Pre Control Charts

Become Future Fit

You will learn

Learn about Pre-Control Charts and their use in Process Control

Level of Difficulty

Medium

Need for Pre-Control Charts

- Control Charts focus on process variation & not on specs & target
- Processes need adjustment to target (setting changes) from time to time
  - Batch processes with incoming raw material differences
  - Machining processes that need to compensate for tool wear
- Control Charts use complex formula for calculating control limits

Pre-control charts use Specification

Limits to compute Control Limits

Vs

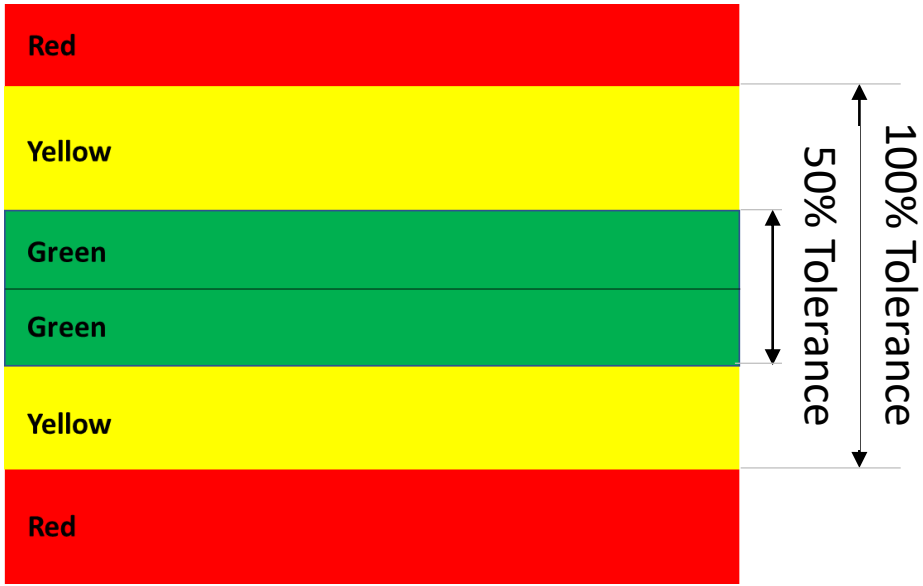
Control charts use Process Variation to

compute Control Limits

- Are simple to set up and use
- Is mostly used for variable data
- Useful during setup operations - can determine if the process setup is producing product within tolerances
- Can identify if the process center has shifted or the spread has increased

Pre-Control Chart Zones

- **Red zone**: Outside specification limits.
- **Yellow zone**: Inside specification limits, & one of the specification limits is closer than the center of the specification.
- **Green zone:** Inside specification limits, the center of the specification is closer than both the specification limits.



Point in green zone: Continue 100% sampling until five successive pieces are in the green zone

Point in yellow zone: check another piece

- Two points in a row in the same yellow zone: reset the process
- Two points in a row in opposite yellow zone: stop, reduce variation, reset the process

Point in the red zone: stop, make correction and reset the process

Apply the pre-control sampling plan:

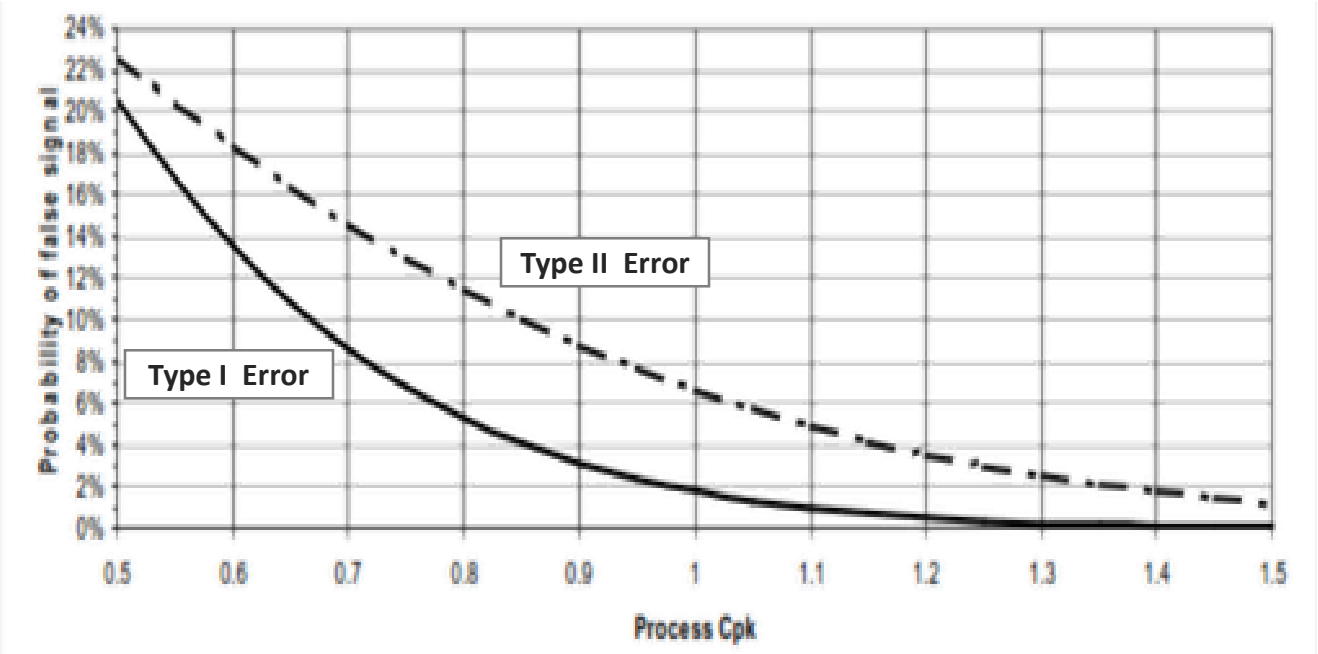
- Once five successive points fall in the green zone, discontinue 100% inspection and start sampling.
- Randomly select two pieces at interval:
    - A point in the red zone: stop, adjust process to remove variation, reset
    - Two points in the opposite yellow zone: stop, adjust process to remove variation
    - Two points in the same yellow zone: adjust process to remove variation
    - Otherwise: Continue

Disadvantages

- Pre control charts cannot be used to study process capability
- Pre control charts may generate more false alarms or missed signals than the control charts

Probability of false signals from pre-control charts

Type II error based on a shift of mean by the USL (50% failure rate)



Advanced Control Charts

Become Future Fit

Group

You will learn

Learn about the advanced Control Charts

Level of Difficulty

High

Advanced Charts

- Moving Average Control Chart
- EWMA Control Chart
- CUSUM Control Chart

Relevance & Application

- Fast in detecting small shift in the process mean *(than traditional charts)*
- Slow in detecting large shift in the process mean
- Used in highly sensitive & close control processes

Moving Average Control Chart

- Moving Average (MA) is computed for last few points and then plotted.
- Early ‘Direction’ indicator

EWMA Control Chart

- EWMA means Exponentially Weighted Moving Average Chart
- Each plotted point includes several observations, but recent points have more weight that older points
- Early ‘Direction’ indicator & more sensitive than MA

Each point is calculated using the formula

$$EWMA_t\ (z_t) = \lambda X_t + (1 - \lambda) z_{t-1}$$

where

z_t = t^{th} EWMA

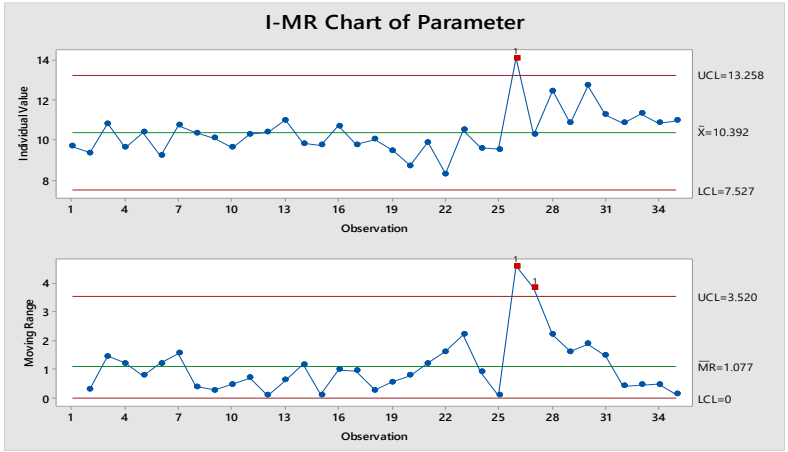
X_t = t^{th} sample result

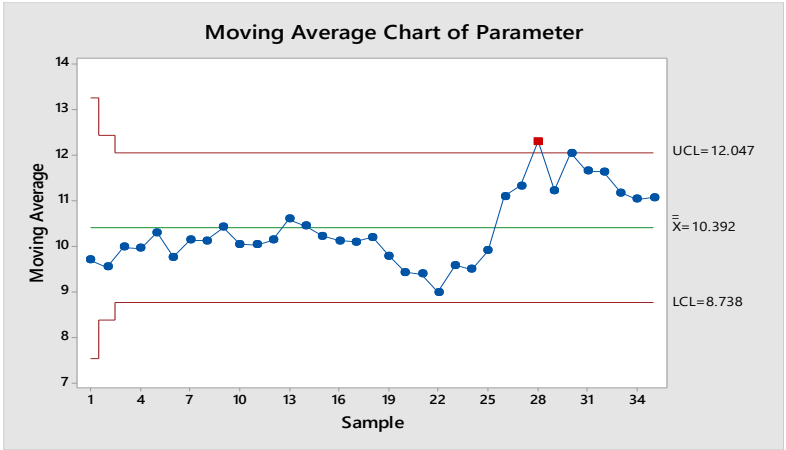
λ = the weighting factor ($0 < \lambda \leq 1$)

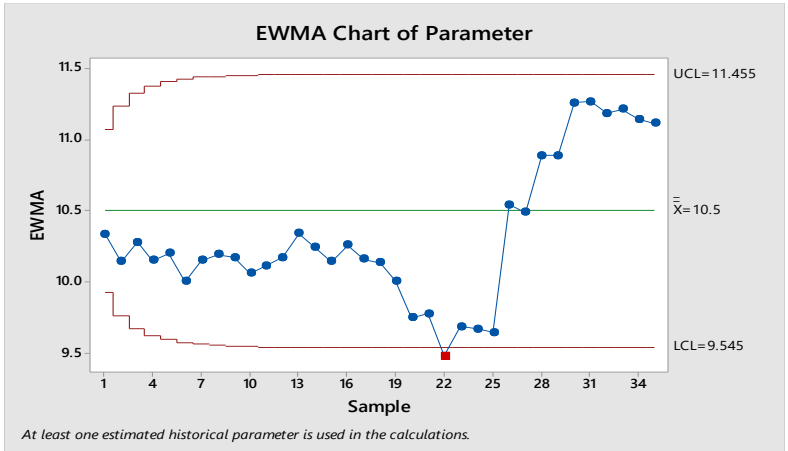
z_{t-1} = $(t-1)^{th}$ EWMA

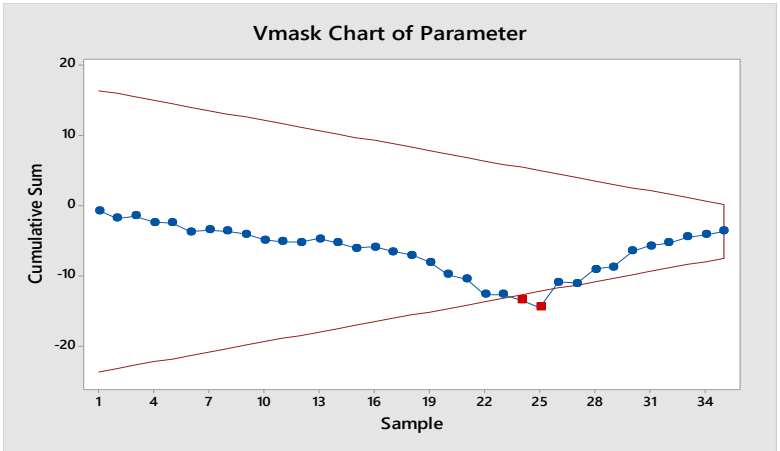
CUSUM Control Chart

- CUSUM means Cumulative Sum
- Plotted points are the cumulative sums of the deviations of each sample value from the target

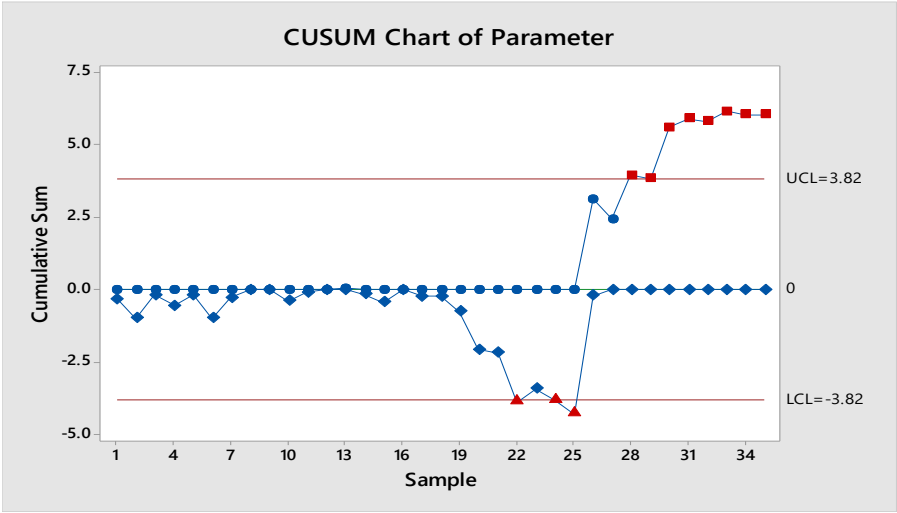

I-MR Chart of Parameter
Individual Value
UCL=13.258
X̄=10.392
LCL=7.527
Observation
Moving Range
UCL=3.520
MR̄=1.077
LCL=0
Observation


Moving Average Chart of Parameter
Moving Average
UCL=12.047
X̿=10.392
LCL=8.738
Sample


EWMA Chart of Parameter
EWMA
UCL=11.455
X̿=10.5
LCL=9.545
Sample
At least one estimated historical parameter is used in the calculations.


Vmask Chart of Parameter
Cumulative Sum
Sample

Tabular Chart



V Mask Chart

Ability to detect when a shift started