

PQ Systems *Proof of quality™*



ASQ Columbus Section
The Global Voice of Quality™

Communicating quality metrics
for all team members

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Statistical Indices 101:

What they are and how to
communicate them effectively

Matt Savage
PQ Systems

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Goals





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34.64	18.243	11.245	7.657	1.34	1.5	34.64	1.34
2.245	20	12.85	1.394	2.245	20	18.243	1.34
10.45	5.08	1.394	1.34	10.45	17.998	5.08	34.64
.015	6.357	6.357	10.45	.015	6.357	6.357	6.357
36.10	34.64	.08	2.536	.049	50.4	.08	.049
50.4	7.657	4.698	15.24	15.24	7.657	18.243	7.657
17.8	15.24	17.998	2.245	11.245	11.245	7.657	7.657
34.64	11.245	17.8	17.8	12.85	12.85	12.85	12.85

Data

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Ppk	Probability	SQRT	Chi-Square	P-value	Cr
A ₂	p-bar	Anderson-Darling	Six Sigma	Cpm	WTH
Variance	Null hypothesis	Cpk	OOS	Central Limit Theorem	Target
CL	Statistical Indices	UCL	Response variable	PPL	U-bar
d ₂	Sigma	R-bar	Poisson	Cpm	Cpm
LSL	P ₂	OOC	Variance	Unimodal	Cpl
R-bar	Ppu	Normality	EWMA	Type I Error	X-bar

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Useful Formula

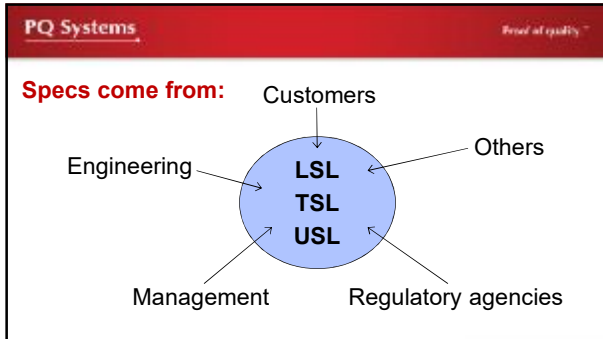
$$C_{pm} = \frac{USL - LSL}{6\hat{\sigma}_{C_{pm}}}$$

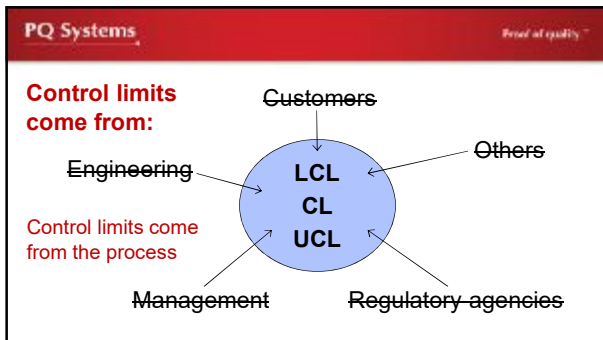
$$s_{C_{pm}} = \sqrt{\frac{\sum (X_i - T)^2}{n-1}}$$

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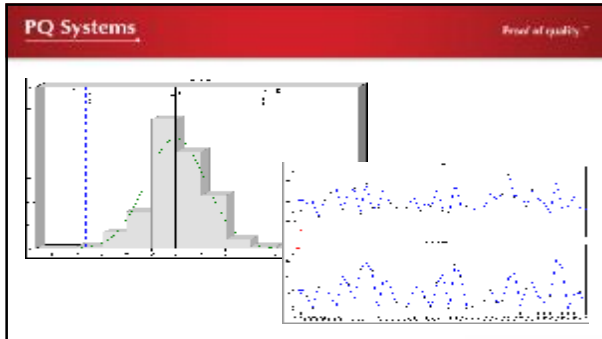
Purpose of:

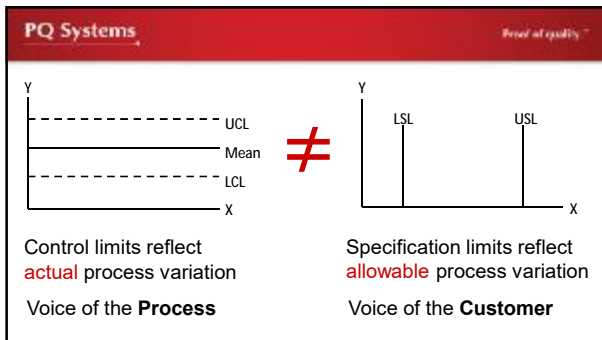
- Specifications
- Control limits
- Control charts
- Capability analysis







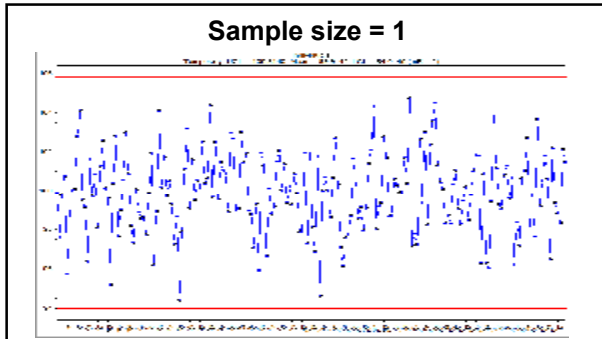


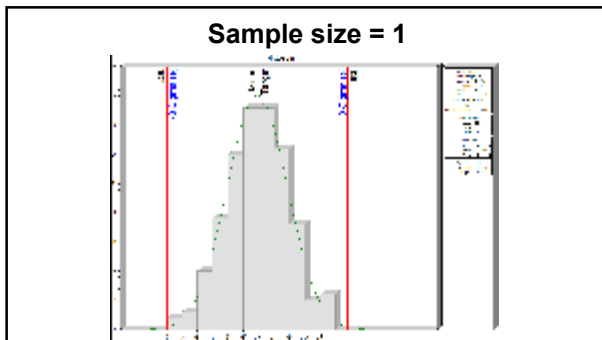


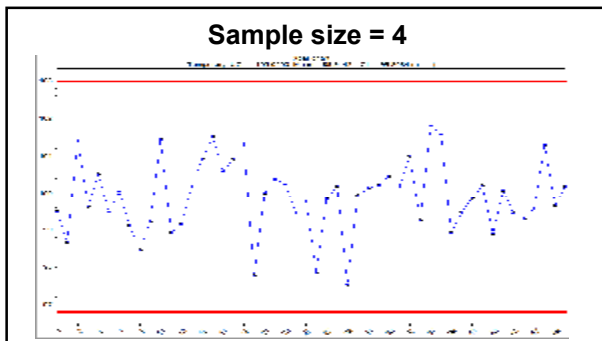
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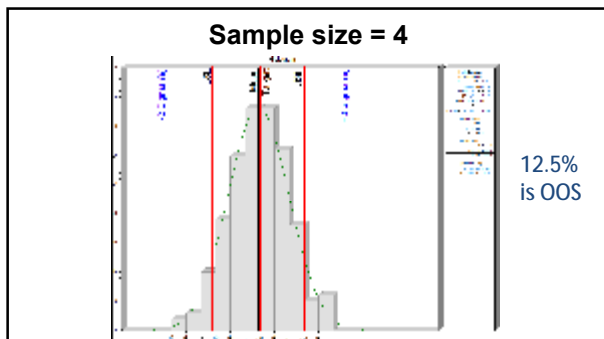
So ...

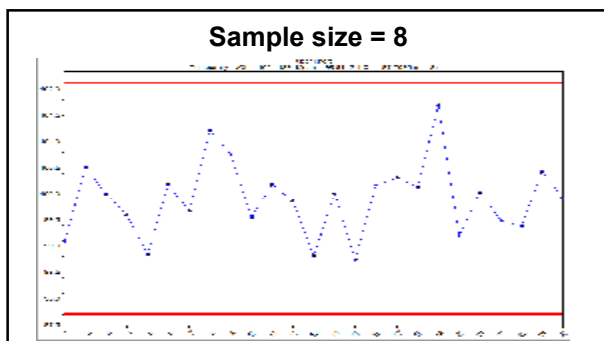
- Can adding specifications to a control chart cause harm?
- What's the benefit of adding specifications to a control chart?

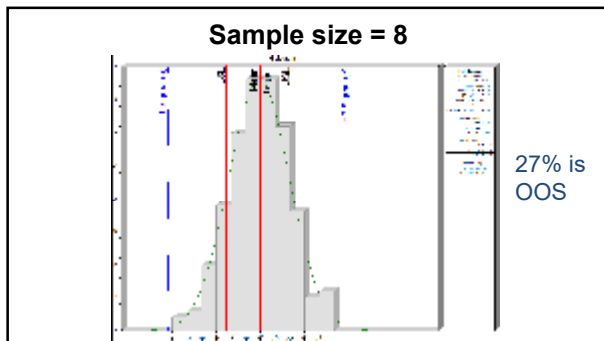


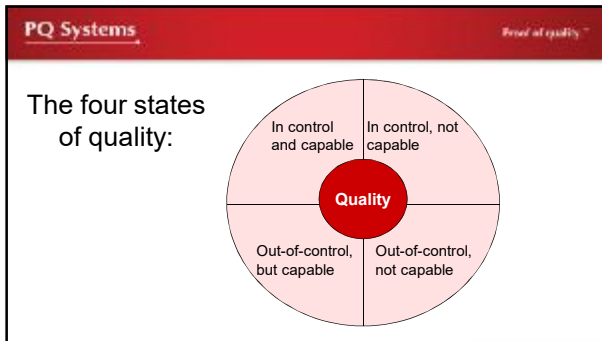


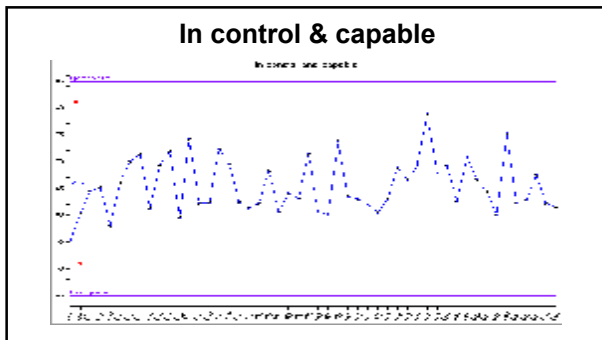


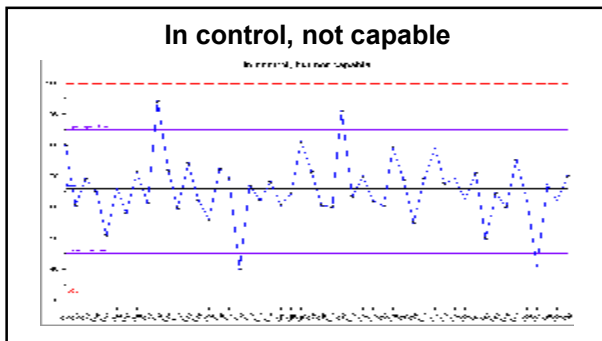


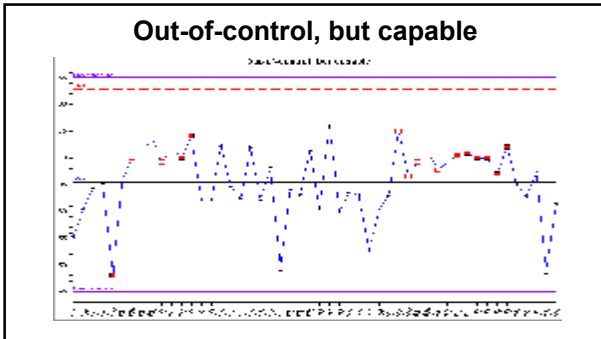


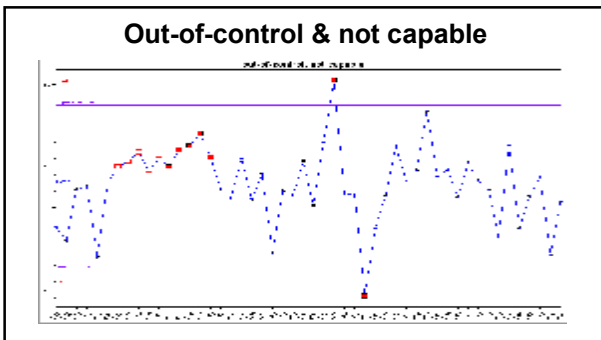












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Control charts & specifications

- Control charts are not designed for comparisons to a specification
- Capability analysis brings together the process limits (± 3 sigma) and specification limits

The two voices:

Voice of the process Voice of the customer

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Customers vs. You

- In-Control, Stable, Predictable
- Out-of-Control, Not Stable, Not Predictable
- Capable
- Not Capable

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Capable or Not Capable

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Types of capability indices

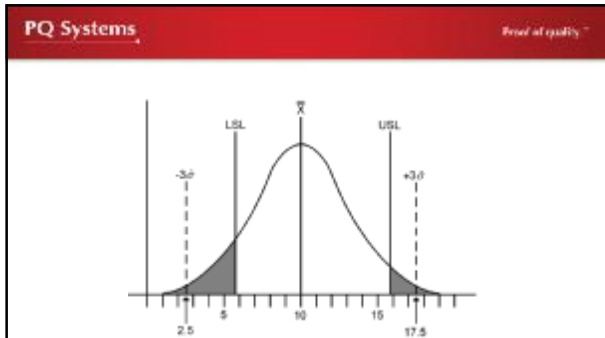
• Cp	• Pp
• Cr	• Pr
• Cpk	• Ppk
• Cpu	• Ppu
• Cpl	• Ppl

• Cpm

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Recommendations:

- Keep control charts in their 'purest' form
- Show spec information - not spec lines
- Add % out-of-spec
- Don't make me think




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Capability Explanation

The image shows a parking lot with two white lines marking a space. In the background, a dark-colored car is parked. The image is used to illustrate process capability, likely relating to the width of the parking space relative to the size of the car.

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Capability Explanation



Ranked by Out-of-Control




Ranked by % Out-of-Spec



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“... and go on till you come to the end; then stop.”
Alice's Adventures in Wonderland - Lewis Carroll



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