

Handout on Creating a Process Behavior Chart

Mark Graban, MS, MBA – Mark@MarkGraban.com

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To learn more, read my book *Measures of Success*.
www.MeasuresOfSuccessBook.com

Step 1: Get Initial Data

- Generally want 20 data points to calculate "process behavior limits"
 - (can start with just 6 or 8)
 - Note: Weekends are excluded here because that is a different "system"

	A	B	C
1		Data	Average
2	1/2/12	999	1576.2
3	1/3/12	1,654	1576.2
4	1/4/12	1,773	1576.2
5	1/5/12	1,523	1576.2
6	1/6/12	1,275	1576.2
7	1/7/12	2,225	1576.2
8	1/8/12	1,916	1576.2
9	1/9/12	1,798	1576.2
10	1/10/12	1,622	1576.2
11	1/11/12	1,385	1576.2
12	1/12/12	1,604	1576.2
13	1/13/12	1,551	1576.2
14	1/14/12	828	1576.2
15	1/15/12	1,502	1576.2
16	1/16/12	1,391	1576.2
17	1/17/12	1,550	1576.2
18	1/18/12	1,700	1576.2
19	1/19/12	1,865	1576.2
20	1/20/12	1,658	1576.2
21	1/21/12	1,705	1576.2
22	1/22/12	1,780	1576.2

Make sure the data points are part of the same “rational subgroup” or the same underlying system.

There are diminishing returns from using more data points to establish this baseline. Using 25 or 30 data points is only marginally better than using 20.

If you have just 6, or 8, or 10 data points to start, use that to calculate the average / mean and limits. Recalculate the limits as you get to 20 data points... but do NOT continually recalculate them over time.

Step 2: Calculate Mean & Moving Ranges

- Calculate mean of the first 20 points

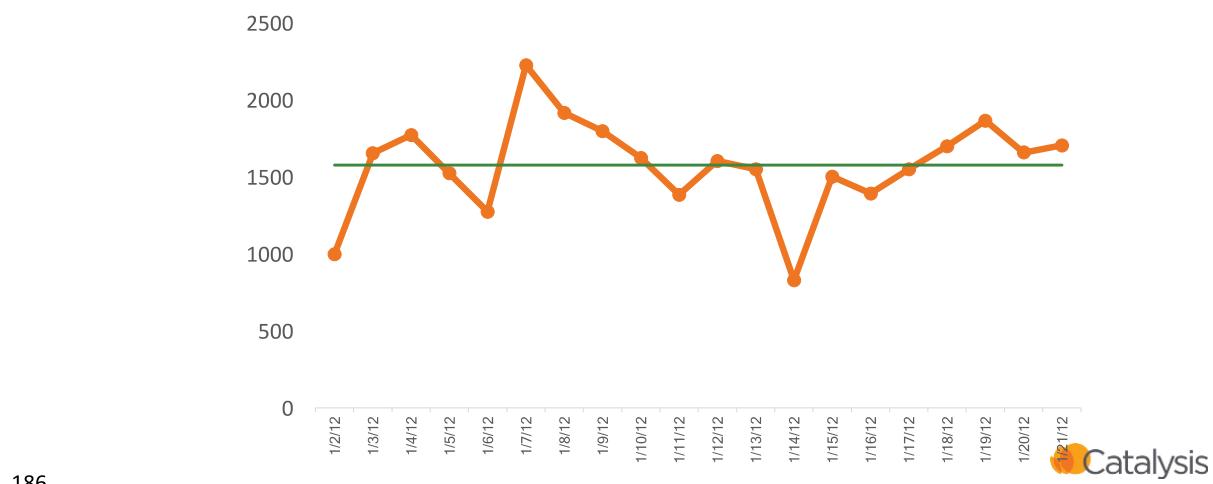
C2: =AVERAGE(B2:B21)
(if data is in column B)

- Calculate the moving range of the first 20 points

D3: =ABS(B3-B2)

	A	B	C	D
1		Data	Average	Moving Range (MR)
2	1/2/12	999	1576.2	
3	1/3/12	1,654	1576.2	655
4	1/4/12	1,773	1576.2	119
5	1/5/12	1,523	1576.2	250
6	1/6/12	1,275	1576.2	248
7	1/7/12	2,225	1576.2	950
8	1/8/12	1,916	1576.2	309
9	1/9/12	1,798	1576.2	118
10	1/10/12	1,622	1576.2	176
11	1/11/12	1,385	1576.2	237
12	1/12/12	1,604	1576.2	219
13	1/13/12	1,551	1576.2	53
14	1/14/12	828	1576.2	723
15	1/15/12	1,502	1576.2	674

Step 3: Draw Initial Chart (with Mean line)



Step 4: Add Natural Process Limits

- Calculate “MR-bar”
 - Average of the 1st 19 MRs
 - E3: =Average(D3:D21)

	A	B	C	D	E	F	G
1		Data	Average	Moving Range (MR)	MR Bar	Lower Limit	Upper Limit
2	1/2/12	999	1576.2	655	293.16	796.52	2355.88
3	1/3/12	1,654	1576.2	119	293.16	796.52	2355.88
4	1/4/12	1,773	1576.2	250	293.16	796.52	2355.88
5	1/5/12	1,523	1576.2	248	293.16	796.52	2355.88
6	1/6/12	1,275	1576.2	950	293.16	796.52	2355.88
7	1/7/12	2,225	1576.2	309	293.16	796.52	2355.88
8	1/8/12	1,916	1576.2	118	293.16	796.52	2355.88
9	1/9/12	1,798	1576.2				

- Calculate the Limits

- Lower = Average – 3*(MR bar)/1.128
 - F2: = C3 – 3 * E3 / 1.128 or C3 – 2.66 * E3
- Upper = Mean + 3*(MR bar)/1.128
 - G2: = C3 + 3 * E3 / 1.128 or C3 + 2.66 * E3

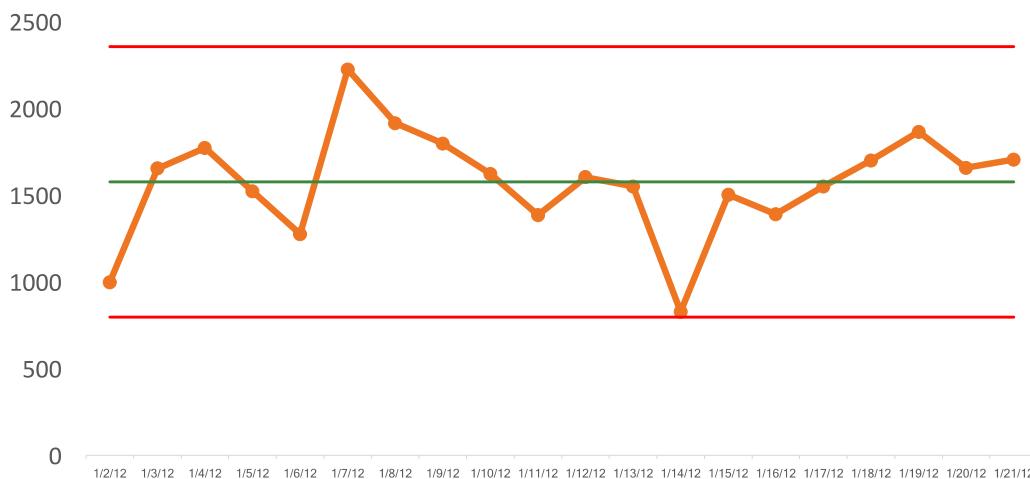
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The first data point does NOT have an MR. If you used 20 data points for the average / mean, then use the first 19 MRs. If you used 25 data points, use the first 24 MRs.

The “3” in the formulas essentially represents the +/- 3 sigma limits.

Step 5: Review Chart with Limits



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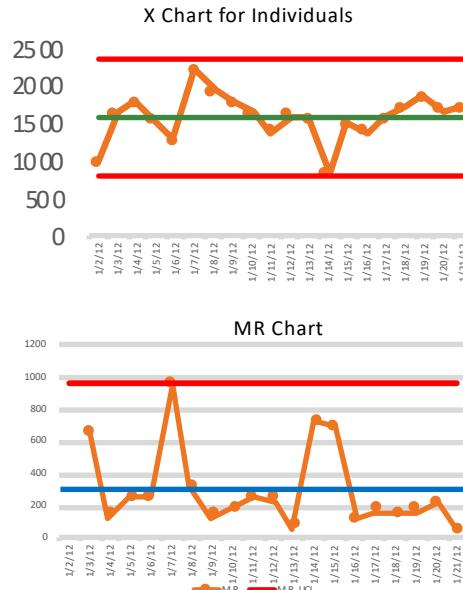
We use three rules to look for signals in the data:

Three Rules for Detecting a Signal

- **Rule 1:** Any single data point outside of the limits.
- **Rule 2:** Eight consecutive points on the same side of the average.
- **Rule 3:** 3 out of 3 (or 3 out of 4) points closer to the same limit than the average.
- Also apply **Rule 1** to the MR chart, if that's being used

Step 6: Draw MR Chart & Evaluate

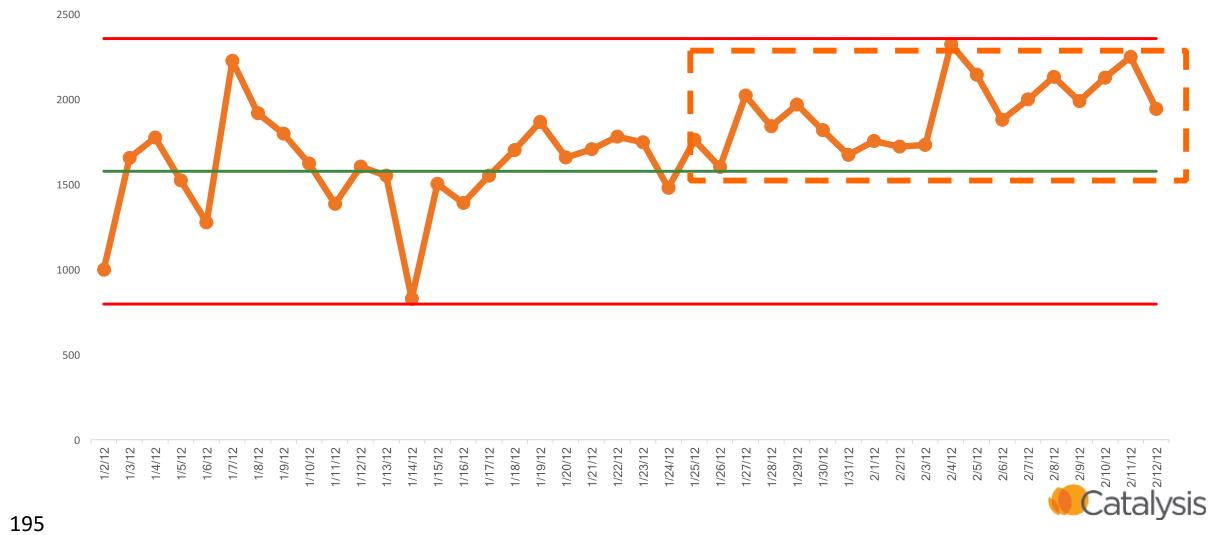
- Calculate MR Chart Upper Limit
 - $UCL = \bar{MR} * 3.268$
 - $H2: = E3 * 3.268$



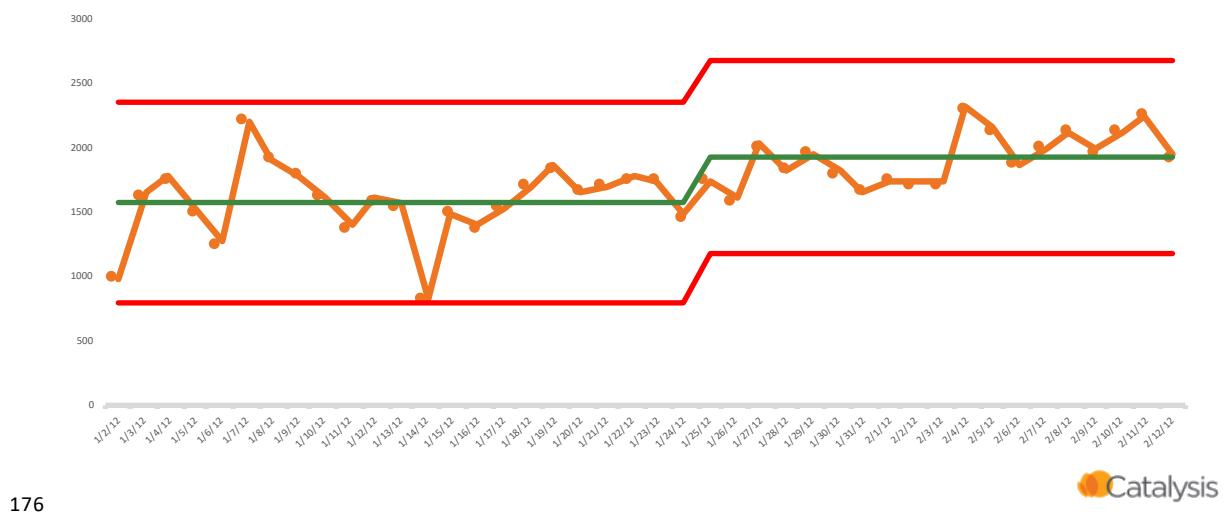
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Catalysis

Step 7: Evaluate Over Time



Step 8: Shift the Limits (If Applicable)



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