Walter Shewhart, PhD

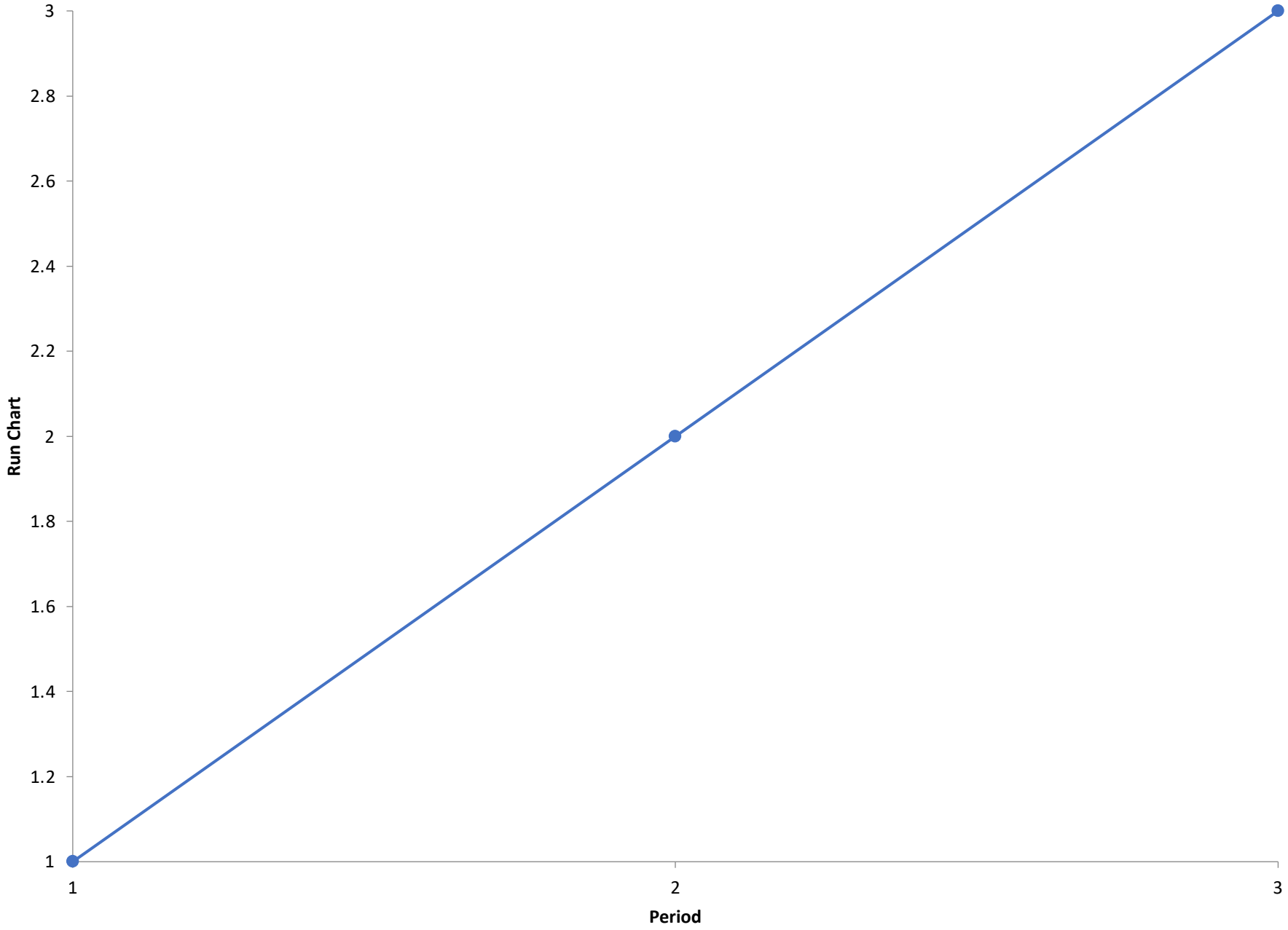
Variation

Common

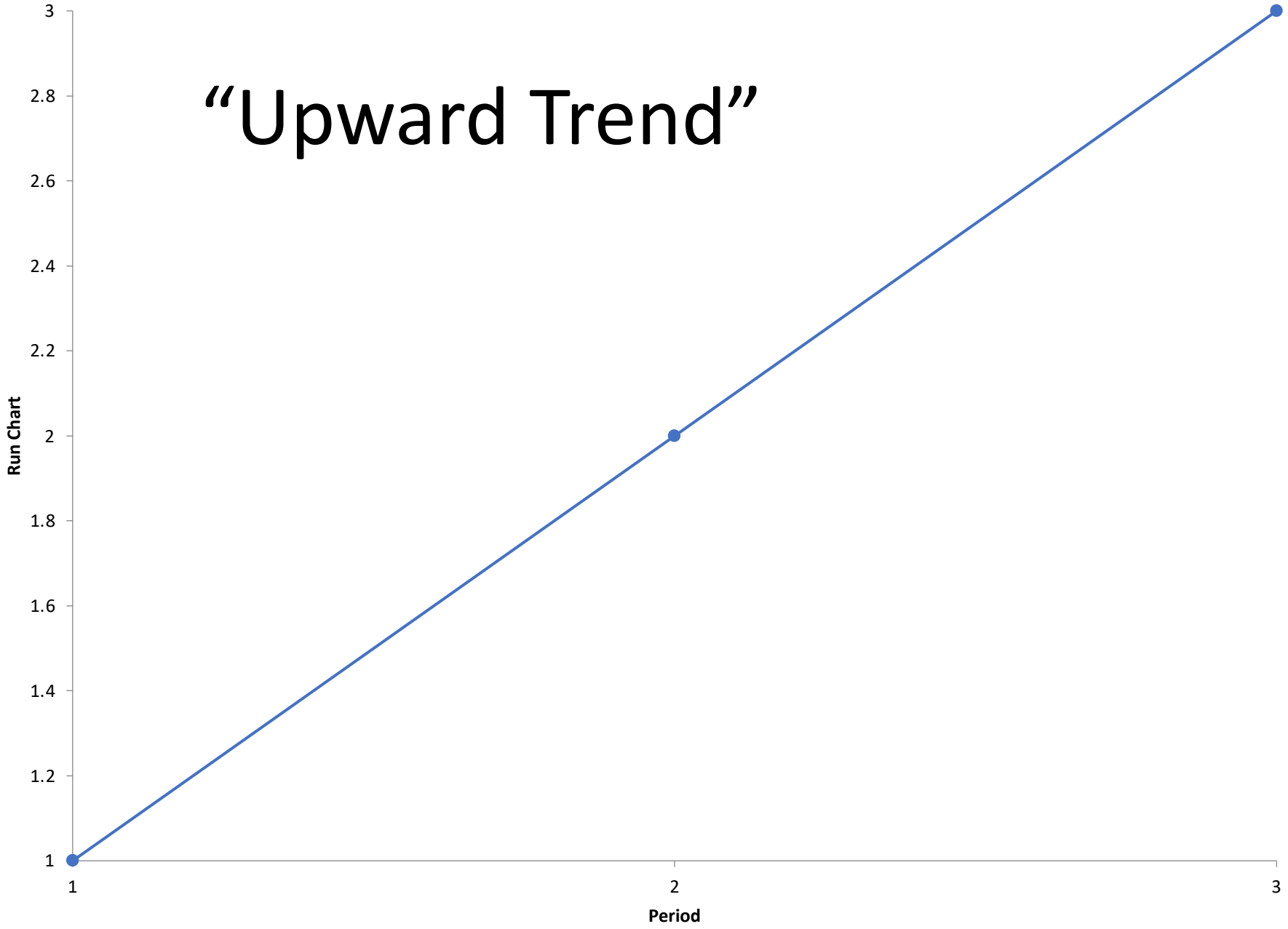
Assignable (Special)

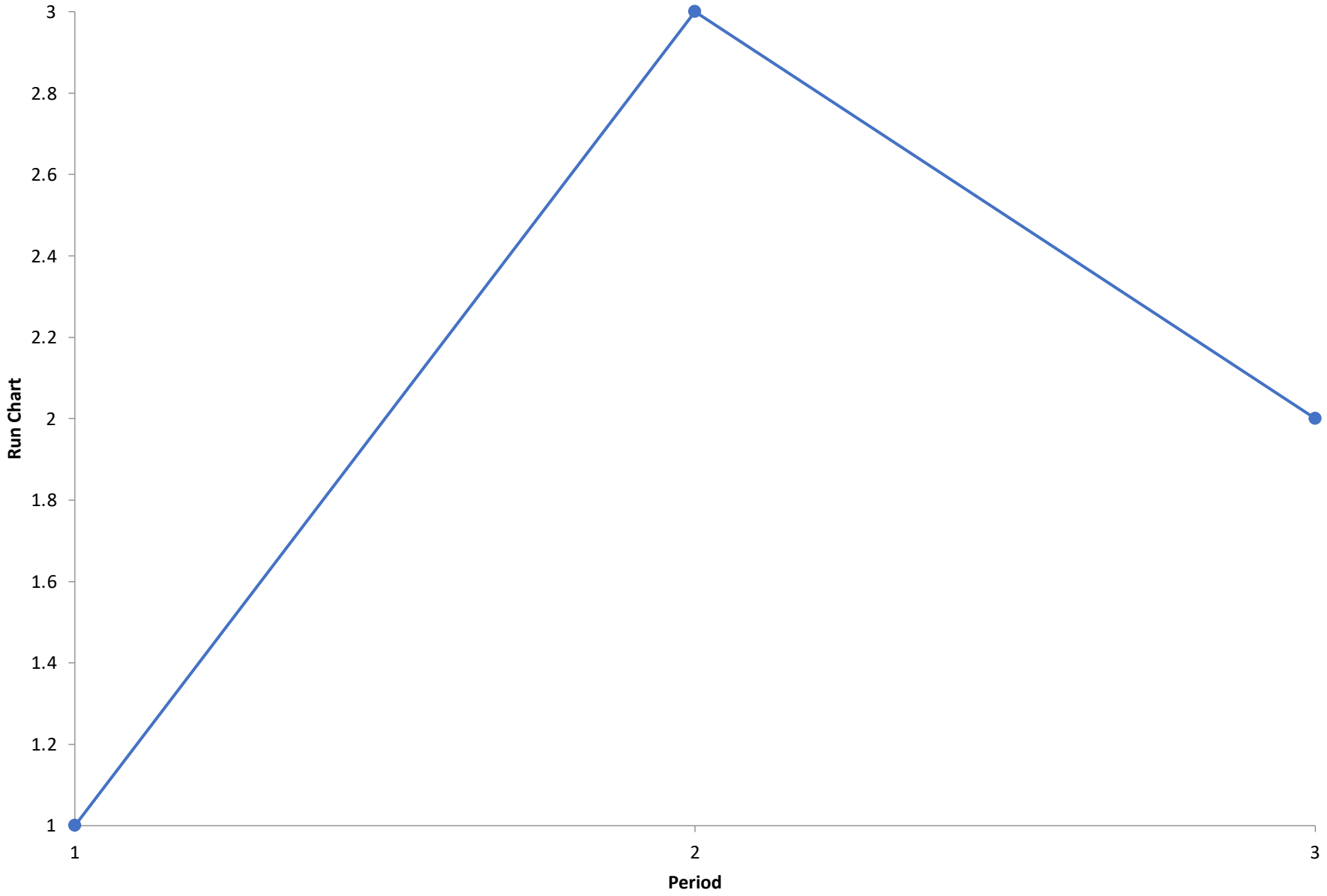
45

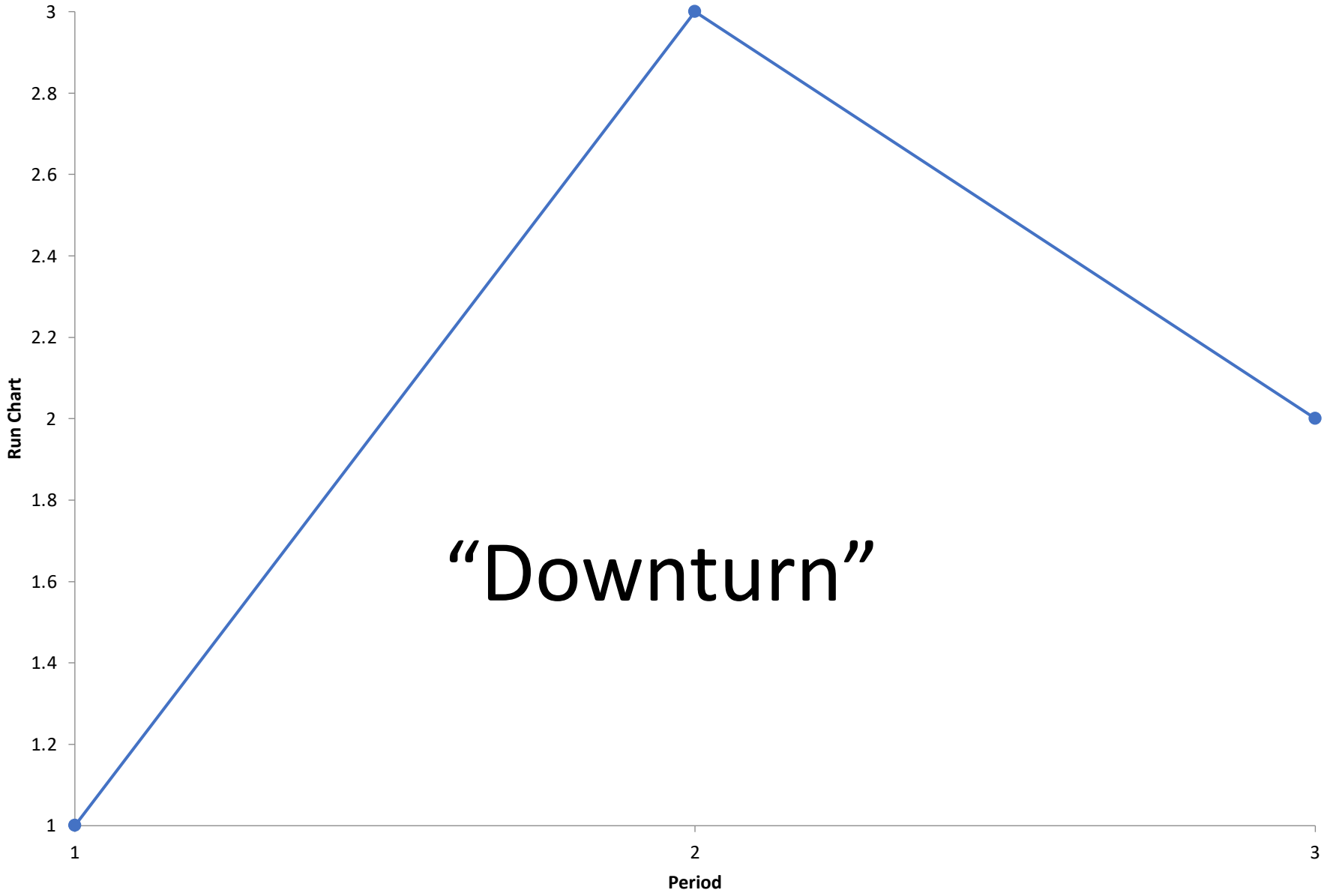
51

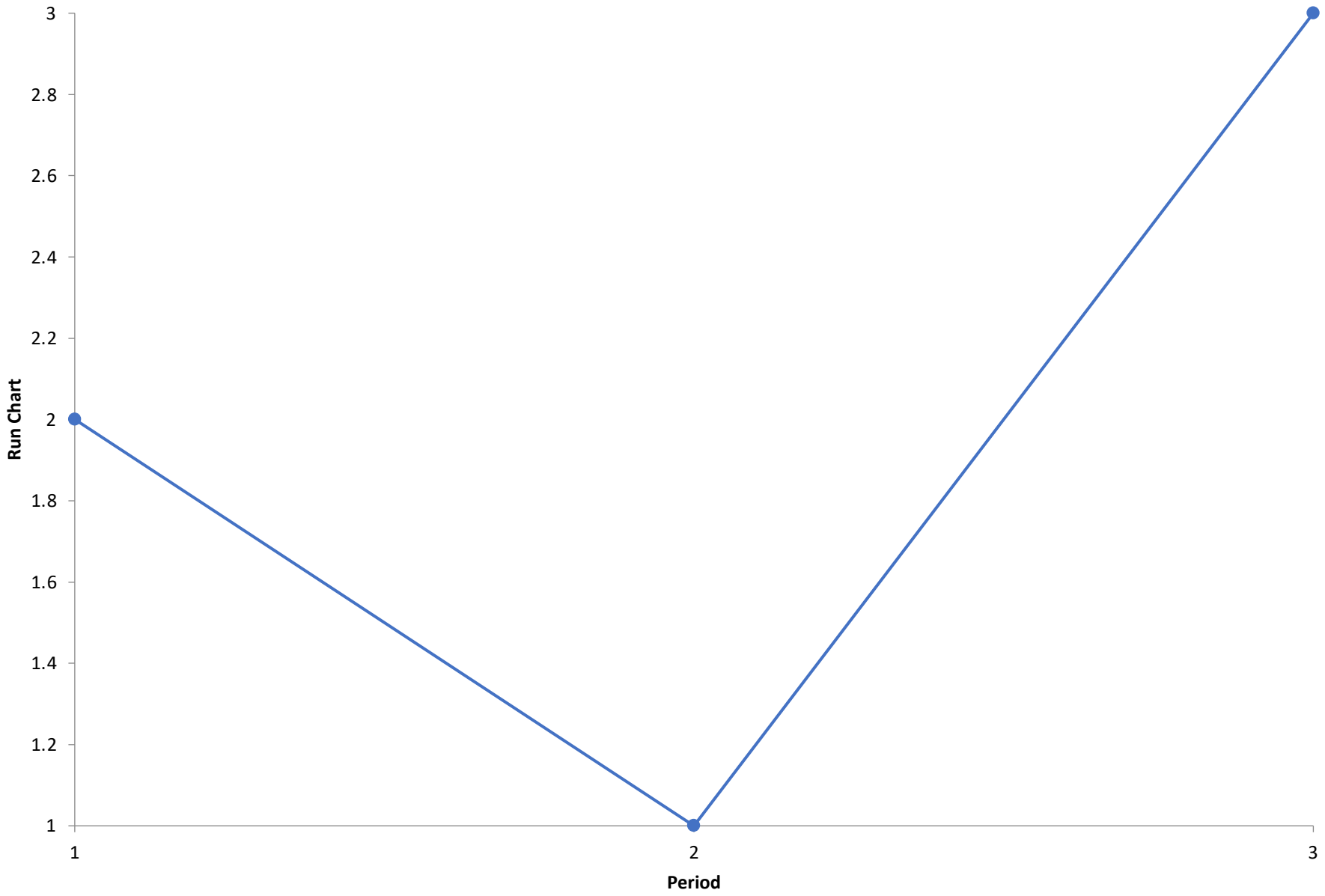

3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Run Chart
1
2
3
Period

“Upward Trend”

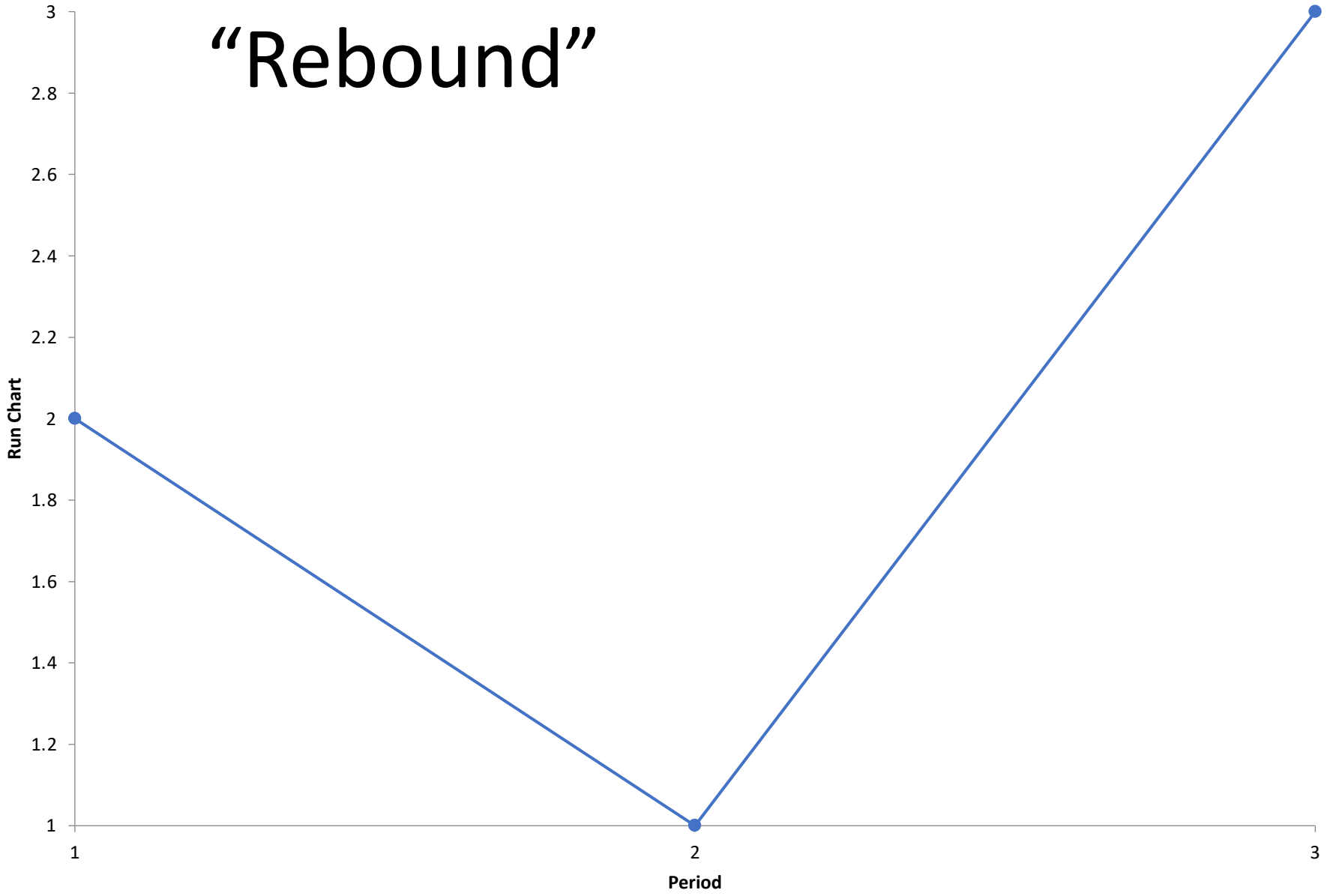


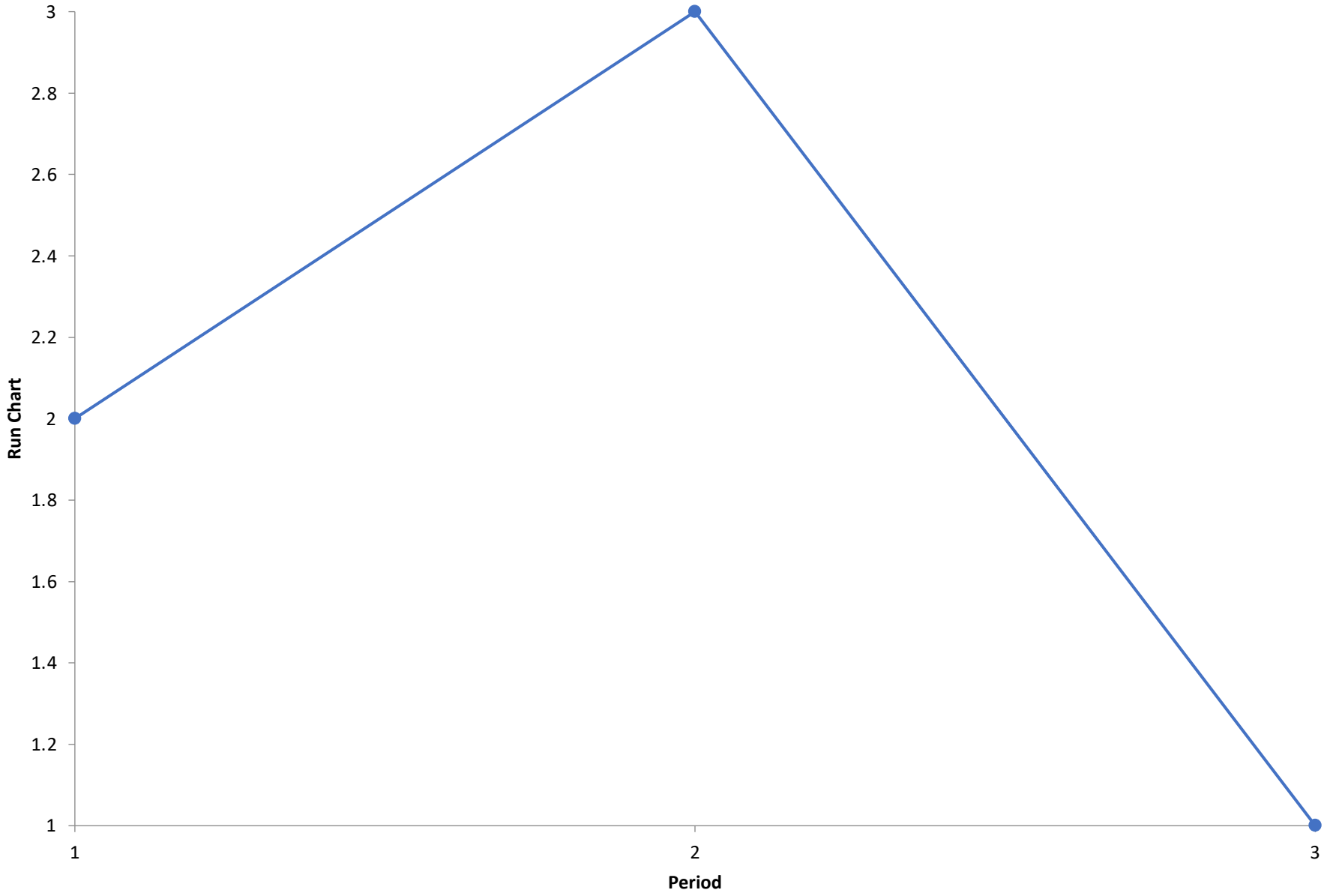

Run Chart
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
1
2
3
Period

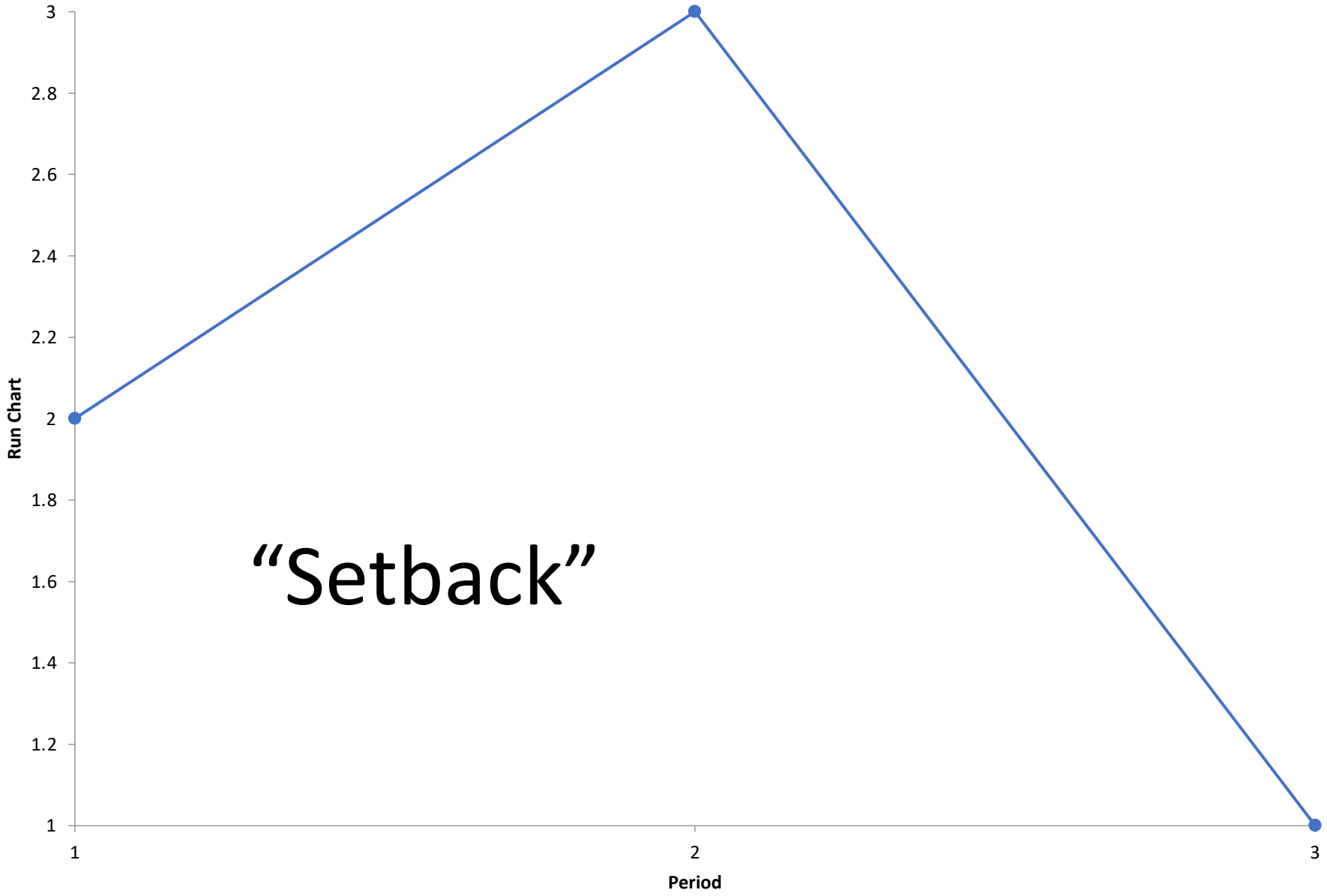

3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Run Chart
1
2
3
Period
“Downturn”

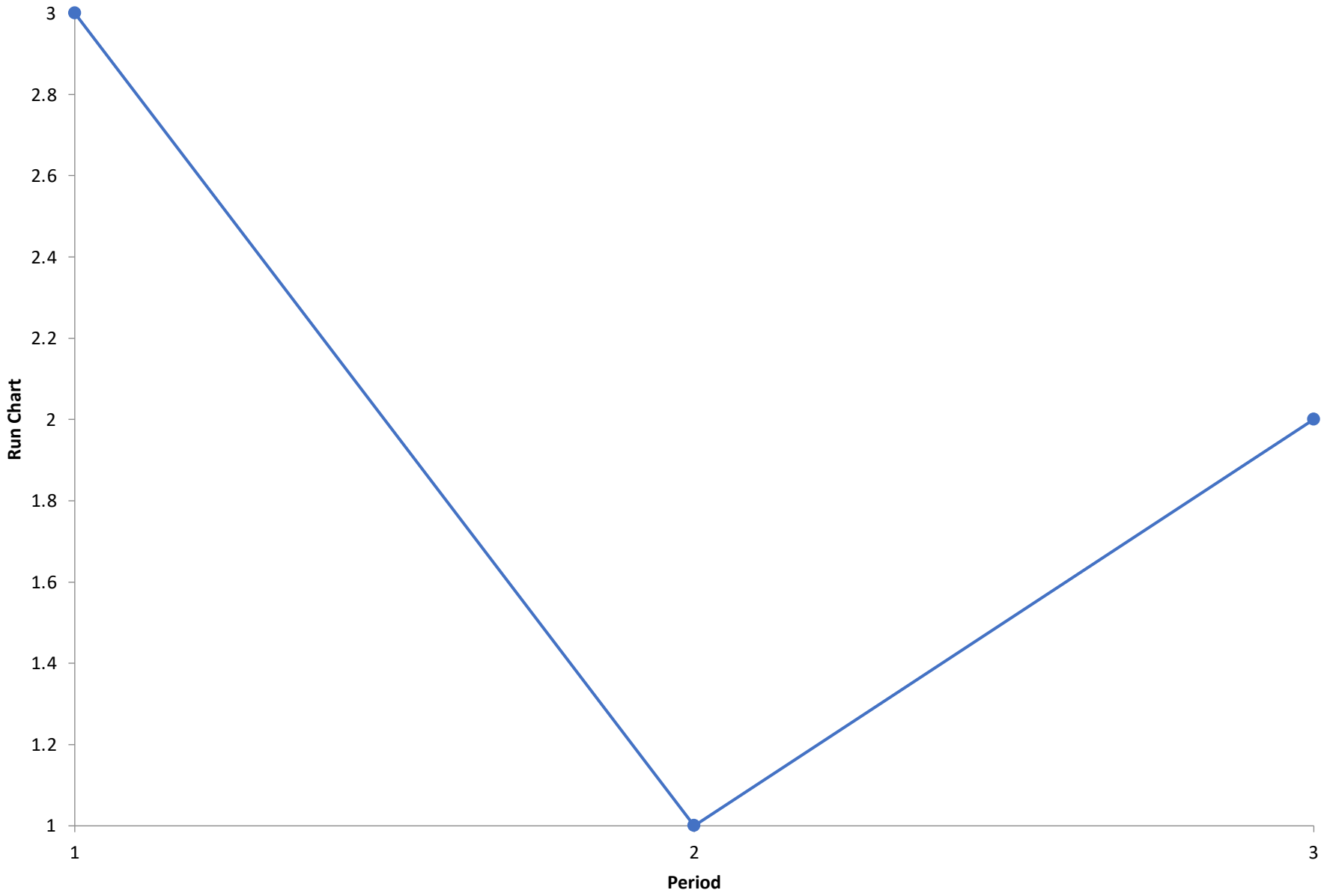

Run Chart
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
1
2
3
Period

“Rebound”

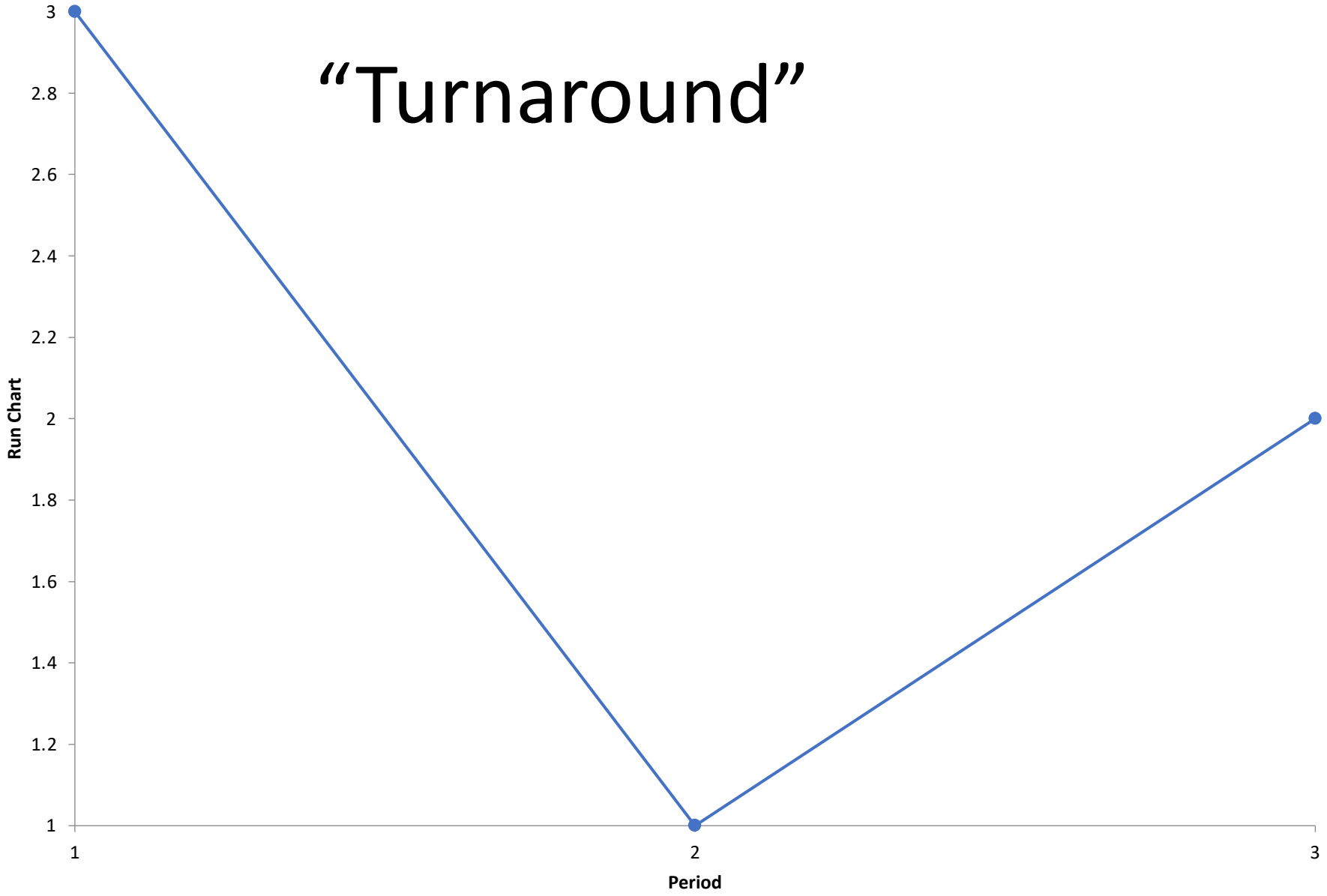


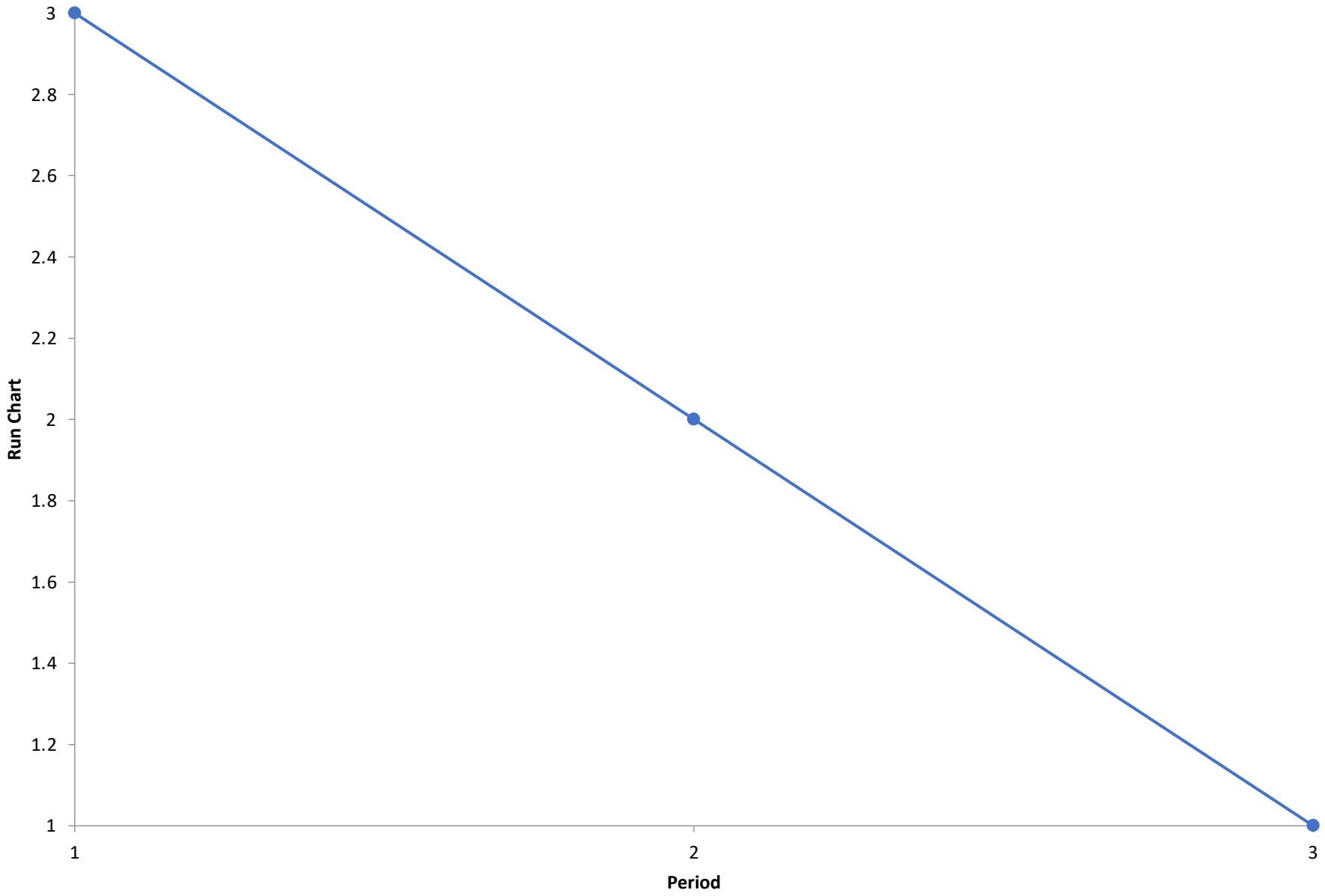

Run Chart
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
1
2
3
Period


3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Run Chart
1
2
3
Period
“Setback”

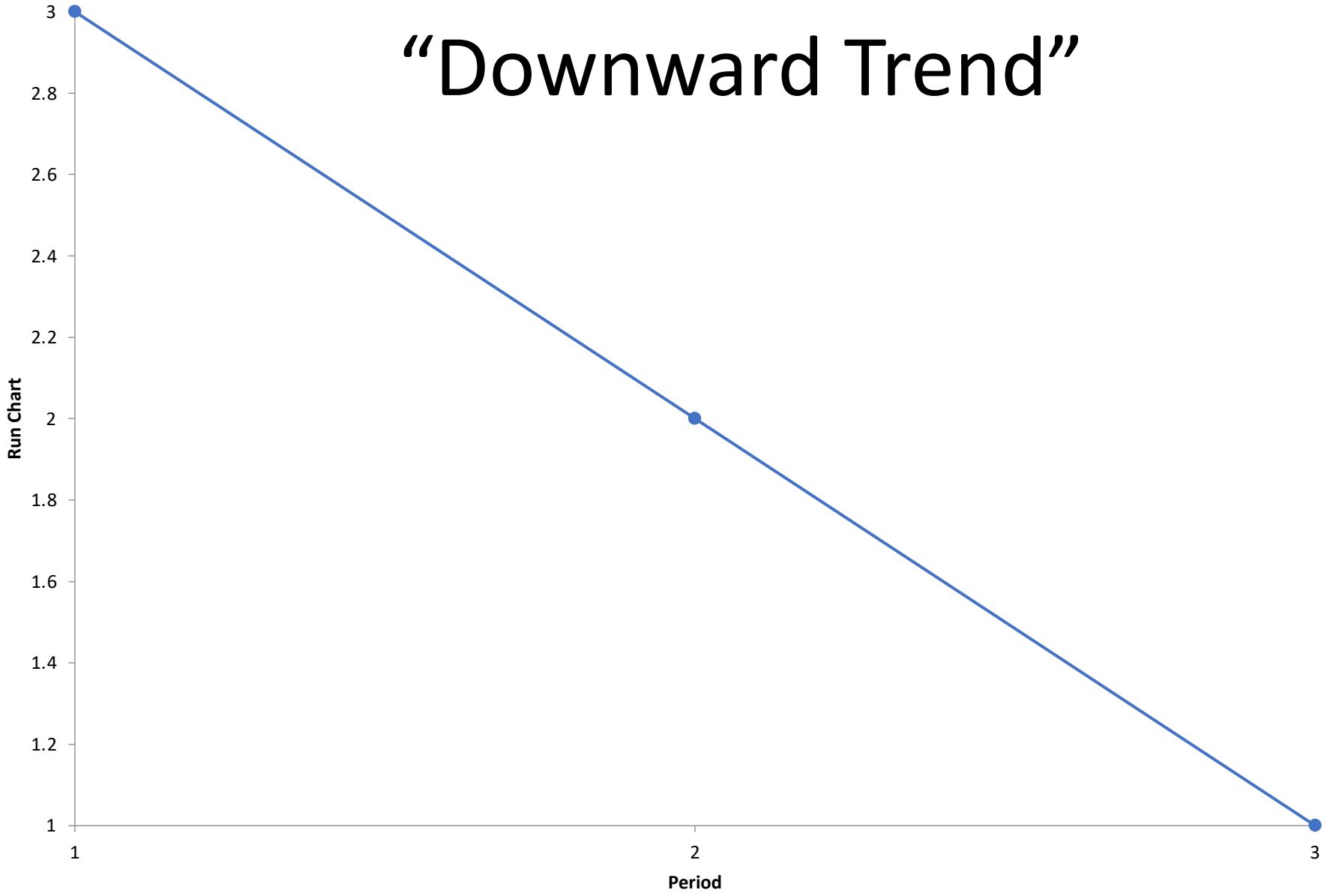

3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Run Chart
1
2
3
Period

“Turnaround”



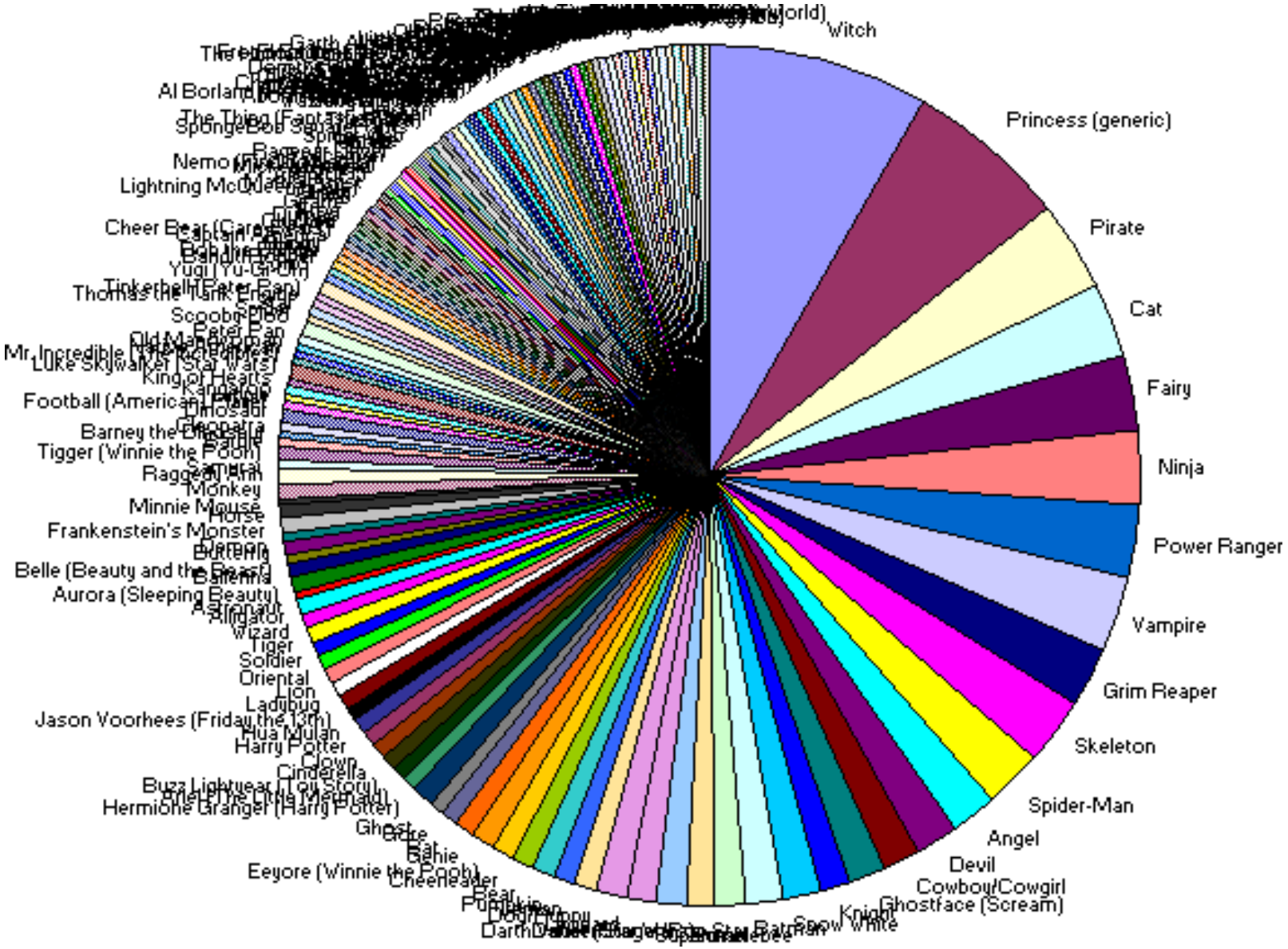

3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Run Chart
1
2
3
Period

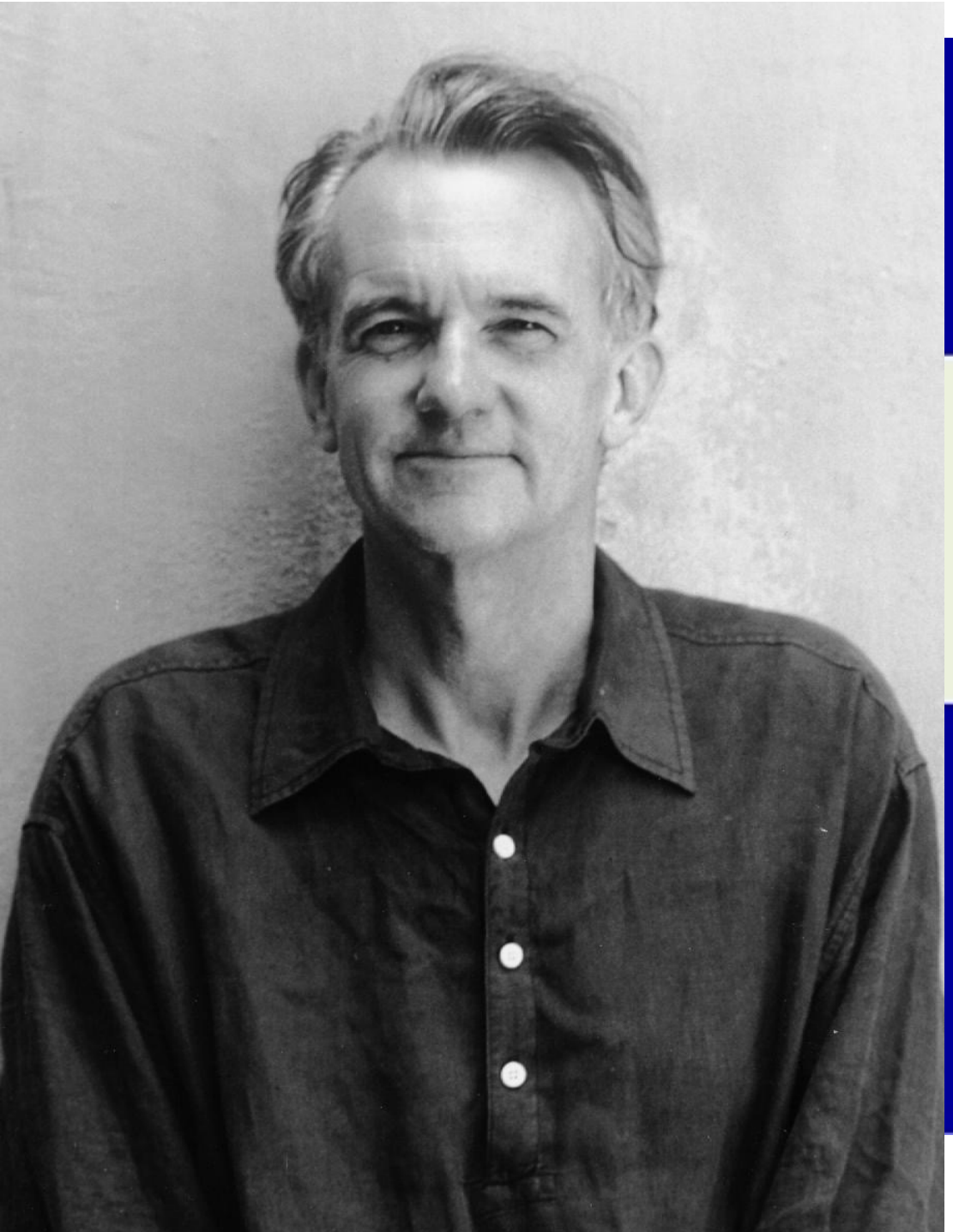
“Downward Trend”




NONSENSE

Popularity of Halloween Costumes

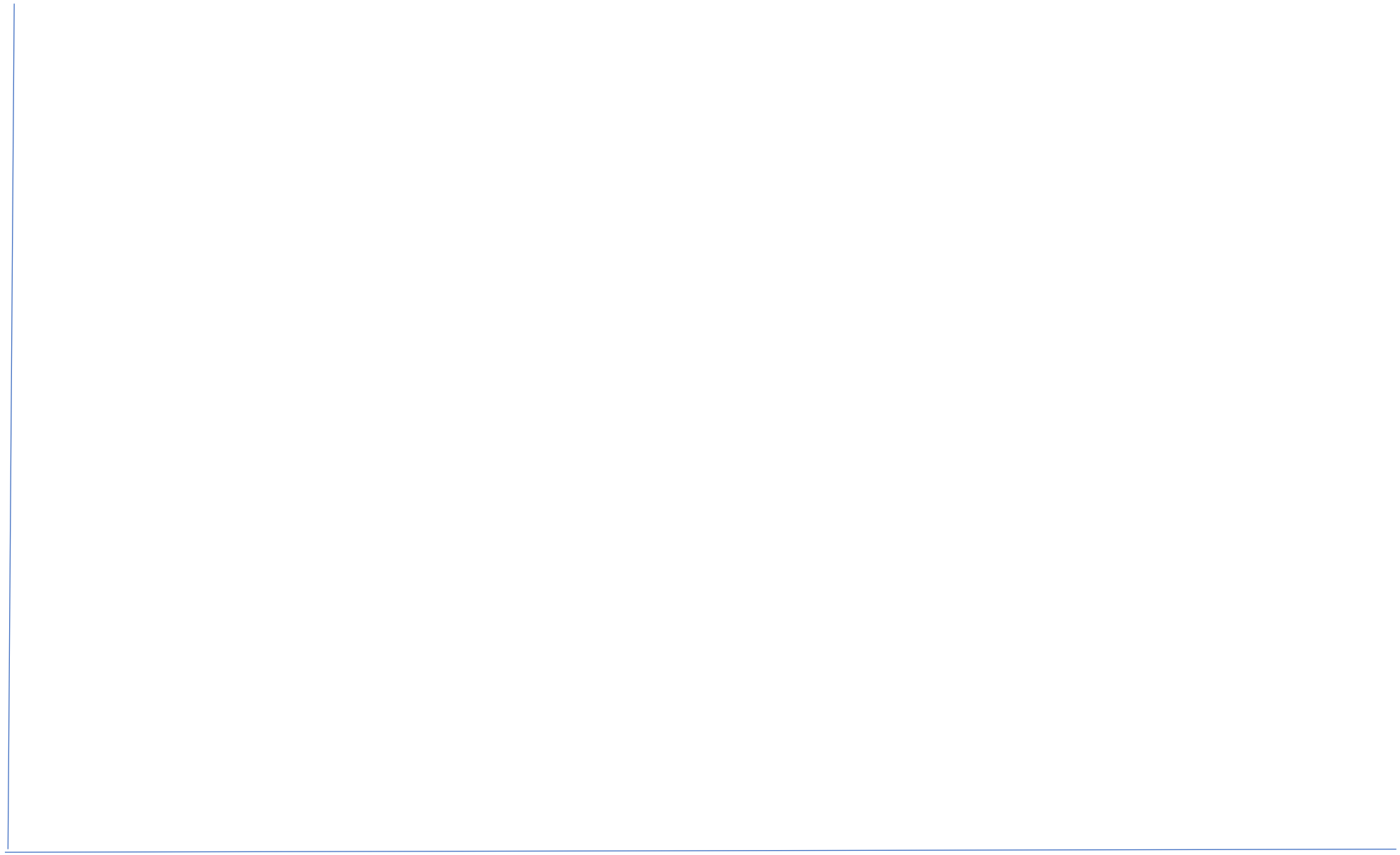


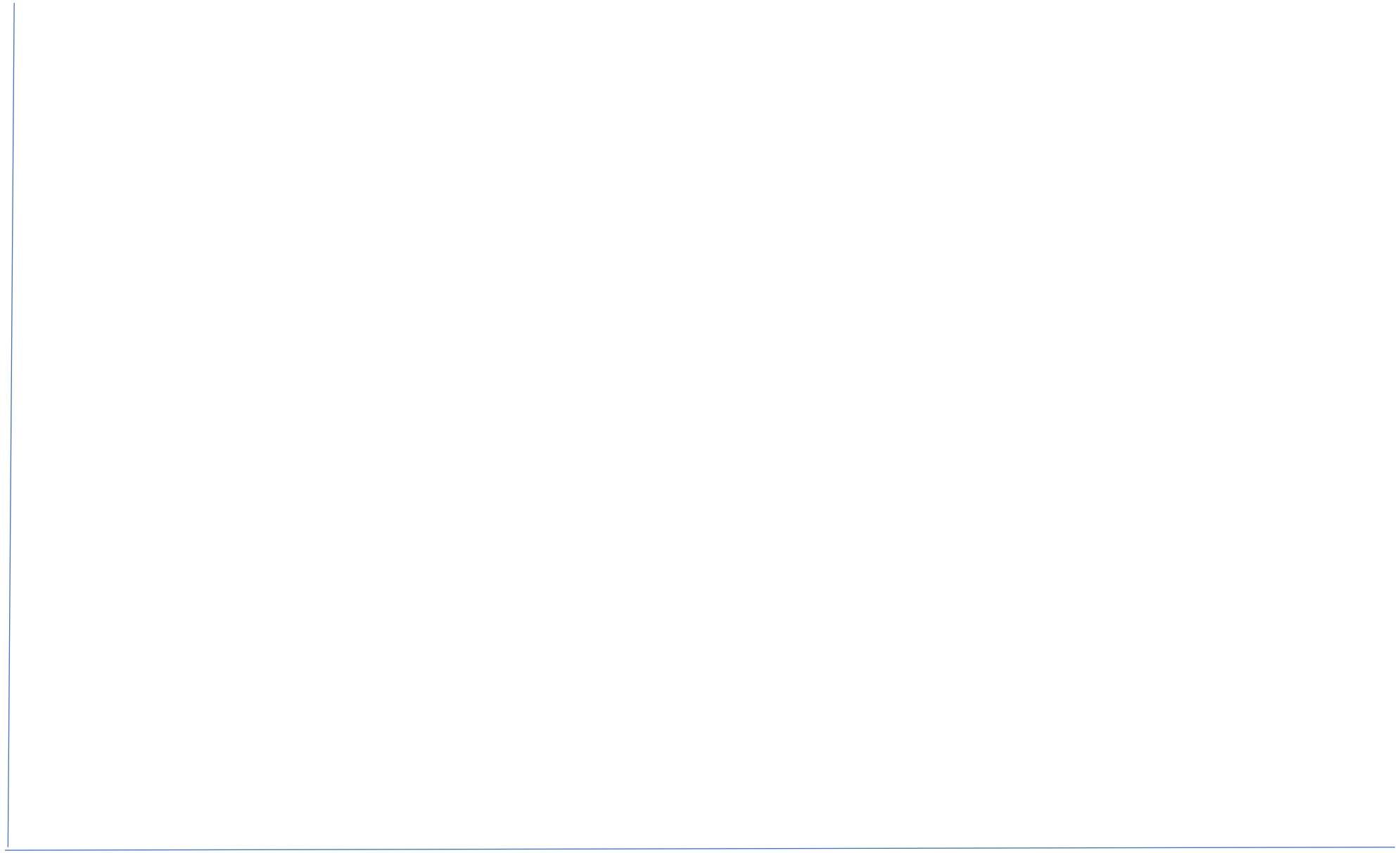


“The only worse design than a pie chart is several of them”

Tufte ER. The visual display of quantitative information.
Cheshire, Connecticut: Graphics Press; 1983


Pie I have eaten
Pie I have not yet eaten



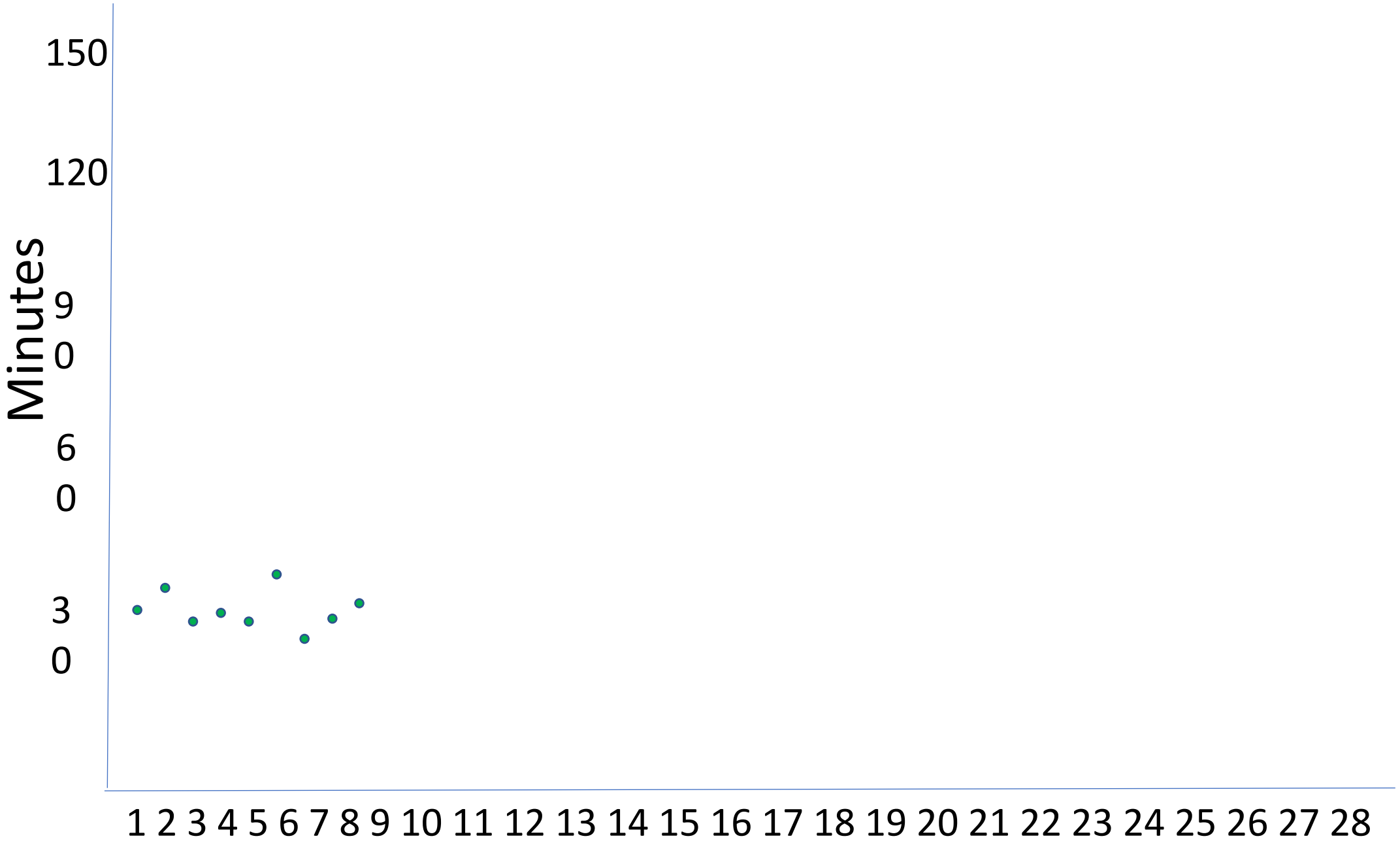


Naturally Occurring Time Order

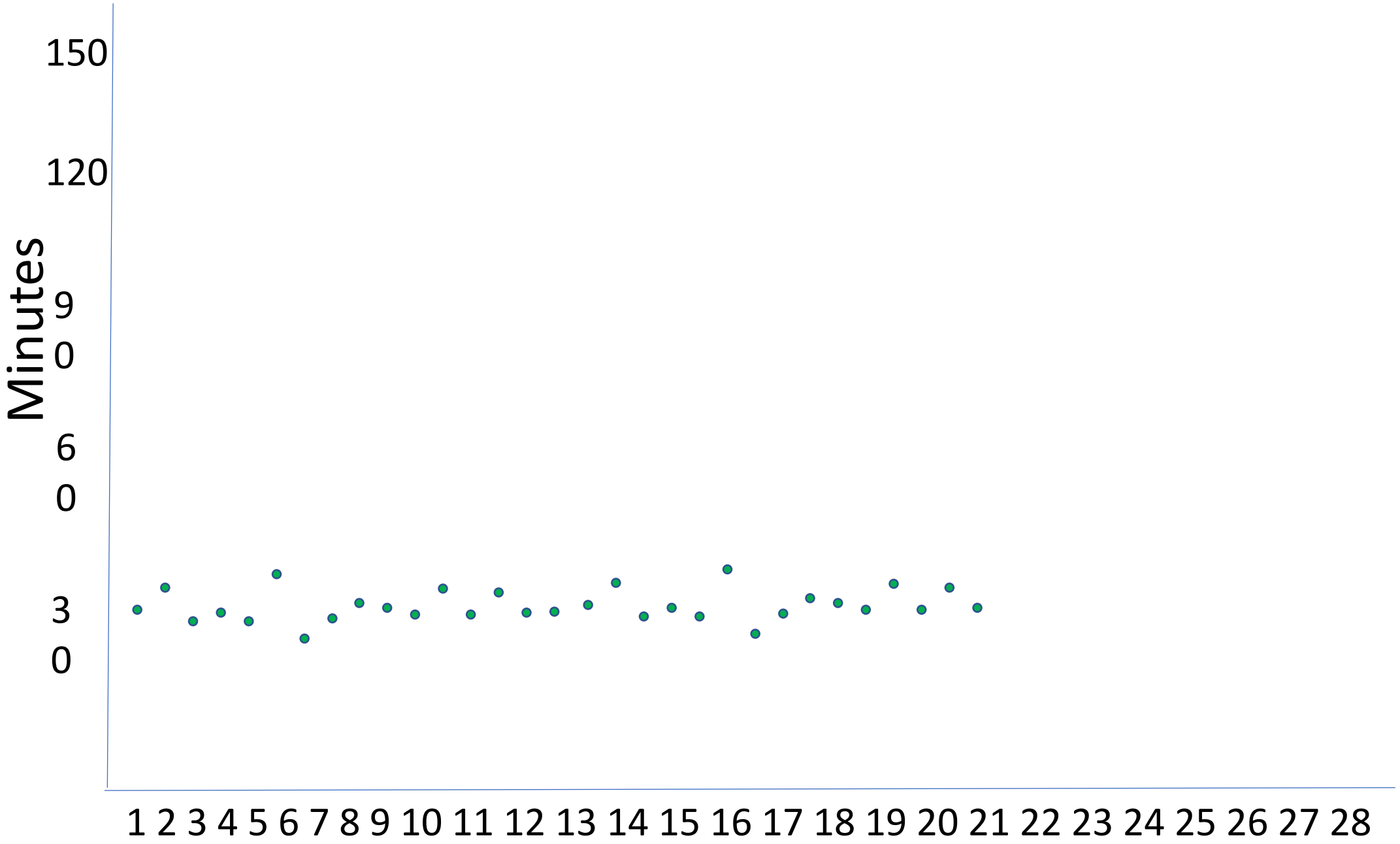

Measure
Naturally Occurring Time Order

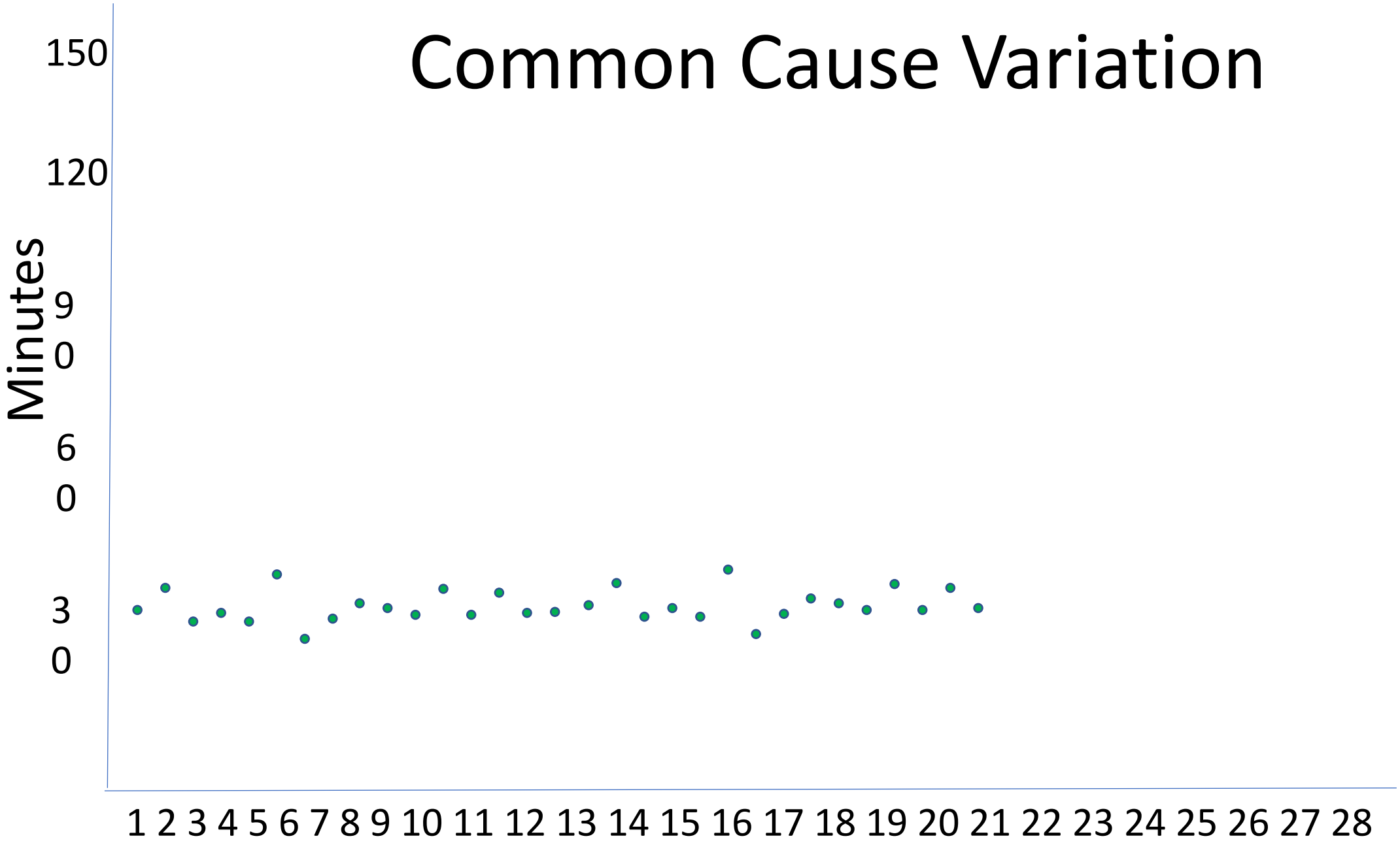

Minutes
150
120
90
60
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28


Minutes
150
120
90
60
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28


150
120
Minutes
90
60
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

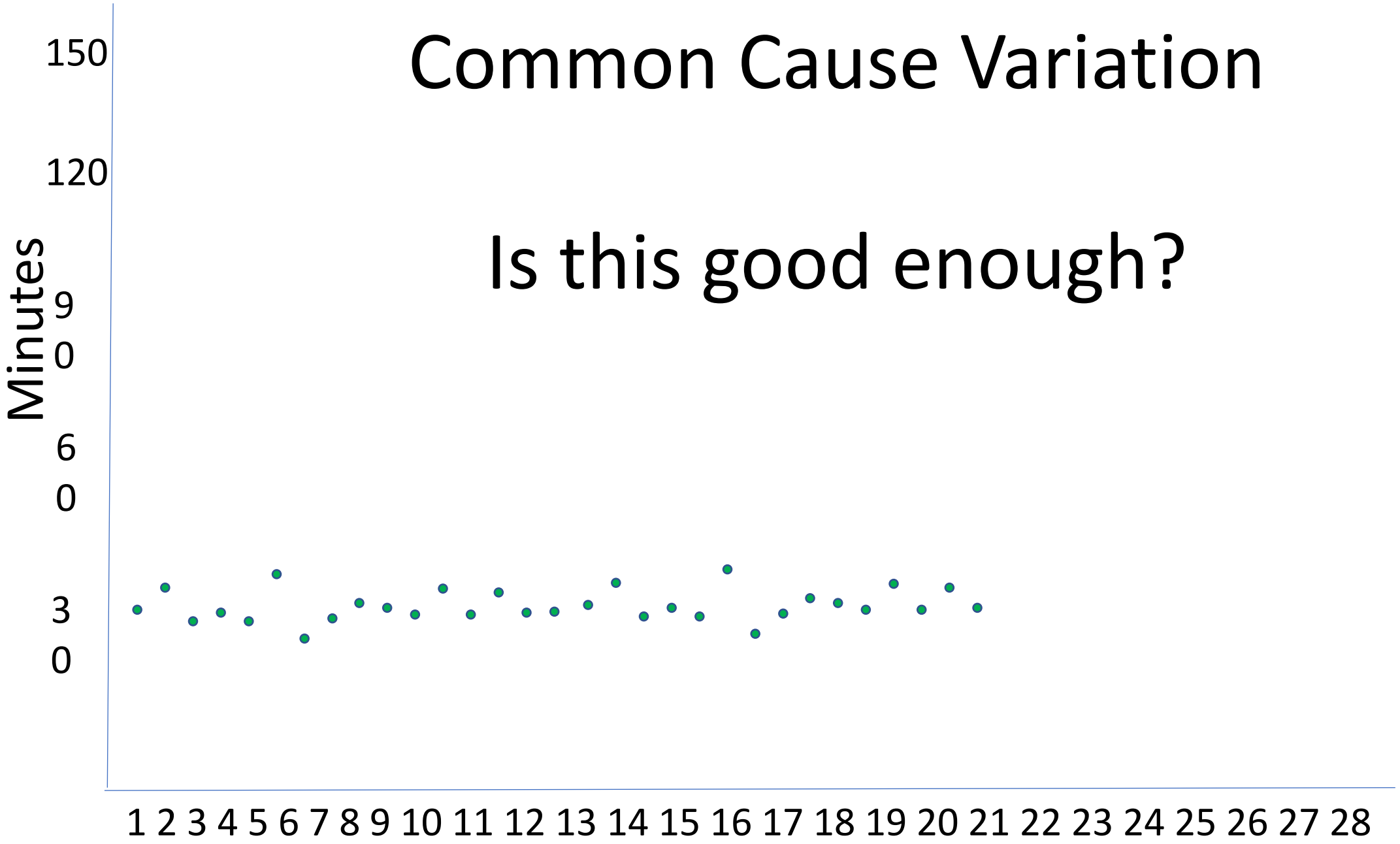

150
120
Minutes
9
0
6
0
3
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

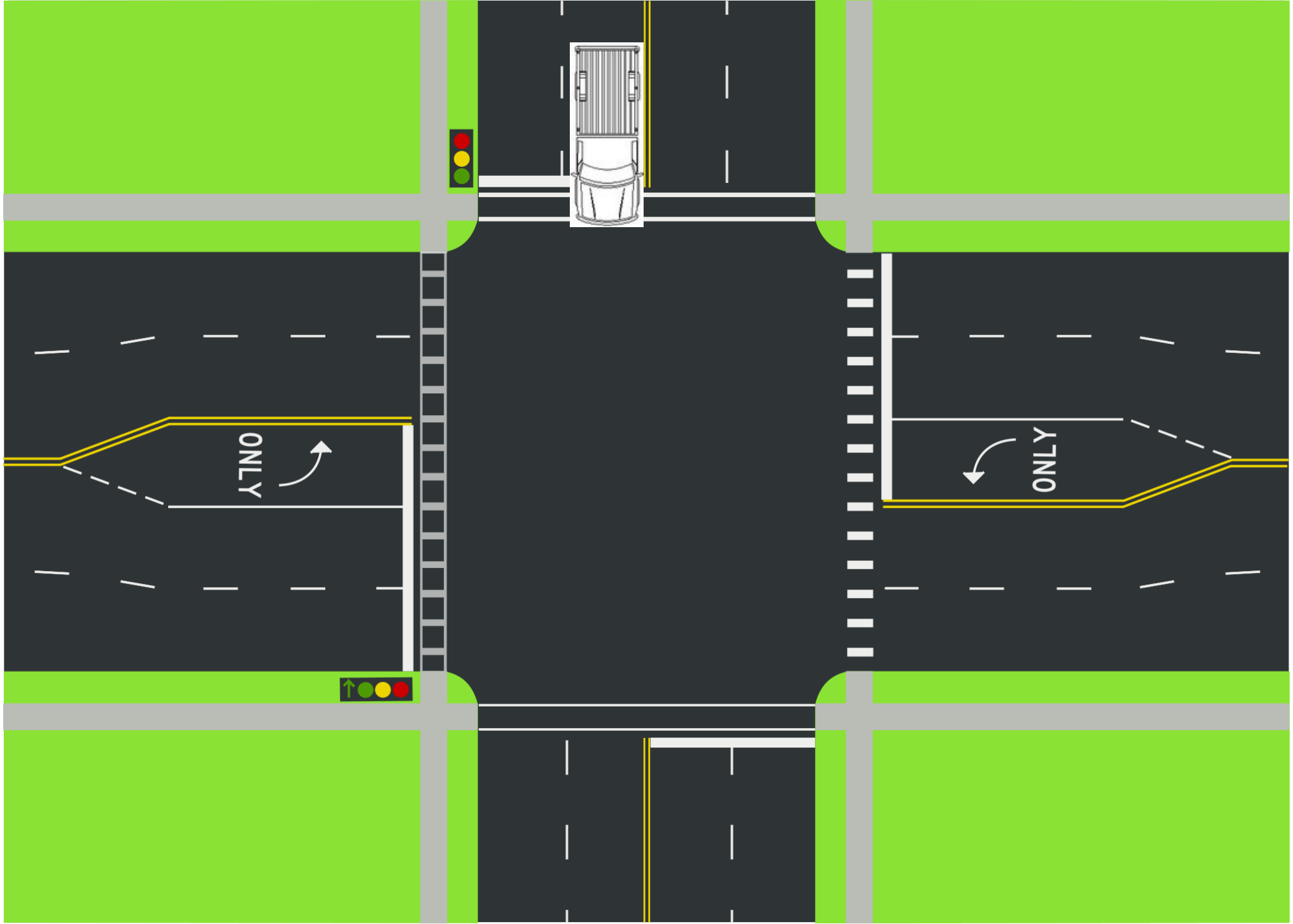

Minutes
150
120
90
60
30
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

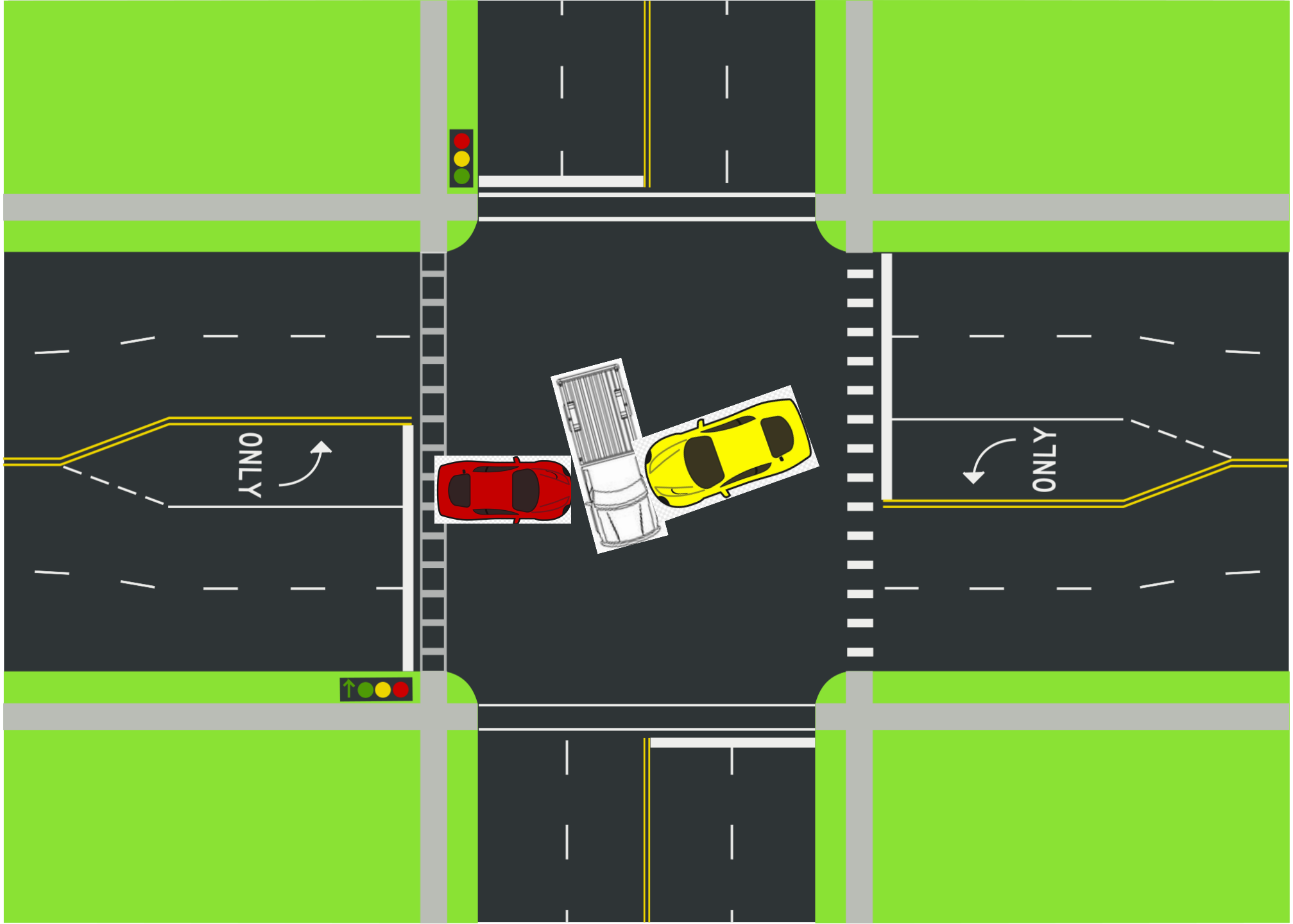

Common Cause Variation
Minutes
150
120
90
60
30
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

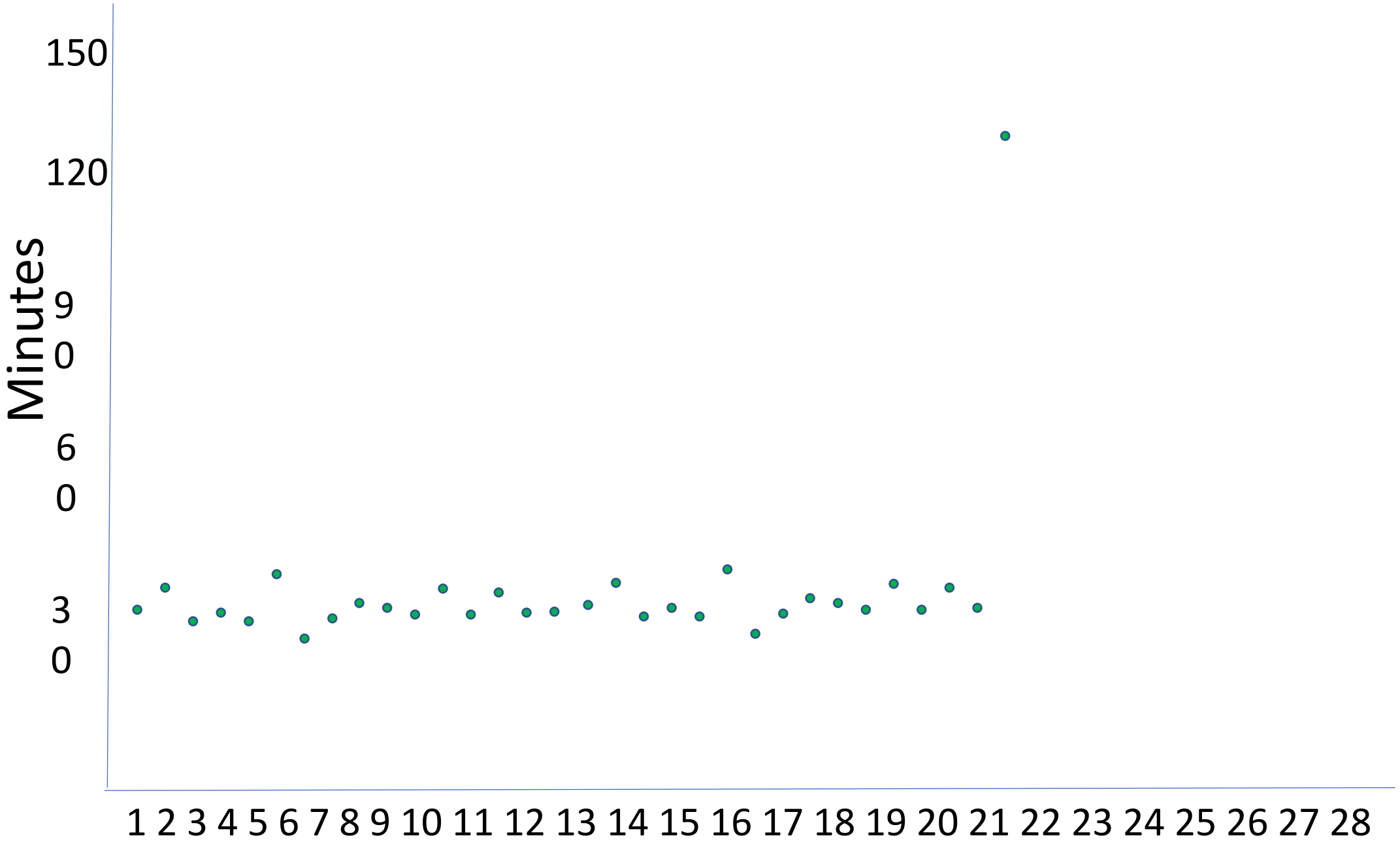
Common Cause Variation

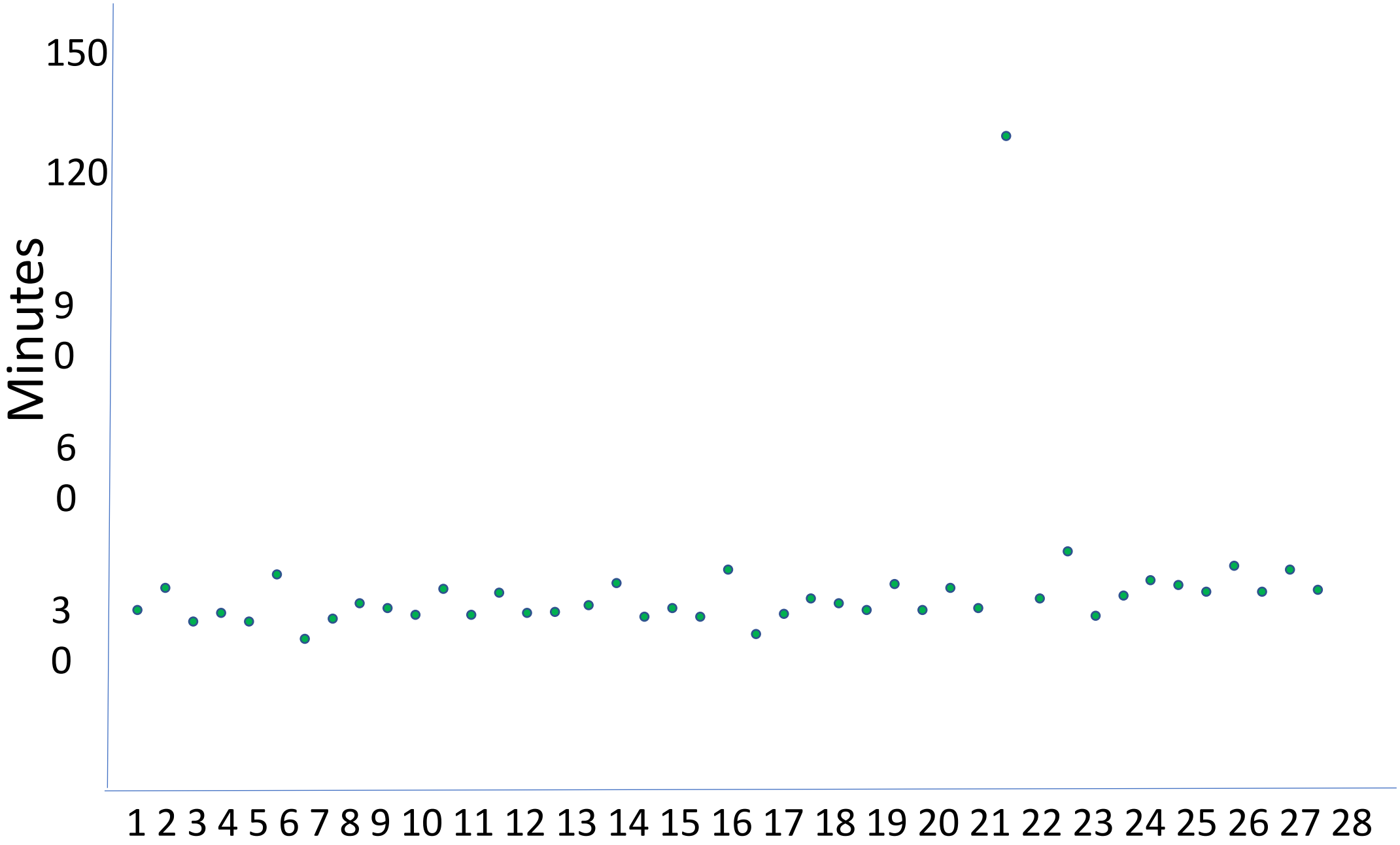
Is this good enough?

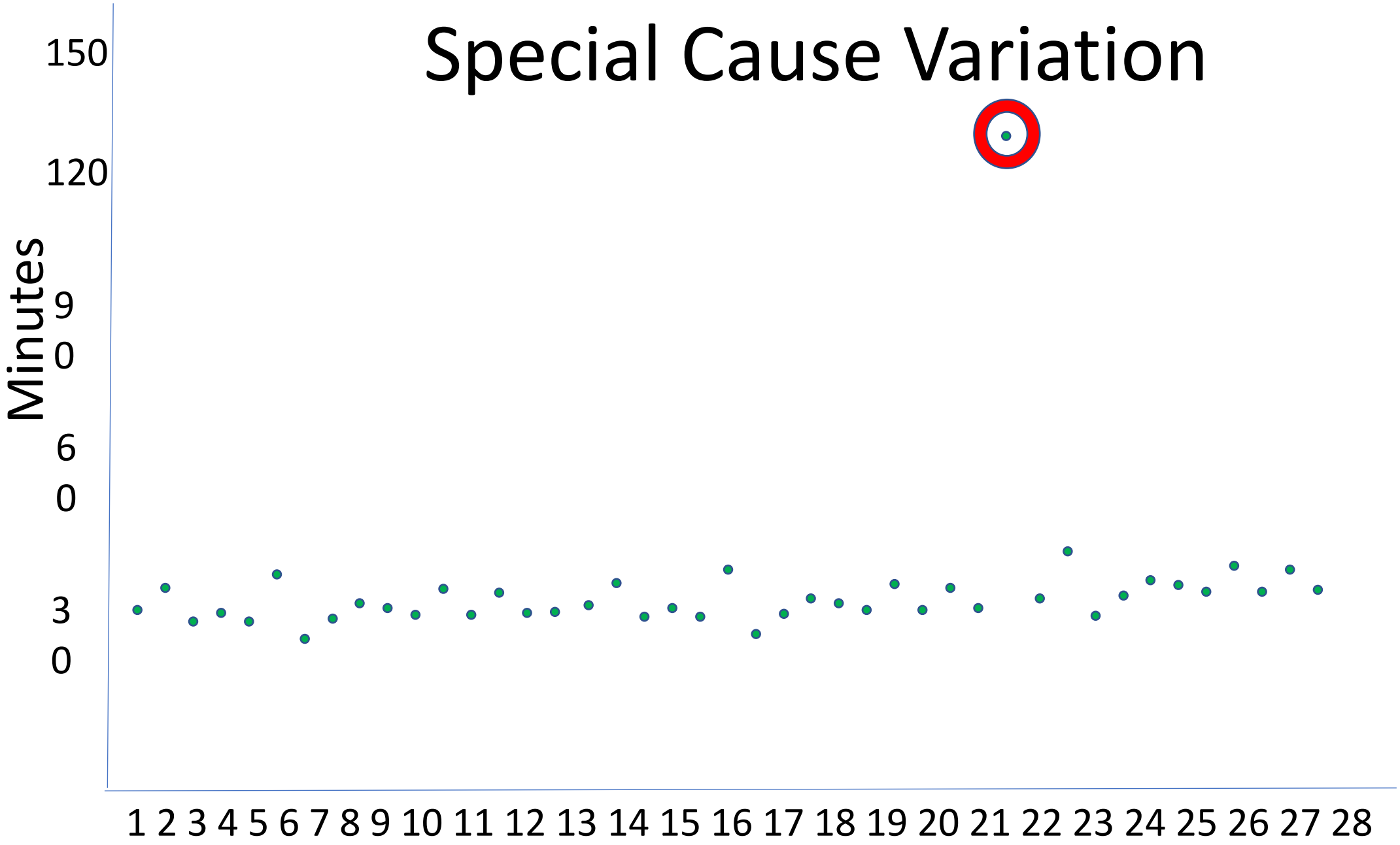



ONLY
ONLY

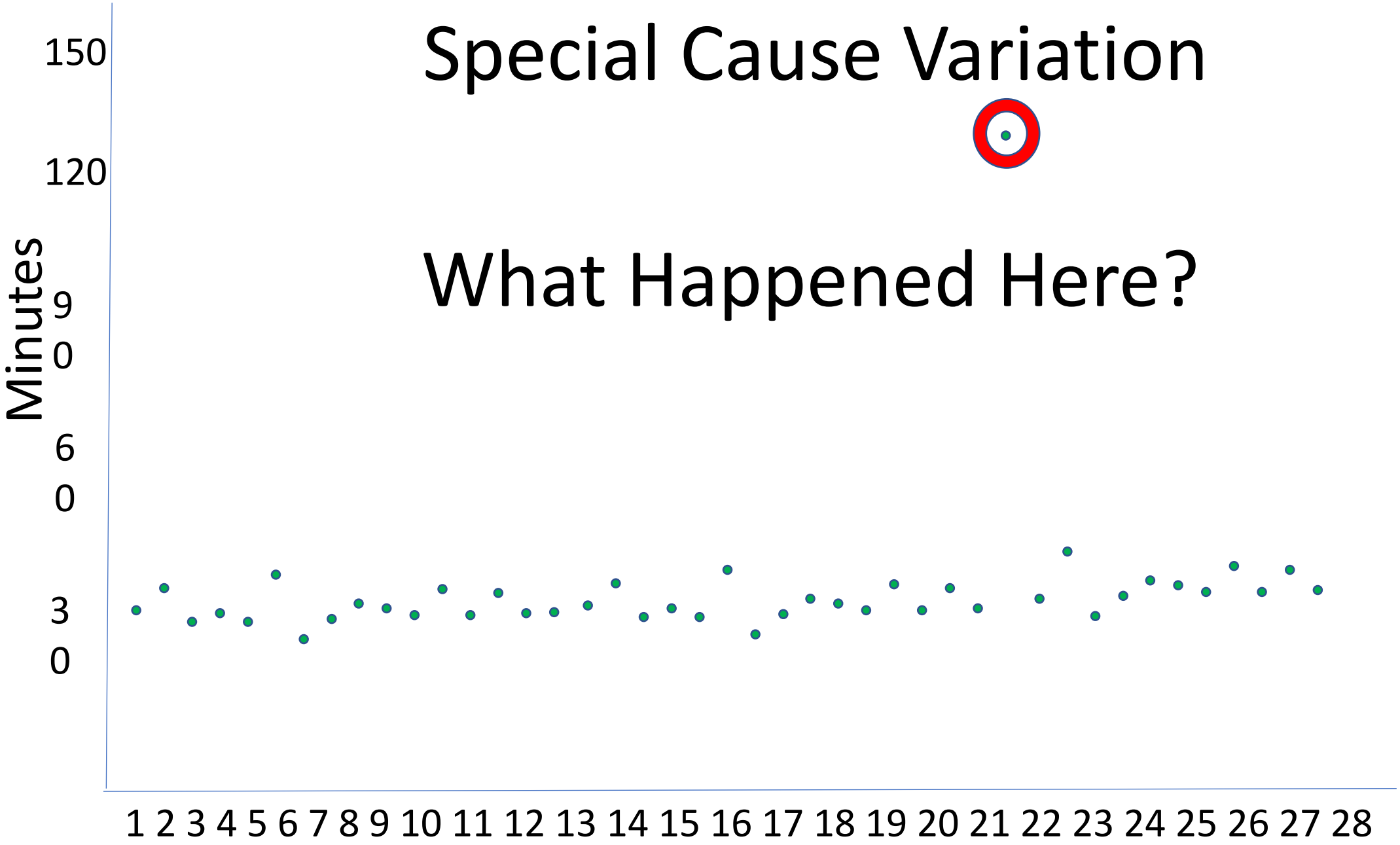

ONLY
ONLY


Minutes
150
120
90
60
30
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28


Minutes
150
120
90
60
30
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

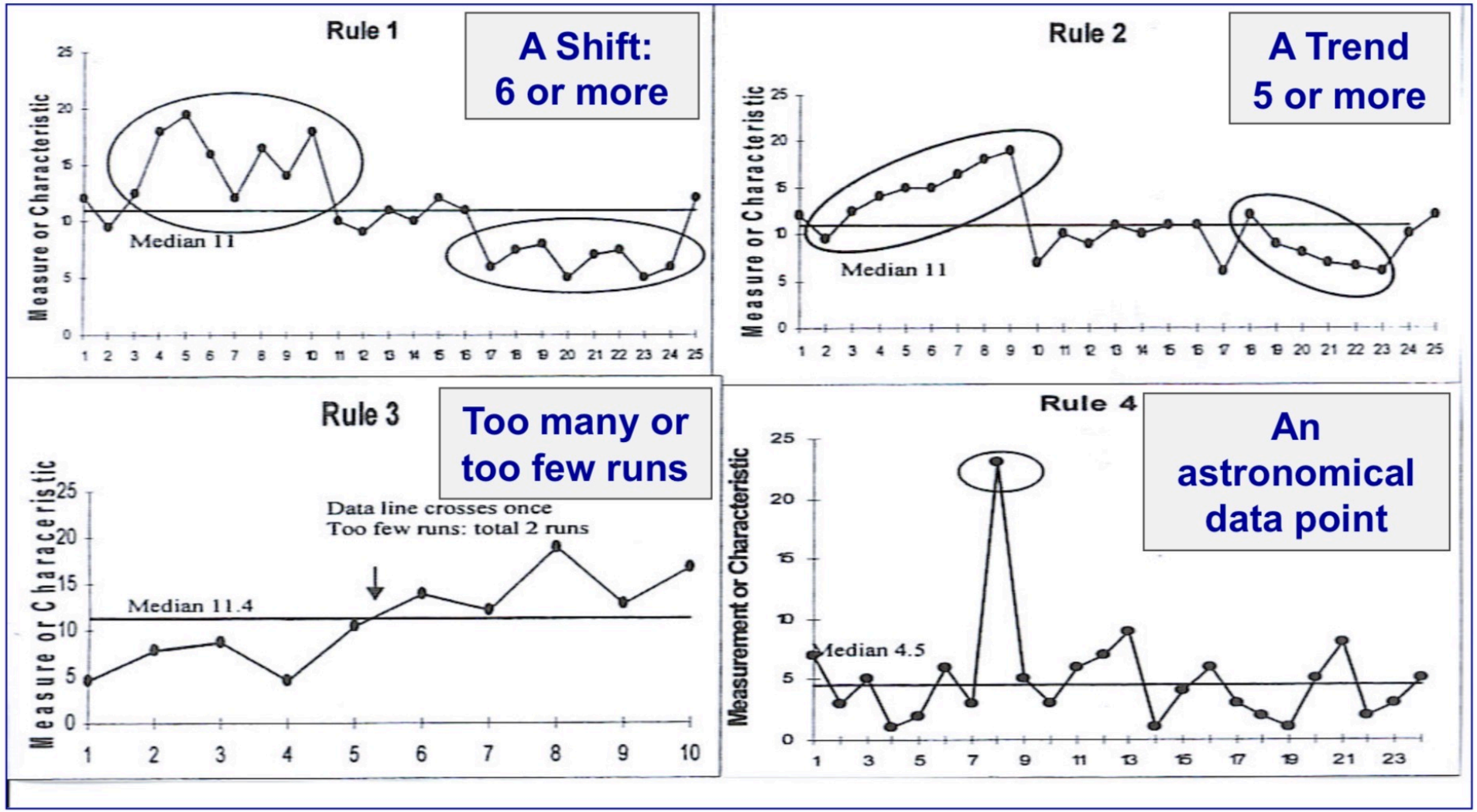

Special Cause Variation
150
120
Minutes
90
60
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Special Cause Variation



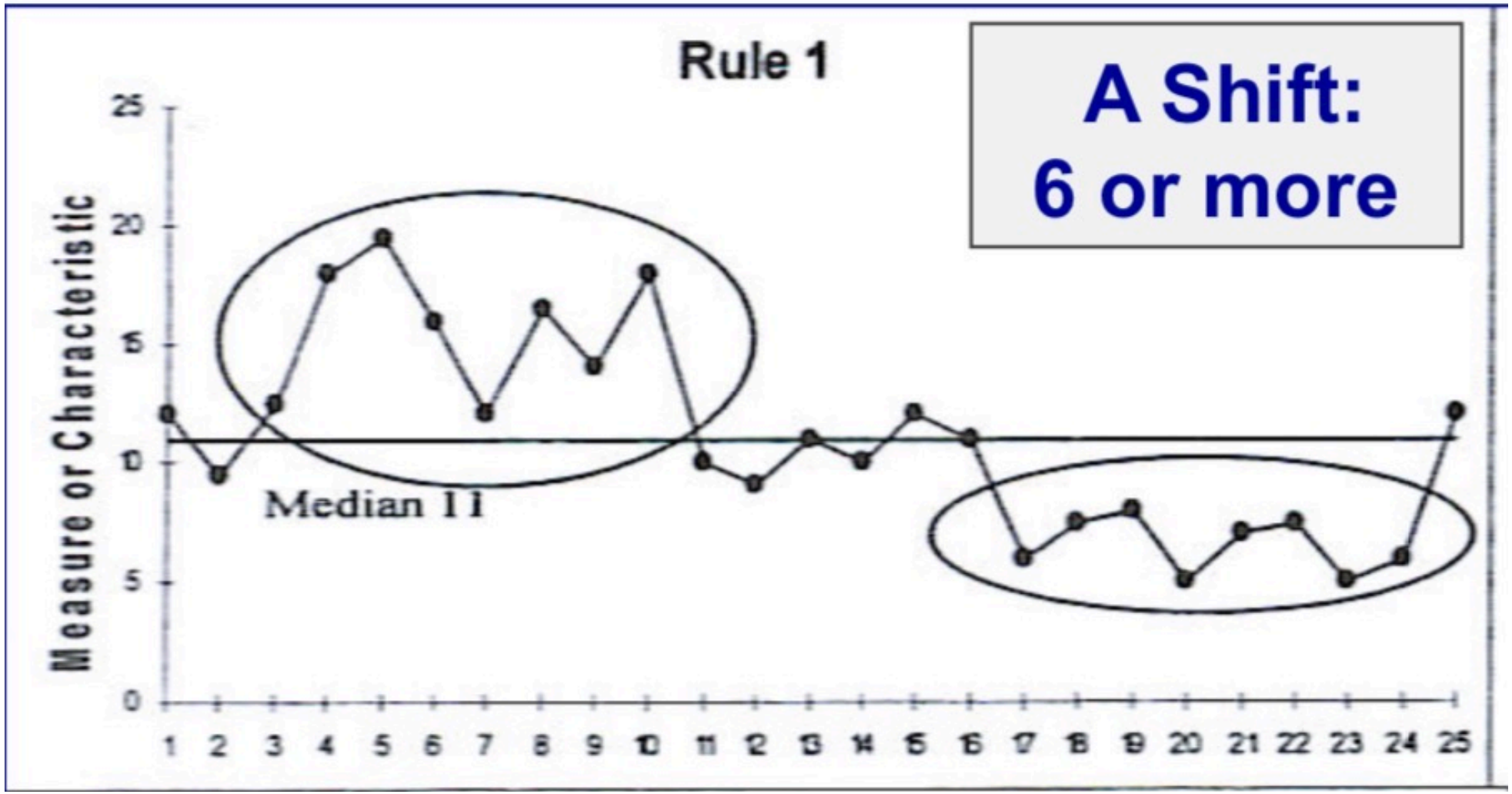
What Happened Here?

Non-Random Rules for Run Charts

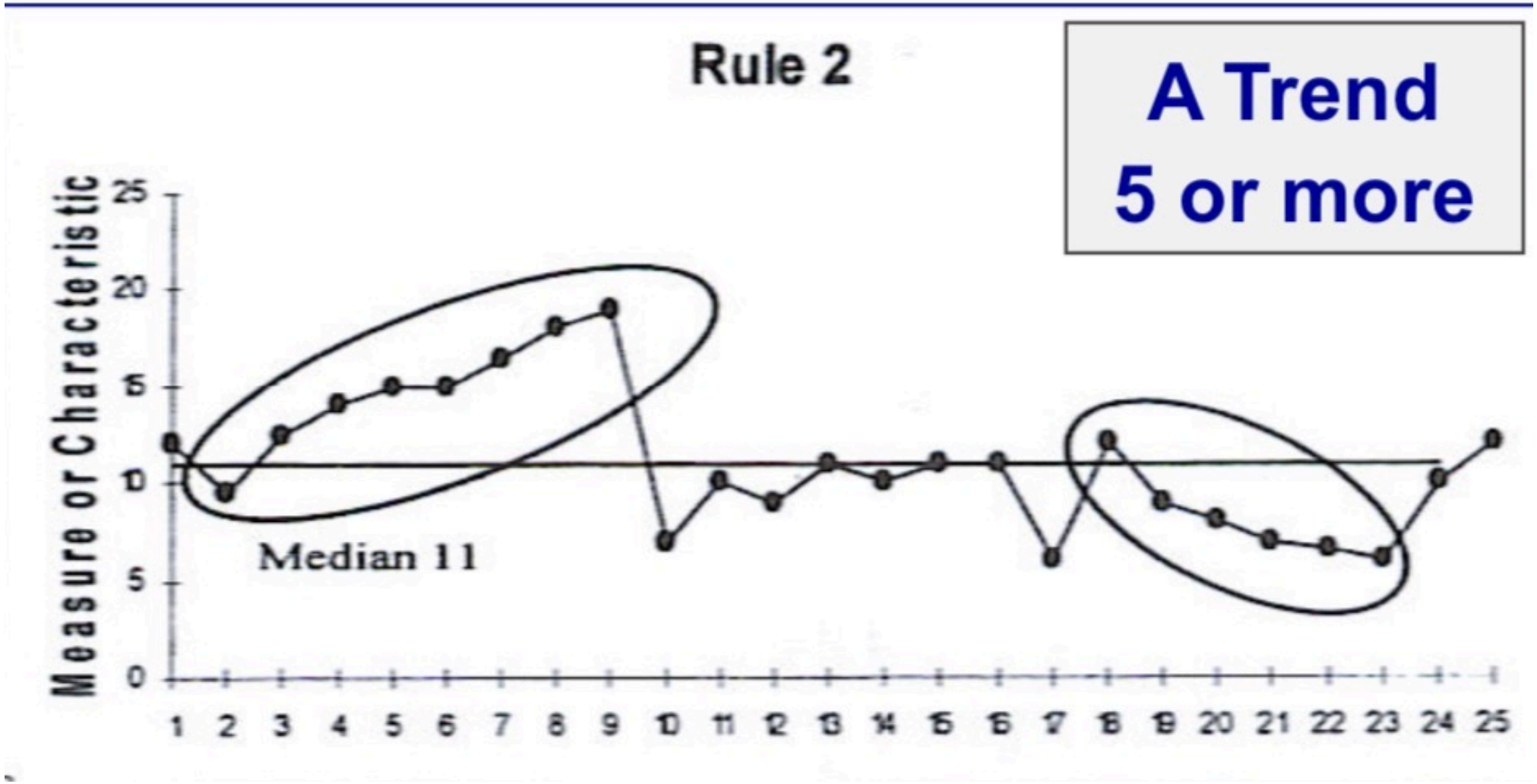


Source: The Data Guide by L. Provost and S. Murray, Jossey-Bass Publishers, 2011.

Non-Random Rules for Run Charts



Non-Random Rules for Run Charts



Non-Random Rules for Run Charts

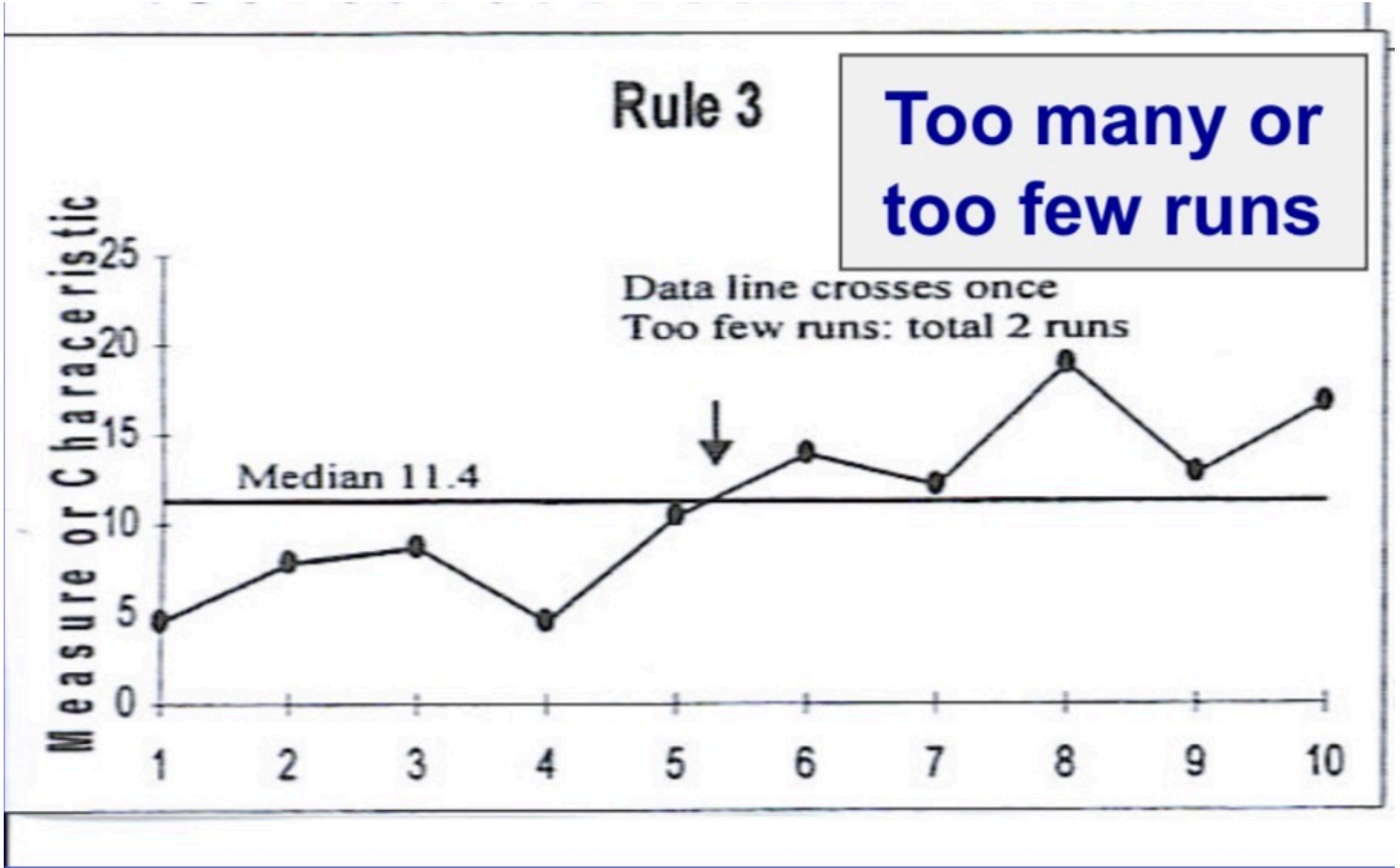
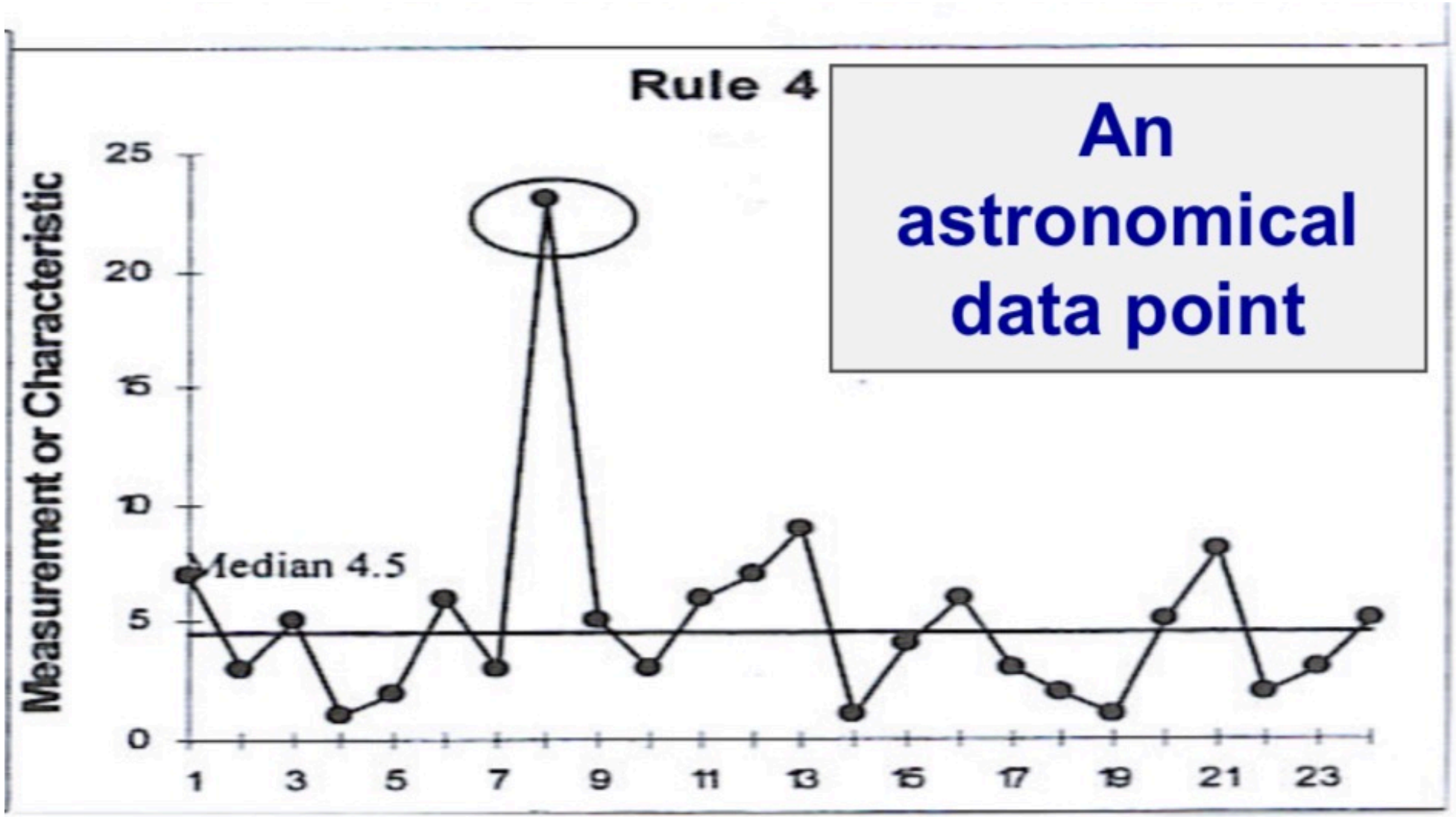


Table 4.2
Tests for Number of Runs Above and Below the Median

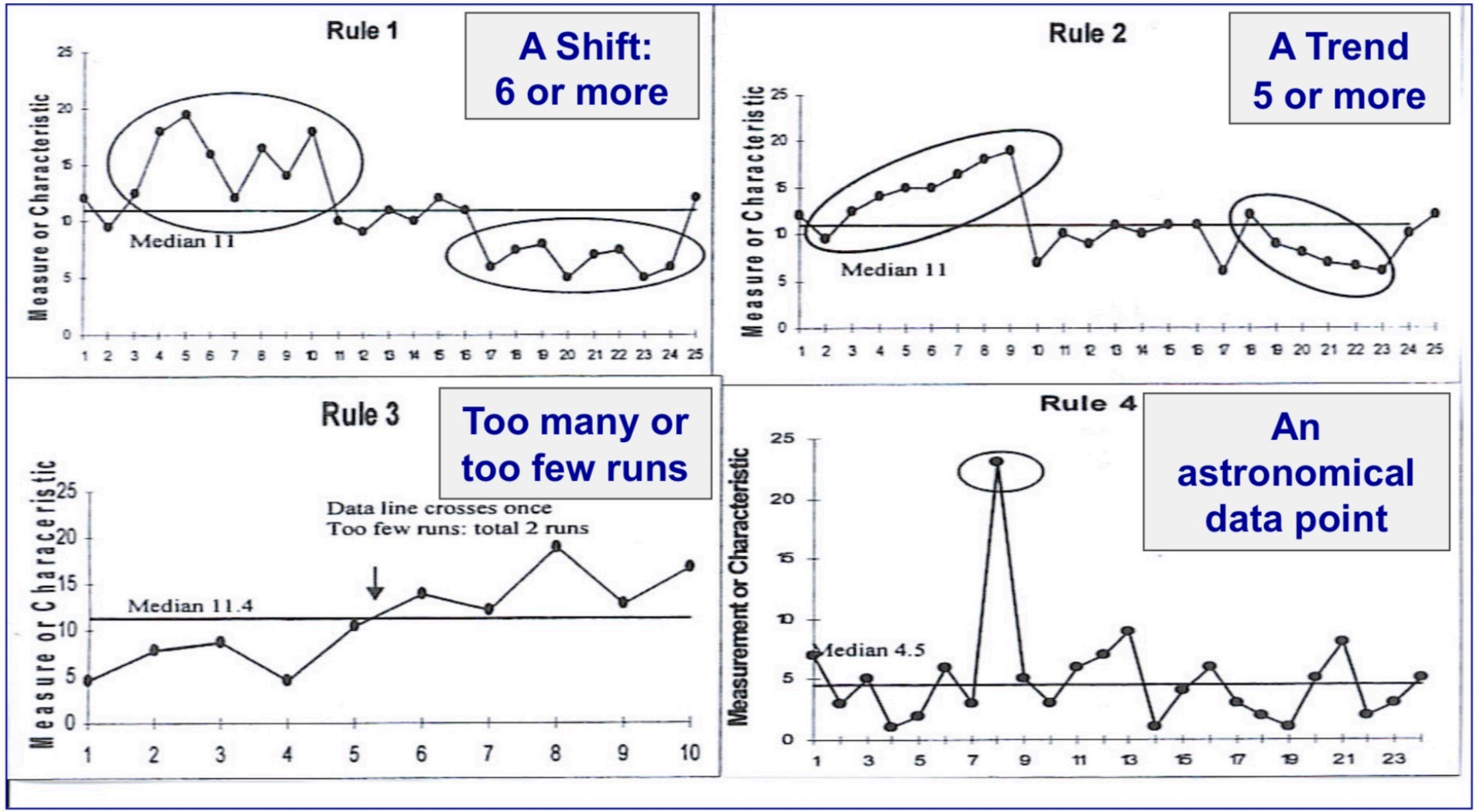
Number of Data Points	Lower Limit for Number of Runs	Upper Limit for Number of Runs
10	3	8
11	3	9
12	3	10
13	4	10
14	4	11
15	4	12
16	5	12
17	5	13
18	6	13
19	6	14
20	6	15
21	7	15
22	7	16
23	8	16
24	8	17
25	9	17
26	9	18
27	9	19
28	10	19
29	10	20
30	11	20

From Balestracci, Davis (2015). *Data Sanity*, (2nd ed). Englewood, CO: MGMA

Non-Random Rules for Run Charts



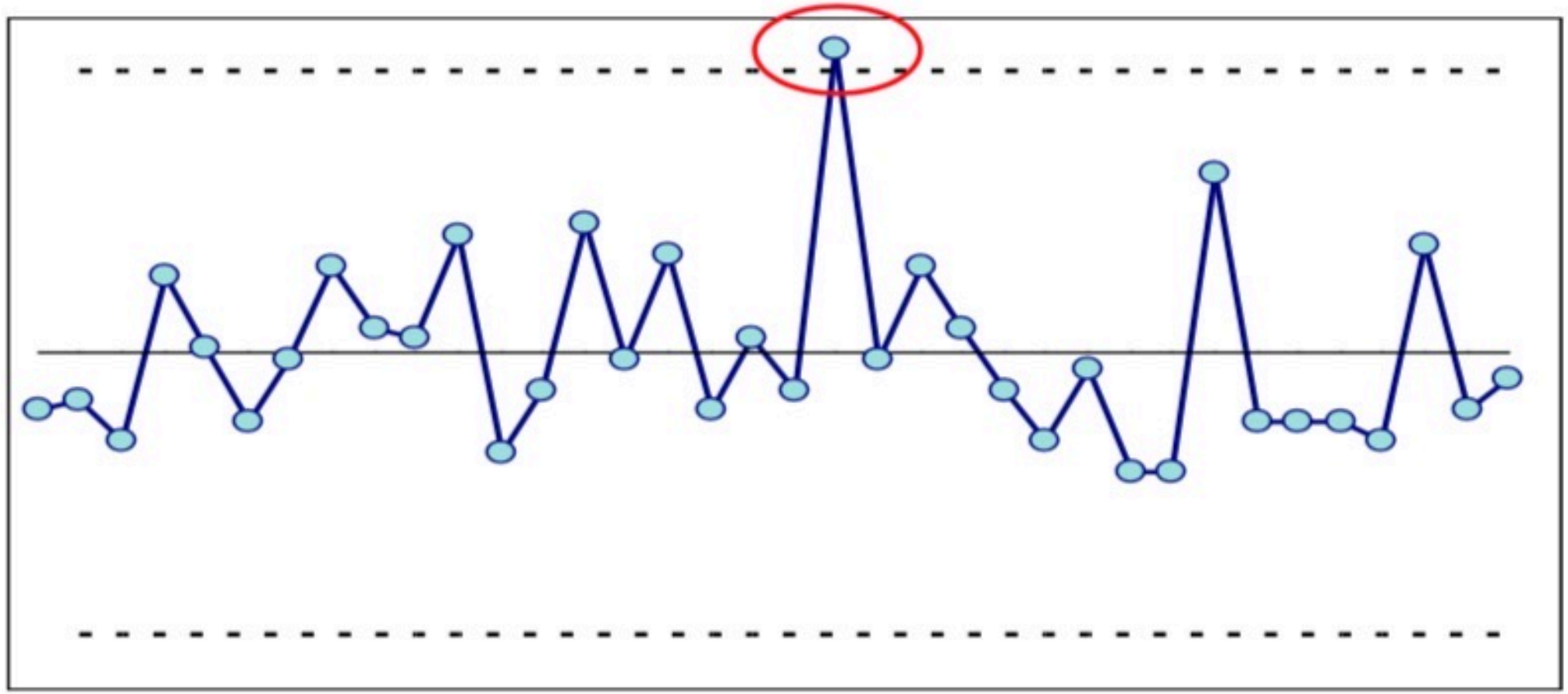
Non-Random Rules for Run Charts



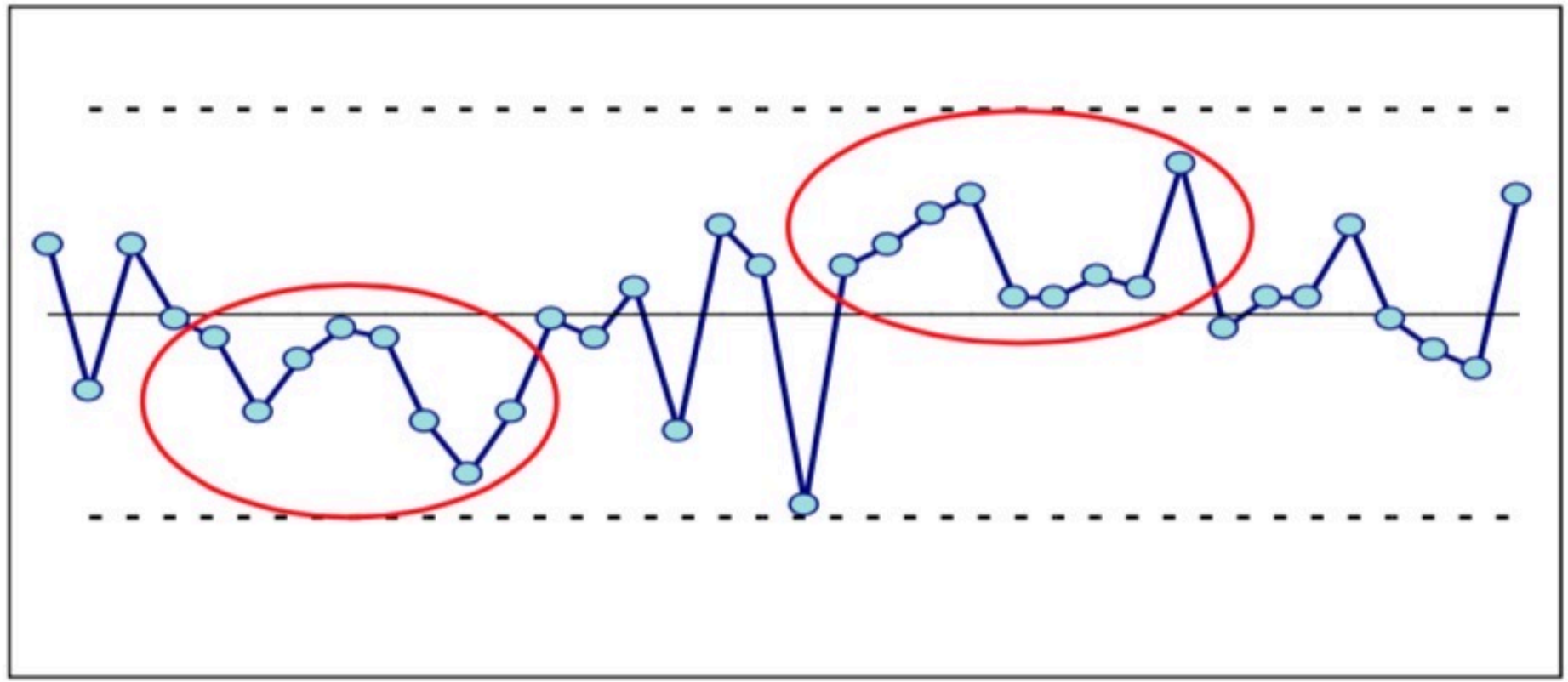
Source: The Data Guide by L. Provost and S. Murray, Jossey-Bass Publishers, 2011.

Rules for Detecting Special Causes on A Shewhart Chart

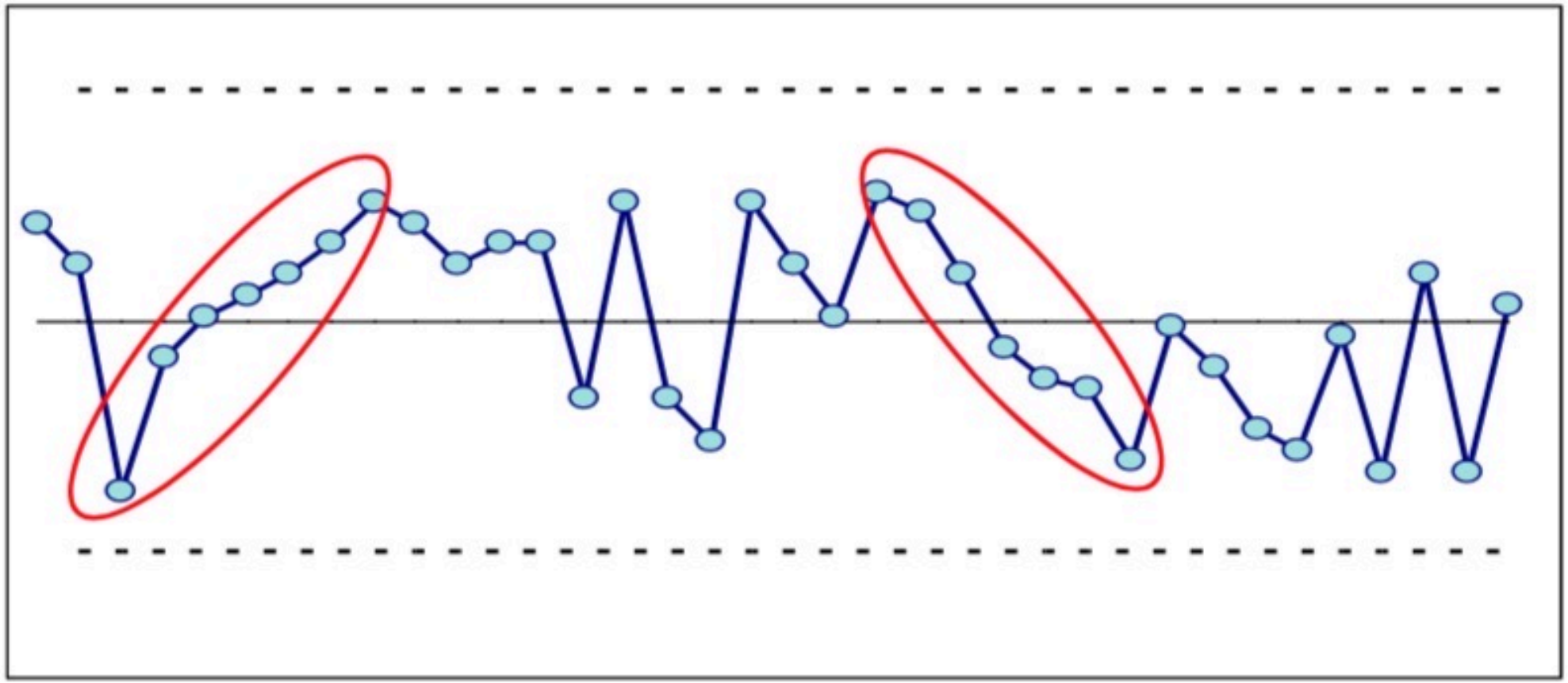
A single point outside the control limits



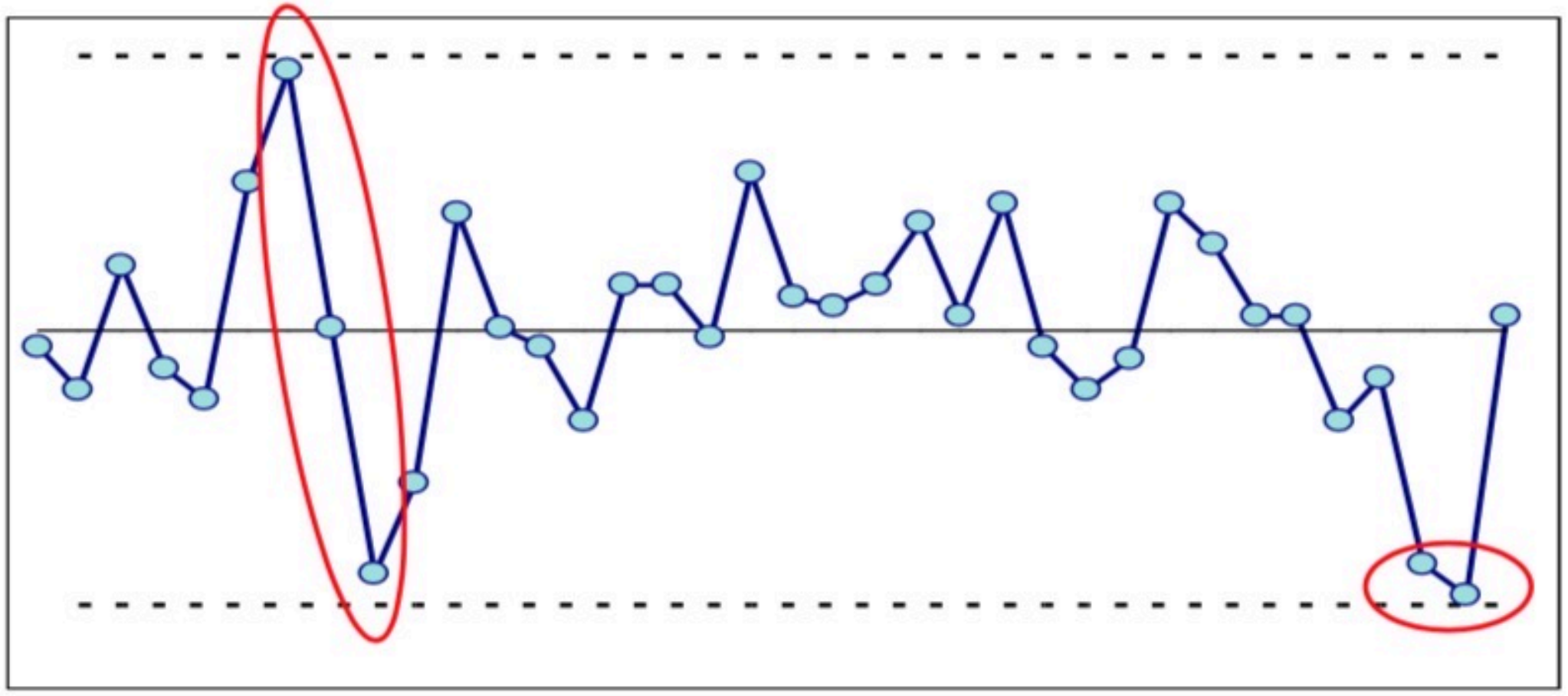
Eight or more consecutive points above or below the centerline



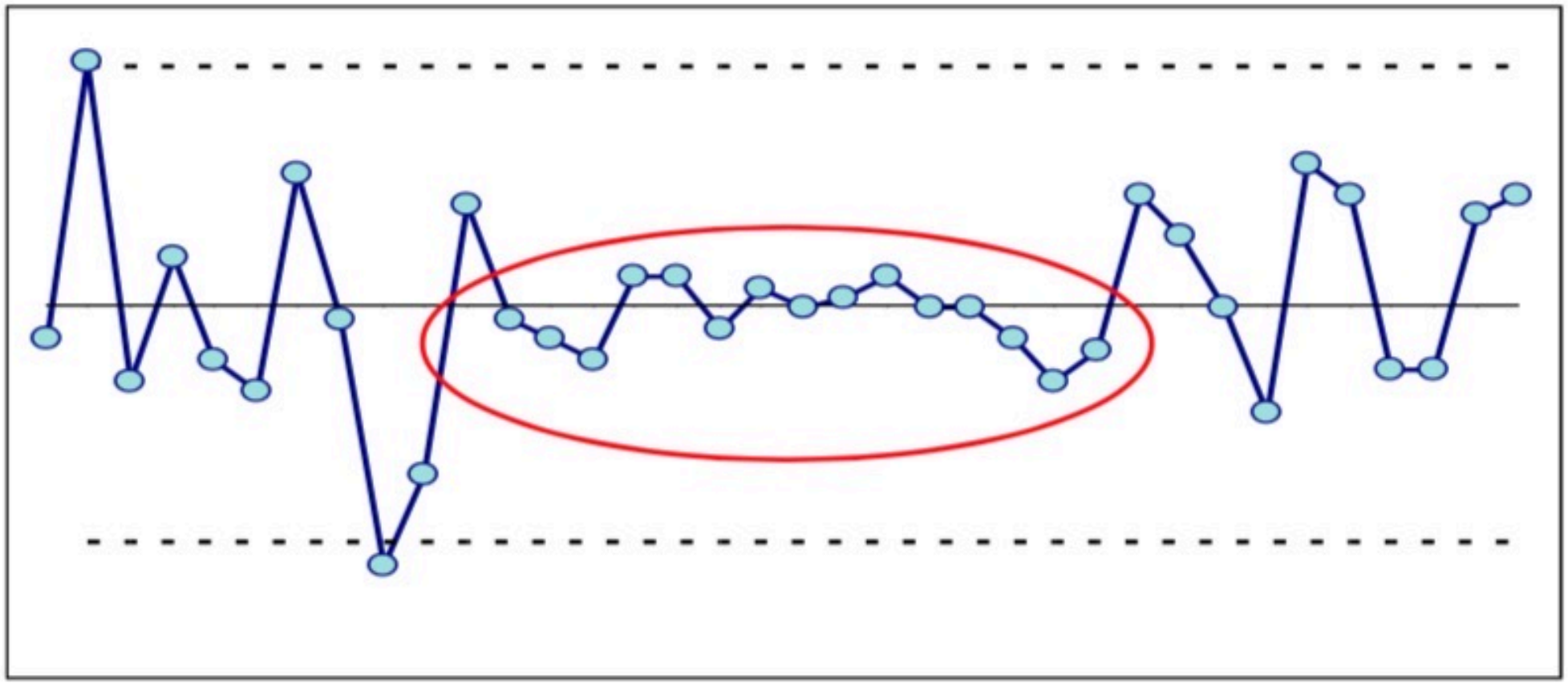
Six consecutive points increasing (trend up) or decreasing (trend down)

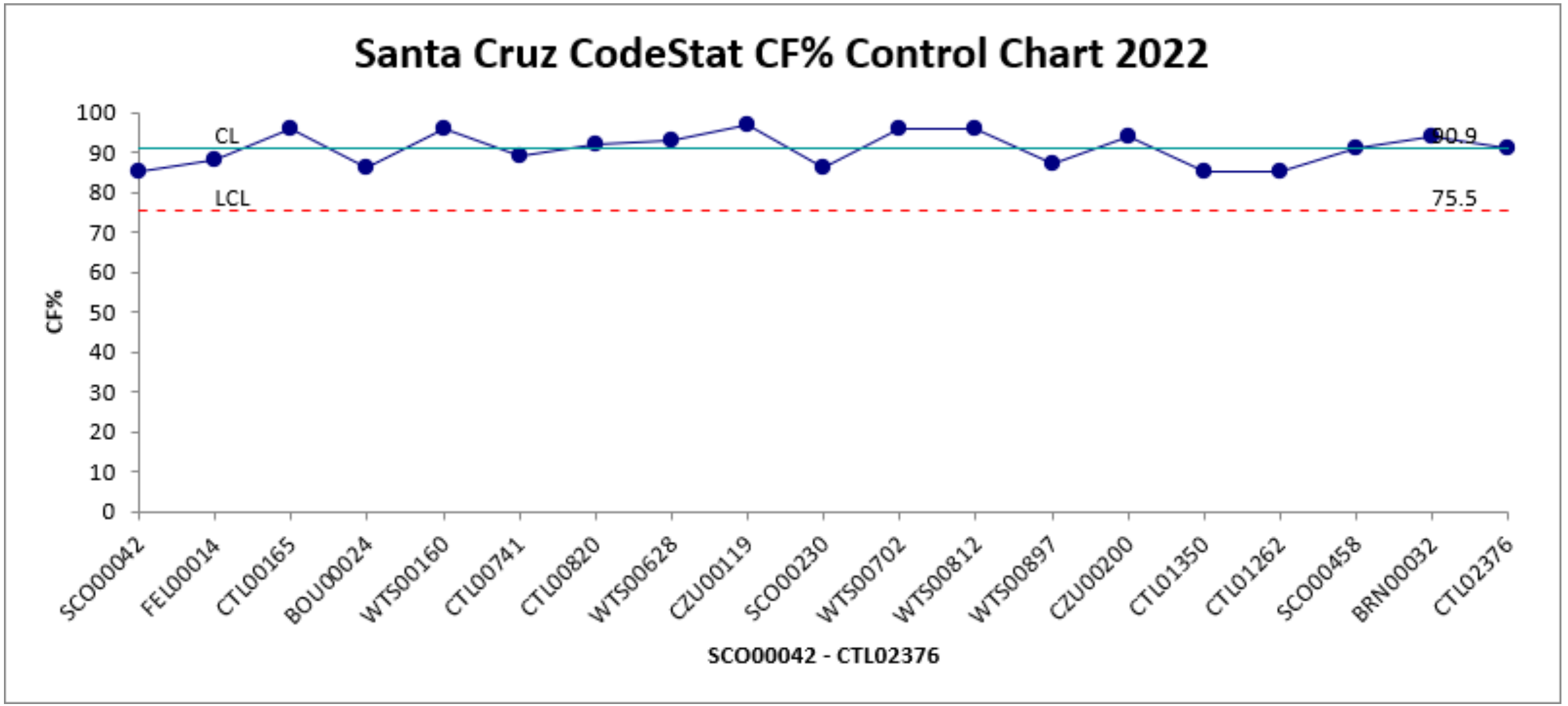


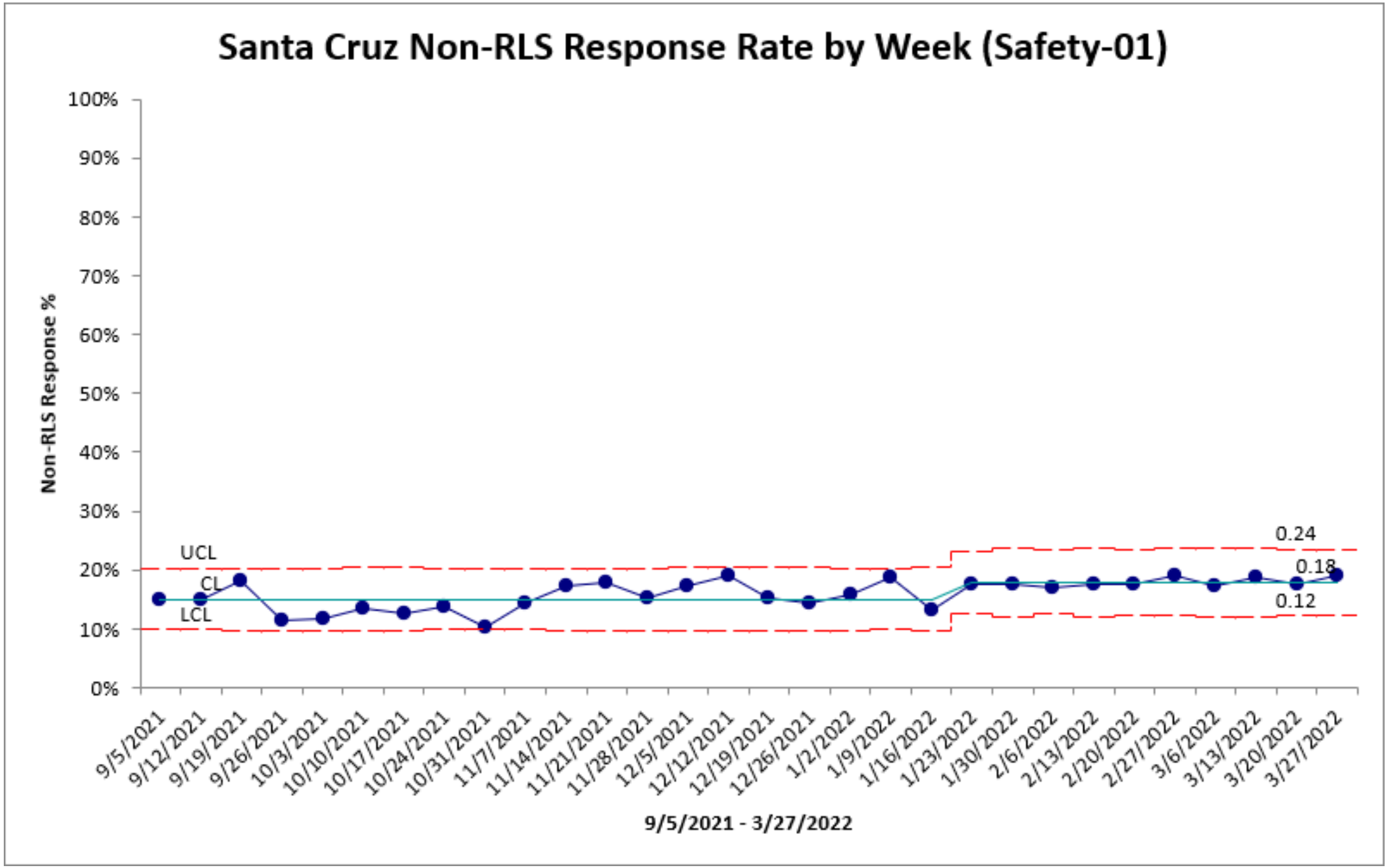
Two out of three consecutive points near a control limit (outer one-third)

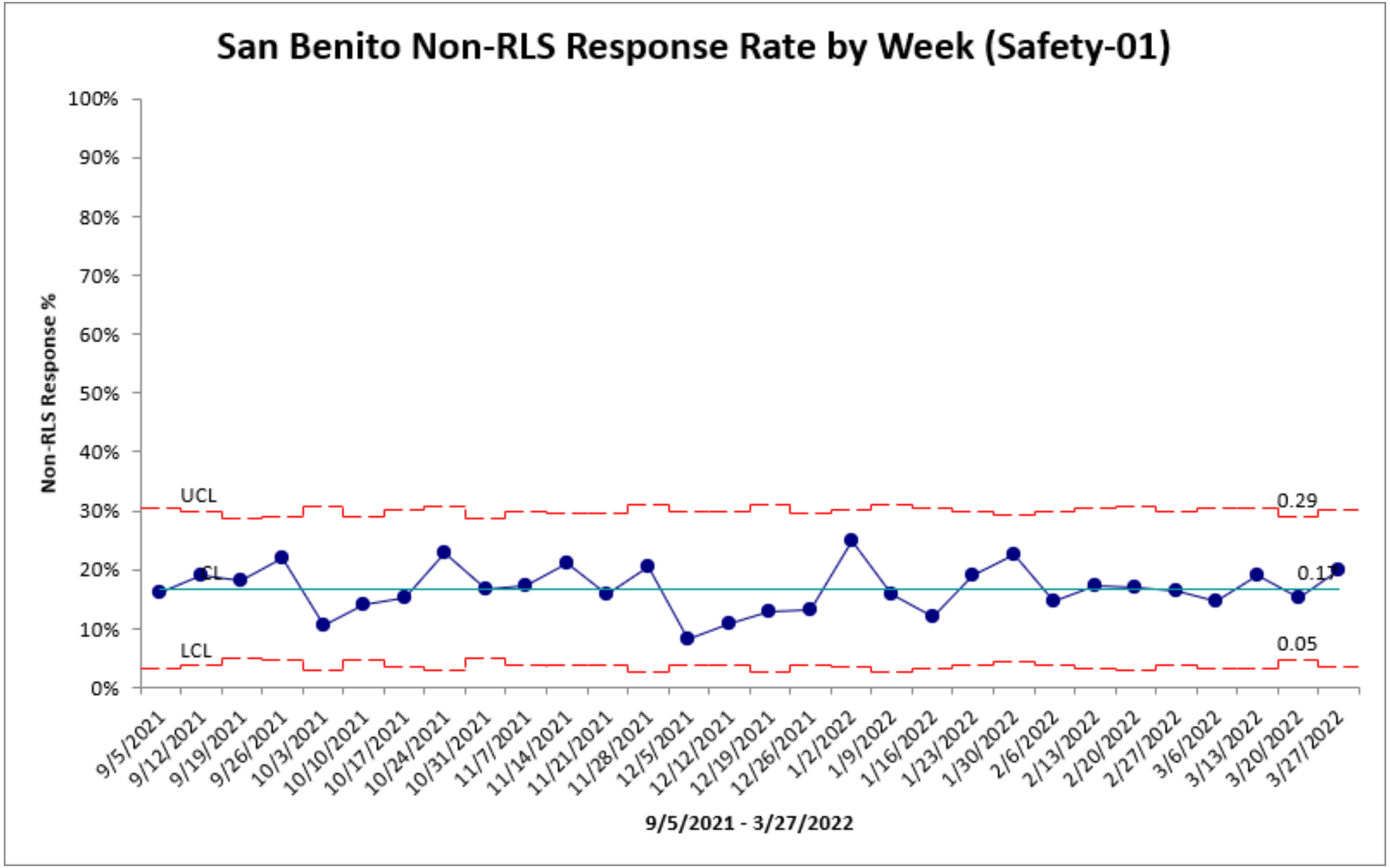


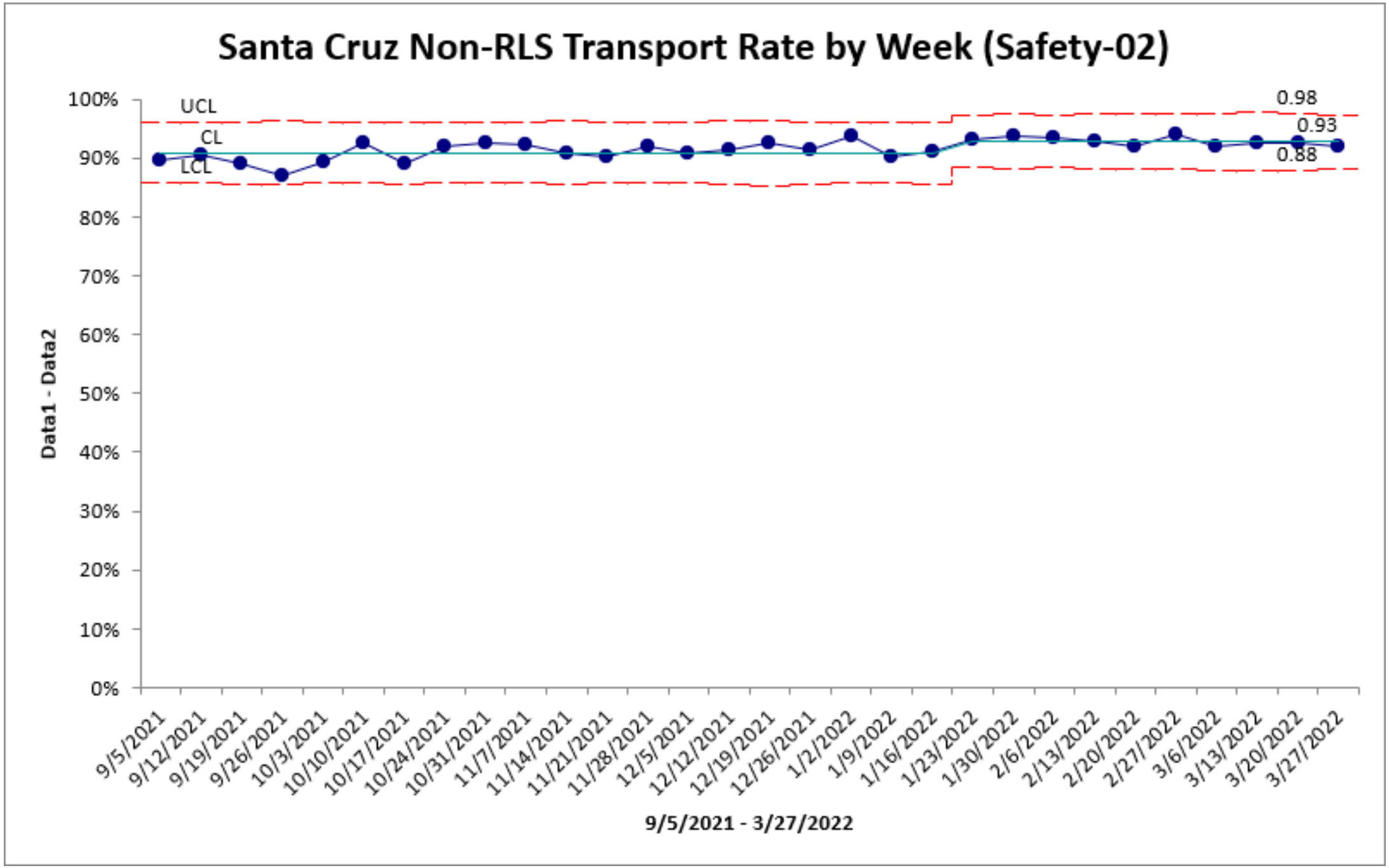
Fifteen consecutive points close to the centerline (inner one-third)

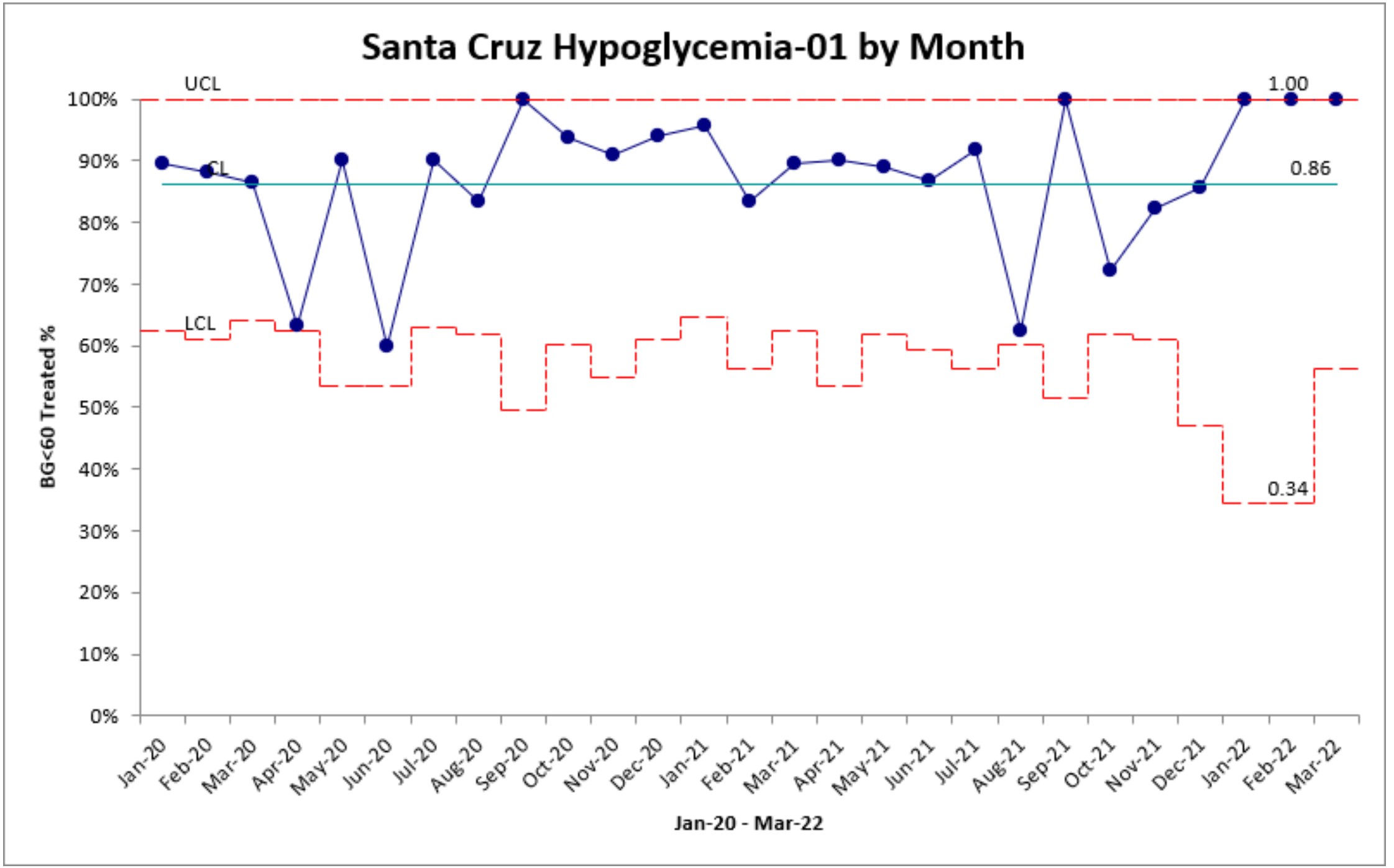


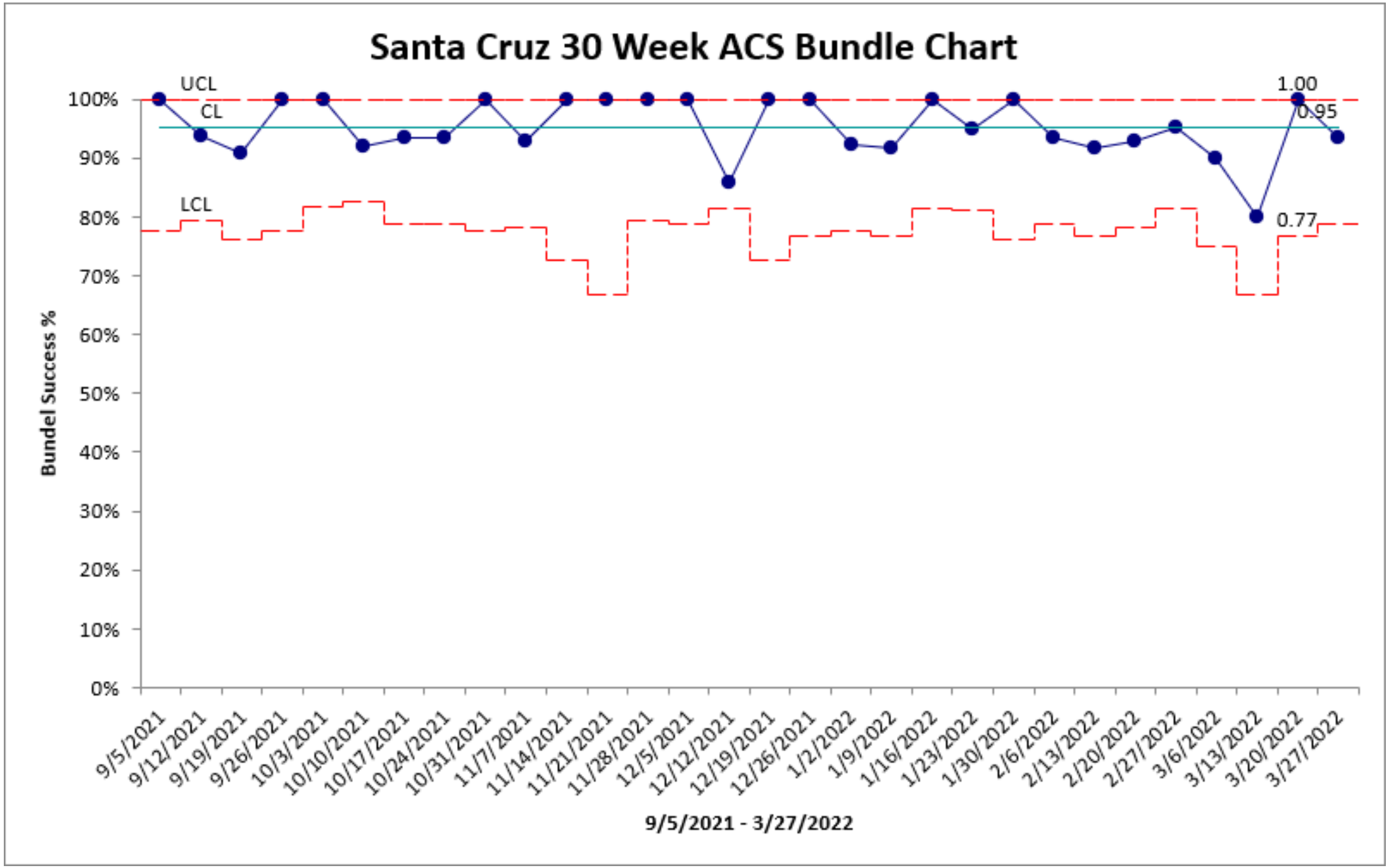

Santa Cruz CodeStat CF% Control Chart 2022
100
90
80
70
60
50
40
30
20
10
0
CF%
CL
LCL
90.9
75.5
SCO00042
FEL00014
CTL00165
BOU00024
WTS00160
CTL00741
CTL00820
WTS00628
CZU00119
SCO00230
WTS00702
WTS00812
WTS00897
CZU00200
CTL01350
CTL01262
SCO00458
BRN00032
CTL02376
SCO00042 - CTL02376

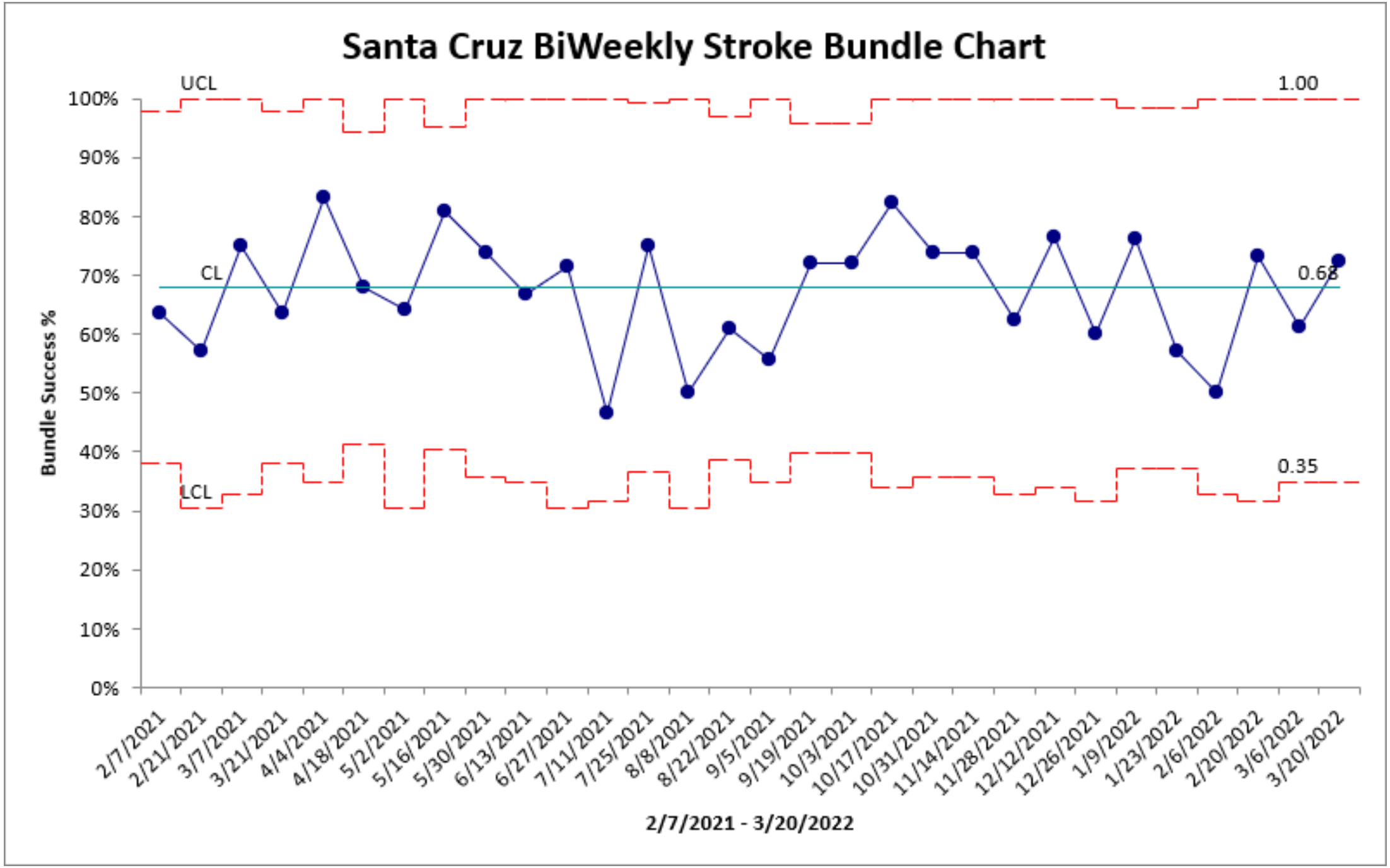

Santa Cruz Non-RLS Response Rate by Week (Safety-01)
Non-RLS Response %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
UCL
CL
LCL
0.24
0.18
0.12
9/5/2021
9/12/2021
9/19/2021
9/26/2021
10/3/2021
10/10/2021
10/17/2021
10/24/2021
10/31/2021
11/7/2021
11/14/2021
11/21/2021
11/28/2021
12/5/2021
12/12/2021
12/19/2021
12/26/2021
1/2/2022
1/9/2022
1/16/2022
1/23/2022
1/30/2022
2/6/2022
2/13/2022
2/20/2022
2/27/2022
3/6/2022
3/13/2022
3/20/2022
3/27/2022
9/5/2021 - 3/27/2022

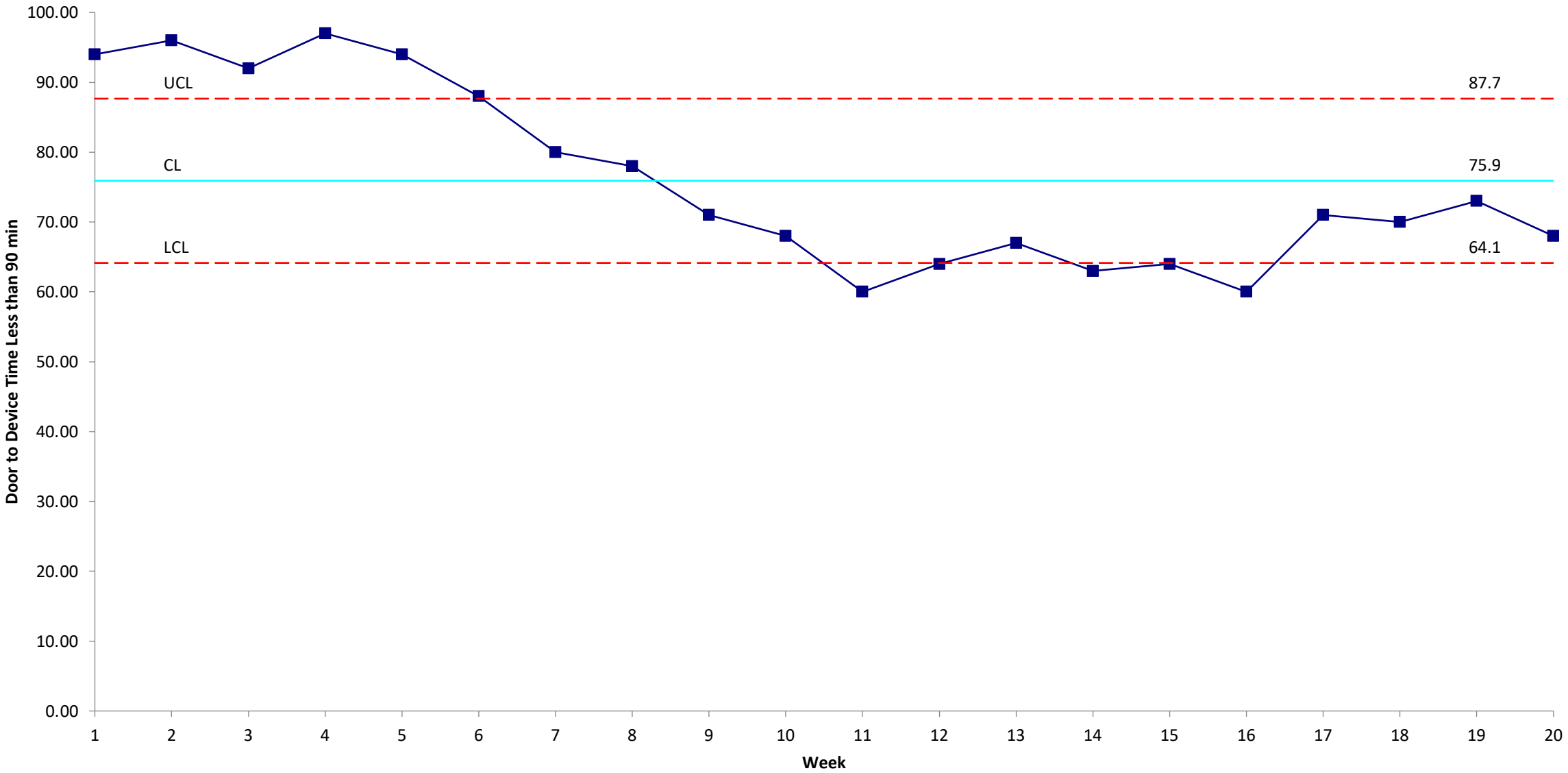

San Benito Non-RLS Response Rate by Week (Safety-01)
Non-RLS Response %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
UCL
CL
LCL
0.29
0.17
0.05
9/5/2021
9/12/2021
9/19/2021
9/26/2021
10/3/2021
10/10/2021
10/17/2021
10/24/2021
10/31/2021
11/7/2021
11/14/2021
11/21/2021
11/28/2021
12/5/2021
12/12/2021
12/19/2021
12/26/2021
1/2/2022
1/9/2022
1/16/2022
1/23/2022
1/30/2022
2/6/2022
2/13/2022
2/20/2022
2/27/2022
3/6/2022
3/13/2022
3/20/2022
3/27/2022
9/5/2021 - 3/27/2022

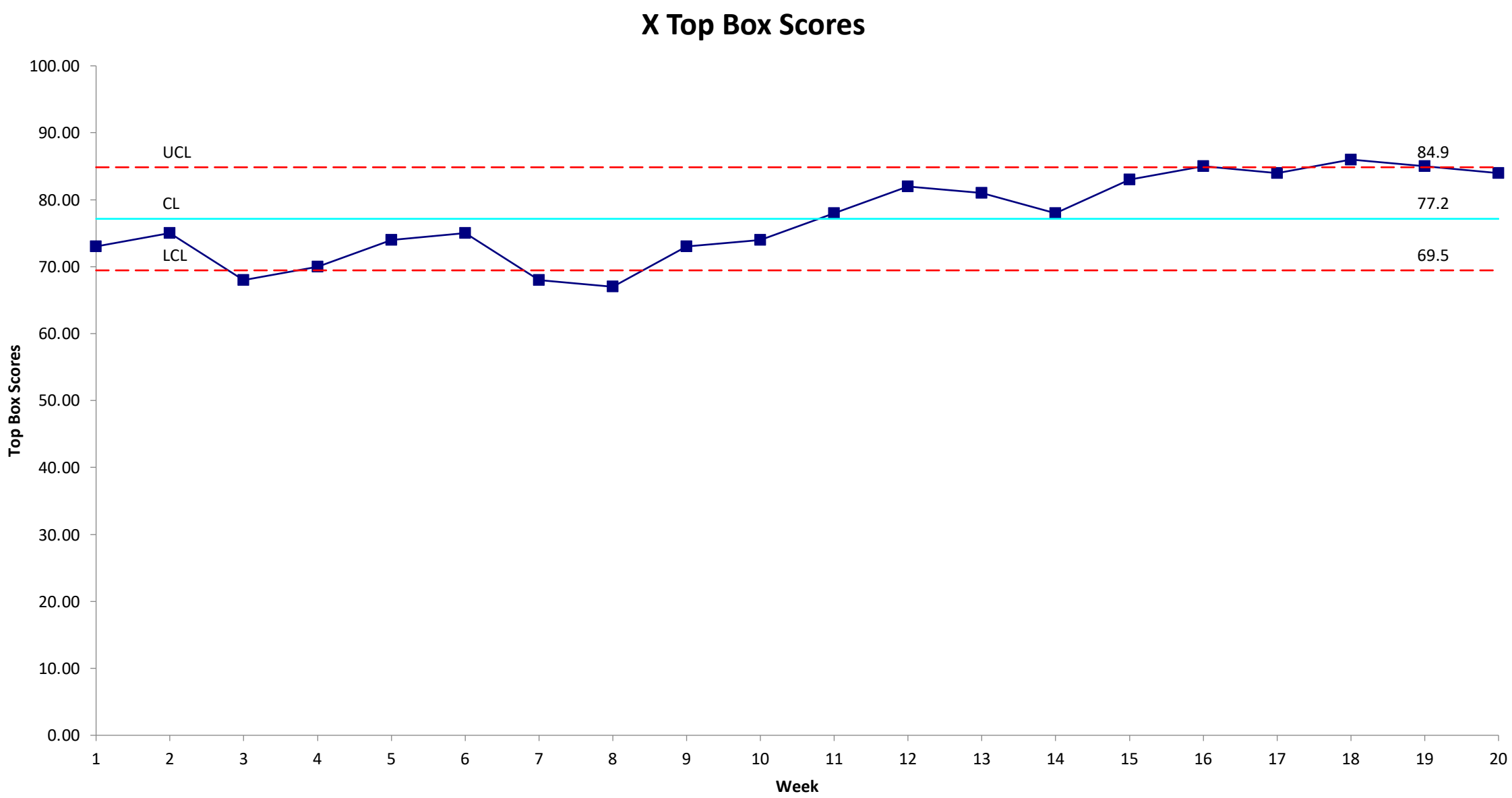

Santa Cruz Non-RLS Transport Rate by Week (Safety-02)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
UCL
CL
LCL
0.98
0.93
0.88
Data1 - Data2
9/5/2021
9/12/2021
9/19/2021
9/26/2021
10/3/2021
10/10/2021
10/17/2021
10/24/2021
10/31/2021
11/7/2021
11/14/2021
11/21/2021
11/28/2021
12/5/2021
12/12/2021
12/19/2021
12/26/2021
1/2/2022
1/9/2022
1/16/2022
1/23/2022
1/30/2022
2/6/2022
2/13/2022
2/20/2022
2/27/2022
3/6/2022
3/13/2022
3/20/2022
3/27/2022
9/5/2021 - 3/27/2022

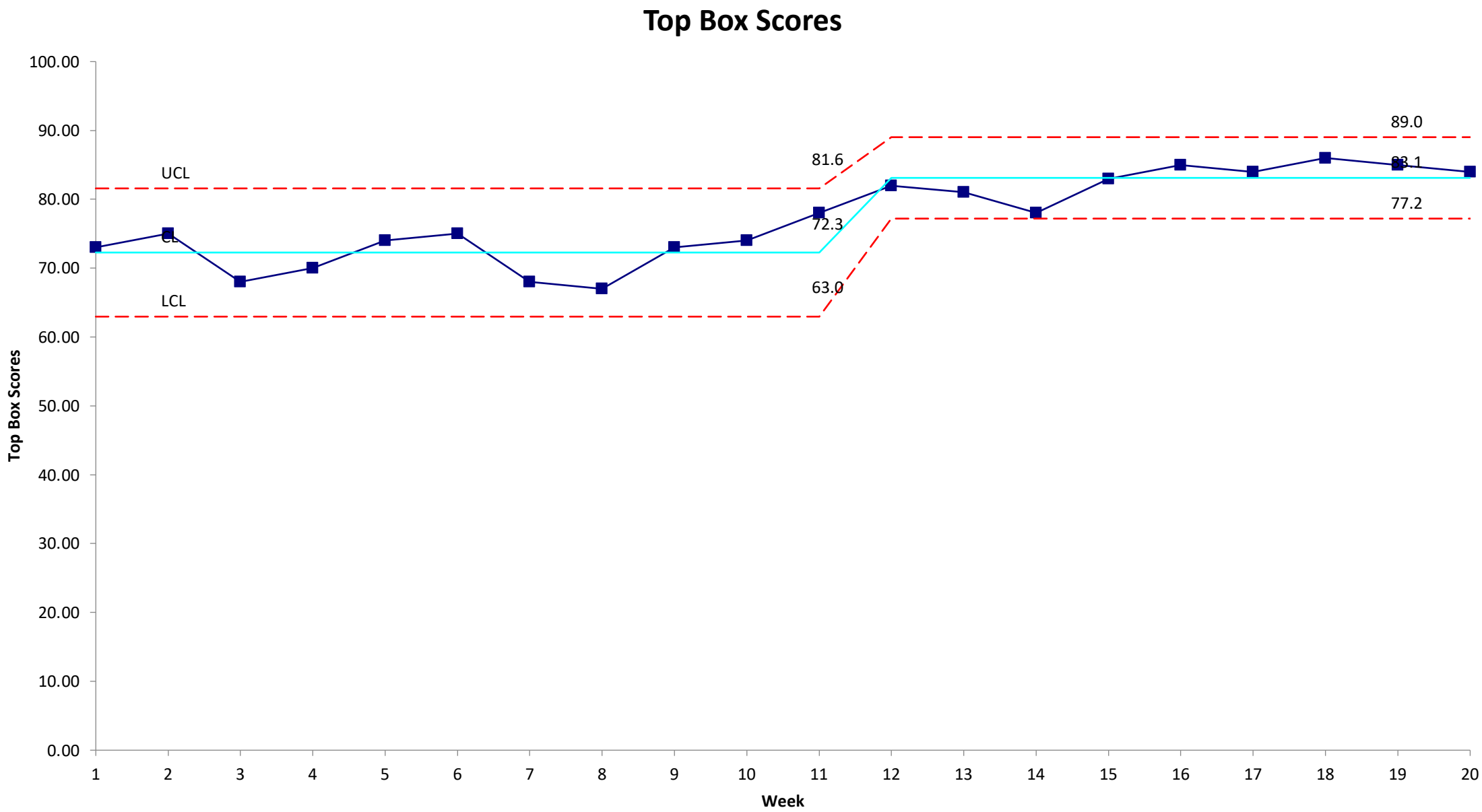

Santa Cruz Hypoglycemia-01 by Month
UCL
CL
LCL
1.00
0.86
0.34
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BG<60 Treated %
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22
Jan-20 - Mar-22

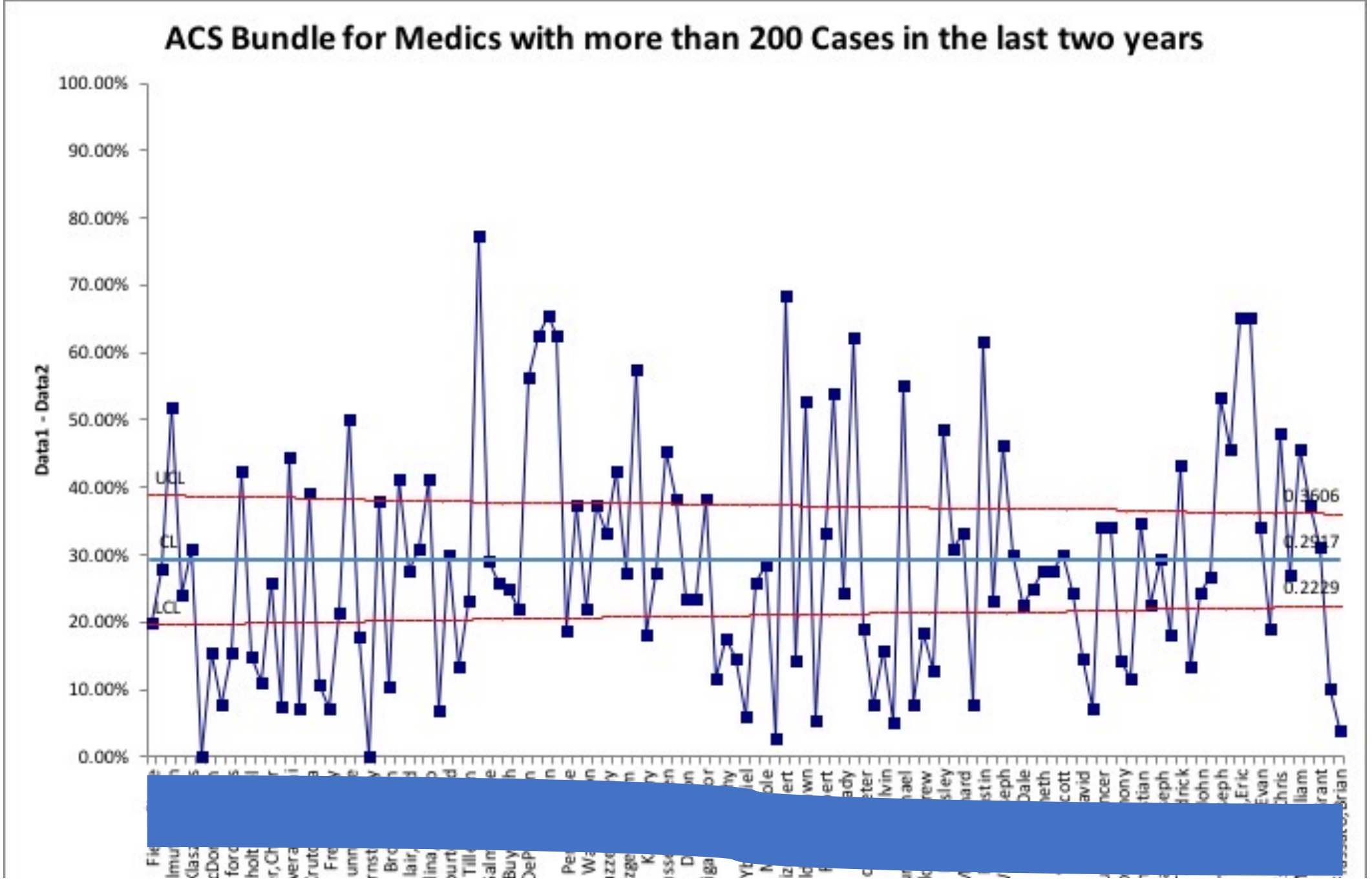

Santa Cruz 30 Week ACS Bundle Chart
UCL
CL
LCL
1.00
0.95
0.77
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Bundel Success %
9/5/2021
9/12/2021
9/19/2021
9/26/2021
10/3/2021
10/10/2021
10/17/2021
10/24/2021
10/31/2021
11/7/2021
11/14/2021
11/21/2021
11/28/2021
12/5/2021
12/12/2021
12/19/2021
12/26/2021
1/2/2022
1/9/2022
1/16/2022
1/23/2022
1/30/2022
2/6/2022
2/13/2022
2/20/2022
2/27/2022
3/6/2022
3/13/2022
3/20/2022
3/27/2022
9/5/2021 - 3/27/2022

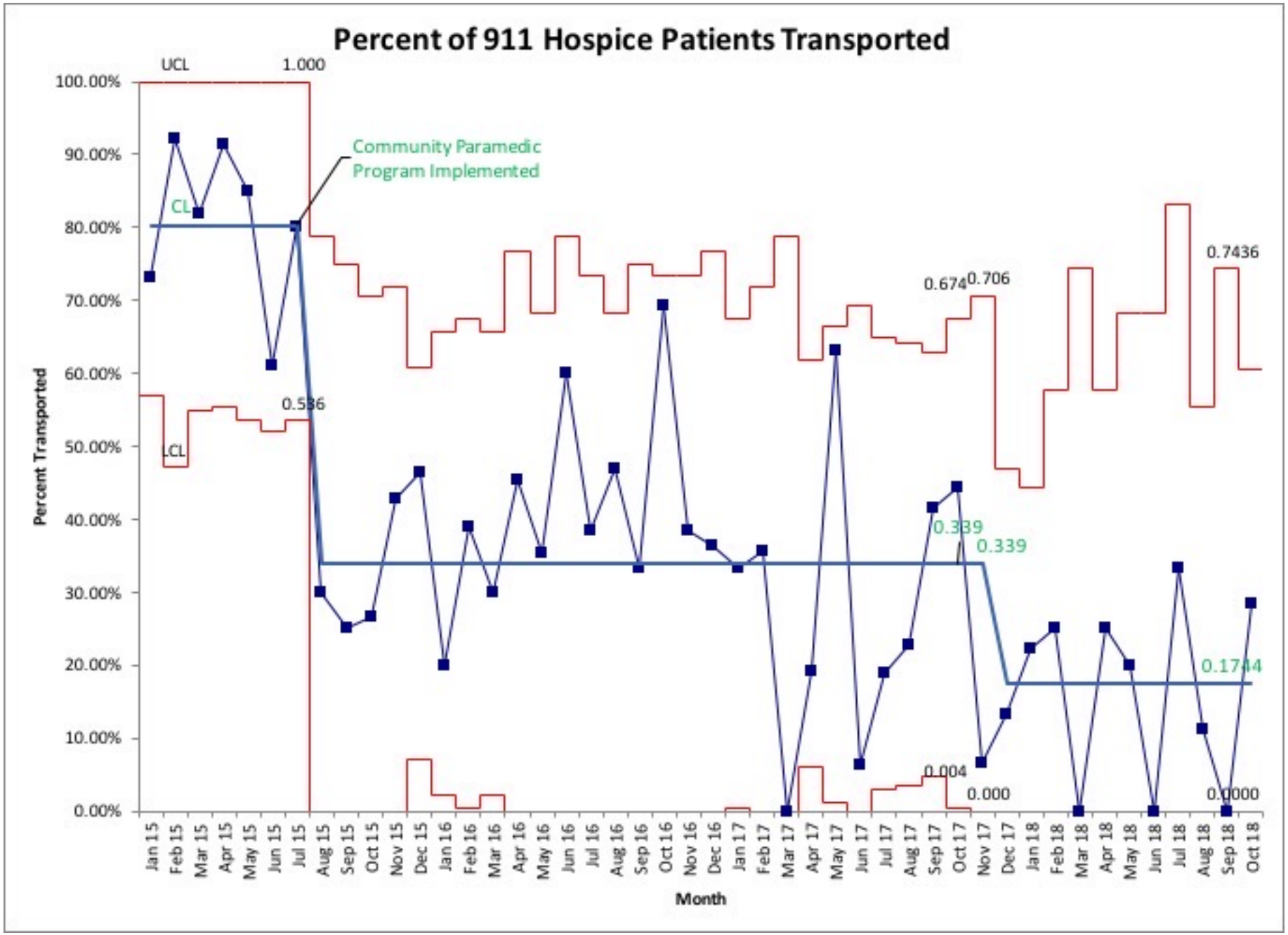

Santa Cruz BiWeekly Stroke Bundle Chart
UCL
1.00
CL
0.68
LCL
0.35
Bundle Success %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2/7/2021
2/21/2021
3/7/2021
3/21/2021
4/4/2021
4/18/2021
5/2/2021
5/16/2021
5/30/2021
6/13/2021
6/27/2021
7/11/2021
7/25/2021
8/8/2021
8/22/2021
9/5/2021
9/19/2021
10/3/2021
10/17/2021
10/31/2021
11/14/2021
11/28/2021
12/12/2021
12/26/2021
1/9/2022
1/23/2022
2/6/2022
2/20/2022
3/6/2022
3/20/2022
2/7/2021 - 3/20/2022


X Door to Device Time Less than 90 min
Door to Device Time Less than 90 min
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
UCL
87.7
CL
75.9
LCL
64.1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Week


X Top Box Scores
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Top Box Scores
UCL
CL
LCL
84.9
77.2
69.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Week


Top Box Scores
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Top Box Scores
UCL
CL
LCL
81.6
72.3
63.0
89.0
83.1
77.2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Week


ACS Bundle for Medics with more than 200 Cases in the last two years
Data1 - Data2
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
UCL
CL
LCL
0.3606
0.2917
0.2229


Percent of 911 Hospice Patients Transported
UCL
1.000
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Community Paramedic
Program Implemented
CL
0.536
LCL
0.674
0.706
0.7436
0.339
0.339
0.1744
0.004
0.000
0.0000
Percent Transported
Jan 15
Feb 15
Mar 15
Apr 15
May 15
Jun 15
Jul 15
Aug 15
Sep 15
Oct 15
Nov 15
Dec 15
Jan 16
Feb 16
Mar 16
Apr 16
May 16
Jun 16
Jul 16
Aug 16
Sep 16
Oct 16
Nov 16
Dec 16
Jan 17
Feb 17
Mar 17
Apr 17
May 17
Jun 17
Jul 17
Aug 17
Sep 17
Oct 17
Nov 17
Dec 17
Jan 18
Feb 18
Mar 18
Apr 18
May 18
Jun 18
Jul 18
Aug 18
Sep 18
Oct 18
Month

Model for Improvement

What are we trying to accomplish?

How will we know that a change is an improvement?

What change can we make that will result in improvement?

Small Fast Test of Change

Small Fast Test of Change

Predict

Small Fast Test of Change

Predict

Try It
Gather Data

Small Fast Test of Change

Predict

Try It
Gather Data

Compare
Results with
Prediction

Small Fast Test of Change

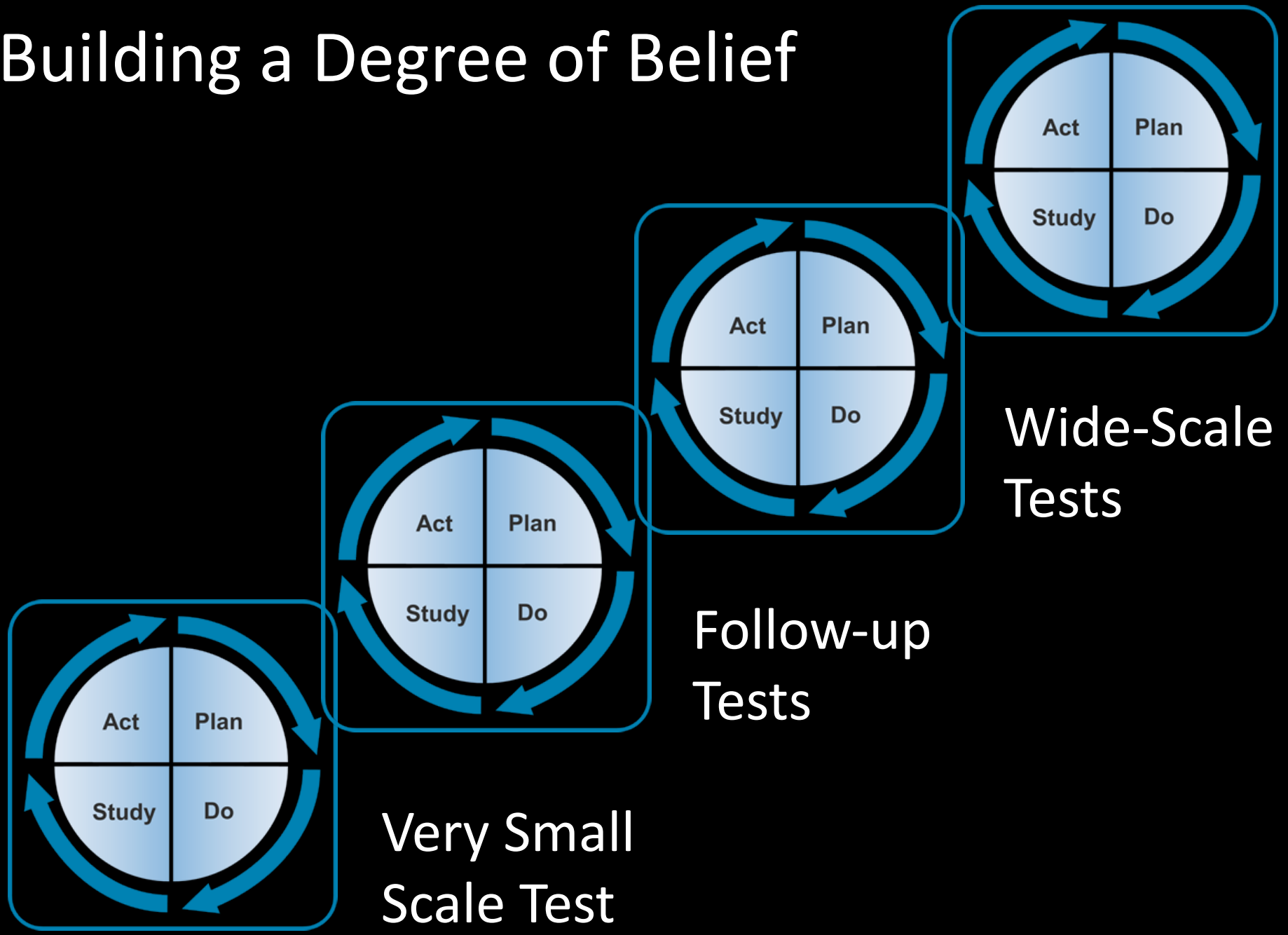
Adopt
Adapt or
Abandon

Predict

Compare
Results with
Prediction

Try It
Gather Data

Building a Degree of Belief



Implementation

Wide-Scale Tests

Follow-up Tests

Very Small Scale Test