

# Control Charts - SigmaXL<sup>®</sup> Version 6.1

- Control Charts: Overview
- Individuals & Moving Range Charts
- X-Bar & R/S Charts
- I-MR-R/S Charts (Between/Within)
- Control Chart Selection Tool
- Use Historical Limits; Flag Special Causes
- Add Comments as Data Labels

- Summary Report on Test for Special Causes
- Use Historical Groups to Display Before VS After Improvement
- Scroll Through Charts
- Process Capability Report (Long Term/Short Term)
- Individuals Charts for Non-normal Data: Johnson Transformation
- Box-Cox Power Transformation
- Reliability/Weibull Analysis

Training Opportunities

# Control Charts

- Individuals
- Individuals & Moving Range
- X-bar & R
- X-bar & S
- P, NP, C, U
- P' and U' (Laney) to handle overdispersion
- I-MR-R (Between/Within)
- I-MR-S (Between/Within)

# Control Charts

- **Tests for Special Causes**
  - Special causes are also labeled on the control chart data point.
  - Set defaults to apply any or all of Tests 1-8
- **Control Chart Selection Tool**
  - Simplifies the selection of appropriate control chart based on data type
- **Process Capability report**
  - Pp, Ppk, Cp, Cpk
  - Available for I, I-MR, X-Bar & R, X-bar & S charts.

# Control Charts

- Add data to existing charts – ideal for operator ease of use!

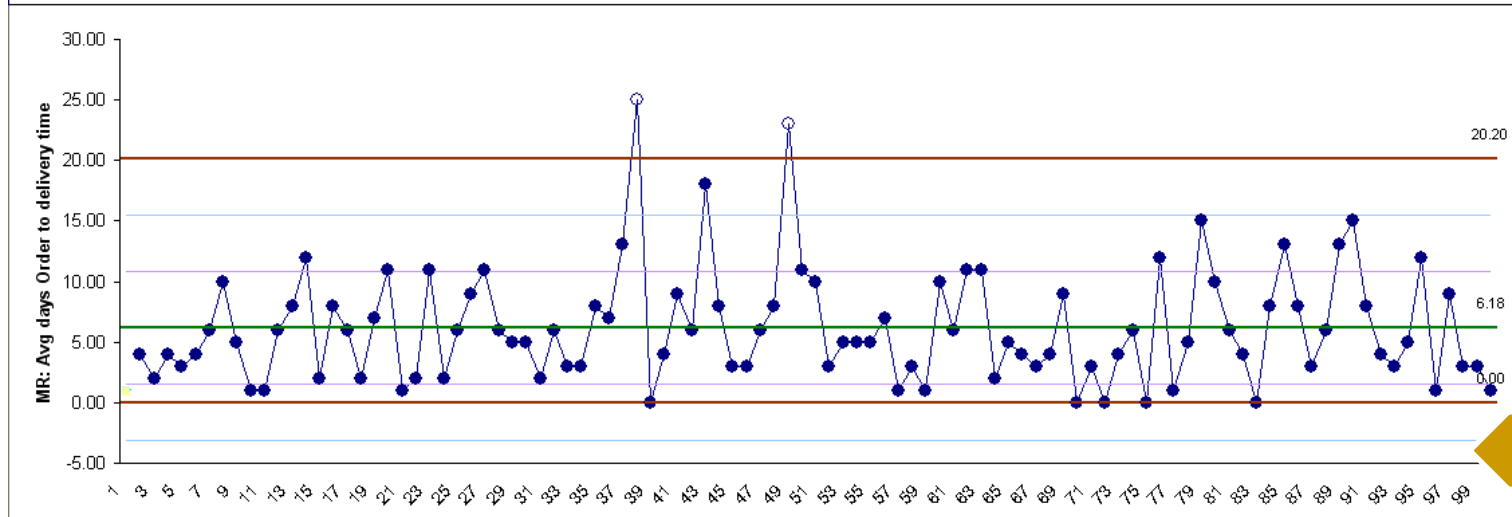
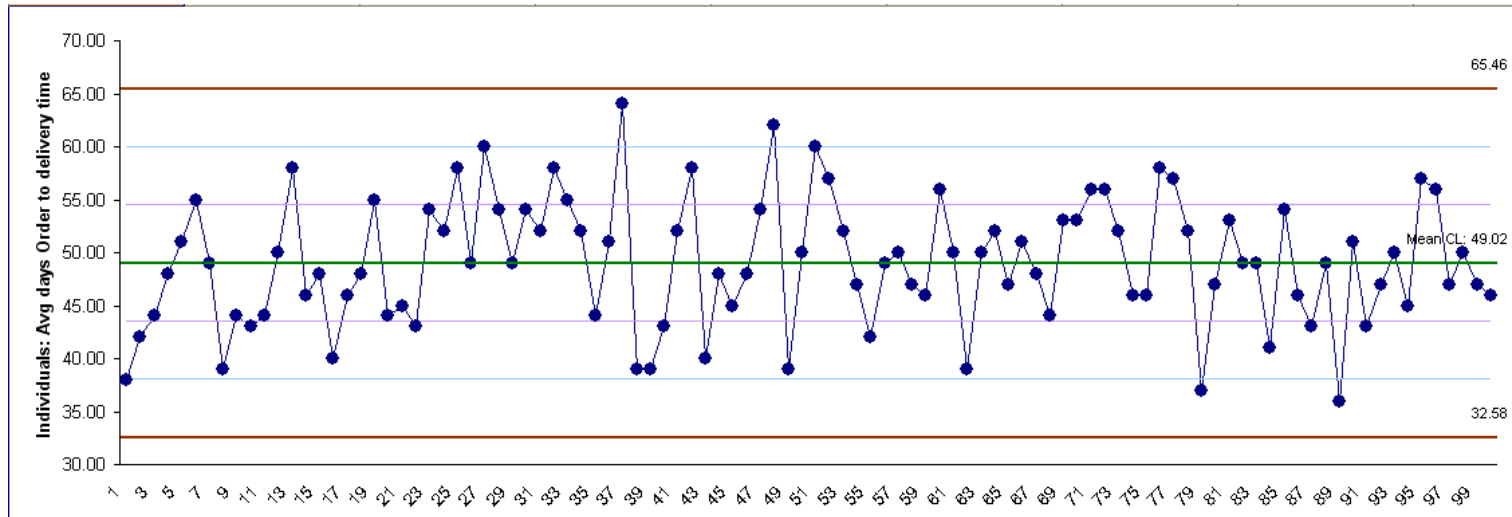


- Scroll through charts with user defined window size
- Advanced Control Limit options: Subgroup Start and End; Historical Groups (e.g. split control limits to demonstrate before and after improvement)

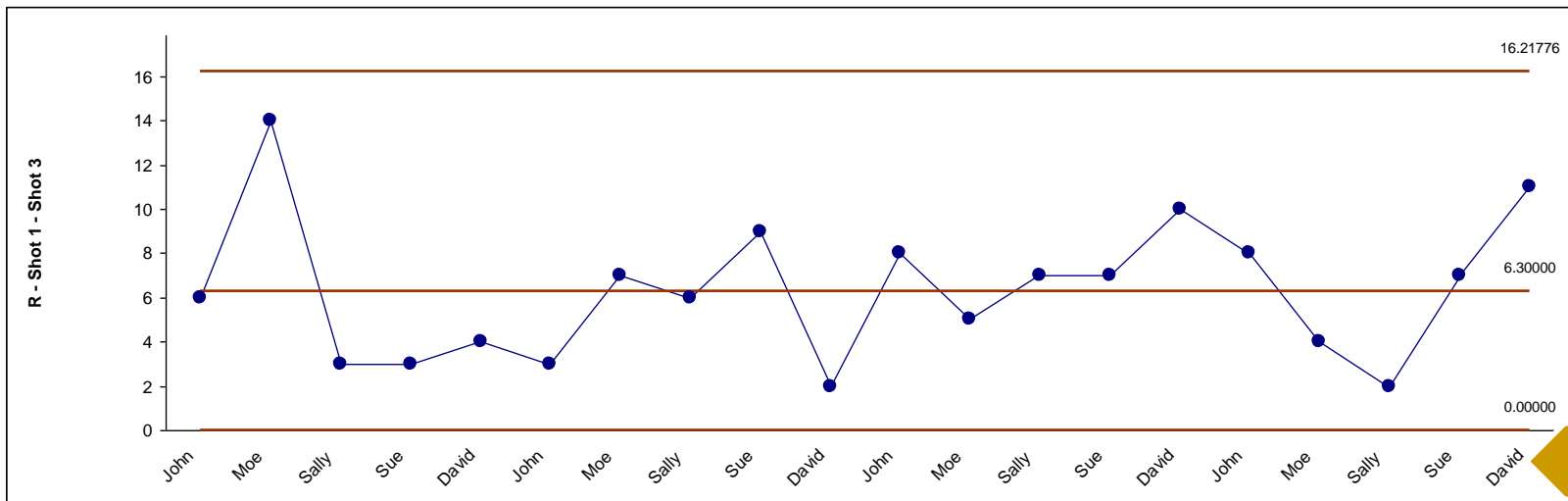
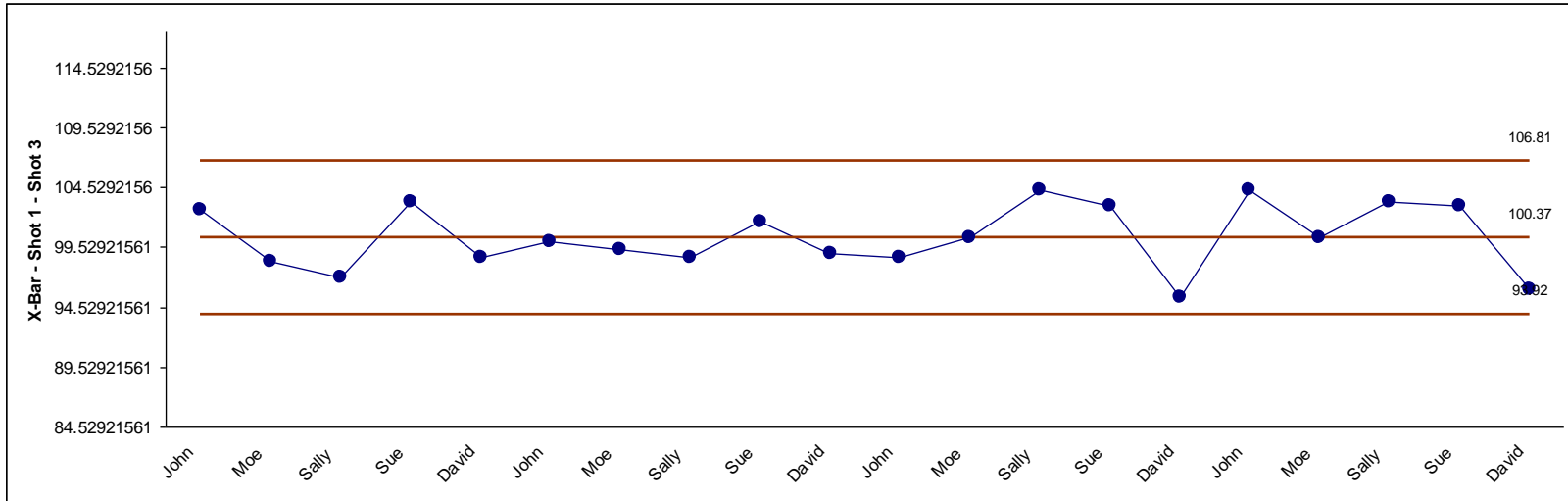
# Control Charts

- Exclude data points for control limit calculation
- Add comment to data point for assignable cause
- $\pm 1, 2$  Sigma Zone Lines
- Control Charts for Nonnormal data
  - Box-Cox and Johnson Transformations
  - 16 Nonnormal distributions supported (see Capability Combination Report for Nonnormal Data)
  - Individuals chart of original data with percentile based control limits
  - Individuals/Moving Range chart for normalized data with optional tests for special causes

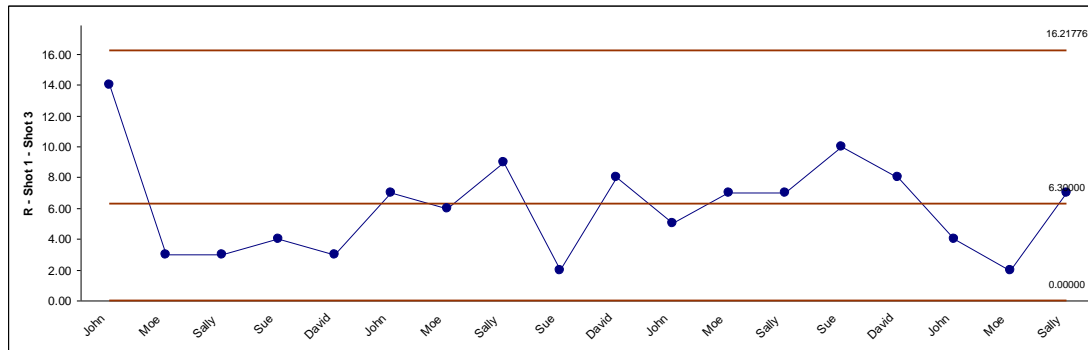
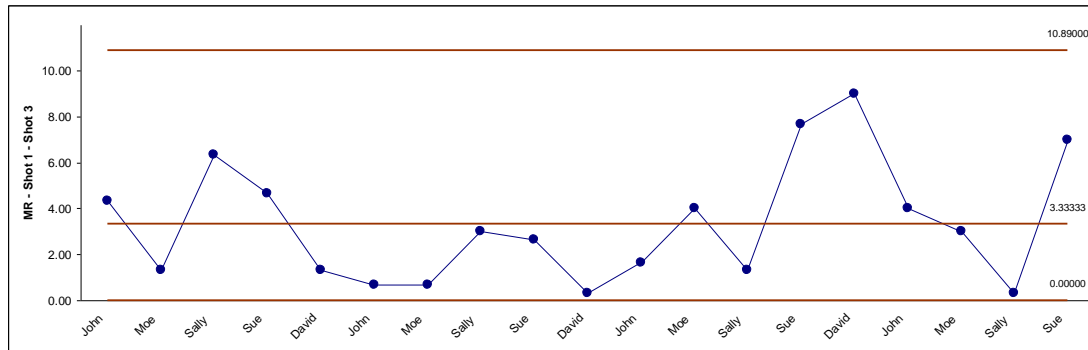
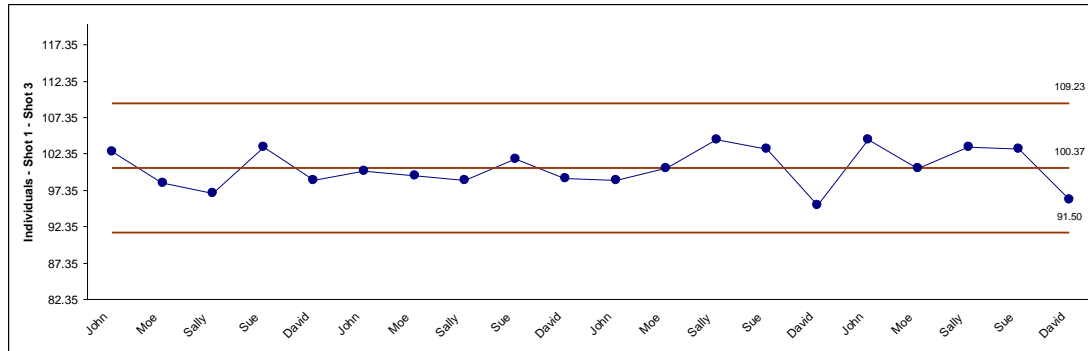
# Control Charts: Individuals & Moving Range Charts



# Control Charts: X-bar & R/S Charts

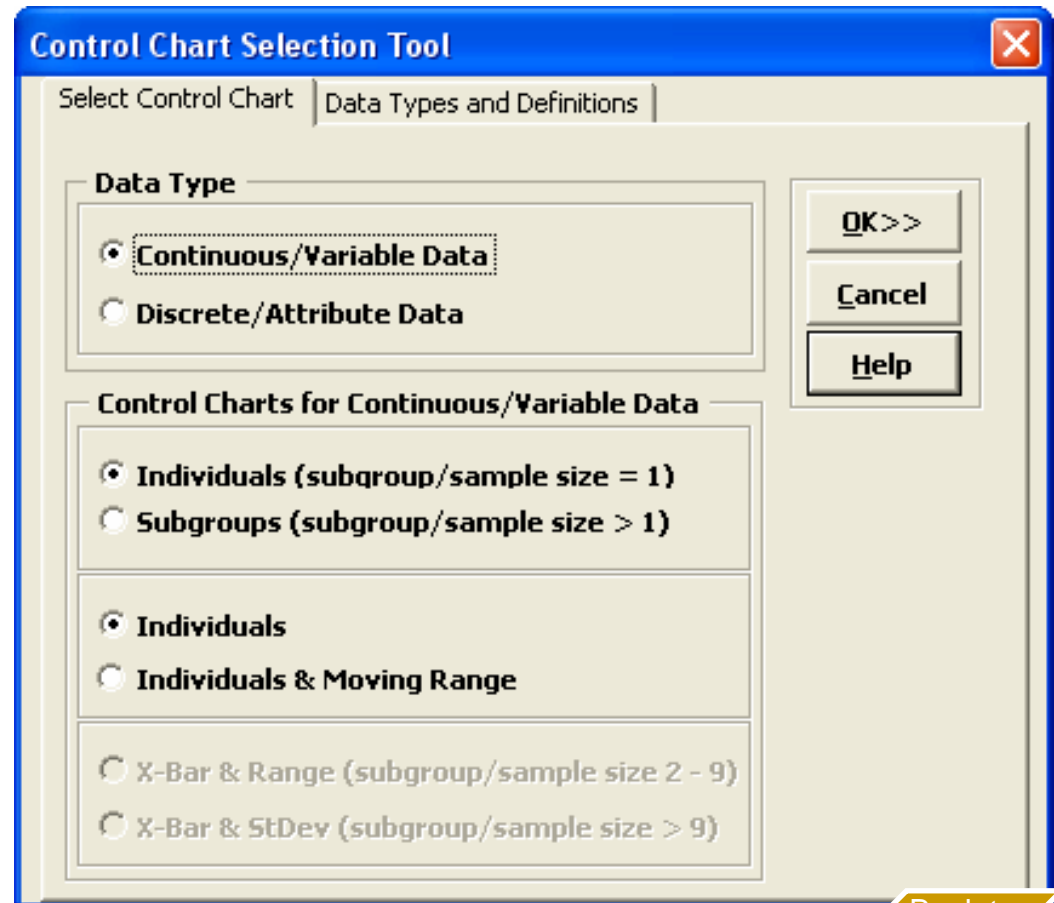


# Control Charts: I-MR-R/S Charts (Between/Within)



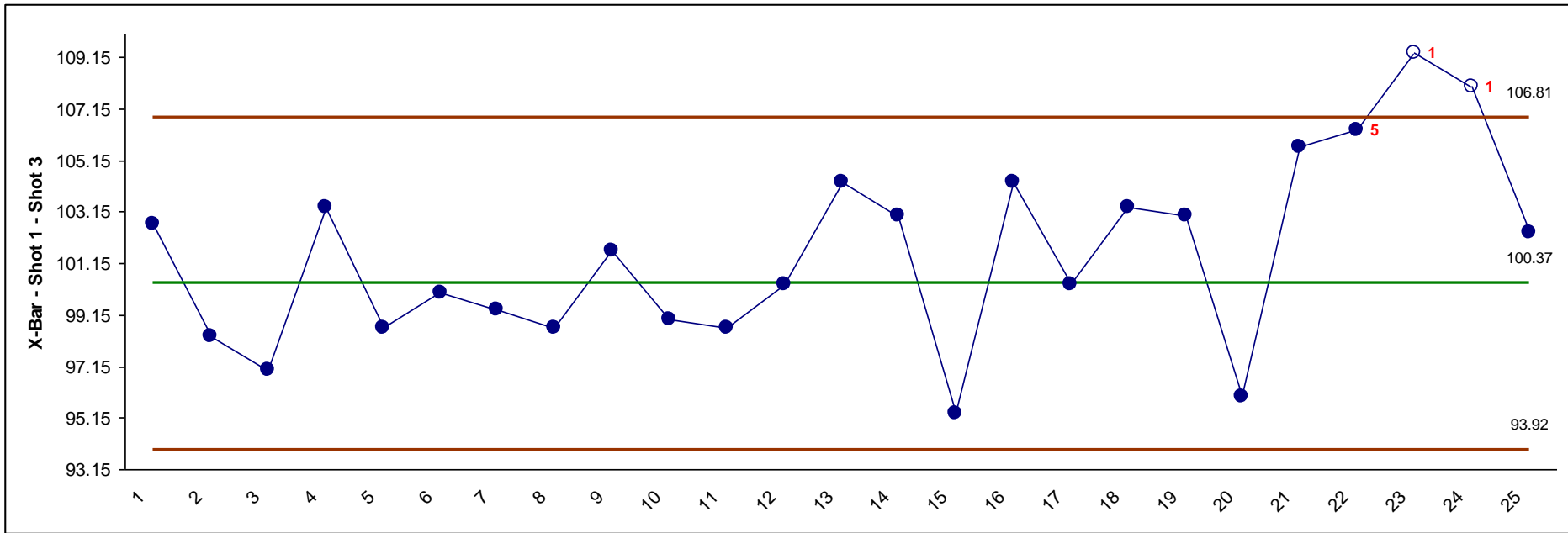
# Control Chart Selection Tool

- Simplifies the selection of appropriate control chart based on data type
- Includes Data Types and Definitions help tab.

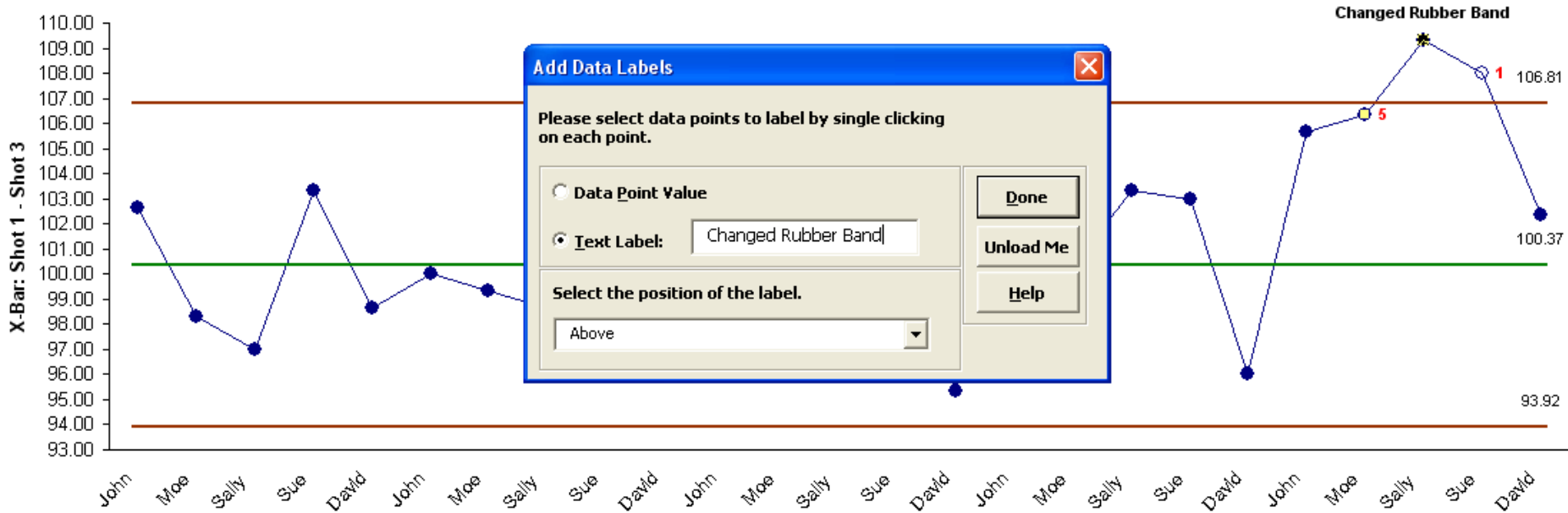




# Control Charts: Use Historical Limits; Flag Special Causes



# Control Charts: Add Comments as Data Labels

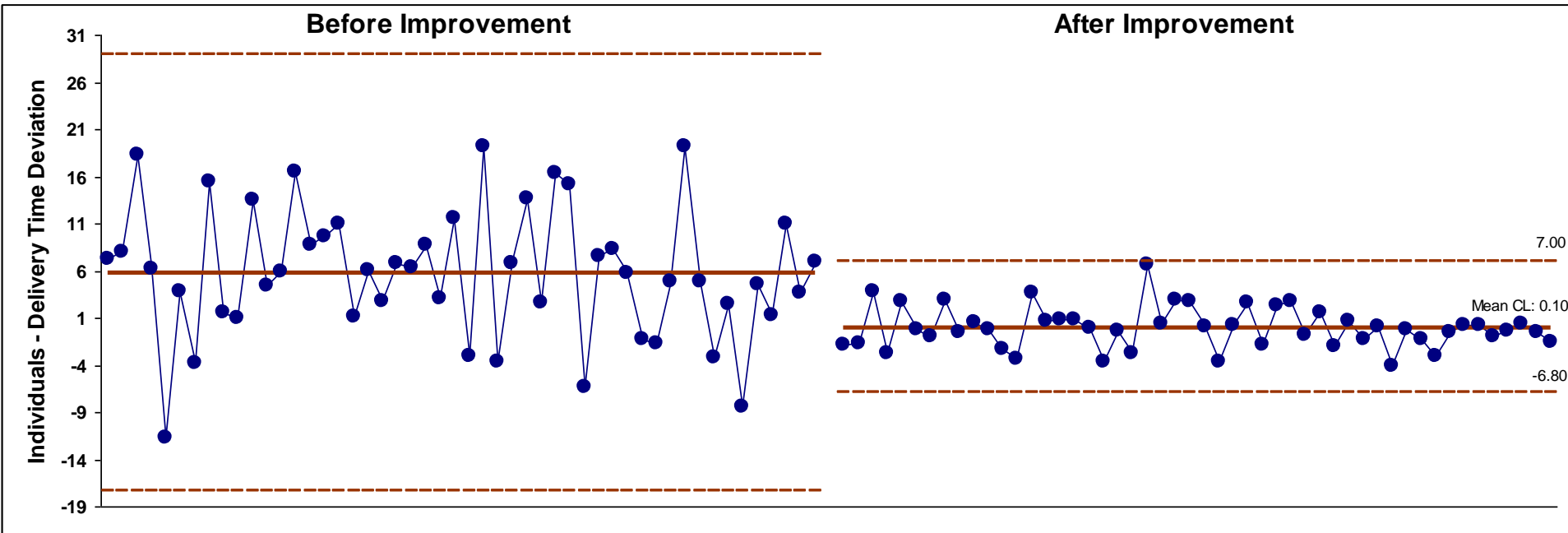




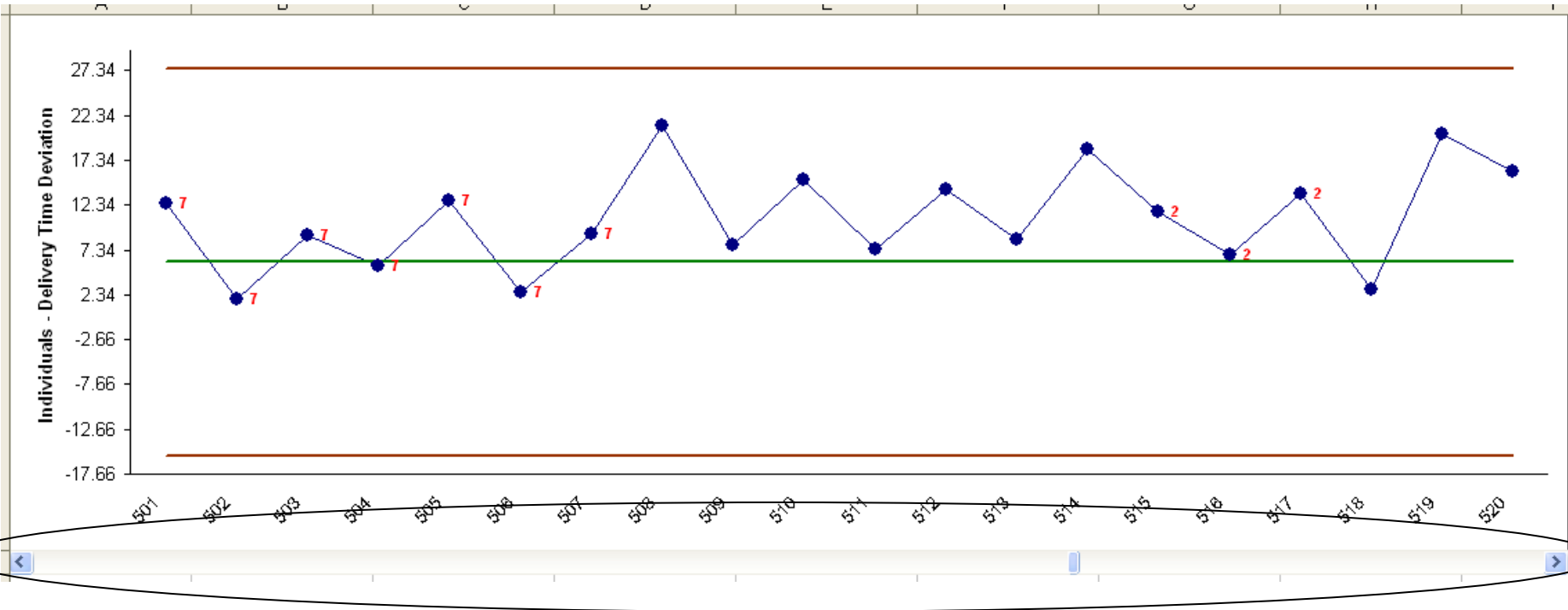
# Control Charts: Summary Report on Tests for Special Causes

Tests for Special Causes - X-Bar -- Shot 3								
Number of Data Points Failing Tests = 3								
Observation No.	Test 1: 1 point more than 3 sigma from CL	Test 2: 9 points in a row on same side of CL	Test 3: 6 points in a row all increasing or all decreasing	Test 4: 14 points in a row alternating up and down	Test 5: 2 out of 3 points more than 2 sigma from CL (same side)	Test 6: 4 out of 5 points more than 1 sigma from CL (same side)	Test 7: 15 points in a row within 1 sigma from CL (either side)	Test 8: 8 points in a row more than 1 sigma from CL (either side)
22					x	x		
23	x				x	x		
24	x				x	x		

# Control Charts: Use Historical Groups to Display Before Versus After Improvement



# Control Charts: Scroll Through Charts With User Defined Window Size



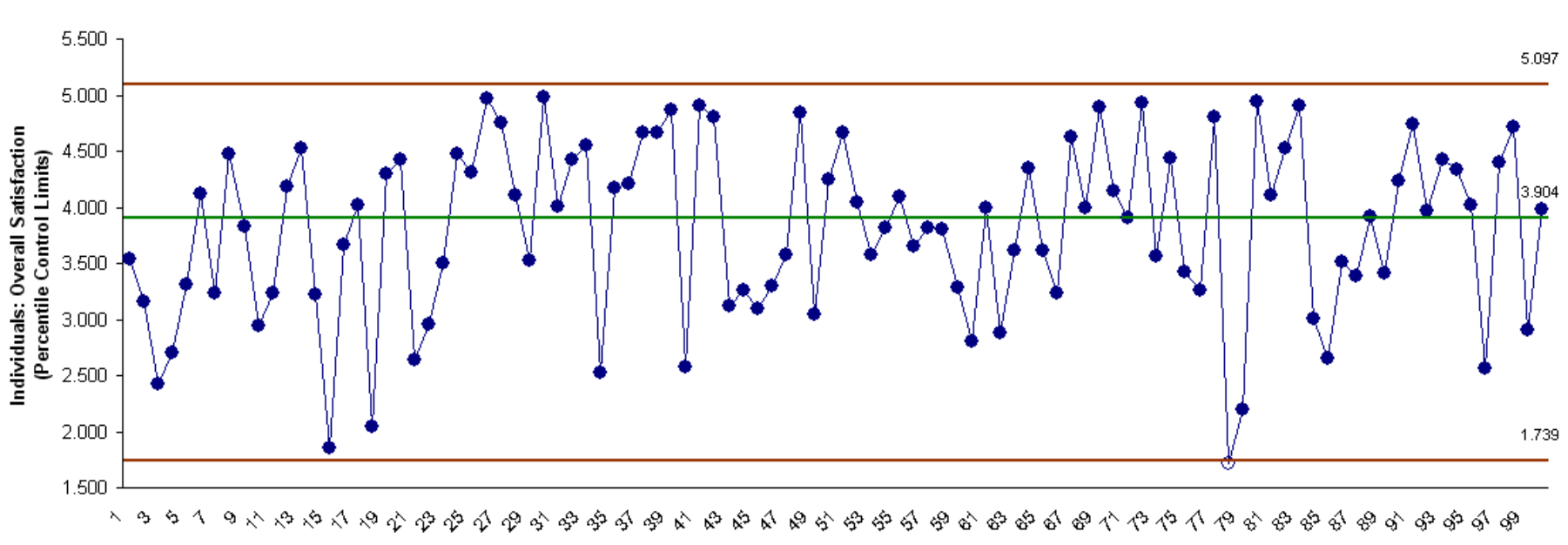


# Control Charts: Process Capability Report (Long Term/Short Term)

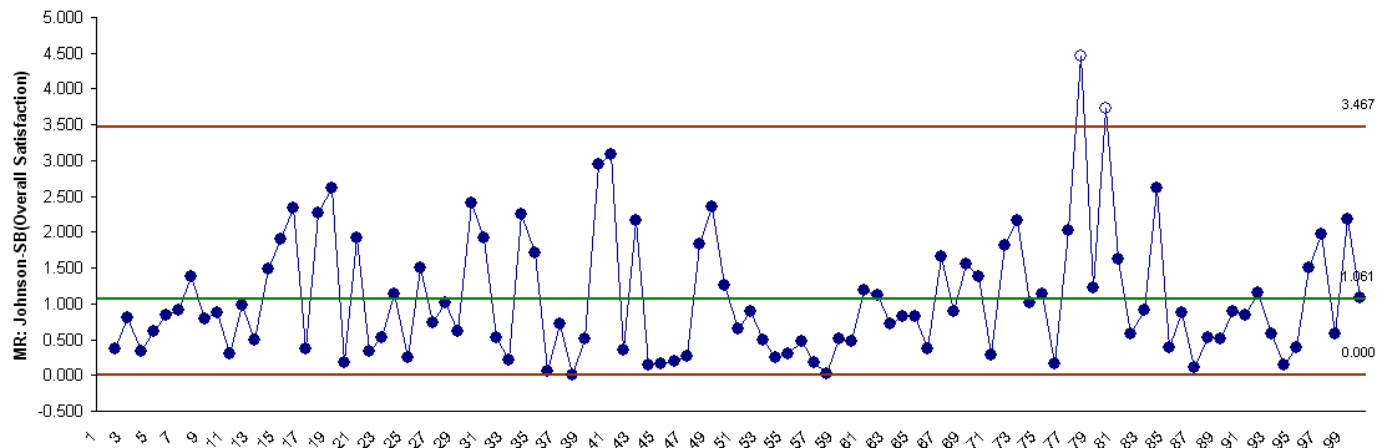
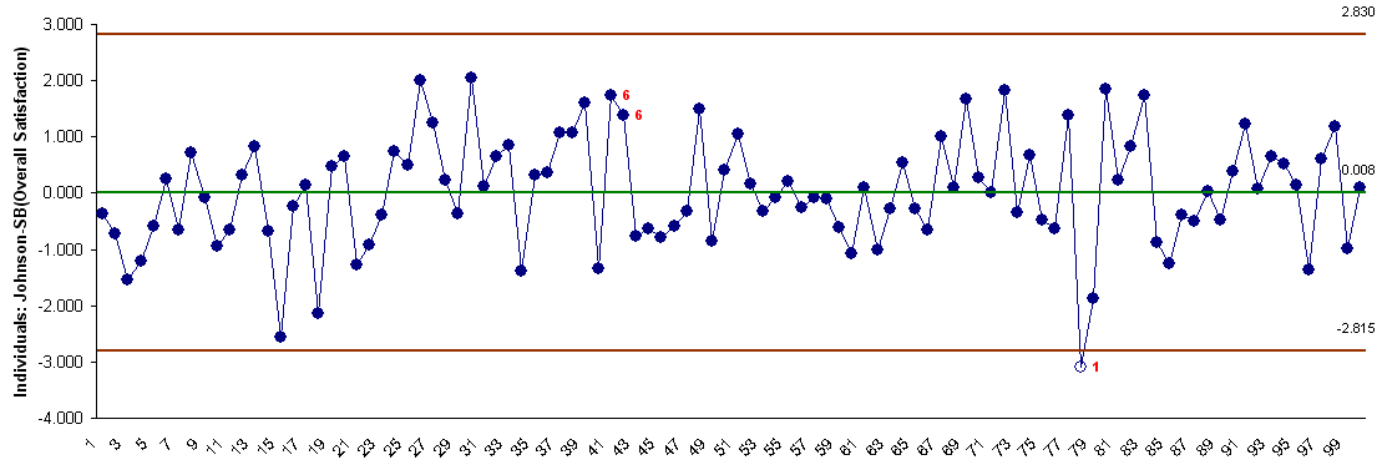
Report: X-Bar & R - Shot 1 - Shot 3	
Count =	75
Mean =	101.56
StDev (Overall, Long Term) =	4.6156
StDev (Within, Short Term) =	2.1484
USL =	108
Target =	100
LSL =	92
<b>Capability Indices using Overall StDev</b>	
Pp =	0.58
Ppu =	0.47
Ppl =	0.69
Ppk =	0.47
Cpm =	0.55
<b>Potential Capability Indices using Within StDev</b>	
Cp =	1.24
Cpu =	1.00
Cpl =	1.48
Cpk =	1.00
<b>Expected Overall Performance</b>	
ppm > USL =	81468
ppm < LSL =	19168
ppm Total =	100636
% > USL =	8.15%
% < LSL =	1.92%
% Total =	10.06%
<b>Actual (Empirical) Performance</b>	
% > USL =	5.33%
% < LSL =	4.00%
% Total =	9.33%

Back to  
Index

# Individuals Chart for Nonnormal Data: Johnson Transformation



# Individuals/Moving Range Chart for Nonnormal Data: Johnson Transformation



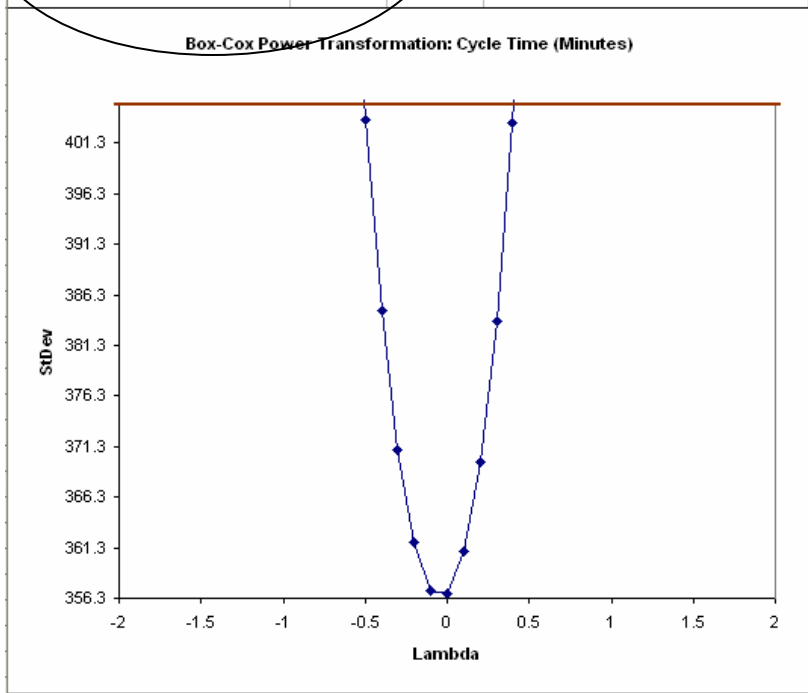
Tests for Special Causes -  
Number of Data Points Failing Tests = 3



# Control Charts: Box-Cox Power Transformation

Box-Cox Power Transformation: Cycle Time (Minutes)		Cycle Time (Minutes)	Transformed Data (Ln(Y))
Optimal Lambda	-0.04	3216	8.07589363
Final Lambda	0	261	5.564520407
UC Lambda (95%)	0.407756	392	5.97126184
LC Lambda (95%)	-0.506879	63	4.143134726
Anderson Darling Normality Test for Transformed Data:		28	3.33220451
A-Squared	0.326821	6101	8.716207971
AD P-value	0.5063	151	5.017279837
		46	3.828641396
		1465	7.289610521
		383	5.948034989
		287	5.659482216
		322	5.774551546
		538	6.28785856
		574	6.352629396
		586	6.37331979
		920	6.82437367
		178	5.18178355
		129	4.859812404
		187	5.231108617
		71	4.262679877
		342	5.834810737
		167	5.117993812
		794	6.677083461
		205	5.323009979
		576	6.356107661
		575	6.354370041
		381	5.942799375
		576	6.356107661
		918	6.822197391
		190	5.247024072

Optimal Lambda	-0.04
Final Lambda	0
UC Lambda (95%)	0.407756
LC Lambda (95%)	-0.506879
Anderson Darling Normality Test for Transformed Data:	
A-Squared	0.326821
AD P-value	0.5063



**Normality Test is automatically applied to transformed data!**

**Back to Index**

# Reliability/Weibull Analysis

- **Weibull Analysis**
  - Complete and Right Censored data
  - Least Squares and Maximum Likelihood methods
  - Output includes percentiles with confidence intervals, survival probabilities, and Weibull probability plot.



# SigmaXL<sup>®</sup> Training

- We now offer On-Site Training in SigmaXL.
- Course Duration: 4.5 Days.
- Instructor is John Noguera, SigmaXL co-founder, Six Sigma Master Black Belt, Motorola University Senior Instructor.
- Hands-on exercises with catapult.



# SigmaXL<sup>®</sup> Training

## Course Contents:

- Day 1: Introduction to SigmaXL, Basic Graphical Tools and Descriptive Statistics
- Day 2: Measurement Systems Analysis, Process Capability
- Day 3: Comparative Methods, Multi-Vari Analysis
- Day 4: Correlation, Regression and Introduction to DOE
- Day 5: Statistical Process Control