Calibrating Control Charts (estimating parameters)

QC has two “phases”. Phase I is used to estimate parameters and figure where to draw center line and control limits.

Phase II is when you actually start using the charts to monitor the process.

In principle, you only do Phase I once; then you are into Phase II for the rest of your life.
Phase I aims to gather data while process is in control. You need good, but realistic data.

- Avoid known special causes
- But don’t do anything unrealistic. (eg use usual operators and not the very best; use usual raw materials and not specially selected ones .....
- Gather some number of rational groups. (Old thinking: maybe 25 of size 5 for total of 125; newer thinking: you probably want more.)
- Estimate the parameters; set up charts.
• Then plot your data on the charts to see if they seemed to be in control.
• If any data seem out of control; try to diagnose special causes
  o If you can find a special cause for some group, remove that group from the data set and re-estimate parameters, draw new charts, repeat process.
  o If you can not find a special cause, *do not remove* that group from the data set.
Example – aspirin setup

X Bar Chart for X1 X2 X3 X4 X5

R Chart for X1 X2 X3 X4 X5

Group 23 below LCL on Xbar; groups 15 and 24 above UCL on R chart.
After diagnosis, we found special causes for 23 and 24 (very dry air made tablets brittle), but no special cause for group 15, so drop 23 and 24, but keep 15.
Estimating process capability

If product has specification limits, we’d like to check that we can meet them. This is often handled as byproduct of Phase I exercise.

Process capability index $C_p$ defined as

$$CP = \frac{USL - LSL}{6\sigma}$$

Traditionally, $C_p > 1$ was OK, $<1$ was not. A decade back, bar moved up to 1.33. Now even higher in some settings.

Aspirins – suppose spec is 74 to 88. We estimate $\sigma = 1.98$, so

$$CP = \frac{88 - 74}{6*1.98} = 1.01$$

Would be OK in the old days, and maybe now still.