?

Fall 2009 cohort, 1 college

742

Incoming students that place 2 levels below college level math

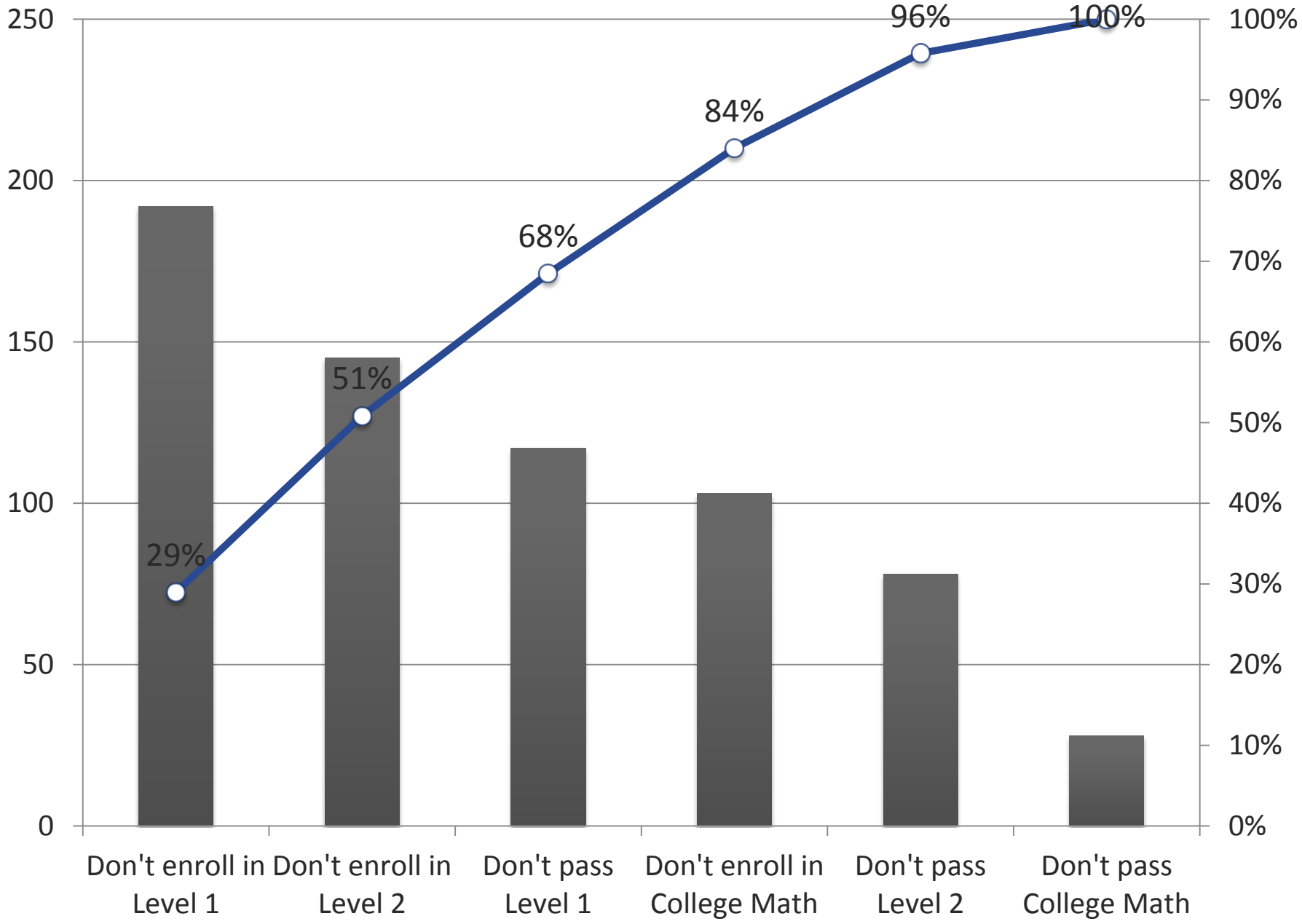


2 years later

(1) Identify LOSS POINTS in the developmental math sequence using the data provided

(2) Create an ordered bar graph

(3) Draw in proportion line



Pareto Chart

Debrief & Questions

- What was easy and what was challenging?
- What did you learn?
- Other questions?

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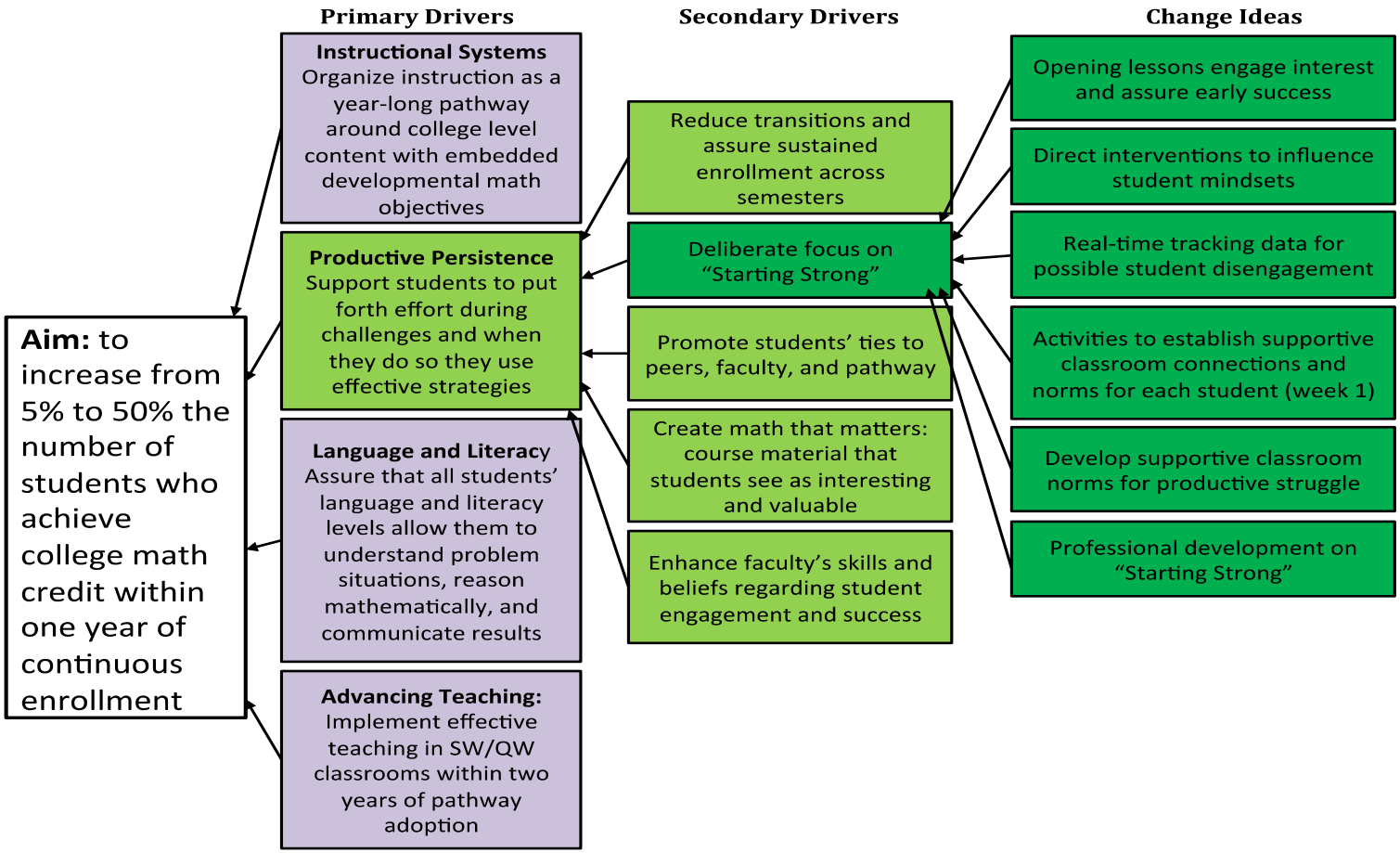
Linking Identification of the Problem to Undertaking Improvement



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One Tool for Understanding Variation: Run Charts

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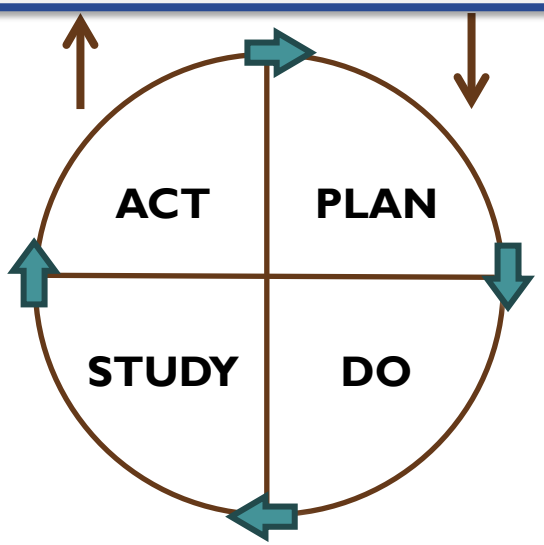
Activity

Is the change an improvement?

What are we trying to accomplish?

How will we know that a change is an improvement?

What change(s) can we make that will result in improvement?



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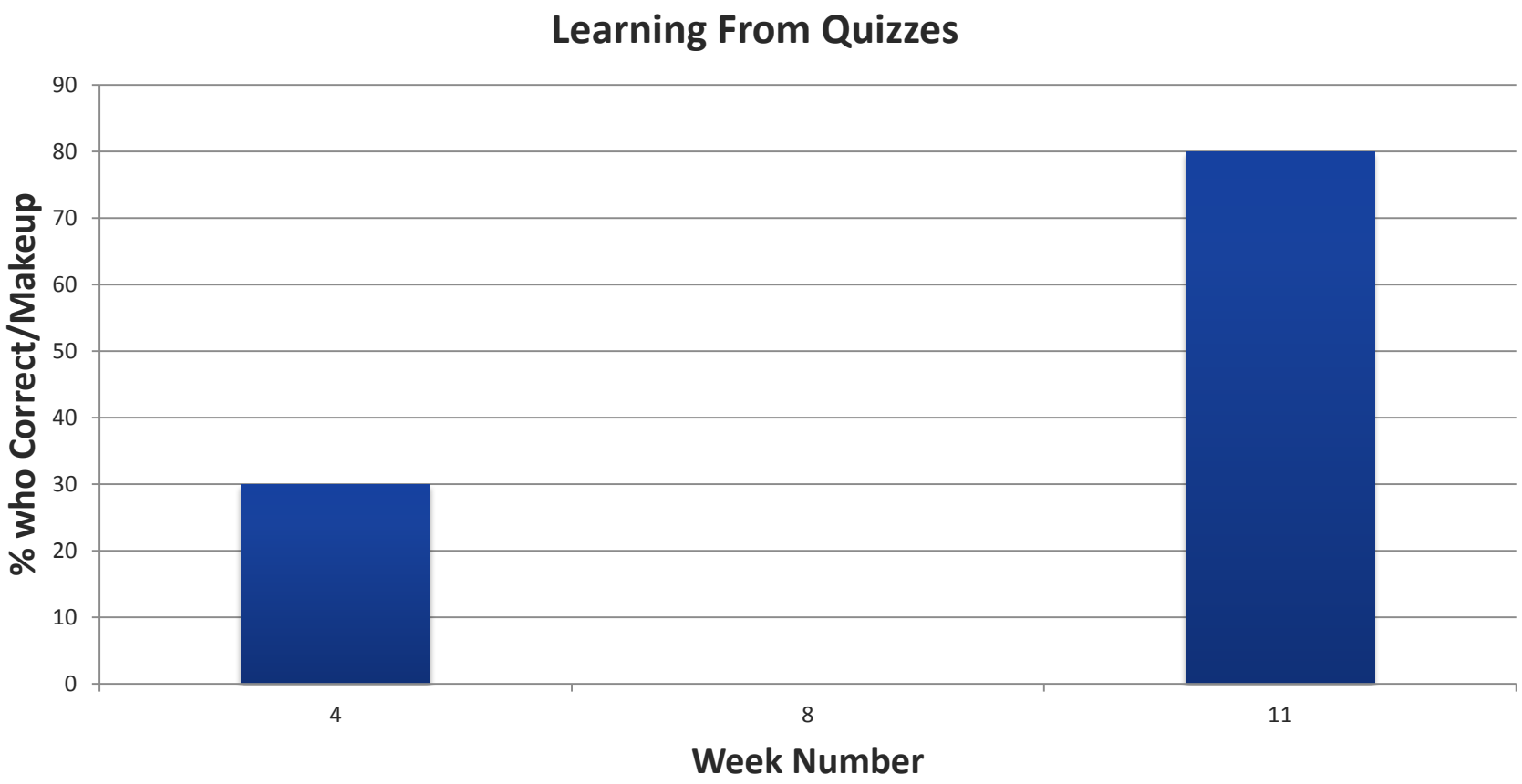
Scenario

- An instructor has 35 students in his college math course and gives a weekly quiz. Every week, he records the percent of students who submit corrections to their quizzes for partial credit back on their scores.
- After the 7th week, he decides to implement a change to see if he can increase the number of students who engage in quiz corrections. She implements the change in time for the 8th quiz.
- It's now Week 11, and he decides to look at data before the change, in Week 4, and after the change, in Week 11.

The "Results"



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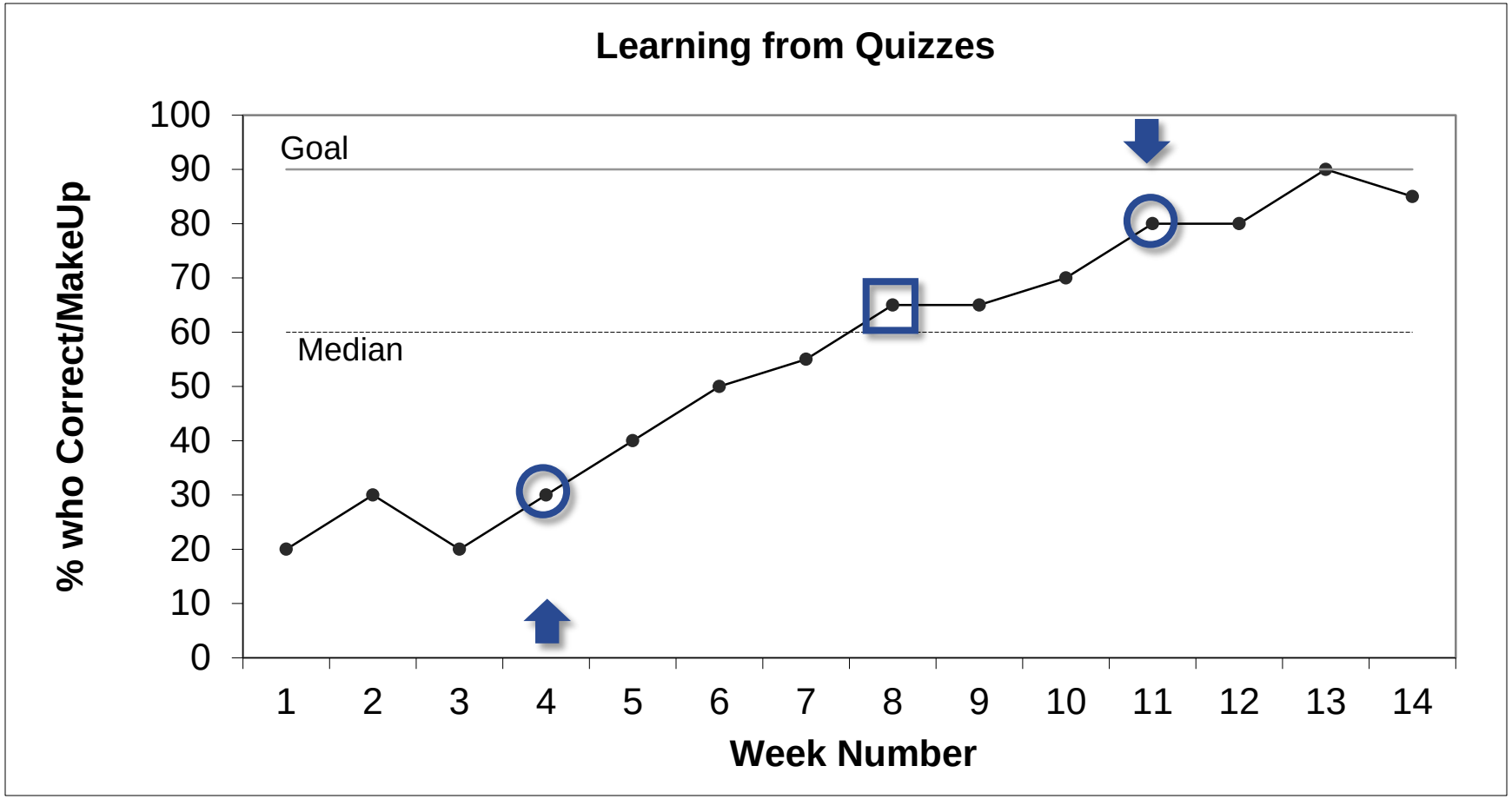
Run Chart #1



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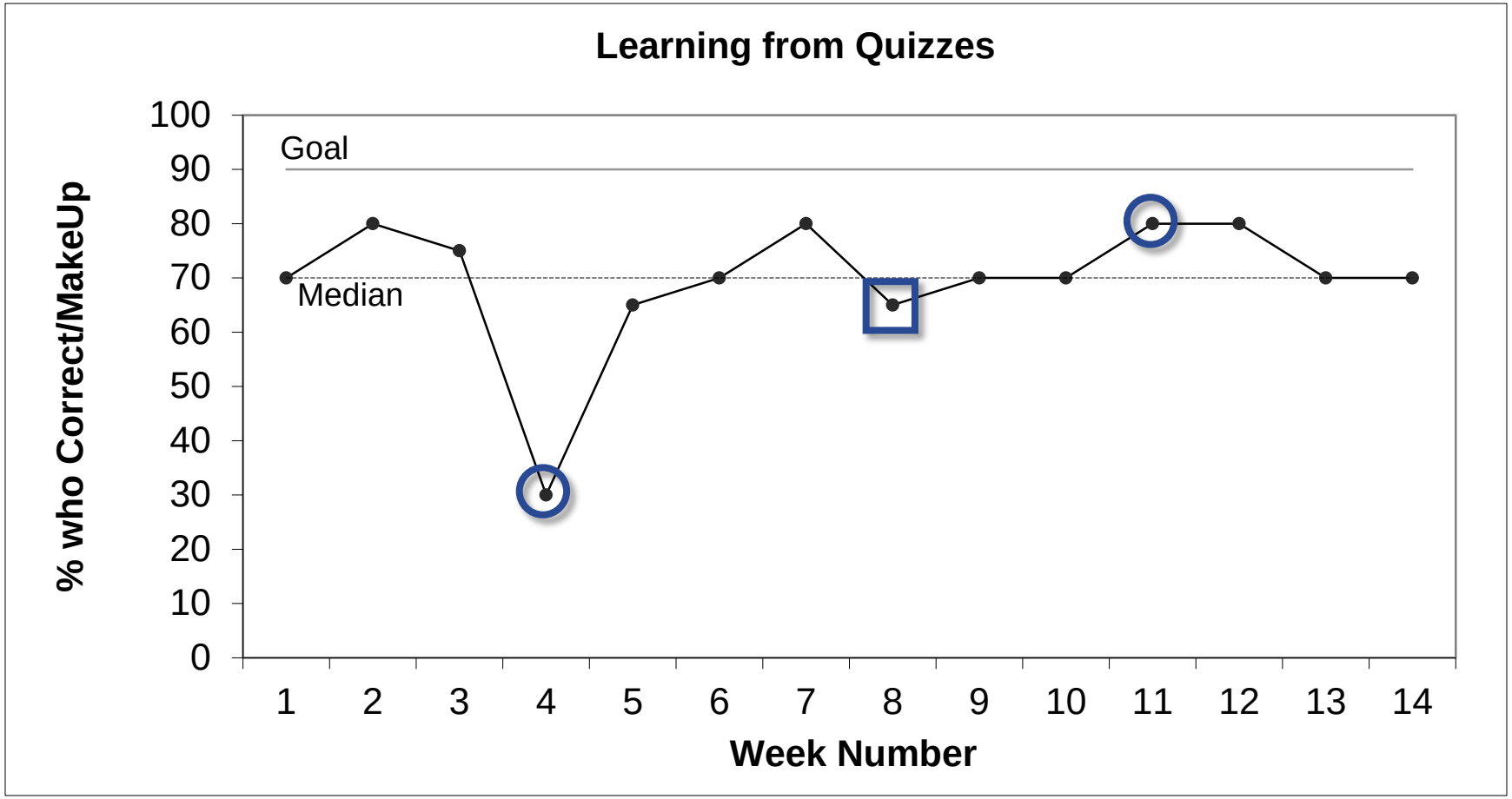
Run Chart #2



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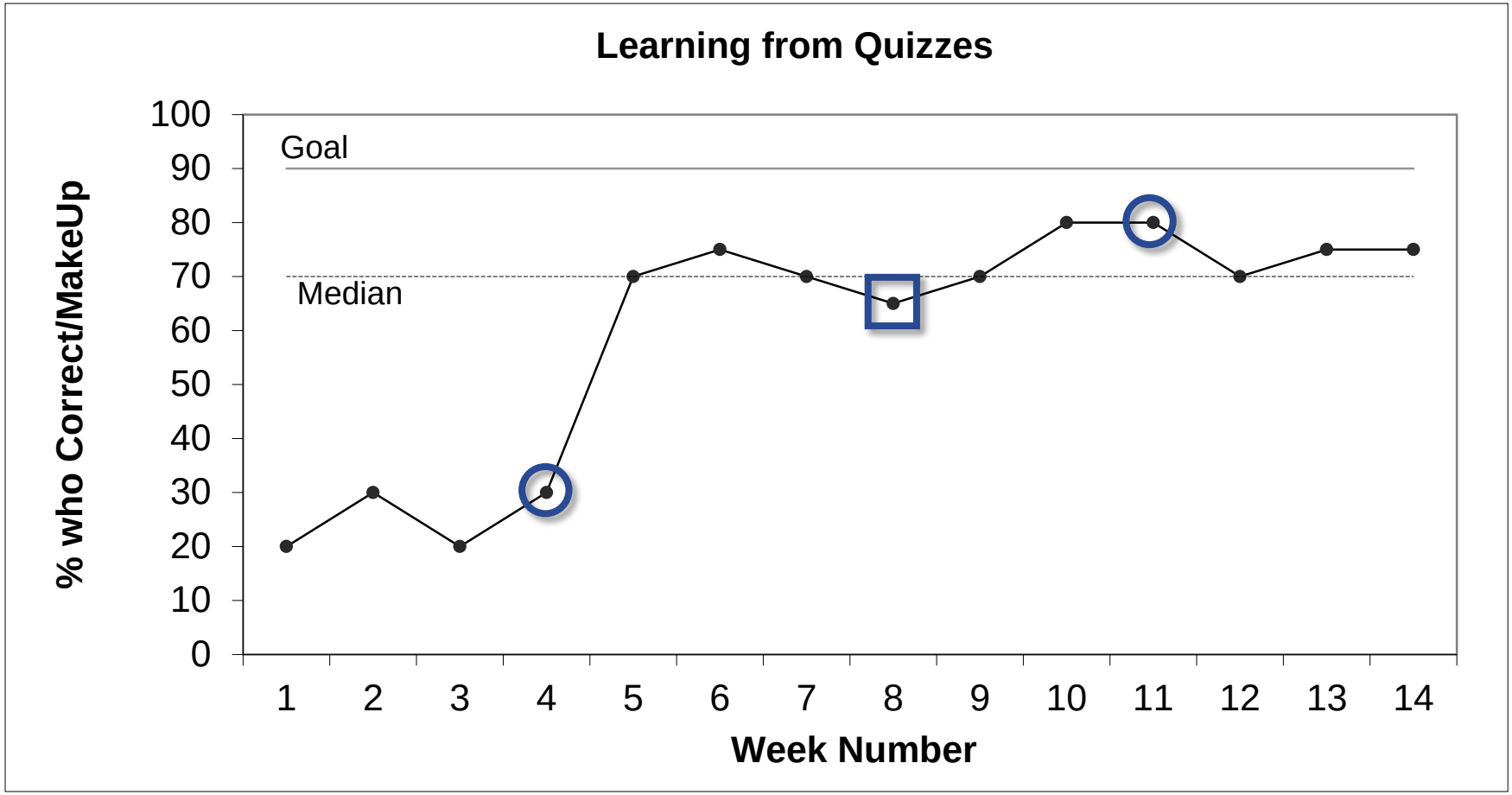
Run Chart #3



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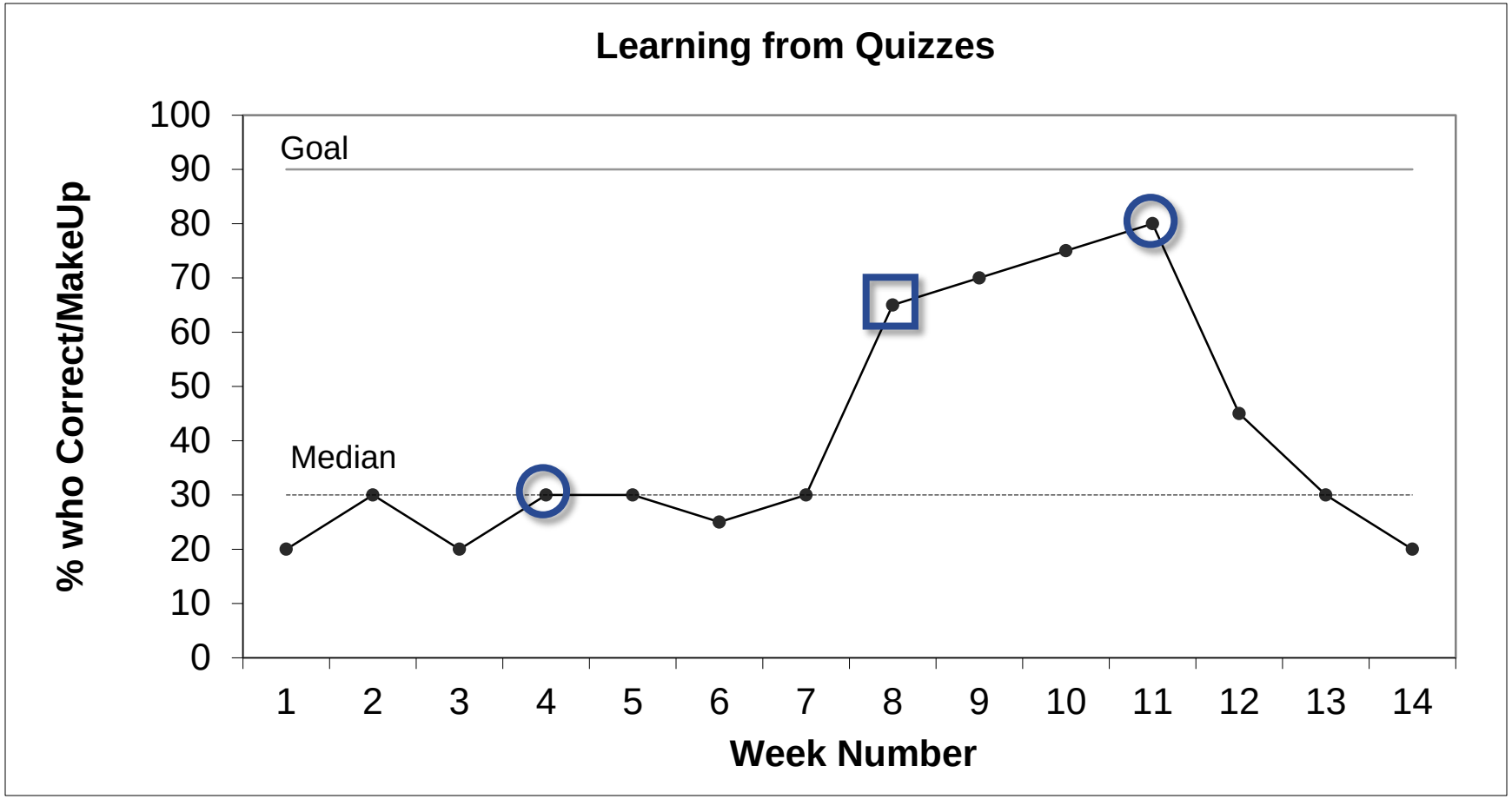
Run Chart #4



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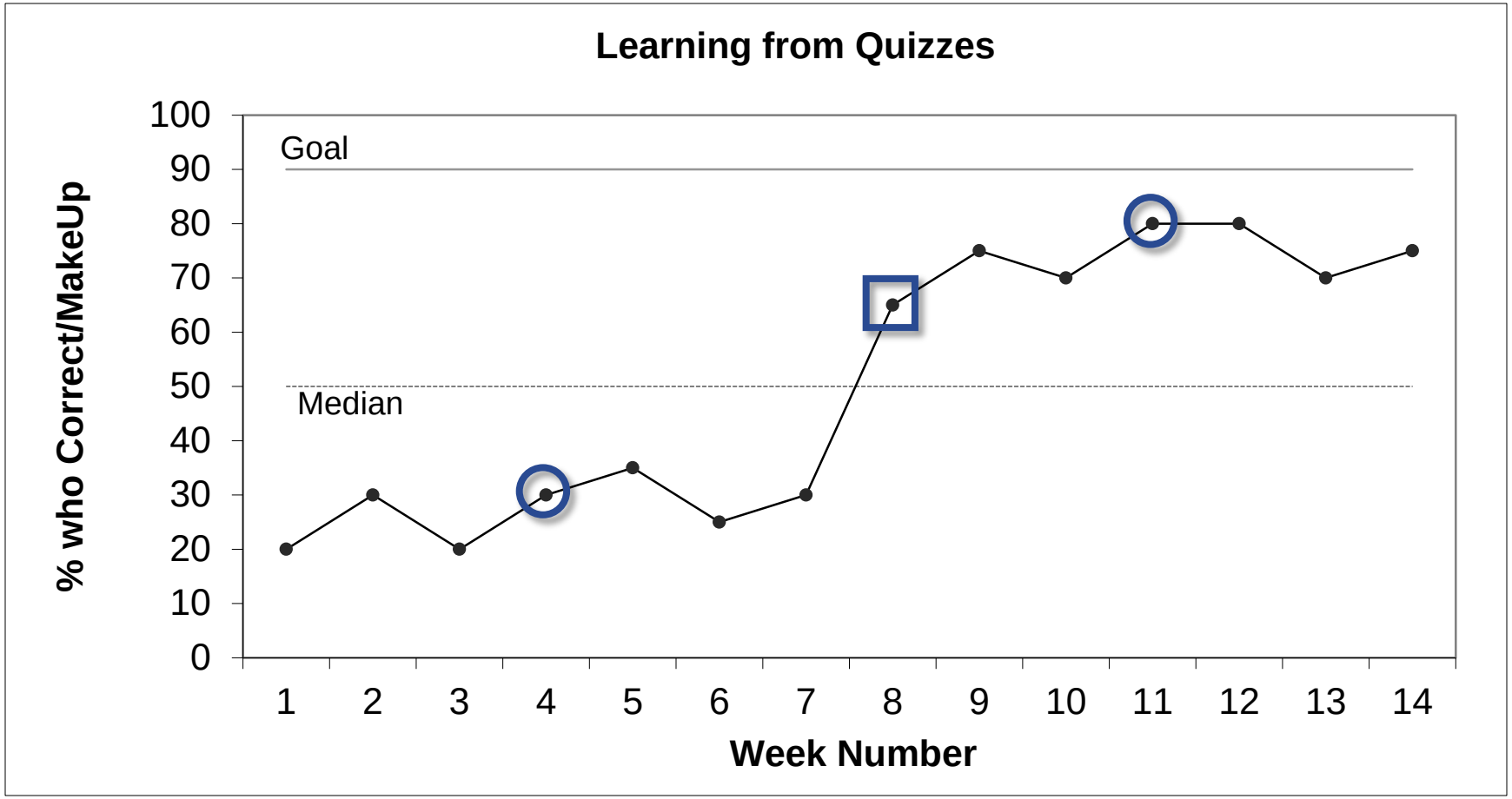
Run Chart #5



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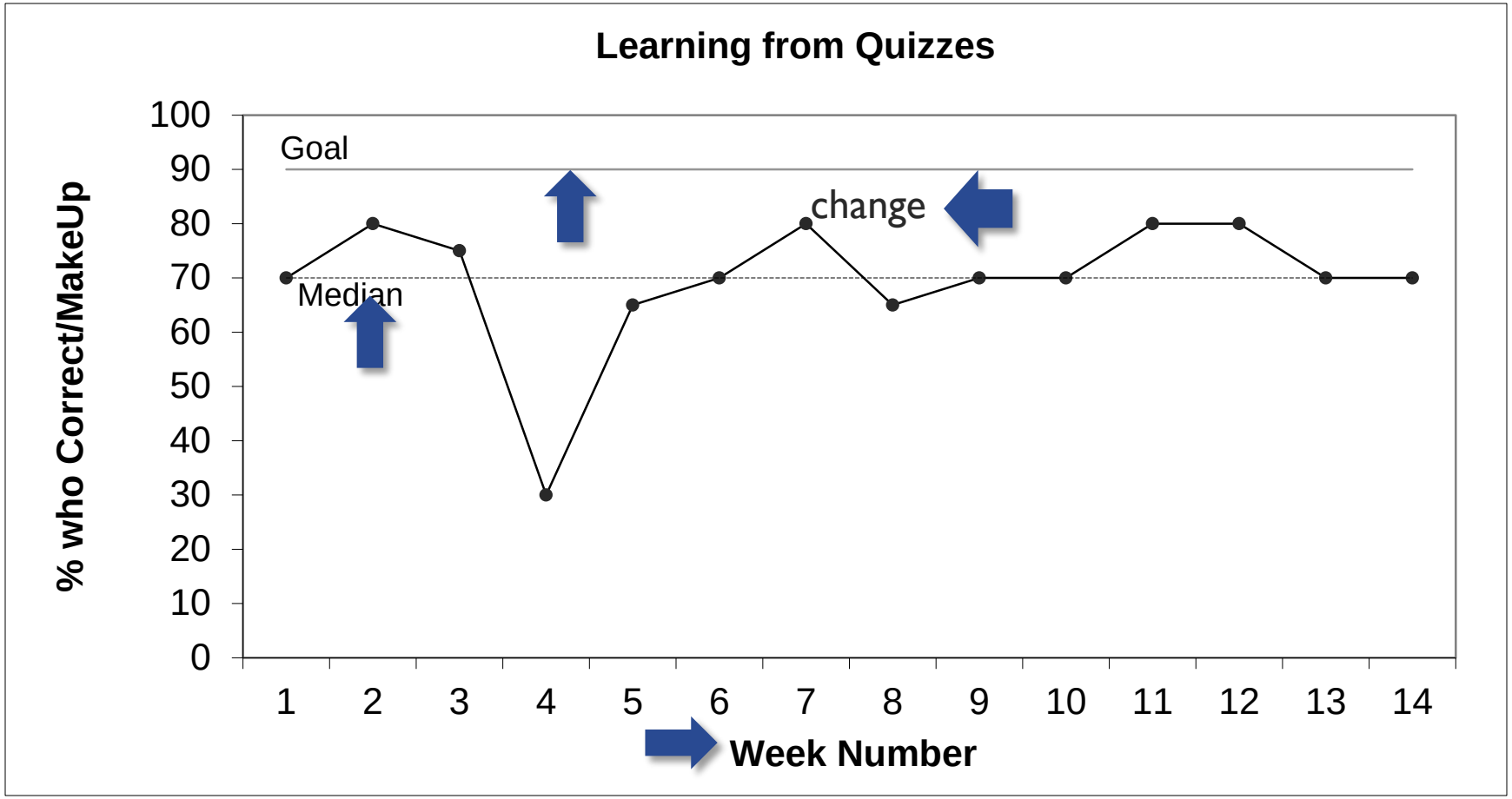
Why (or when) a run chart?

- **See variation** over time
  - Helps assess whether a change is an improvement
  - Assess whether improvement is sustained
  - Look at process performance

Elements of a Run Chart



How do we assess when improvement has occurred?

- First by understanding and detecting when there is non-random variation present in the performance of a measure
- Second in linking (often through annotation) the intentional changes we are making to the performance of a measure
- Two cautions we always have to be aware of:
  - Allowing the data to speak for itself (it reveals random or non-random variation to us, not the other way around)
  - Sometimes non-random variation occurs and it is not because of something we did. In those cases we must go and investigate what is happening in the system

Signals

- We have Four Rules to decide when the data give us a "signal" of improvement (or the reverse)…
- These rules are intended to support our visual analysis
  1. Shift
  2. Trend
  3. Too many or too few Runs
  4. Astronomical Data Point

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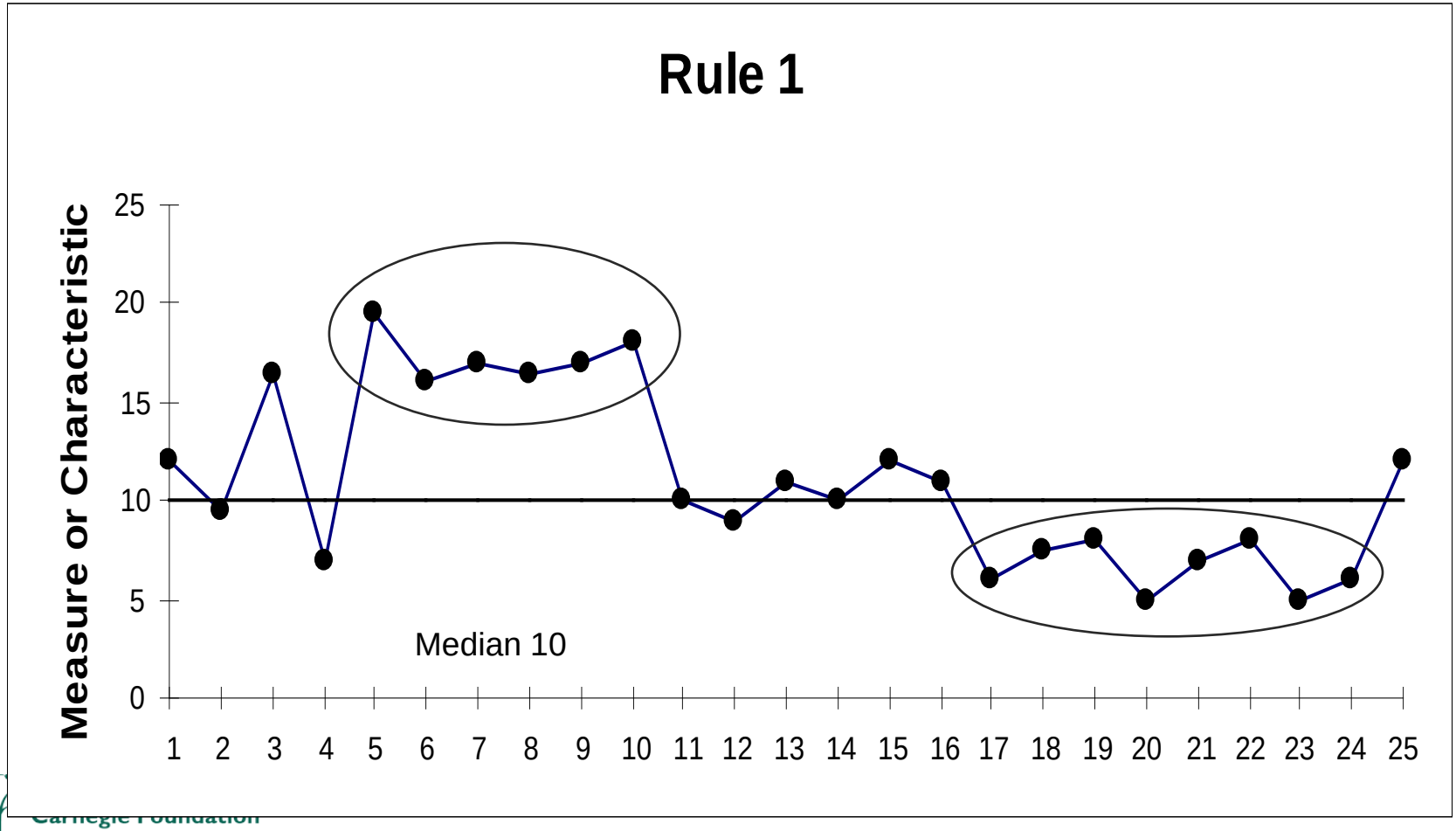
Rules For Determining Probability Based Signals of Change

Rule 1 (Shift) : Six or more consecutive POINTS either all above or all below the median. Skip values on the median and continue counting points. Values on the median DO NOT make or break a shift.



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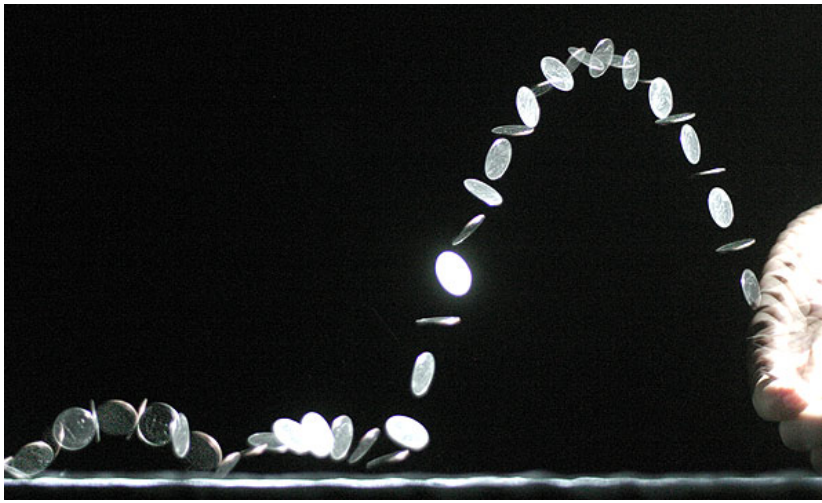
Murray and Provost

Why do we need 6 points?

- What is the probability of a coin landing heads or tails?



- .5
- .5 x .5 = .25
- .5 x .5 x .5 = .125
- .5 x .5 x .5 x .5 = .0625
- .5 x .5 x .5 x .5 x .5 = .03125
- .5 x .5 x .5 x .5 x .5 x .5 = .015625

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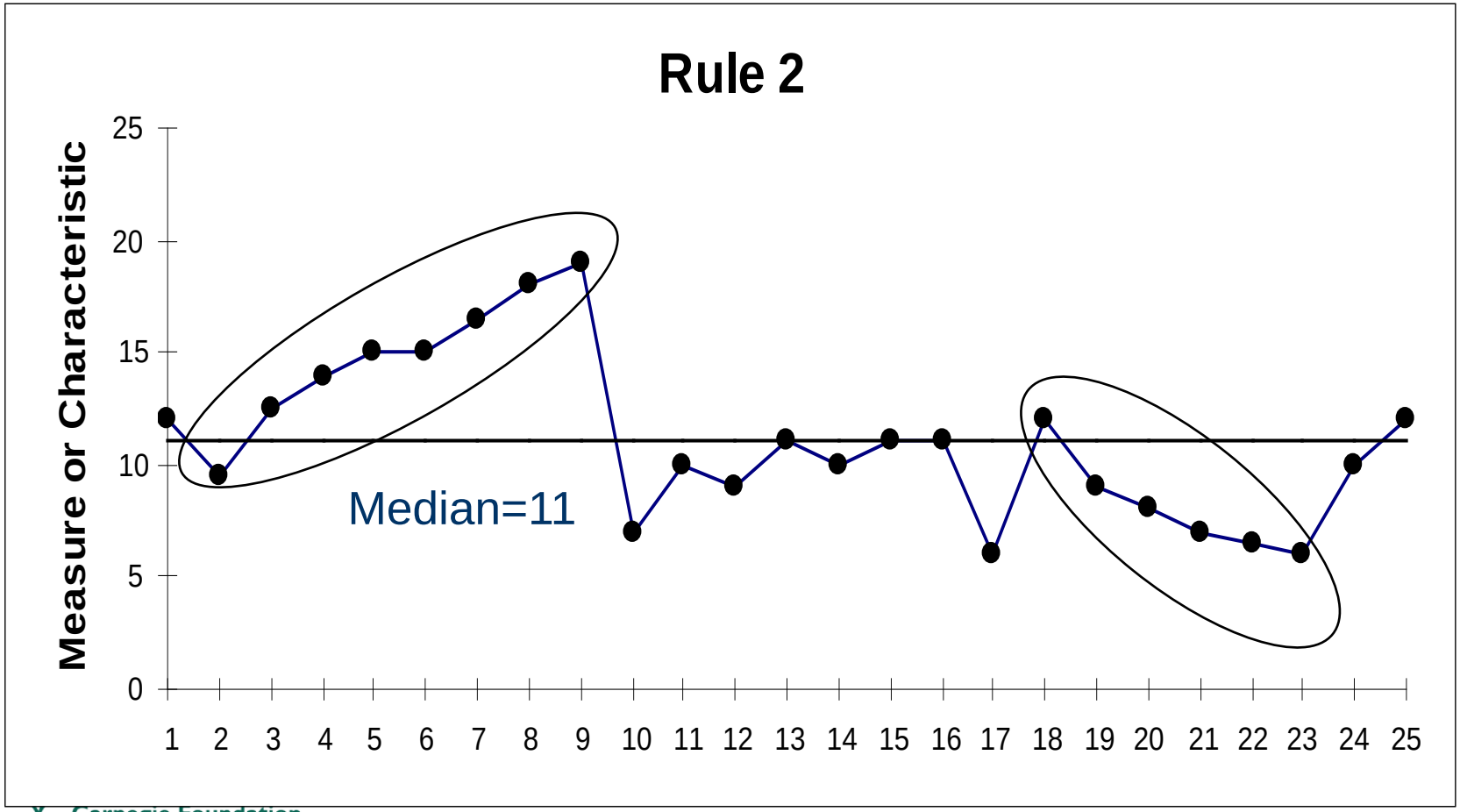
Rules For Determining Probability Based Signals of Change

Rule 2 (Trend): Five points all going up or all going down. If the value of two or more successive points is the same, ignore one of the points when counting; like values do not make or break a trend.



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Murray and Provost

Table for Checking for Too Many or Too Few Runs on a Run Chart

Total number of data points on the run chart *that do not fall on the median*	Lower limit for the number of runs (< than this number of runs is "too few")	Upper limit for the number of runs (> than this number of runs is "too many")
10	3	9
11	3	10
12	3	11
13	4	11
14	4	12
15	5	12
16	5	13
17	5	13
18	6	14
19	6	15
20	6	16
21	7	16
22	7	17
23	7	17
24	8	18
25	8	18

Table is based on about a 5% risk of failing the run test for random patterns of data.

Adapted from Swed, Feda S. and Eisenhart, C. (1943). "Tables for Testing Randomness of Grouping in a Sequence of Alternatives. Annals of Mathematical Statistics. Vol. XIV, pp.66 and 87, Tables II and III.

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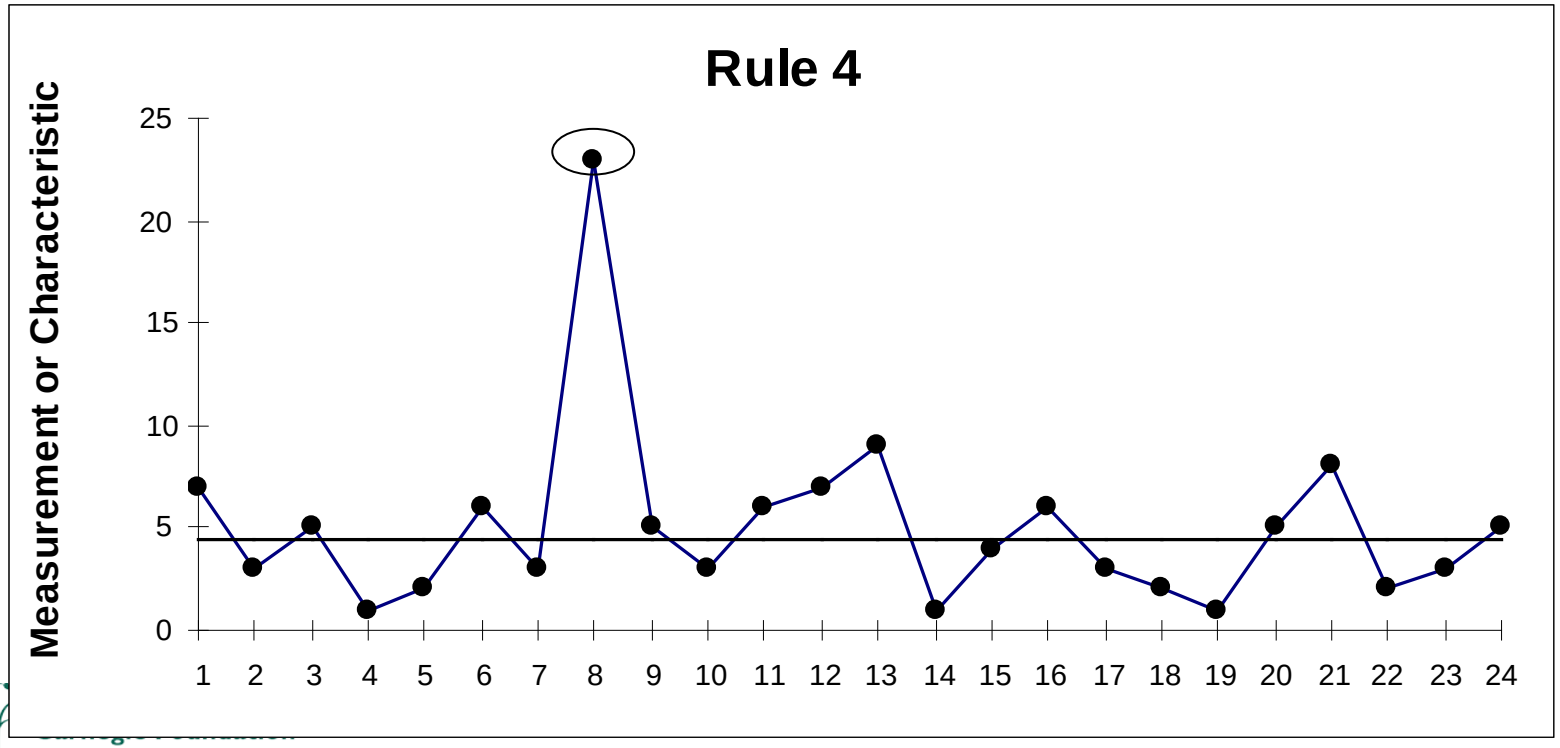
Rules For Determining Probability Based Signals of Change

RULE 4:Astronomical
For detecting unusually large or small numbers:

Data that is Blatantly Obvious different value
Everyone studying the chart agrees that it is unusual
Remember:
Every data set will have a high and a low - this does not mean the high or low are astronomical



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Murray and Provost

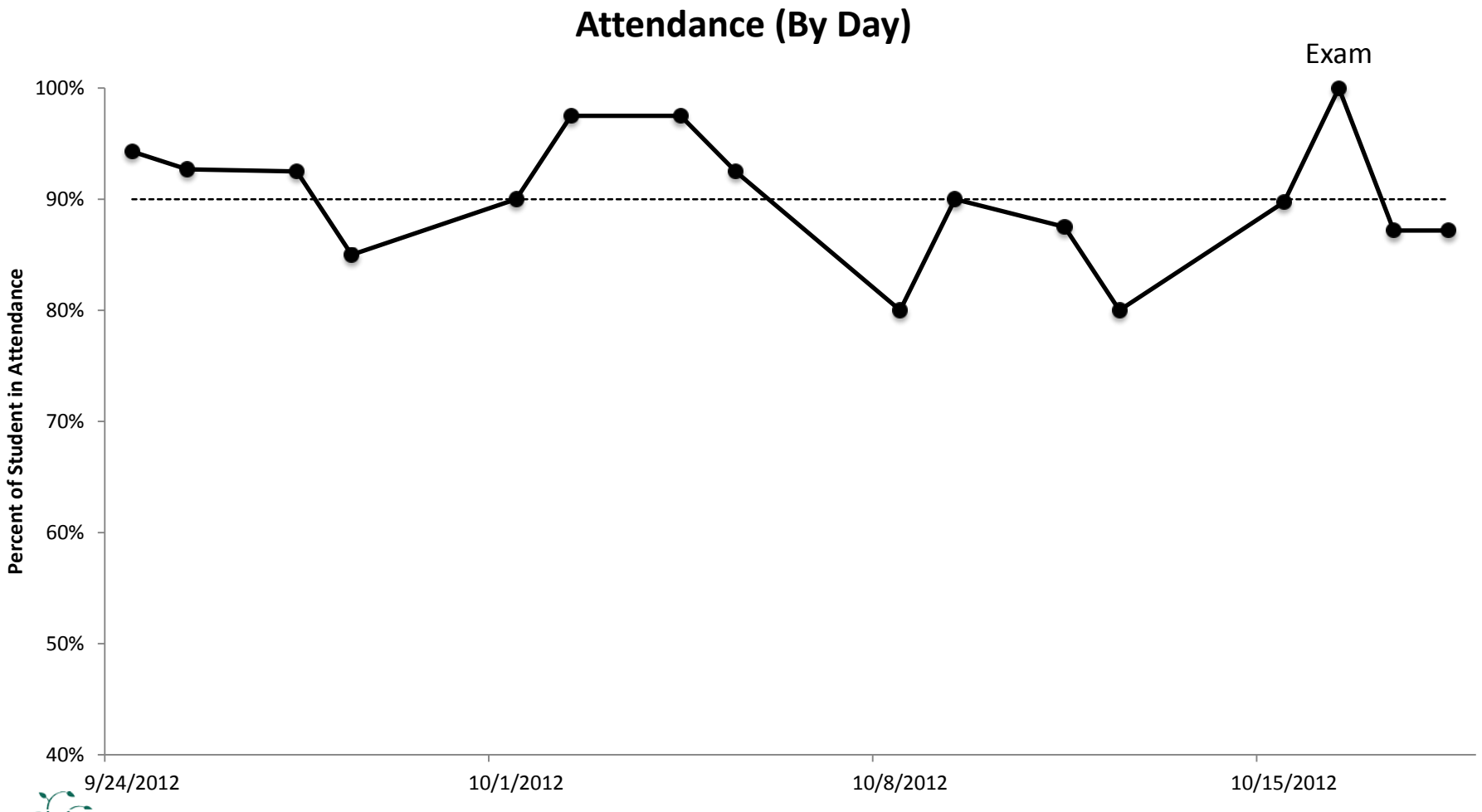
Activity

- Using the packet provided:
- Examine the chart challenges
- Can you identify if they display random or non-random variation?
- If a chart contains non-random variation, identify which rule(s) you used to identify the important variation

Debrief

- What did you discover for each of the four chart challenges?

Example 1: Do any rules apply?



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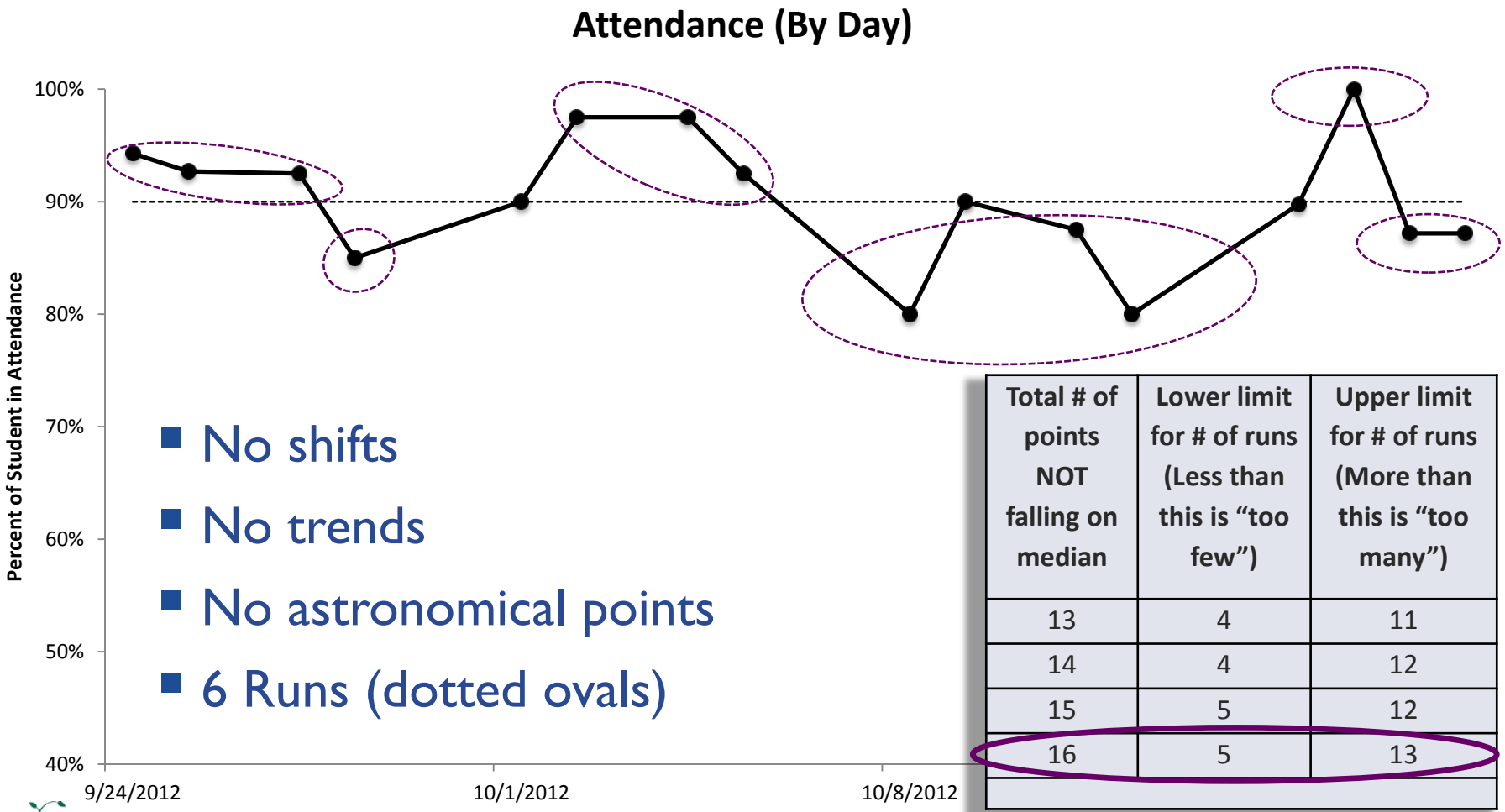
Example 1: Analysis



- No shifts
- No trends
- No astronomical points
- 6 Runs (dotted ovals)

Total # of points NOT falling on median	Lower limit for # of runs (Less than this is "too few")	Upper limit for # of runs (More than this is "too many")
13	4	11
14	4	12
15	5	12
16	5	13

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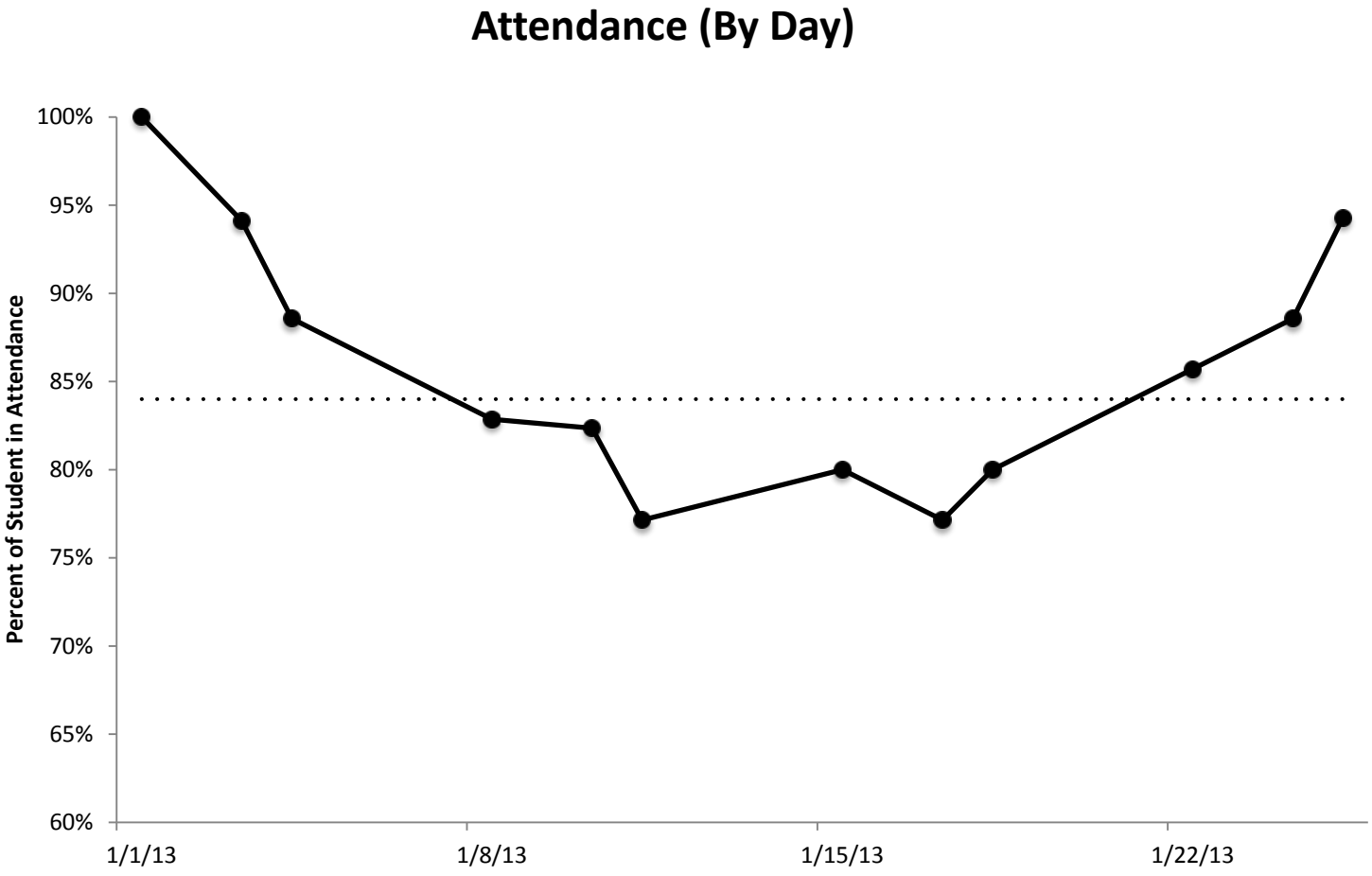
Example 2



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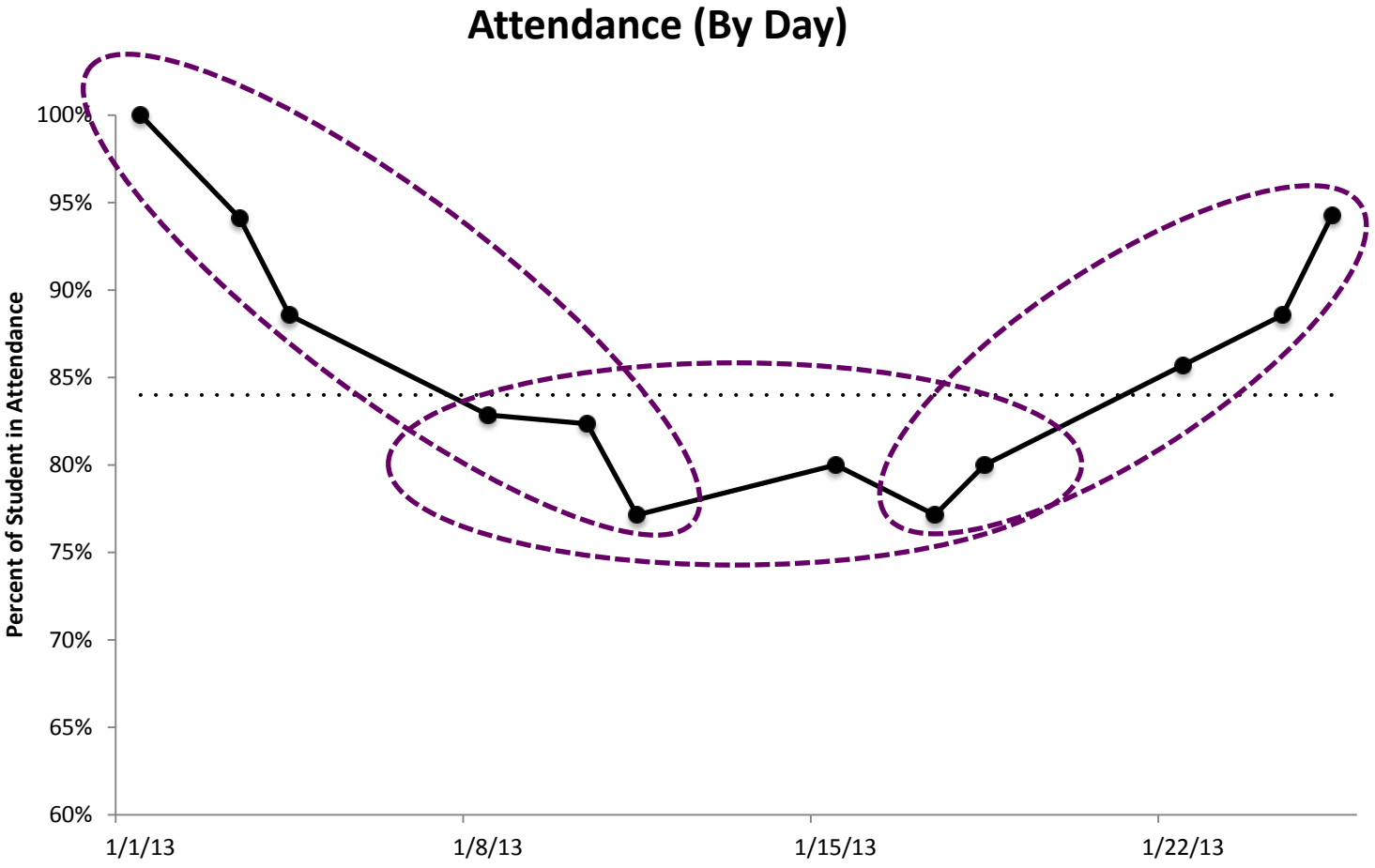
Example 2



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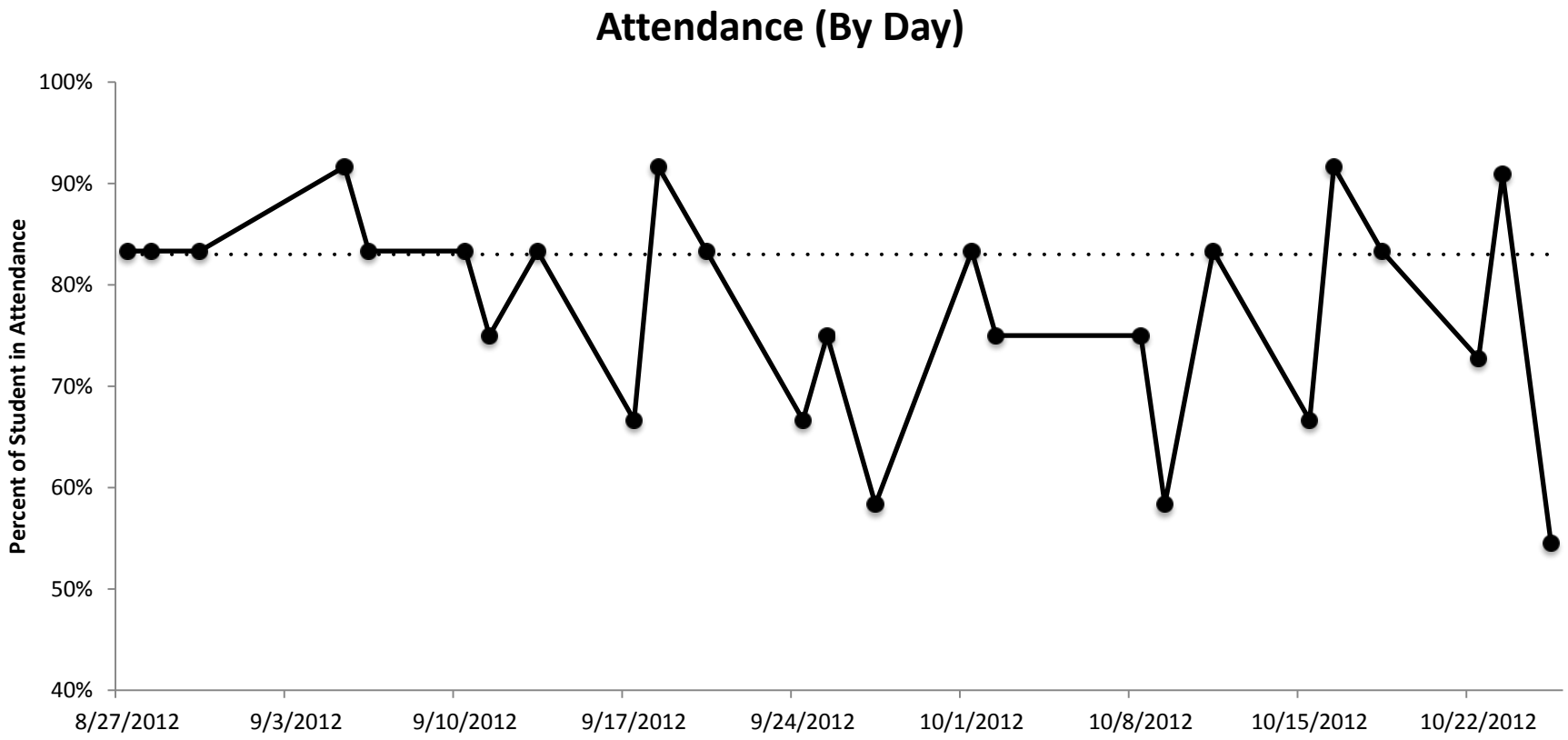
Example 3



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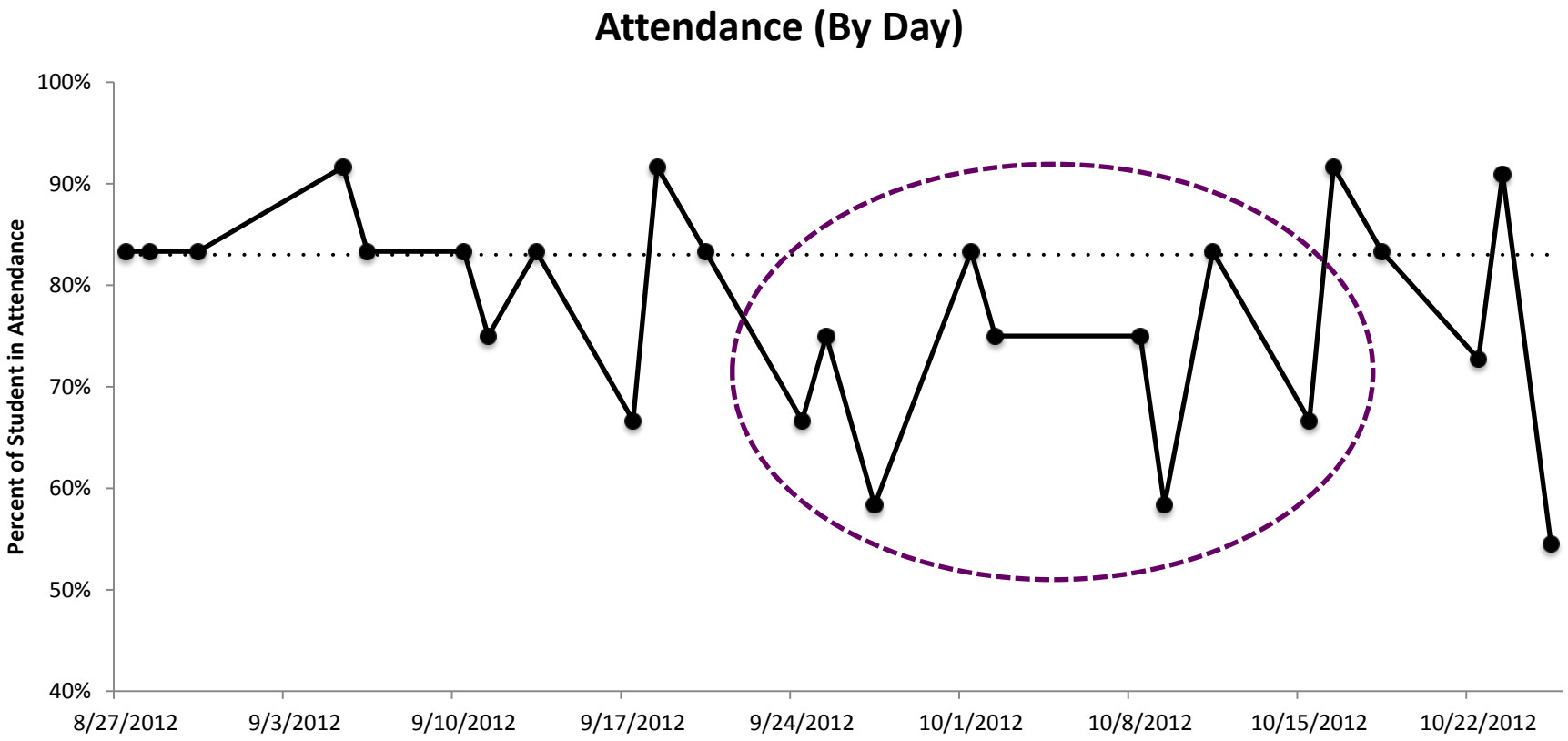
Example 3



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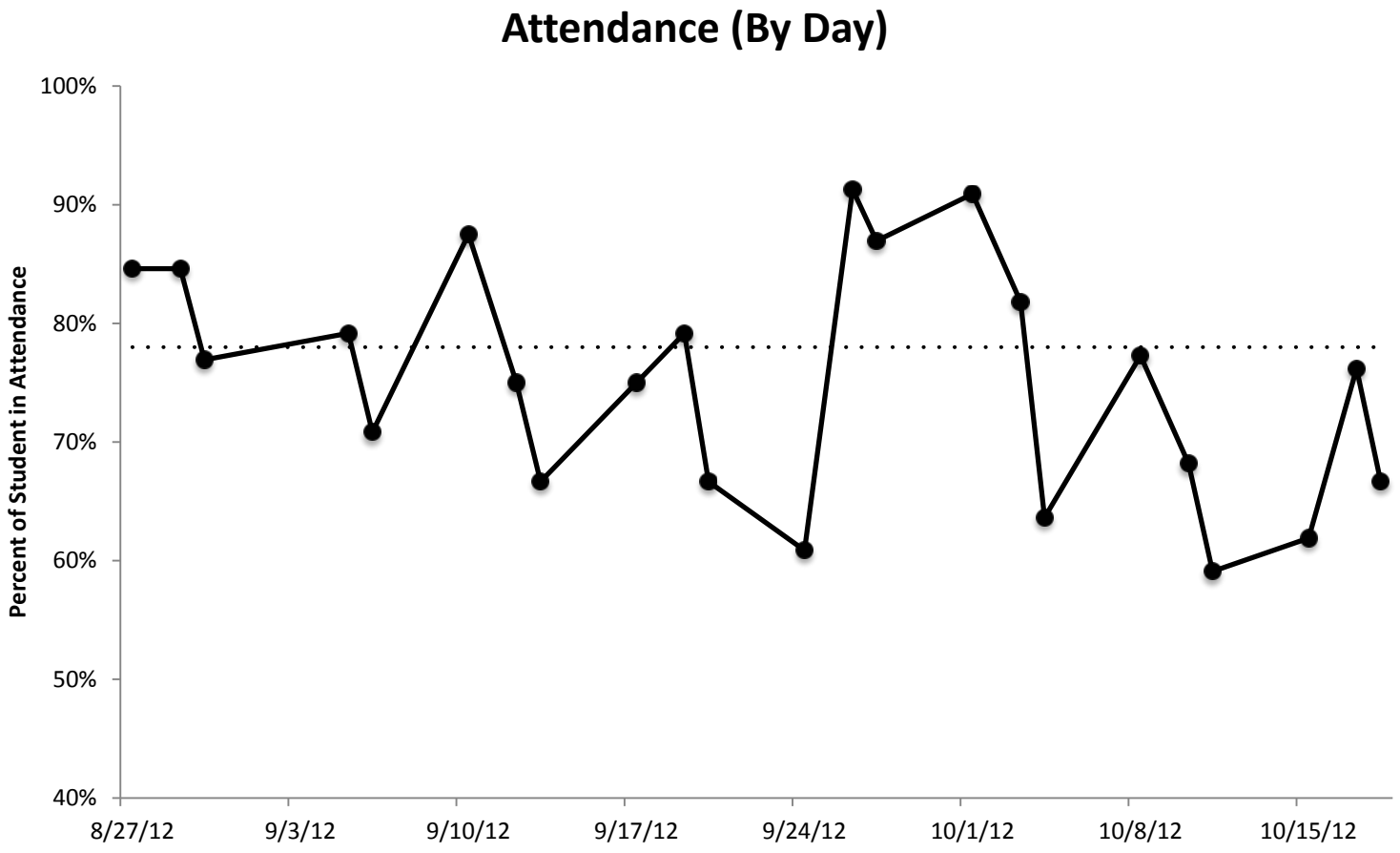
Example 4



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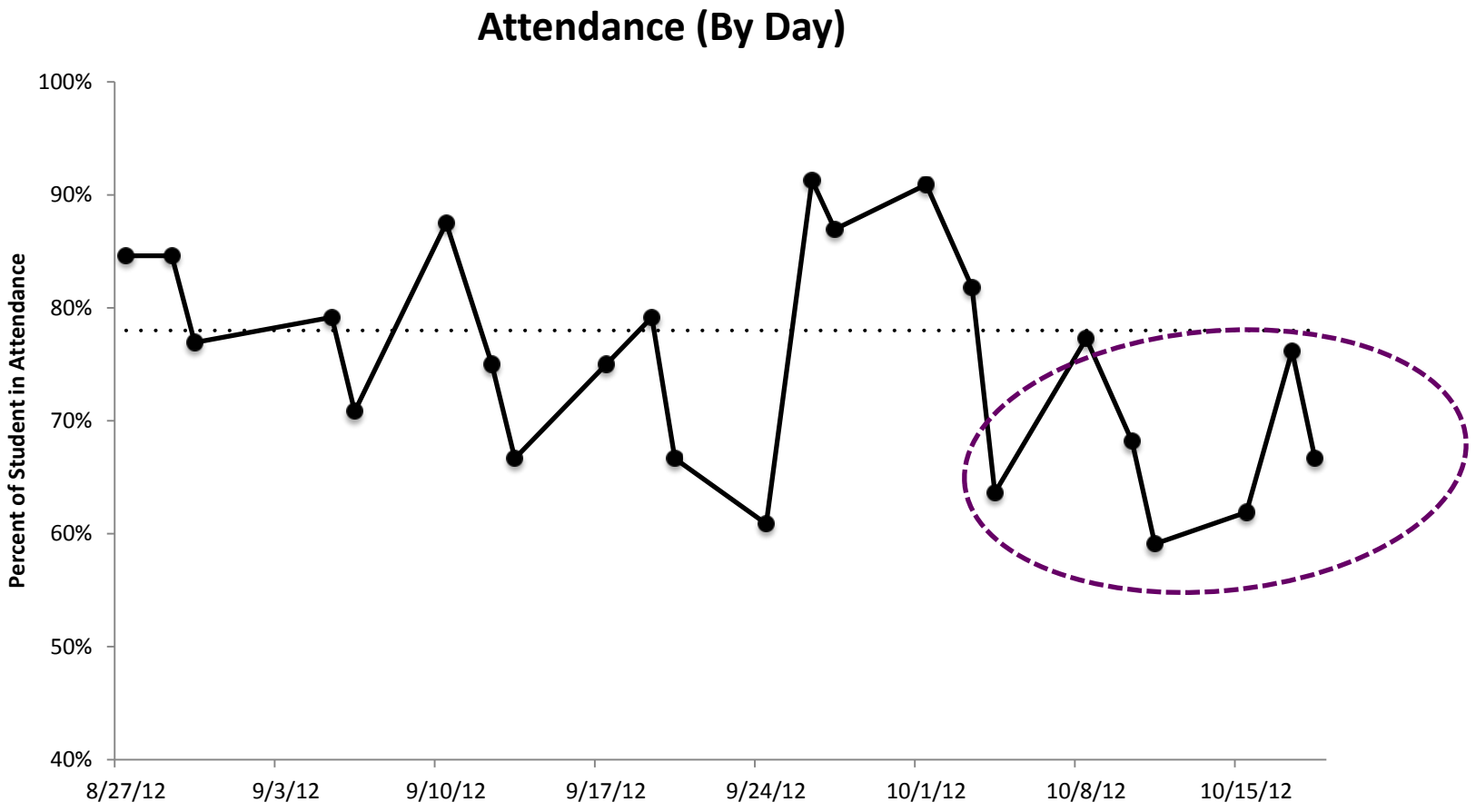
Example 4



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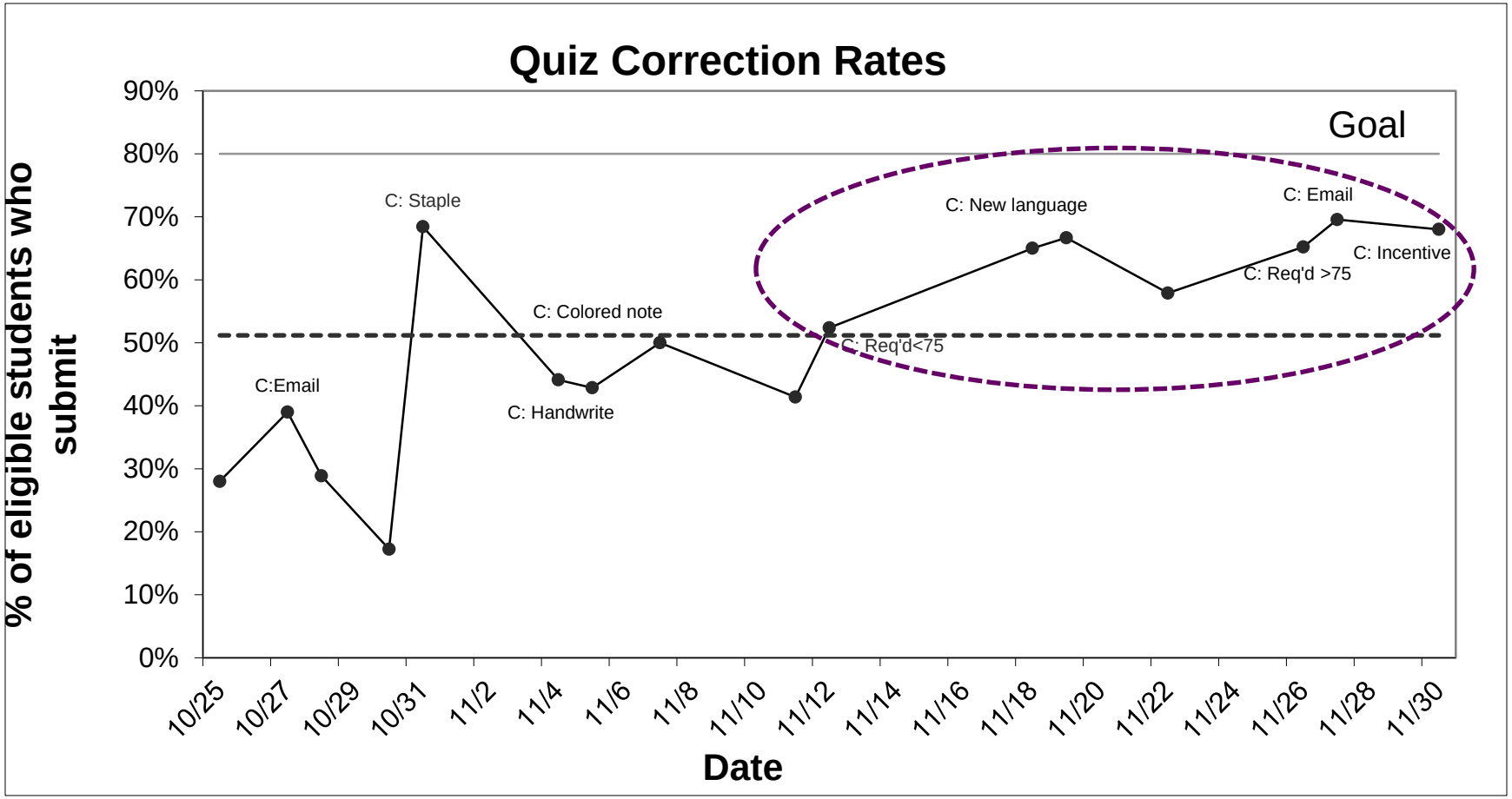
Remember Lawrence: Quiz Data Revisited



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Final Thoughts and Questions

- Resources to learn more:
  - Pareto Charts
    - Provost and Murray – The Health Care Data Guide
    - Togue – The Quality Toolbox
  - Run Charts:
    - Perla, Provost and Murray – The Run Chart
    - Ott – Process Quality Control
    - Provost and Murray – The Health Care Data Guide

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