



Statistical Process Control (SPC)

Bc. Denisa Fabiánová

Bc. František Holík

Bc. Jiří Ihnařo

Bc. Adéla Kuchválková

Bc. Jan Sýkora

AGENDA

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6. Normal Distribution
7. Control Charts
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Process Definitions

“A series of things that are done in order to achieve a particular result.”
(Oxford University Press, 2024)

“A continuous action, operation, or series of changes taking place in a definite manner.”
(Dictionary, 2024)

Examples: Quality Control, Testing, Planning, etc.

Statistical Process Control

“Use of statistical techniques to control a process or production method.”

“SPC tools and procedures can help you monitor process behavior, discover issues in internal systems, and find solutions for production issues.”

(American Society for Quality, 2024)

Benefits:

Maximized productivity, increased operational efficiency, decreased manual inspections, improved client satisfaction, and reduced costs. (IntraStage, 2024)

Sample X Population

Population

= The entire set of items from which you draw data for a statistical study.

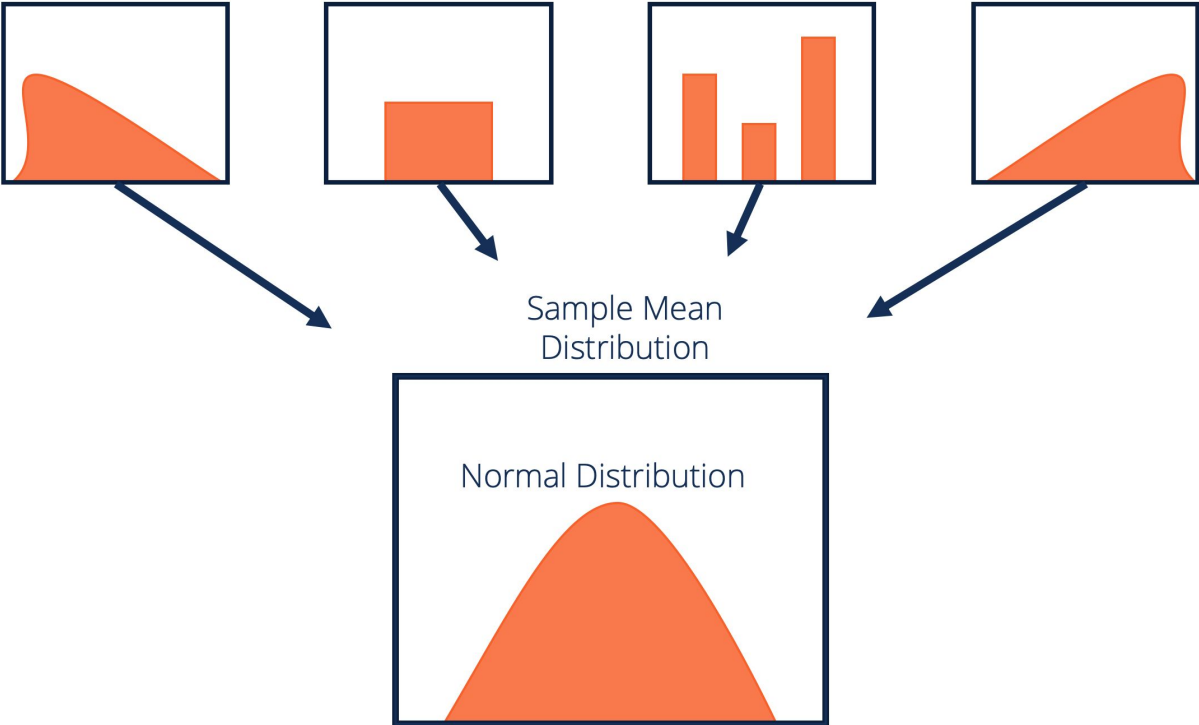
Example: Group of individuals, A set of items, etc.

Sample

= A smaller and more manageable representation of a larger group & a subset of a larger population that contains characteristics of that population. (Ravikiran, 2023)

Central Limit Theorem (CLT)

- Invented by Abraham de Moivre in 1733 & named by George Pólya in the 1920s.
- The sampling distribution of a sample mean is approximately normal if the sample size is large enough, even if the population distribution is not normal. (Zach, 2019)
- Sample sizes of around 30-50 are deemed sufficient for the CLT.
- CLT is useful in finance when analyzing a large collection of securities to estimate portfolio distributions and traits for returns, risk, and correlation. (Ganti, 2024)



(Corporate Finance Institute, 2023)

Mean, Median & Mode

Mean

= Adding up all the data points and dividing the sum by the number of data points (or total number of numbers). It is also known as 'arithmetic mean'.

Median

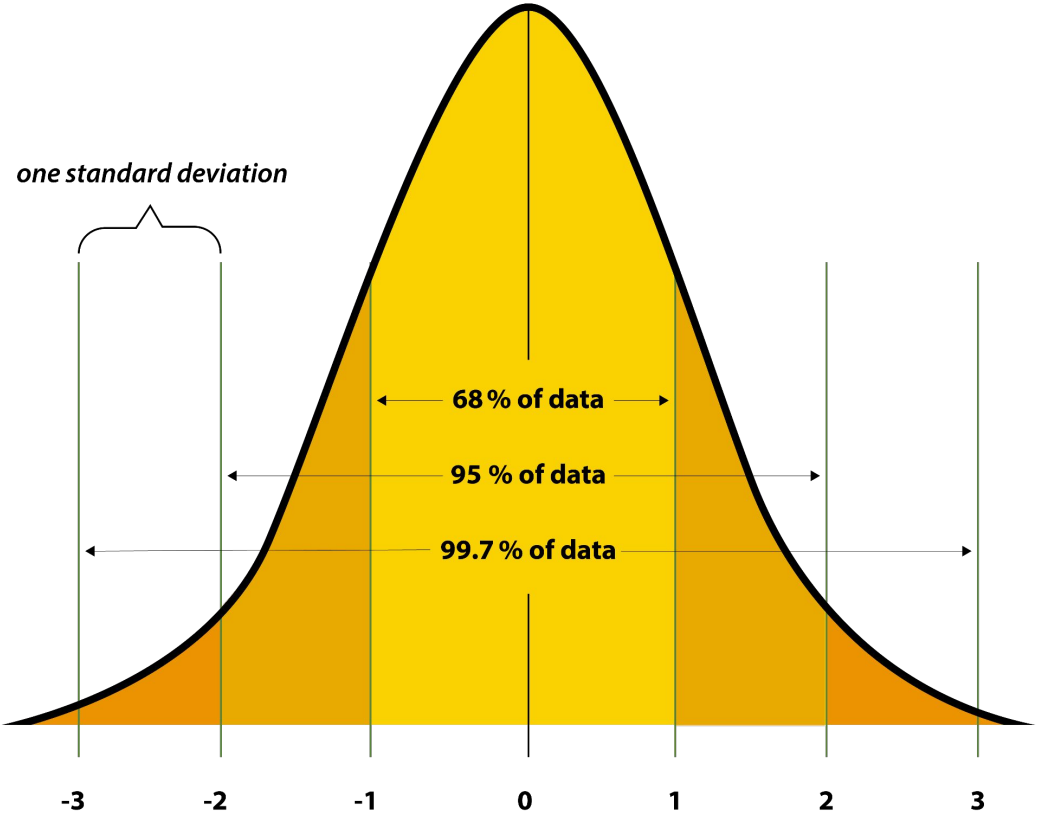
= The middle value (or midpoint) after all the data points have been arranged in value order as a list of numbers.

Mode

= The value that appears the most number of times in a data set. (Almond, 2024)

Normal Distribution

- A continuous probability distribution that is symmetrical on both sides of the mean, so the right side of the center is a mirror image of the left side.
- Traits: Symmetrical sides & Asymptotic tails
- Determined by 2 parameters - **Mean & Variance**
- **Standard normal distribution** = Normal distribution with a mean of 0 and a standard deviation of 1. (Mcleod, 2023)



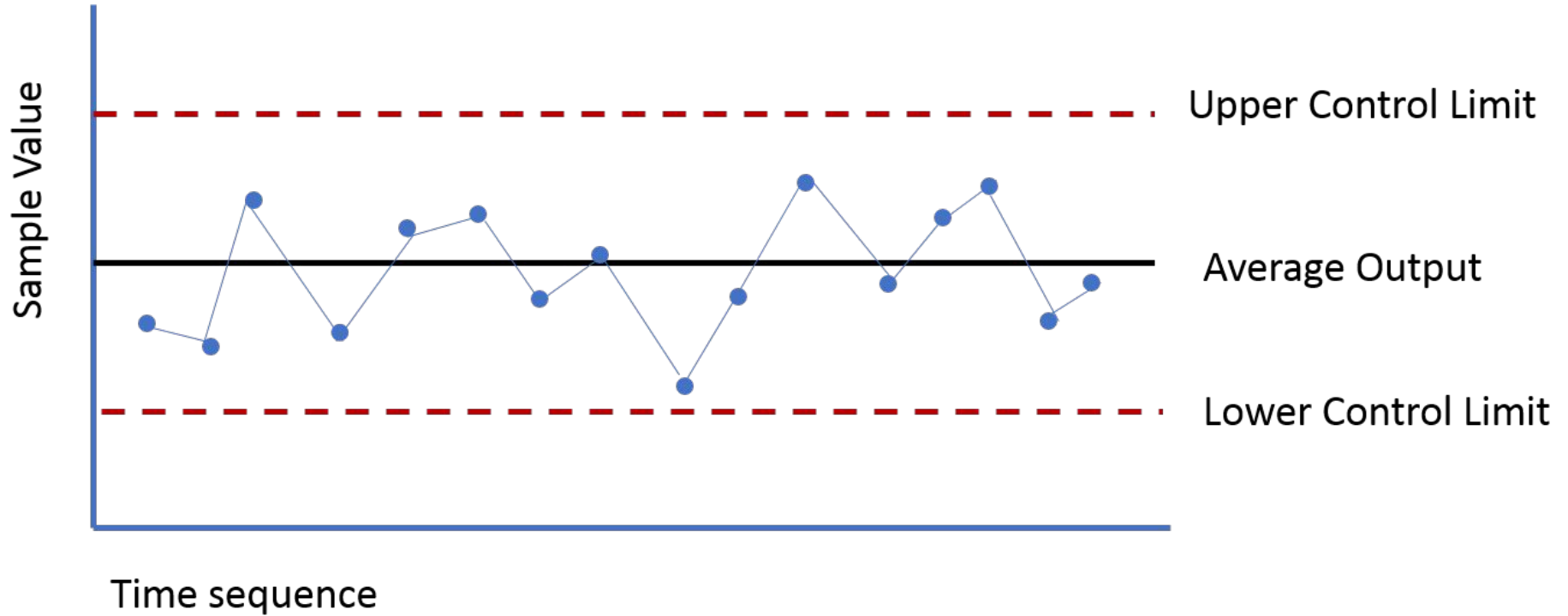
(National Library of Medicine, 2024)

Control Chart

= A graph used to study how a process changes over time. (American Society for Quality, 2023)

- **LSL & USL** = Lower Specification Limit & Upper Specification Limit
- **Mean** = The average of the data points
- **LCL & UCL** = Lower Control Limit & Upper Control Limit

= To conclude whether the process variation is consistent/unpredictable. (Serensits, 2020)

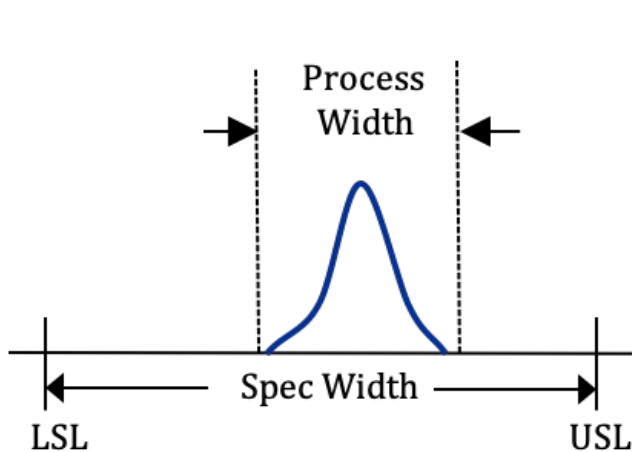


(Banna, 2018)

Cp & Cpk

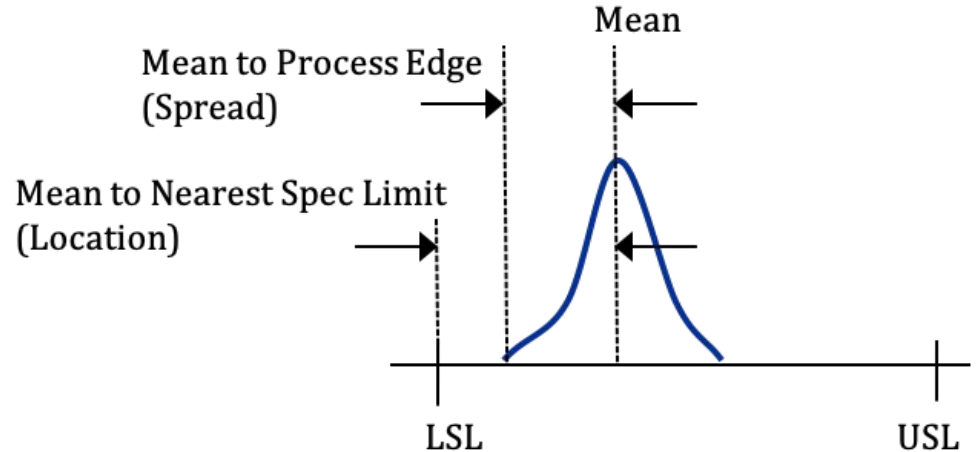
- Connected with **Capability Analysis** = A statistical tool that assesses whether a manufacturing process is capable of meeting customers' requirements.
- **Cp - Process Capability** = Measures the ability of the manufacturing process to produce a product within specification limits.
- **Cpk - Process Capability Index** = Measures how close the manufacturing process is to the centre of the specification limits. (Panell, 2022)

$$C_p = \frac{\text{Specification Width}}{\text{Process Width}}$$



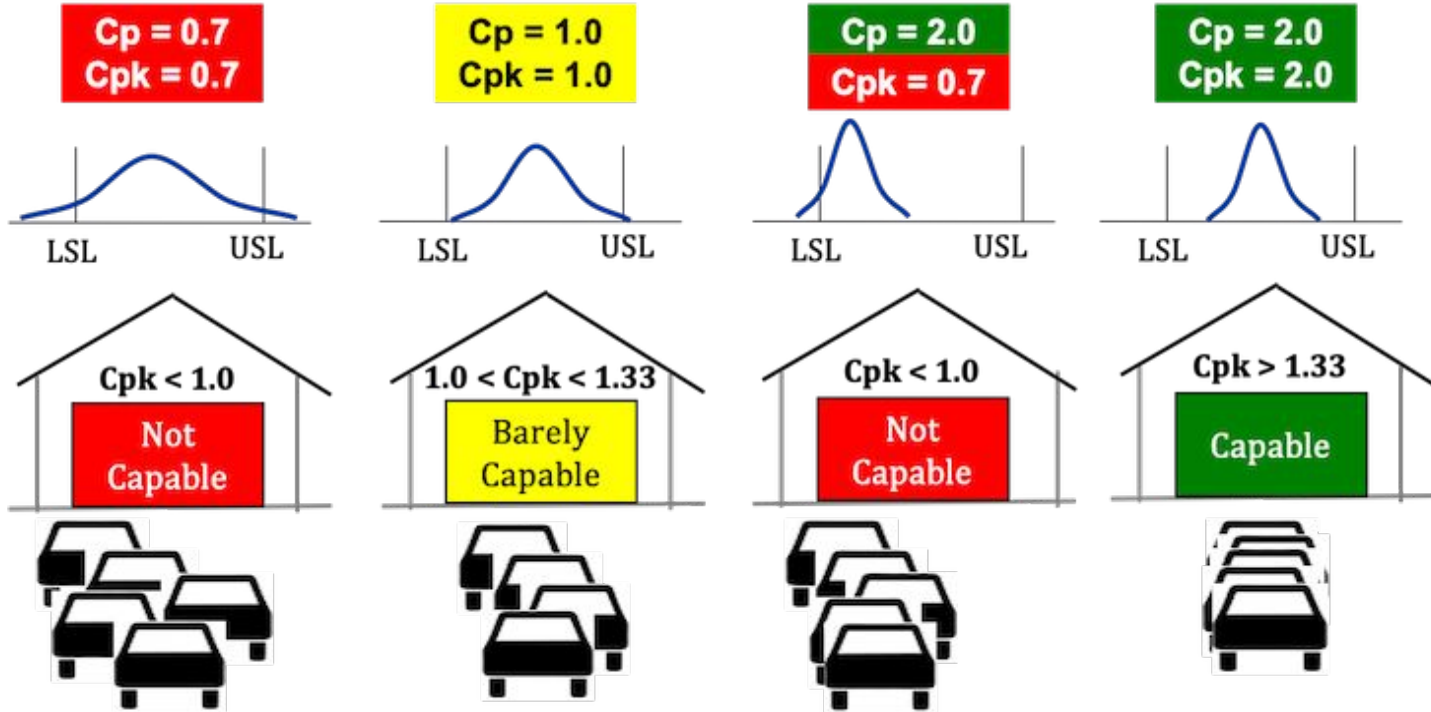
Cp accounts for only the spread (or variation) of the process.

$$C_{pk} = \frac{\text{Distance from Mean to Nearest Spec Limit}}{\text{Distance from Mean to Process Edge}}$$



Cpk accounts for both the spread and location of the process.

(1factory, 2024)



(1factory, 2024)

Sigma Level

“A key metric used to measure the capability of a process - it indicates how well a process meets customer requirements and can be used to compare different processes against each other.”

“Sigma level measures the number of standard deviations from the mean that a process falls within its specification limits.”

- Consists of **6 levels describing the percentage of scraps in 1 million units.** (Panell, 2023)

Sigma Level	Percent of Success	Percent of Defects	Defect Per Million Opportunities (DPMO)
1	31%	69%	691 462
2	69%	31%	308 538
3	93.3%	6.7%	66 807
4	99.33%	0.67%	6 210
5	99.977%	0.023%	233
6	99.99966%	0.00034%	3.4

(Own processing according to Eby, 2017)

KAHOOT TIME!

<https://play.kahoot.it/v2/lobby?quizId=fc22e46f-117f-49cd-8514-83af41e9fcf8>



Thank you for your attention!

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