Coursera Guided Project

# RStudio for Six Sigma Control Charts

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# Learning Objectives

Overview Of Statistical Process Control (SPC)

Understand Data Types & Select Control Chart

Rules To Detect Out Of Control Signal In A Process

Plot & Interpret Variables Charts (XmR, Xbar-R, Xbar-S)

Plot & Interpret Attribute Charts (NP, P, U and C)

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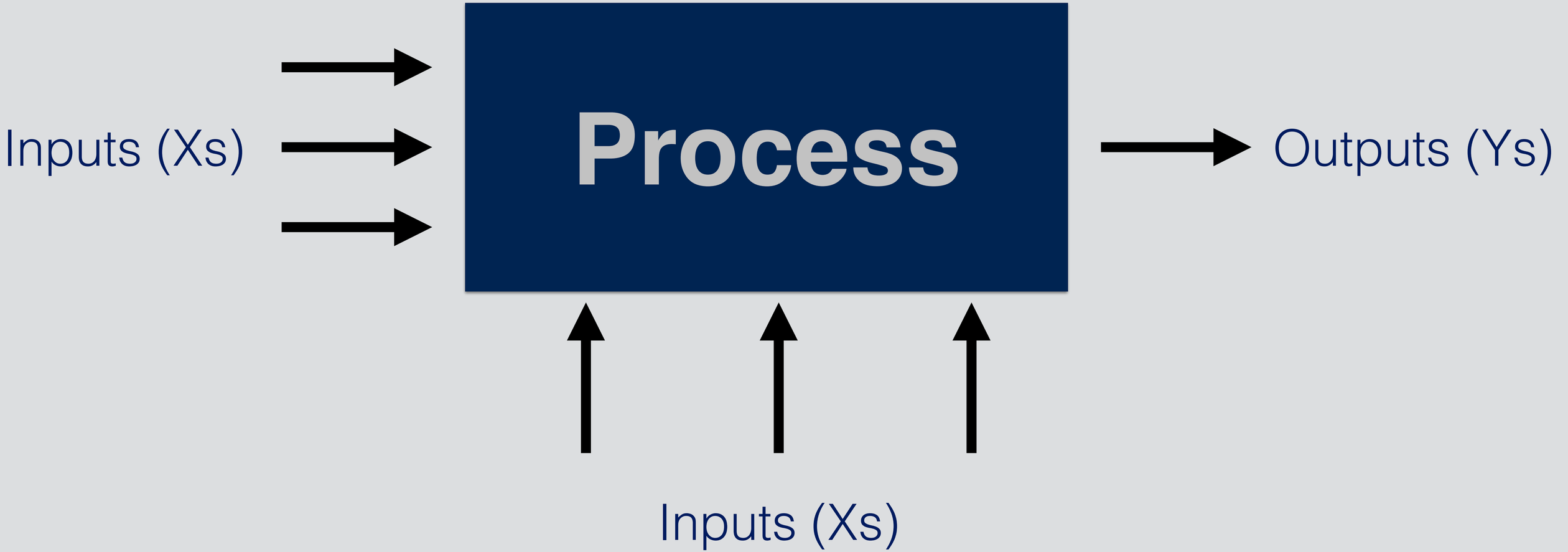
# Statistical Process Control



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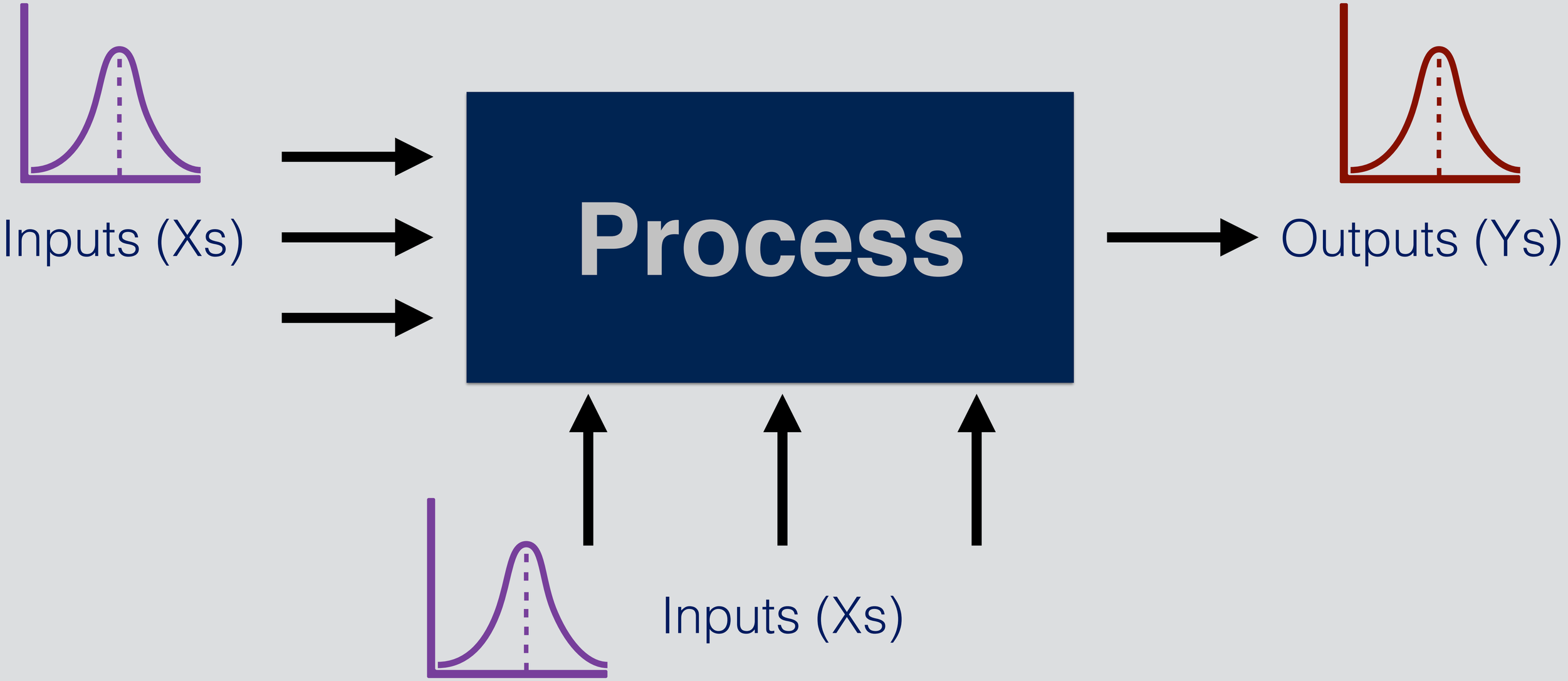


# Statistical Process Control

## Purpose of Control Charts

Monitor Process Inputs (Xs) And Process Outputs (Ys)

Detect When The Process Goes Out Of Control

## Control Charts Do Not

Reflect The Process Capability In Meeting The Specs

Identify The Causes Underlying Process Disturbances

# Statistical Process Control

Common Cause Variation

Random Variation

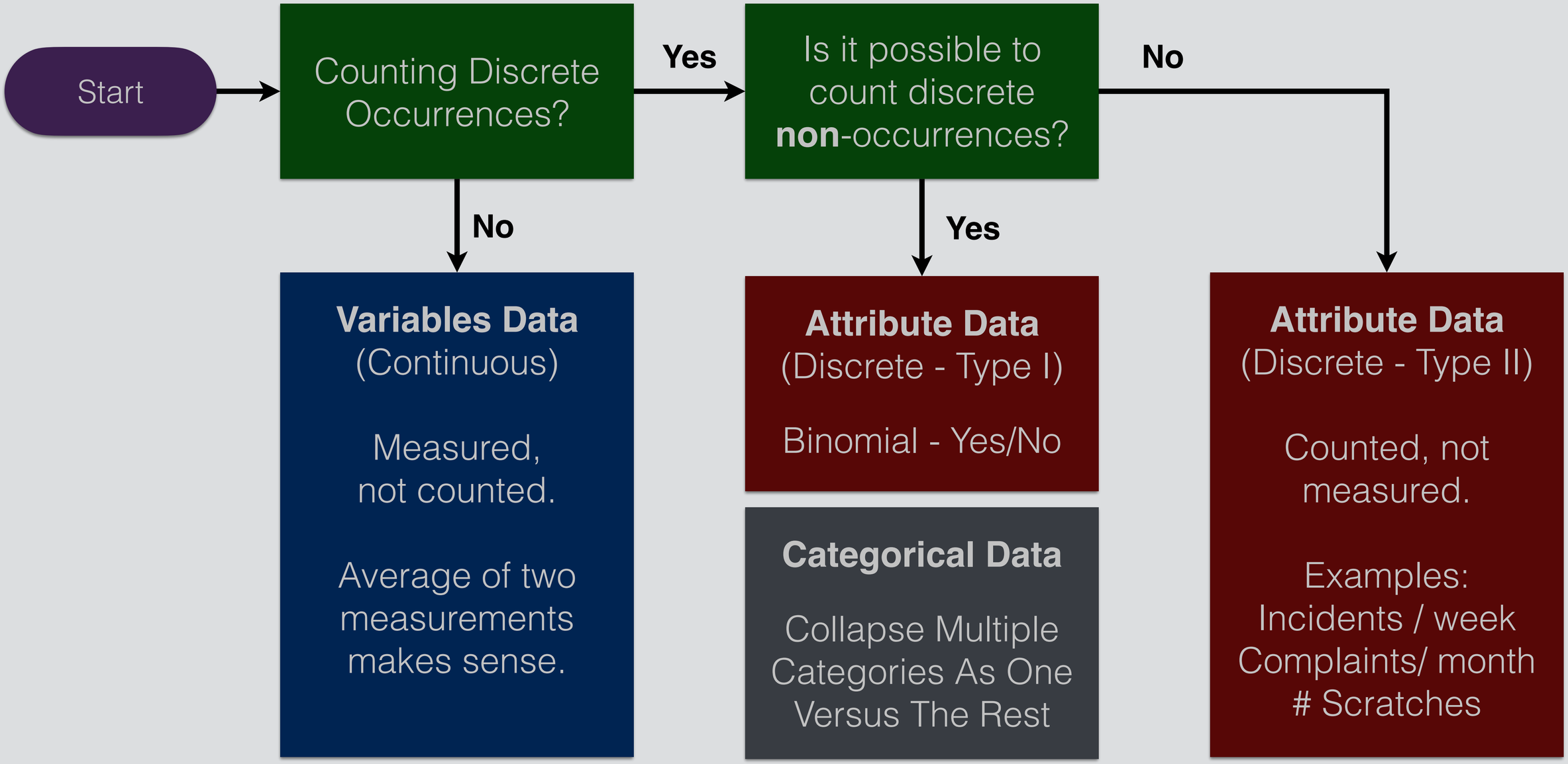
Process In Control

Special Cause Variation

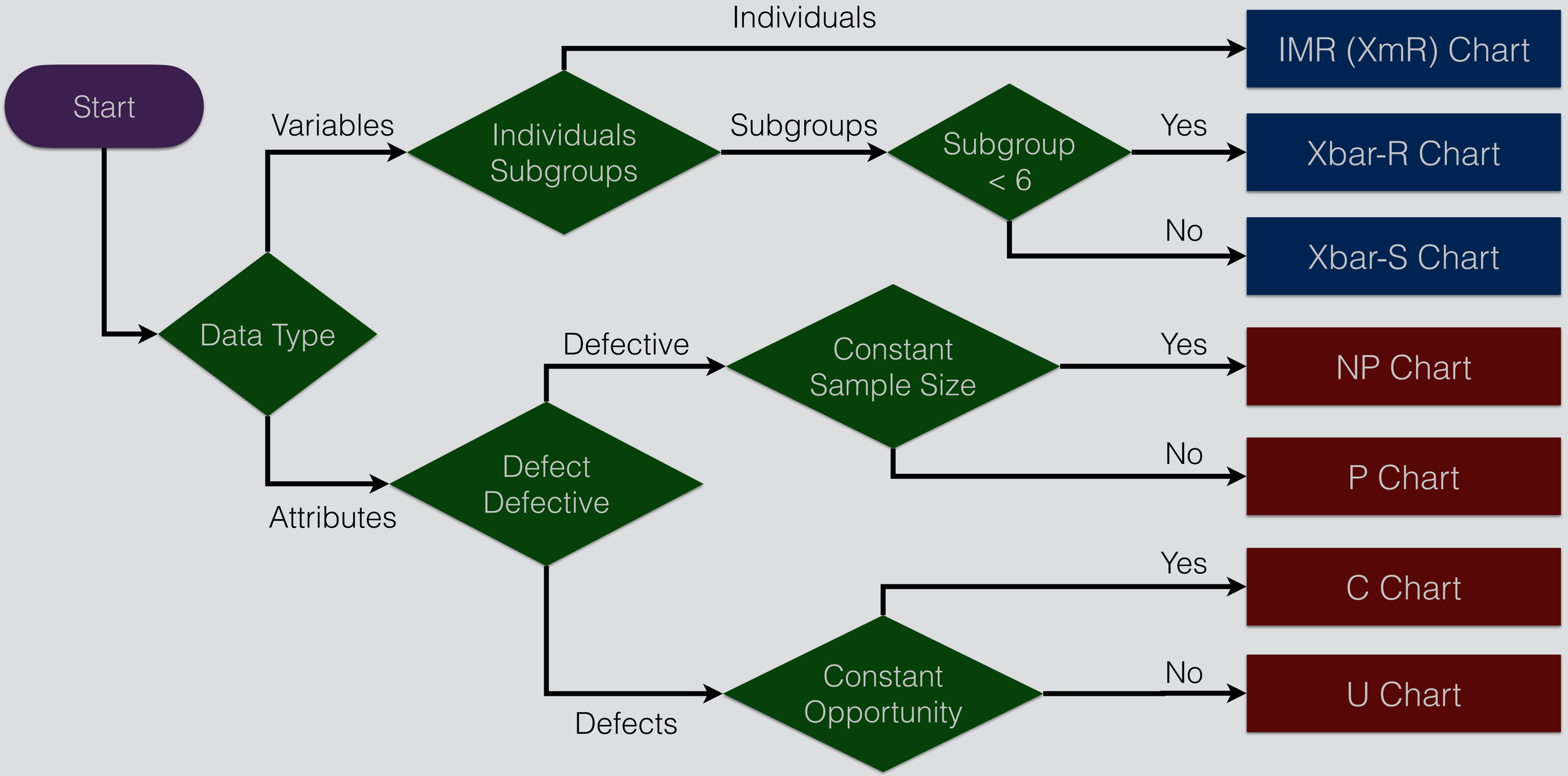
Non-Random Variation

Process Out Of Control

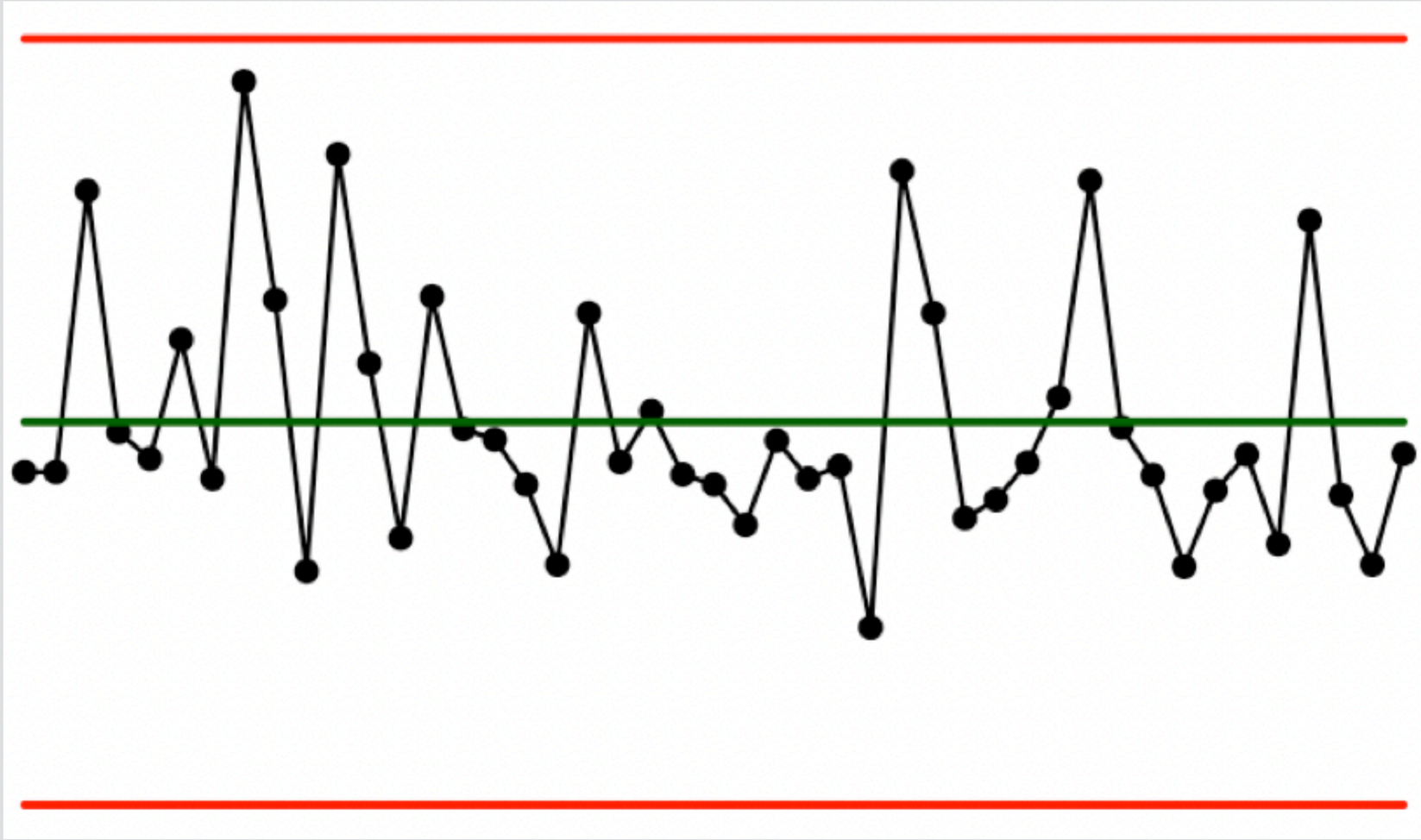
# Data Types For Control Charts



# Control Chart Selection Algorithm



# Western Electric Rules



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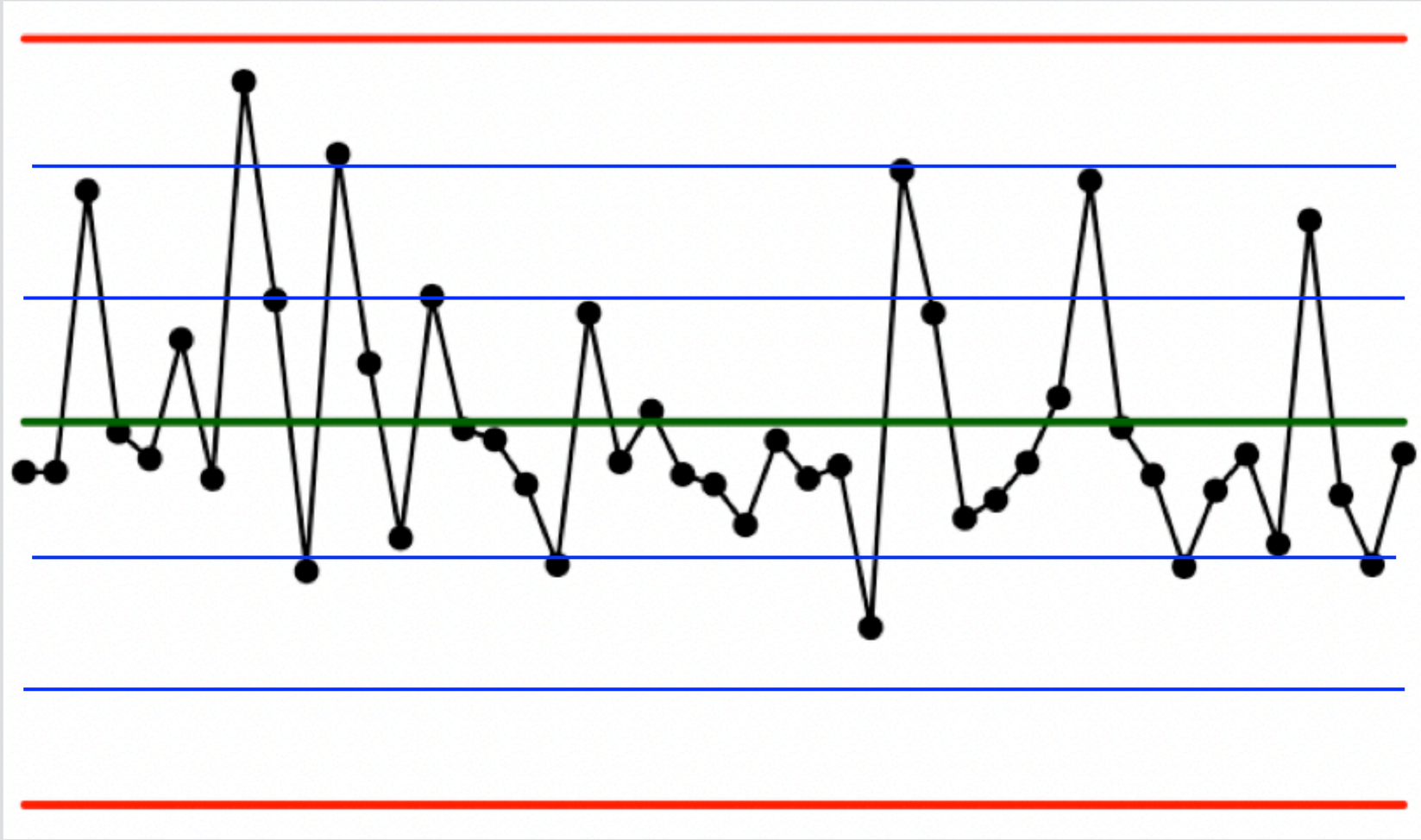

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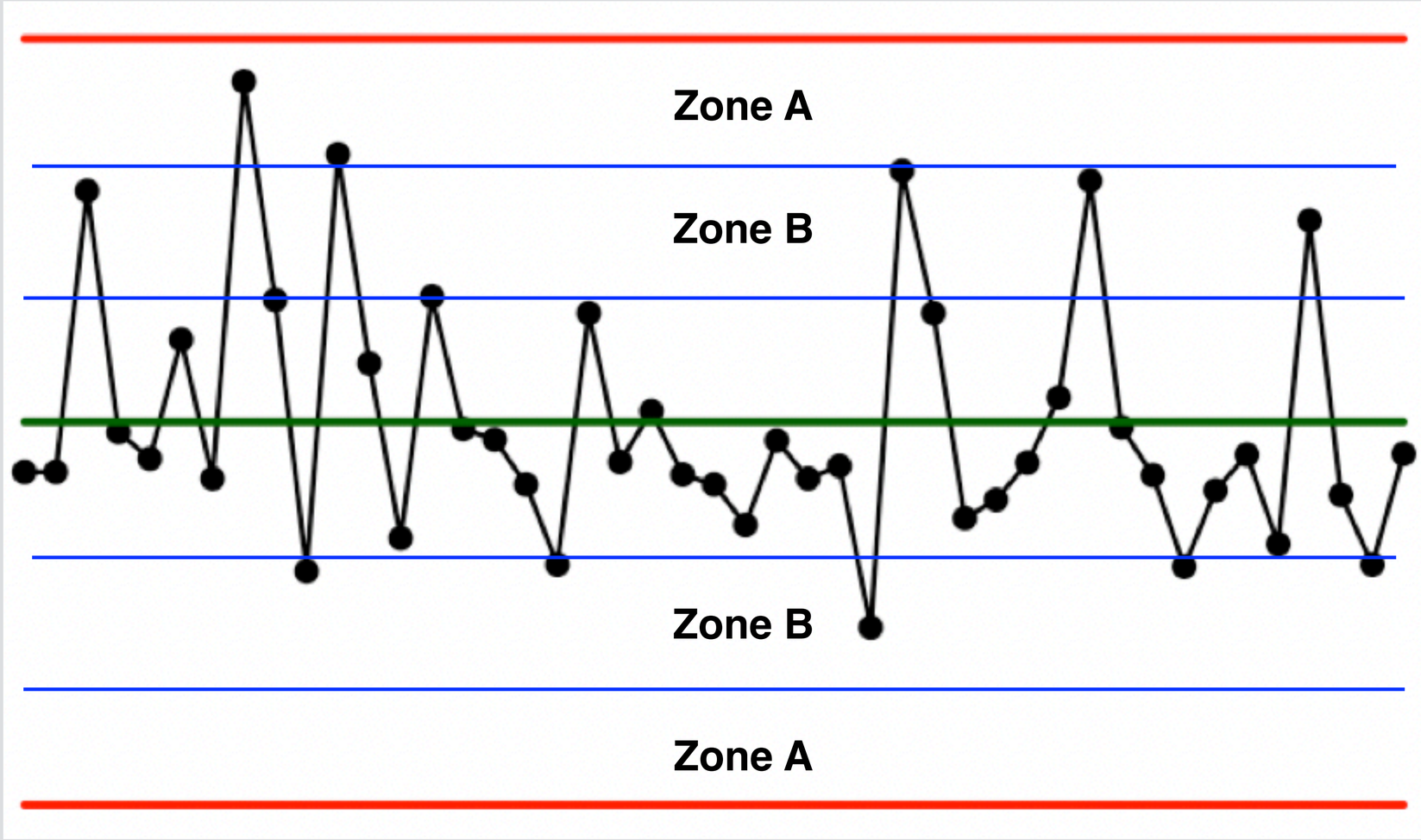

# Western Electric Rules

| | |
|---|---|
| **Rule 1** | One or more points beyond Zone A |
| **Rule 2** | 2 out of 3 consecutive points fall in Zone A or beyond |
| **Rule 3** | 4 out of 5 consecutive points fall in Zone B or beyond |
| **Rule 4** | 9+ consecutive points on the same side of the centre line |

# Nelson's Rules

| | | |
|---|---|---|
| **Rule 1** | One or more points beyond Zone A | WE |
| **Rule 2** | 9+ consecutive points on the same side of the CL | WE |
| **Rule 3** | 6+ consecutive points steadily increasing (decreasing) | |
| **Rule 4** | 14+ consecutive points alternating up and down | |
| **Rule 5** | 2 out of 3 consecutive points fall in Zone A or beyond | WE |
| **Rule 6** | 4 out of 5 consecutive points fall in Zone B or beyond | WE |
| **Rule 7** | 15+ consecutive points are in Zone C, either side of CL | |
| **Rule 8** | 8+ points in a row on either size of CL; but none in Zone C | |

# Control Chart Formulae

| Chart Type | Centre Line | LCL | UCL |
|---|---|---|---|
| X in XMR Chart | $\bar{x}$ | $\bar{x} - 3\overline{MR}/d_2$ | $\bar{x} + 3\overline{MR}/d_2$ |
| MR in XMR Chart | $\overline{MR}$ | – | $D_4\overline{MR}$ |
| X in Xbar-R Chart | $\bar{\bar{x}}$ | $\bar{\bar{x}} - A_2\bar{R}$ | $\bar{\bar{x}} + A_2\bar{R}$ |
| R in Xbar-R Chart | $\bar{R}$ | $D_3\bar{R}$ | $D_4\bar{R}$ |
| X in Xbar-S Chart | $\bar{\bar{x}}$ | $\bar{\bar{x}} - A_3\bar{s}$ | $\bar{\bar{x}} + A_3\bar{s}$ |
| S in Xbar-S Chart | $\bar{s}$ | $B_3\bar{s}$ | $B_4\bar{s}$ |
| P-Chart | $\bar{p}$ | $\bar{p} - 3\sqrt{\bar{p}(1-\bar{p})/n_i}$ | $\bar{p} + 3\sqrt{\bar{p}(1-\bar{p})/n_i}$ |
| NP-Chart | $n\bar{p}$ | $n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$ | $n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$ |
| C-Chart | $\bar{c}$ | $\bar{c} - 3\sqrt{\bar{c}}$ | $\bar{c} + 3\sqrt{\bar{c}}$ |
| U-Chart | $\bar{u}$ | $\bar{u} - 3\sqrt{\bar{u}/n}$ | $\bar{u} + 3\sqrt{\bar{u}/n}$ |