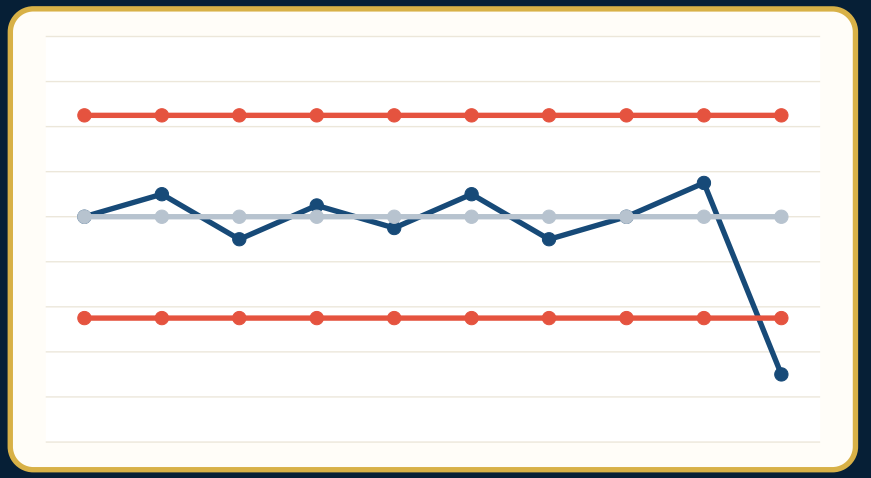
FREE LESSON SLIDES · SIX SIGMA YELLOW BELT · BoK IV.E.2

Variation

Common Cause and Special Cause

Noise or signal? How to tell them apart, and the right way to respond to each.



▶️ Watch the video lesson (8:33): scqualityguild.com/academy/topics

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TODAY

Four things you'll be able to do

1

Explain what variation is

and why every process has it

2

Name the two kinds of causes

common (noise) and special (signal)

3

Tell them apart with data

time-order plots and natural limits

4

Respond the right way

and why tampering makes it worse

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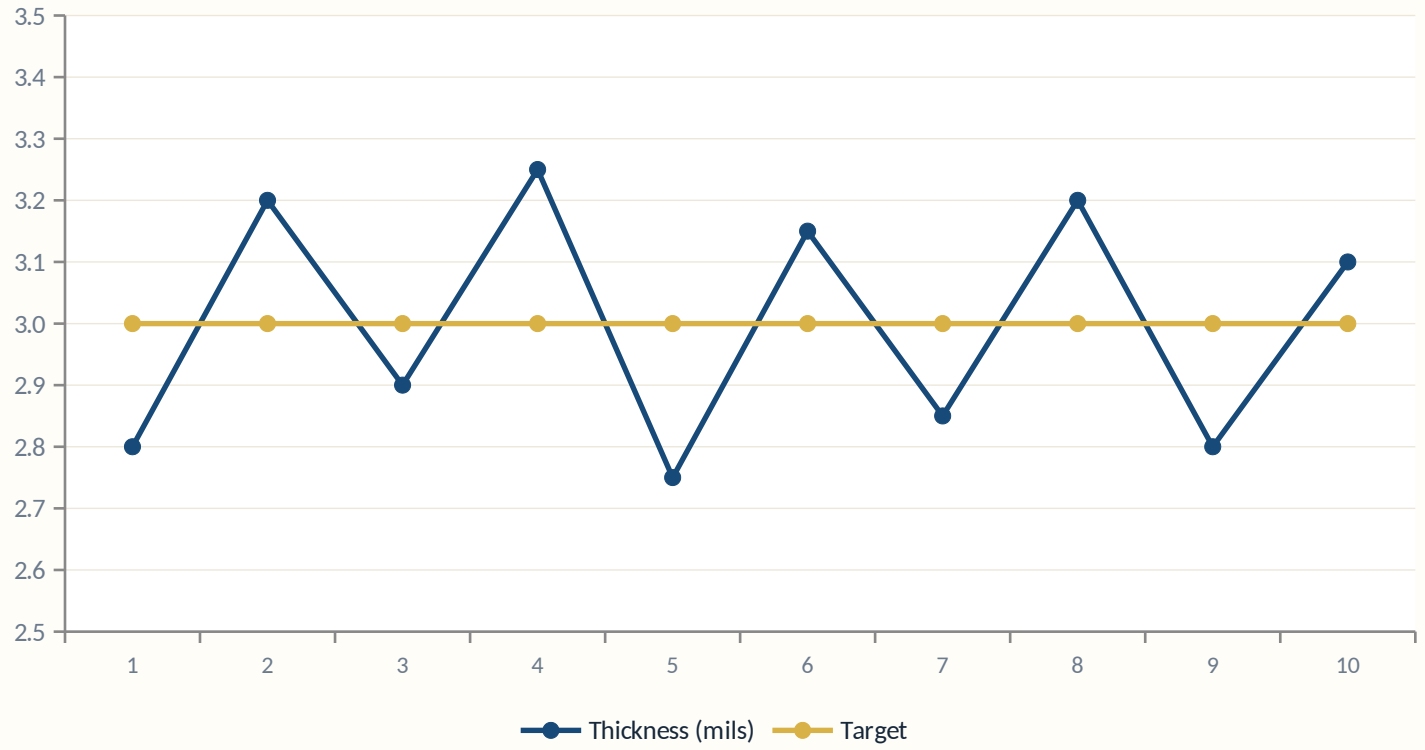
Every check, someone turns the gun



↑ gun up ↓ gun down ↑ up ↓ down …

- Target: 3.0 mils
- Shift 1 reads 2.8: turn it up
- Shift 2 reads 3.2: turn it down
- By Friday: adjusted at almost every check

"What's wrong with the line?" Maybe nothing at all.

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1

What variation is

Noise, signals, and what "stable" really means

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VARIATION

No two things come out exactly the same

Ten slats from one batch (target 19.00 mm):

19.02 mm	18.97 mm	19.01 mm	18.99 mm

Everything wiggles a little:

- People
- Machines
- Methods
- Materials
- Measurement
- Environment

The question is never "is there variation?" It's "what kind is it?"

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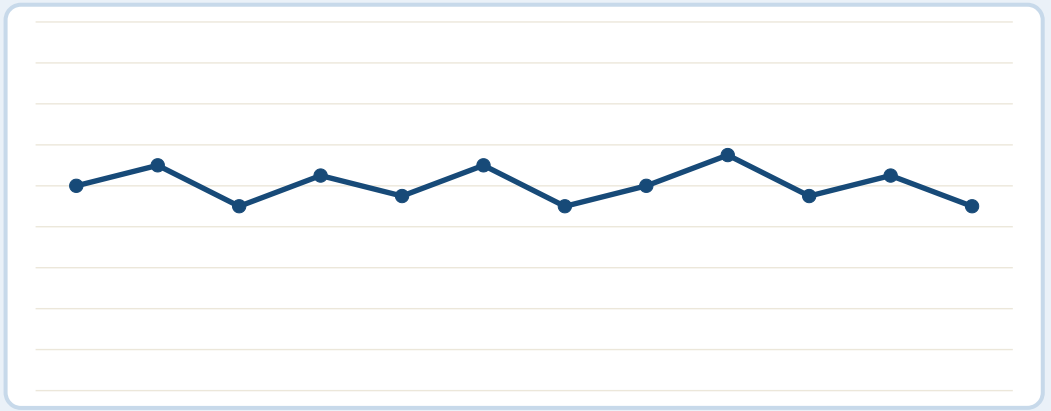
TWO KINDS OF VARIATION

Noise vs. signal

Common cause

also called chance causes

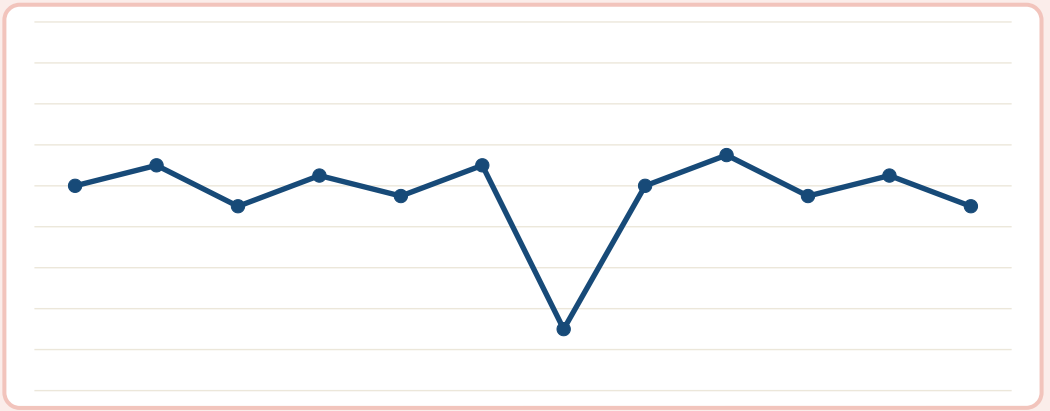


- Built into the process
- Many small causes, always there

NOISE

Special cause

also called assignable causes



- Something specific and unusual
- A clogged nozzle, a bad lot

SIGNAL

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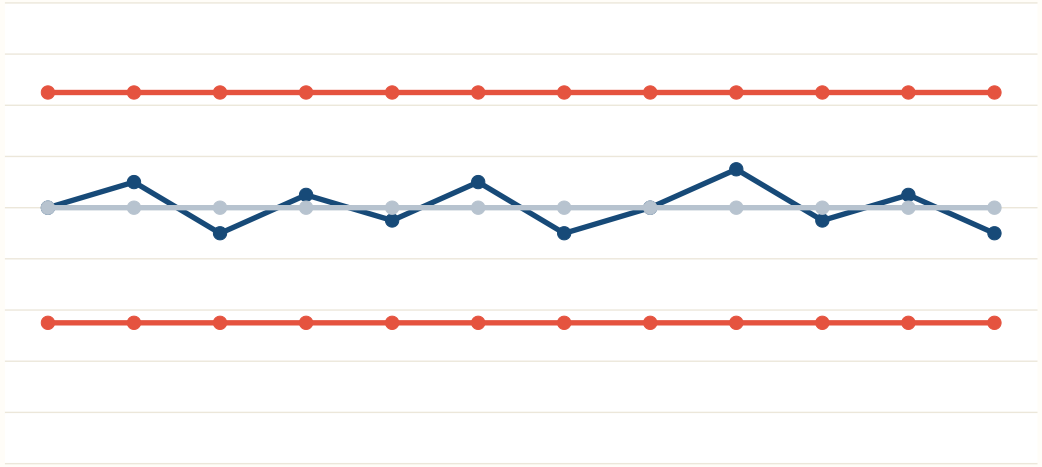
STABLE VS. UNSTABLE

Stable means predictable, not good

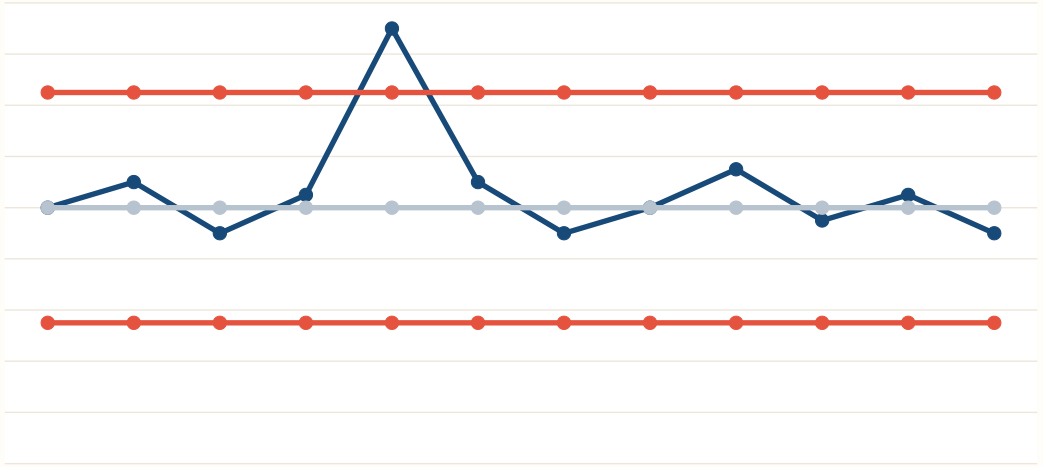
Only common cause: stable

You can predict where tomorrow lands



A special cause appears: unstable

You can no longer predict it



Warning: a process can be perfectly stable and still make parts outside the spec every day.

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2

Why it matters

The right fix depends on the kind of cause

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TWO WAYS TO GET IT WRONG

React to signals. Leave the noise alone.

MISTAKE 1

Treat noise as a signal

Chase every wiggle, adjust the machine, blame the operator. Things get worse.

MISTAKE 2

Treat a signal as noise

Shrug it off as "just variation" and miss a real problem until the customer finds it.

Both mistakes cost money. The goal: react to signals, leave the noise alone.

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3

How it works

Telling them apart, and responding to each

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AT THE COATING LINE

Common causes vs. special causes

Common causes

Always there · none big on its own

- Small changes in powder flow
- Humidity in the booth
- Tiny differences in the tubes
- The gauge itself

Special causes

One specific thing you can find and fix

- A partly clogged gun nozzle
- A powder lot mixed wrong
- Oven drift after a burner fault
- A new operator nobody trained

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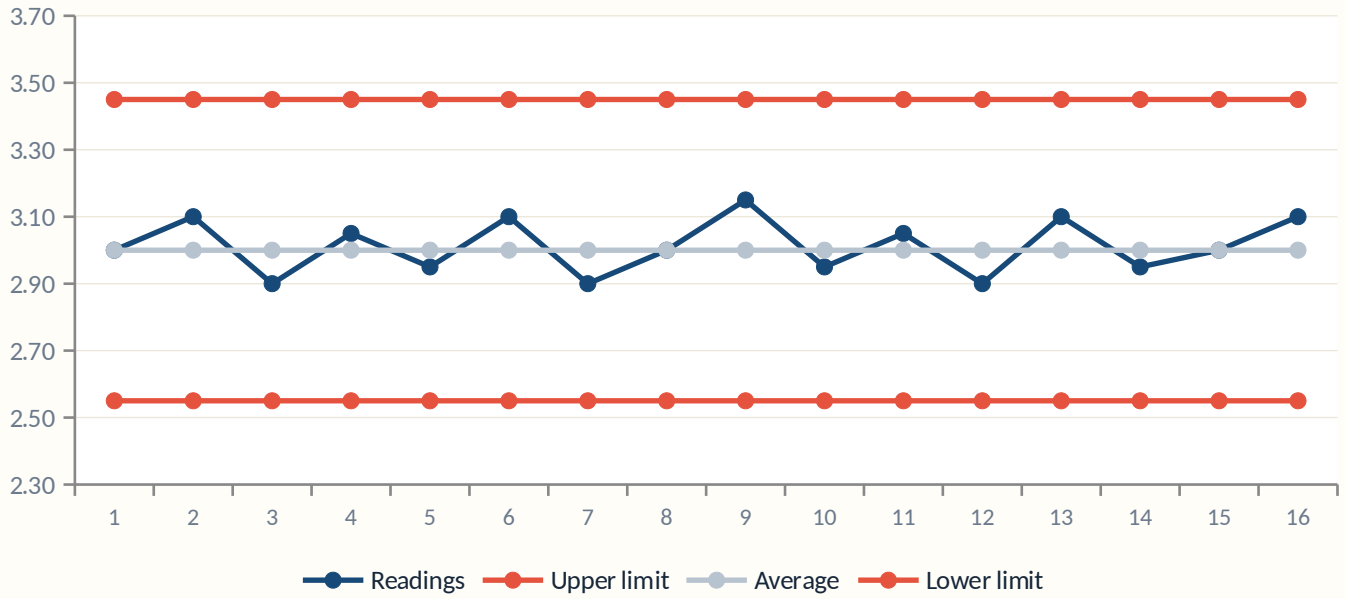
TELLING THEM APART

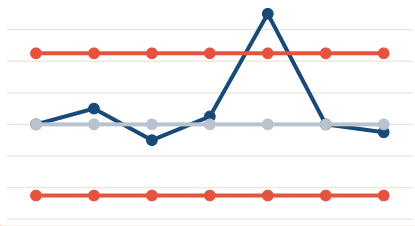
Plot in time order, add natural limits



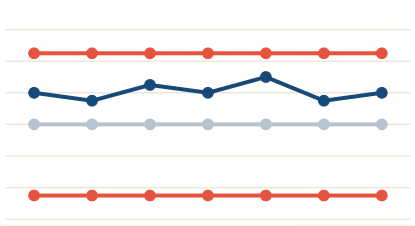
Natural limits

Average ± 3 standard deviations, from the process's own data. Inside the limits with no pattern = common cause.

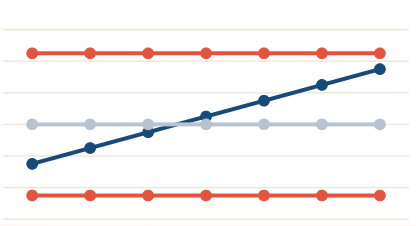
THREE SIGNALS OF A SPECIAL CAUSE



A point outside



A long run on one side



A steady climb

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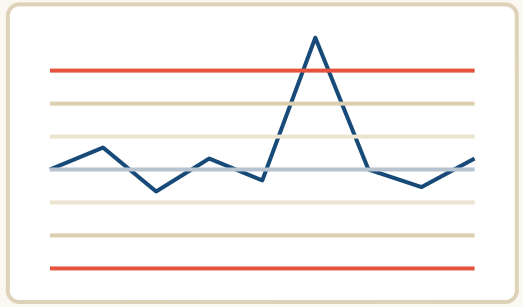
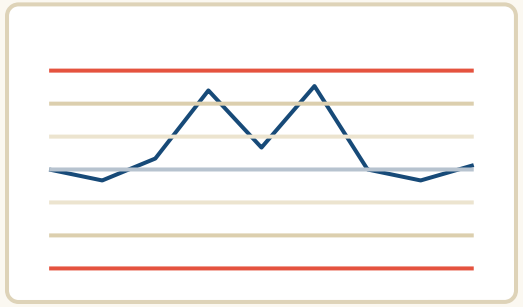
OUT-OF-CONTROL SIGNALS

The seven rules for out of control

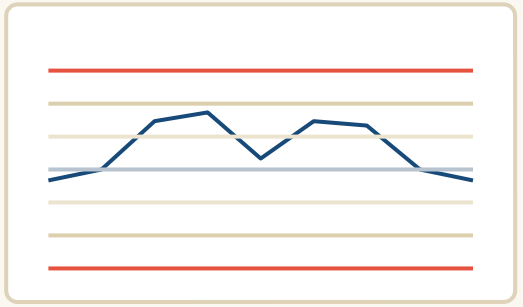
1 One point beyond 3σ



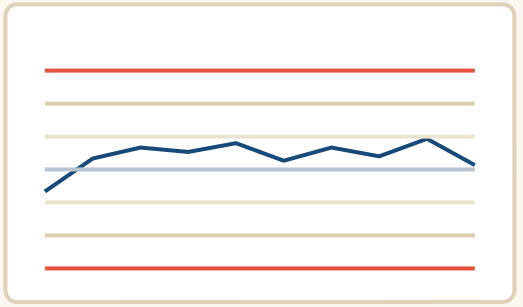
2 2 of 3 beyond 2σ, same side



3 4 of 5 beyond 1σ, same side



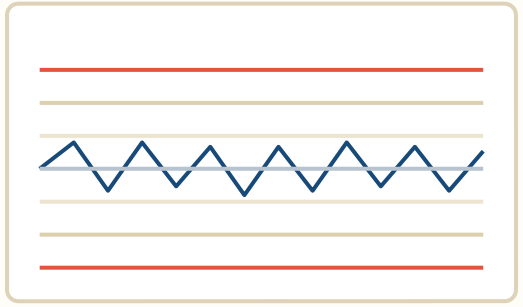
4 8 in a row on one side



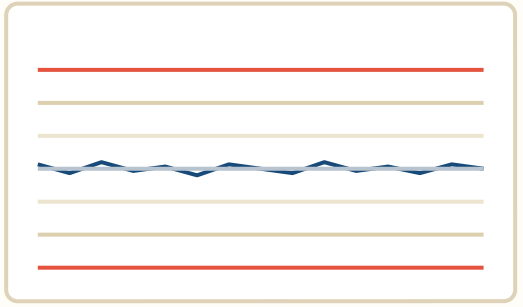
5 6 in a row rising or falling



6 14 in a row alternating up/down



7 15 in a row hugging the average



Any rule broken? Look for a special cause.

Red lines: 3σ limits. Tan lines: 1σ and 2σ zones. Run lengths vary a little by reference; pick one set and use it consistently.

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RESPONDING THE RIGHT WAY

Different causes, different responses

Common cause (noise)



Adjust after every reading; tell the operator to be more careful



Leave it alone and keep plotting. Too wide? Change the system: equipment, method, material.

Usually management's job: only management can change the system.

Special cause (signal)



Ignore it because it's "still in spec," or redesign everything over one point



Act fast while the trail is warm: find what was different, fix it, stop it coming back.

Ask the people closest to the work first.

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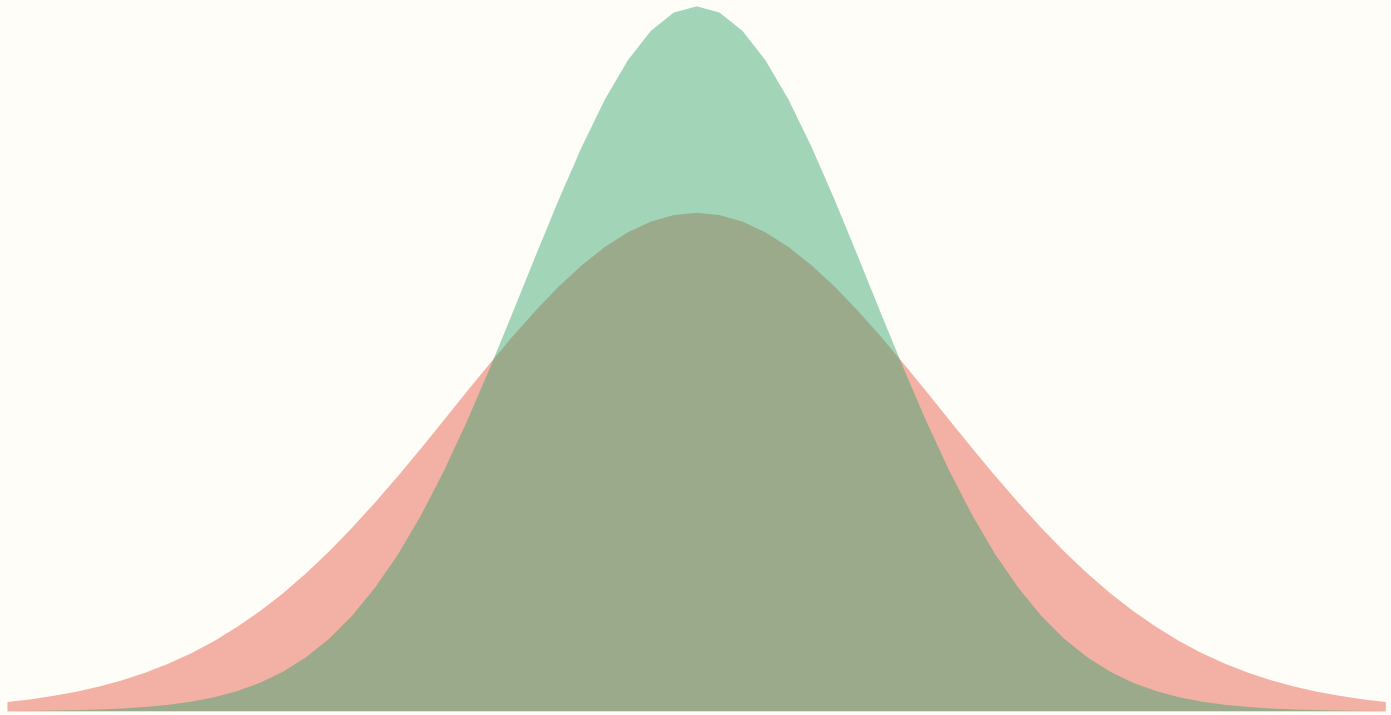
TAMPERING

Adjusting a stable process makes it worse



+40%

more variation, just from trying to help

- Moving the gun by each reading's error carries that noise forward
- Spread grows by √2 ≈ 1.41

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Worked example

Back to the coating line, with real numbers

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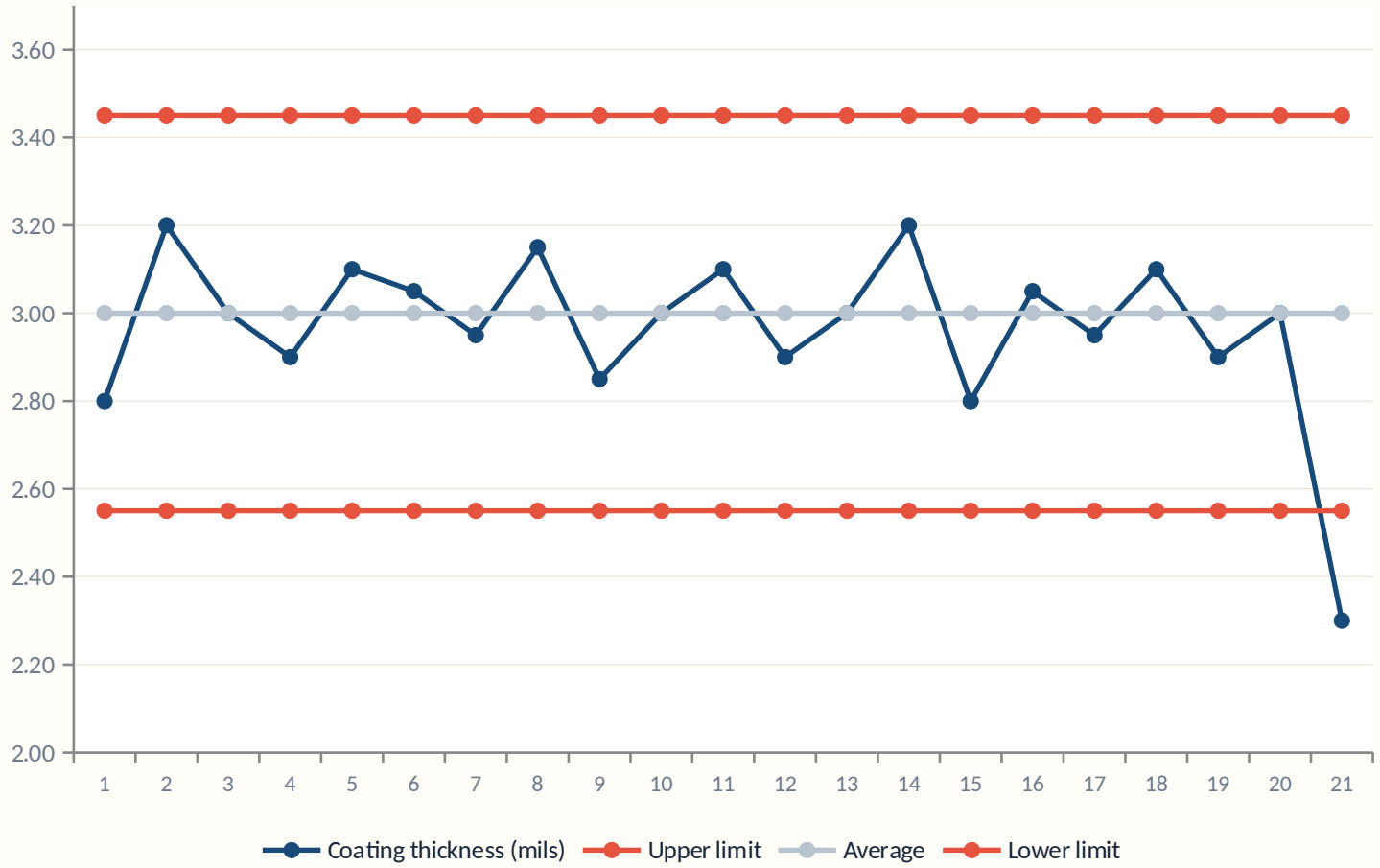
TWO WEEKS, NO ADJUSTING

Reading 21 falls below the lower limit



3.0 average of the first 20 readings (mils)

2.55–3.45 natural limits (mils)

2.3 reading 21: below the limit and the 2.5 spec

Cause: a partly clogged nozzle. Cleaned; added to start-up checks.

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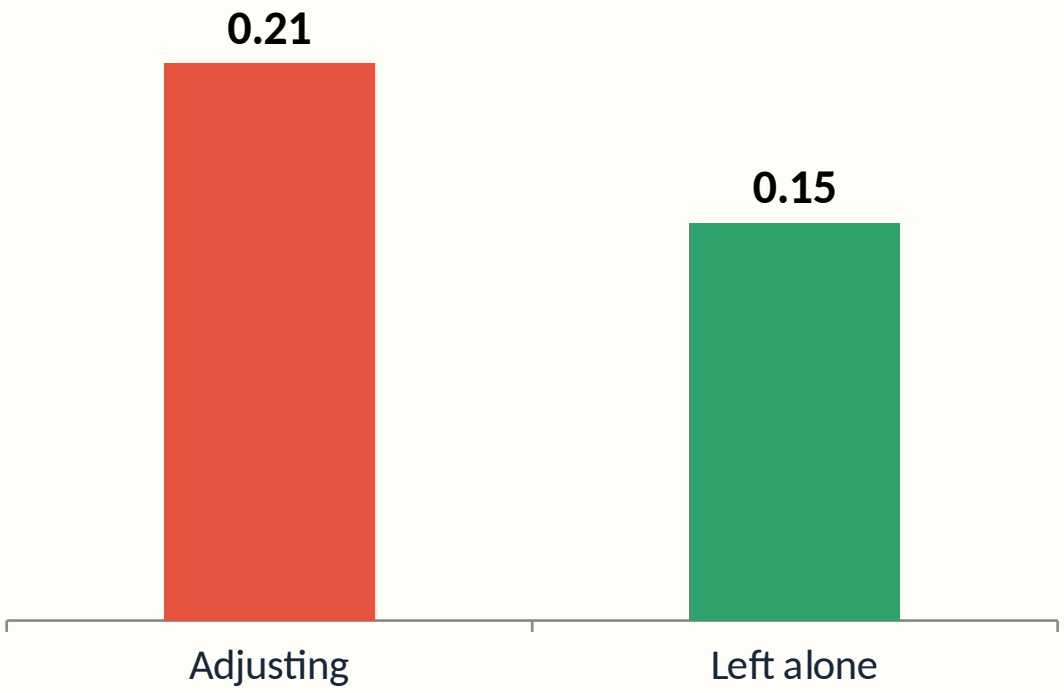
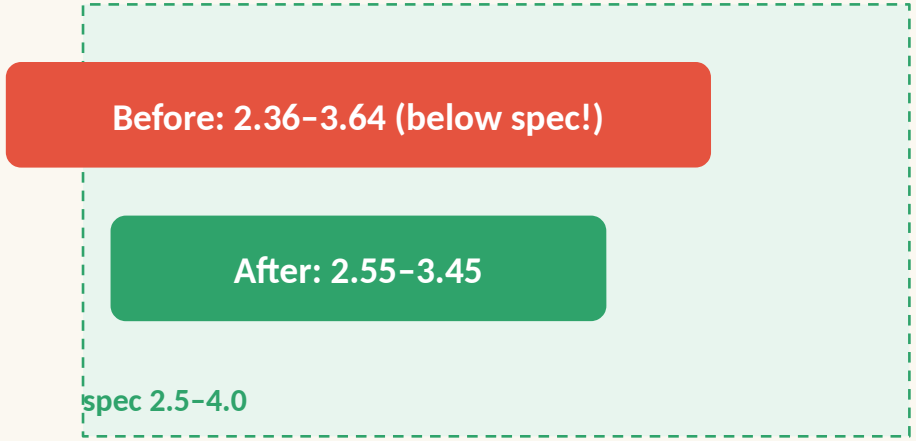
Stable, and capable



Natural limits vs. the 2.5–4.0 spec



0.21 ÷ 0.15 = 1.4, the same 40%. Now the limits sit inside the spec: stable and capable.

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WATCH OUT FOR

Common mistakes

- Using spec limits to decide if something changed
- Reacting to every point (tampering)
- Blaming people for common cause variation
- Calling a real signal "just variation"
- Thinking stable means good enough

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RECAP

Key points

Every process varies

Common cause is the normal noise of the system

Special cause is a signal

Something specific changed

Time order + natural limits

Limits from the process, not the spec

Respond to the cause

Common: improve the system.
Special: find and remove it

Don't tamper

Adjusting a stable process makes it worse

Stable ≠ good

Stable only means predictable

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