CERTIFICATION PREP

Six Sigma Black Belt Exam Flashcards

Master Your Certification Prep

48 essential flashcards covering the full Body of Knowledge — from DMAIC methodology and statistical tools to Lean principles and process capability. Test yourself, reinforce key concepts, and build the confidence you need to pass.

Learn

Core concepts & definitions

Test

Challenge your recall

Master

Ace the exam

[Management and Strategy Institute]

FLASHCARD 1

What is Six Sigma?

> A disciplined, **data-driven approach** to eliminate defects and reduce process variation across any business process.

Six Sigma focuses on improving quality and operational efficiency to consistently meet — and exceed — customer expectations. It uses statistical methods to measure performance and drive sustainable improvements.

Key Takeaways

- Data-driven decision making
- Defect elimination focus
- Variation reduction
- Customer-centric quality
- Structured methodology

FLASHCARD 2

What does DMAIC stand for?

Define

Scope the problem

Measure

Quantify current state

Analyze

Find root causes

Improve

Implement solutions

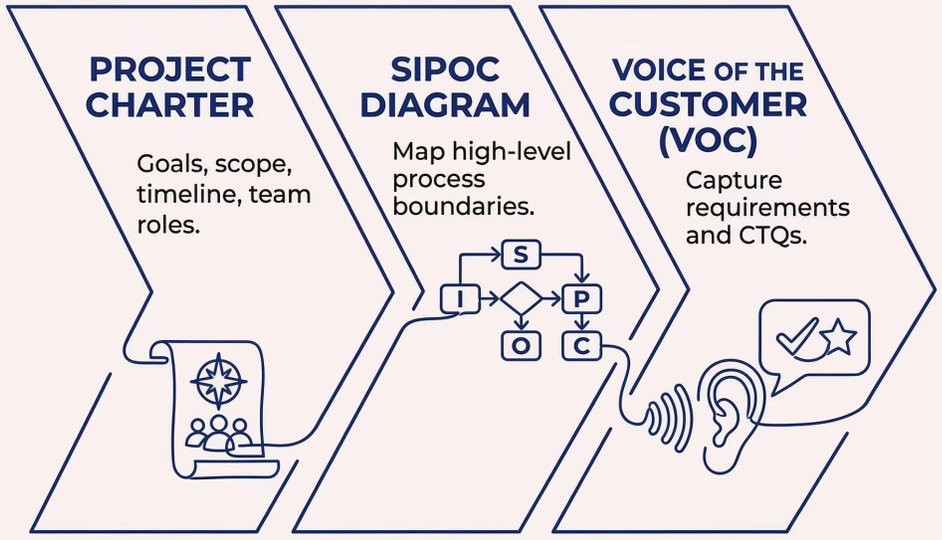
Control

Sustain the gains

DMAIC is the **core methodology** for process improvement in Six Sigma projects. Each phase builds on the last to ensure rigorous, evidence-based problem solving.

DMAIC — DEFINE

Define the Define Phase



The Define phase establishes the **foundation** of every Six Sigma project by answering three critical questions:

- What is the problem or opportunity?
- Who is the customer and what do they need?
- What is the project scope and goal?

A strong project charter prevents scope creep and aligns stakeholders from day one.

FLASHCARD 4

What is VOC?

Voice of the Customer — the systematic process of capturing customer needs, expectations, and preferences to drive quality improvements.

Surveys

Structured questionnaires for quantitative feedback

Focus Groups

Guided discussions revealing deeper insights

Interviews

One-on-one conversations for detailed understanding

Complaints

Direct signals of unmet requirements

FLASHCARD 5

What is a SIPOC Diagram?

Suppliers Who provides inputs	**Inputs** Materials, data, resources	**Process** High-level steps
Outputs Deliverables produced	**Customers** Who receives outputs	

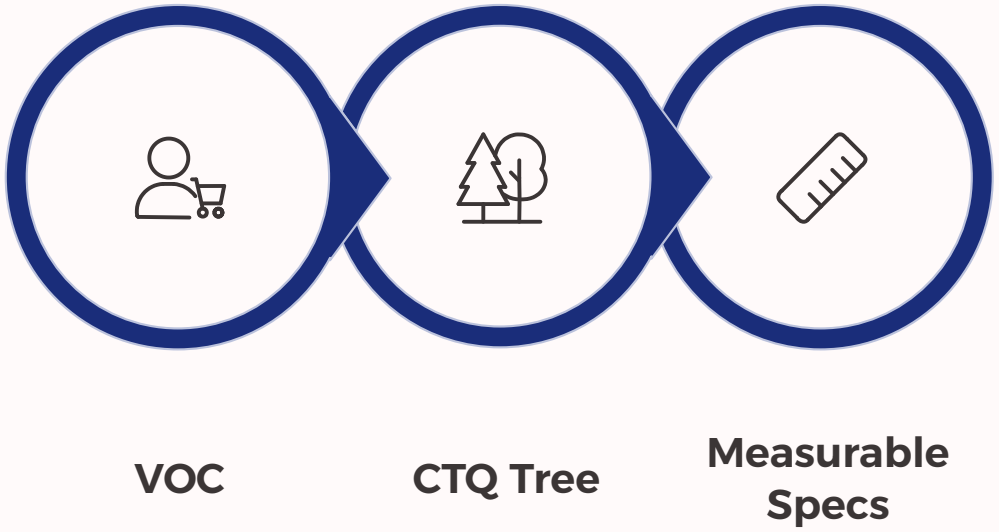
A high-level process map used in the **Define phase** to clarify boundaries, identify key stakeholders, and align the team before detailed analysis begins.

FLASHCARD 6

What is CTQ?

Critical to Quality — the measurable characteristics of a product or process that must be met to satisfy the customer.

CTQs are derived directly from VOC data and translated into specific, quantifiable requirements that guide every improvement effort.



Without well-defined CTQs, improvement teams risk solving the wrong problem.

DMAIC — MEASURE

Measure Phase Tools

The Measure phase quantifies current performance to establish a reliable baseline. Key tools include:

1

MSA

Measurement System Analysis validates data reliability

2

Run Charts

Track process performance trends over time

3

Pareto Charts

Prioritize problems by frequency or impact

4

Descriptive Stats

Summarize data with mean, median, std dev

FLASHCARD 8

What is Measurement System Analysis (MSA)?

MSA evaluates the **accuracy and precision** of measurement instruments and methods to ensure data reliability for decision-making.

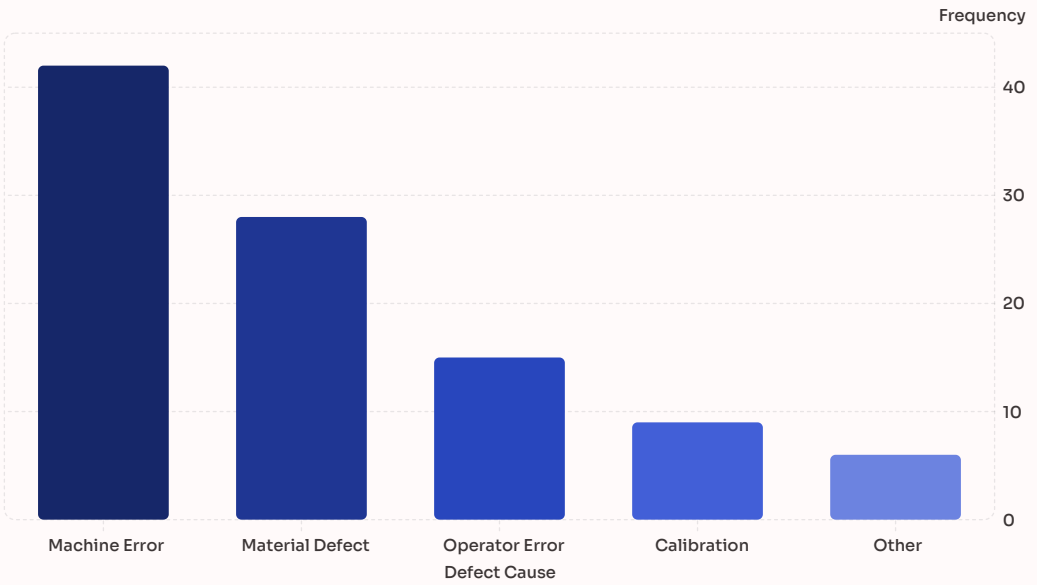
Before analyzing any data, you must first confirm that your measurement system isn't introducing error that could mask — or exaggerate — the real process variation.

MSA Evaluates

- **Bias** — systematic offset
- **Linearity** — bias across range
- **Stability** — consistency over time
- **Repeatability** — same operator
- **Reproducibility** — different operators

FLASHCARD 9

What is a Pareto Chart?



A bar chart ranking problems by frequency or impact, based on the **80/20 rule**:

> 80% of problems typically come from 20% of causes.

Pareto charts help teams focus limited resources on the vital few issues that will yield the greatest improvement.

DMAIC — ANALYZE

What is the Analyze Phase Objective?

Identify and validate **root causes** of defects or variation using data-driven analysis tools.

Hypothesis Testing

Statistically validate assumptions about process parameters

Cause-and-Effect Diagrams

Visually map all potential root causes by category

Regression Analysis

Model relationships between input and output variables

FLASHCARD 11

What is Hypothesis Testing?

A **statistical method** used to validate or refute assumptions about process parameters based on sample data.

The test compares observed results to what would be expected by chance alone, providing an objective basis for decision-making.

H_0 (Null)

No significant difference exists

H_a (Alternative)

A significant difference exists

If p-value ≤ α, reject H_0. If p-value > α, fail to reject H_0.

FLASHCARD 12

What is an ANOVA Test?

Analysis of Variance — compares the means of **three or more groups** to determine if at least one is statistically different from the others.

When to Use

Comparing output means across multiple input levels (e.g., 3 suppliers, 4 shifts)

How It Works

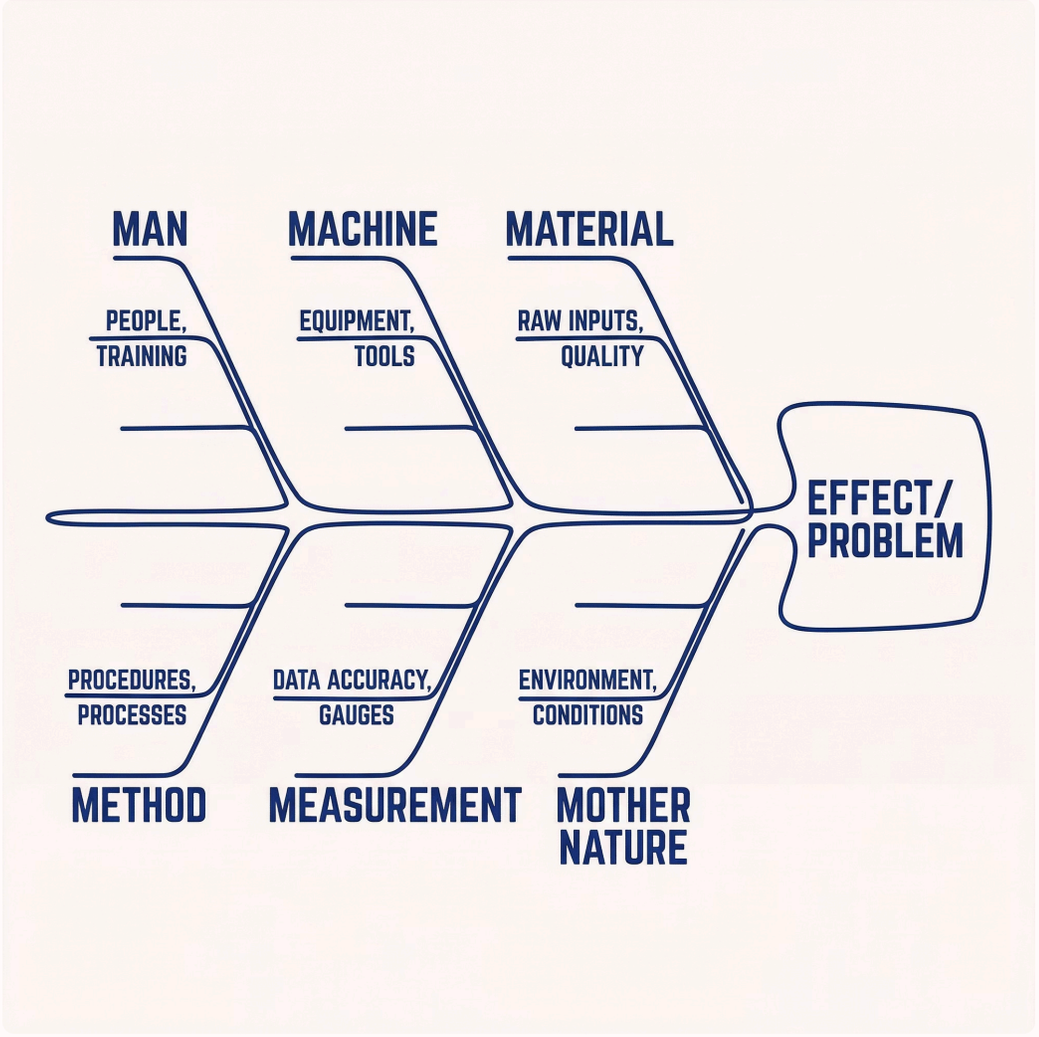
Partitions total variation into between-group and within-group components

Key Output

F-statistic and p-value determine if group differences are significant

FLASHCARD 13

What is a Cause-and-Effect Diagram?



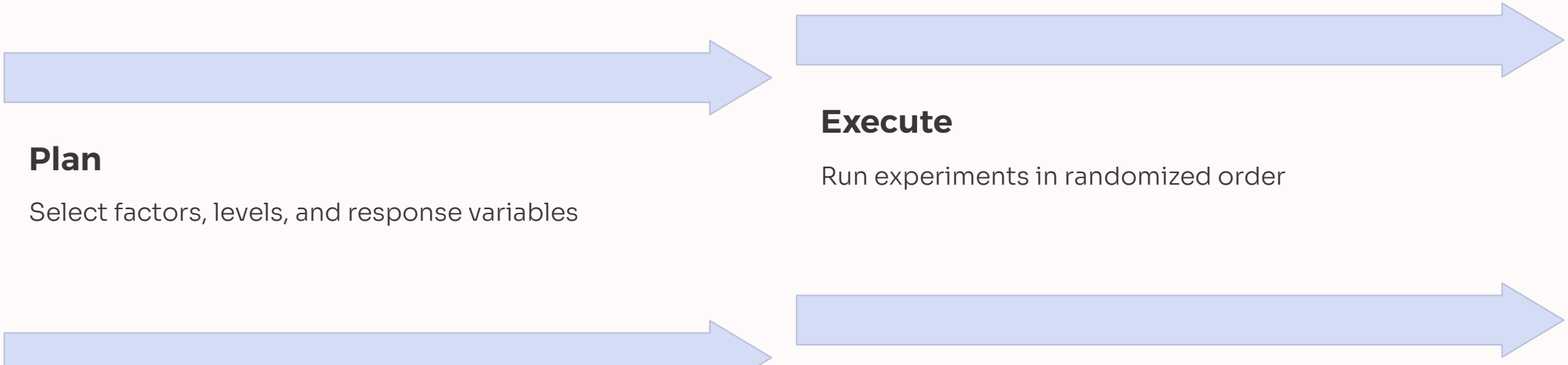
Also called a **Fishbone** or **Ishikawa** diagram. A visual tool that organizes potential root causes into categories along a central spine.

Common categories use the **6M framework**: Man, Machine, Material, Method, Measurement, Mother Nature.

FLASHCARD 14

What is Design of Experiments (DOE)?

A **structured statistical method** to test multiple factors simultaneously, revealing interactions and optimal process settings that one-factor-at-a-time testing would miss.



Plan

Select factors, levels, and response variables

Execute

Run experiments in randomized order

Analyze

Identify main effects and interactions

Optimize

Determine optimal factor settings

DMAIC — IMPROVE

What is the Improve Phase Focus?

Develop, test, and implement solutions that **eliminate root causes** identified in the Analyze phase.

Pilot Tests

Small-scale trials to validate solutions before full rollout

FMEA

Proactive risk assessment of proposed changes

Process Redesign

Restructure workflows to eliminate waste and variation

FLASHCARD 16

What is FMEA?

Failure Modes and Effects Analysis — a proactive tool to identify potential failure points before they occur and prioritize mitigation actions.

1 Identify Failure Modes

What could go wrong at each process step?

2 Rate Severity, Occurrence, Detection

Score each on a 1–10 scale

3 Calculate RPN

Risk Priority Number = S × O × D

4 Take Action

Address highest RPNs first with countermeasures

DMAIC — CONTROL

What is the Control Phase Purpose?

Sustain improvements by monitoring process performance and preventing regression to the old way of doing things.

The Control phase ensures that gains achieved in Improve become the permanent new standard.

Control Charts

Monitor stability in real time

Control Plans

Document who, what, when, how

SOPs

Standardize the improved process

FLASHCARD 18

What are Control Charts?

Graphical tools that monitor **process stability over time** by plotting data points against upper and lower control limits.

Common Cause

Natural, inherent variation — process is **in control**

Special Cause

Unusual, assignable variation — process is **out of control**

Look for runs, trends, and points beyond control limits as signals of special cause variation.

FLASHCARD 19

What are the 7 Wastes of Lean?

Remember: **TIMWOOD**

Defects

Over-production

Transportation

Waiting

Inventory

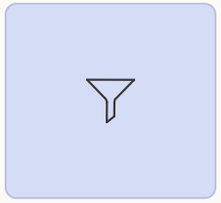
Motion

Over-Processing

FLASHCARD 20

What is 5S?

A workplace organization methodology that improves **efficiency, safety, and morale**.



Sort

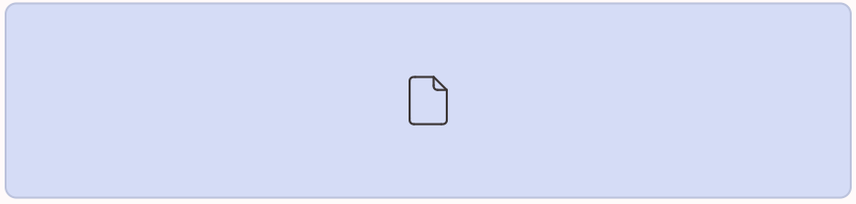
Remove unnecessary items

Straighten

Organize what remains

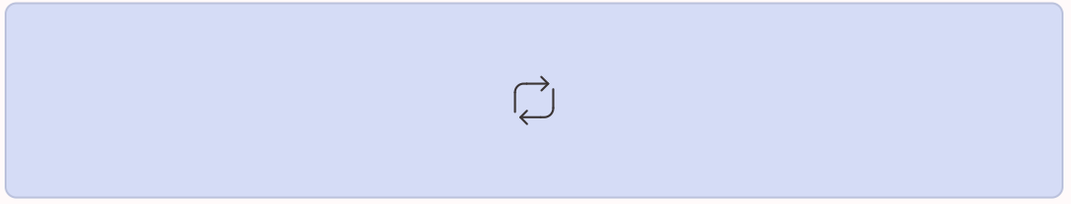
Shine

Clean and inspect regularly



Standardize

Create consistent procedures



Sustain

Maintain discipline over time

FLASHCARD 21

What is the 8D Problem-Solving Process?

01

D1 — Define the Problem

02

D2 — Establish the Team

03

D3 — Describe the Problem

04

D4 — Interim Containment Actions

05

D5 — Root Cause Analysis

06

D6 — Permanent Corrective Actions

07

D7 — Prevent Recurrence

08

D8 — Recognize the Team

FLASHCARD 22

What is Rolled Throughput Yield (RTY)?

The probability that a unit passes through **all process steps** defect-free on the first attempt.

$$RTY = Y_1 \times Y_2 \times Y_3 \times \cdots \times Y_n$$

Example

A 3-step process with yields of 95%, 90%, and 92%:

$$RTY = 0.95 \times 0.90 \times 0.92 = 0.787$$

Only **78.7%** of units pass through defect-free.

Why It Matters

RTY reveals **hidden factory** costs — rework and scrap that final yield alone cannot show.

FLASHCARD 23

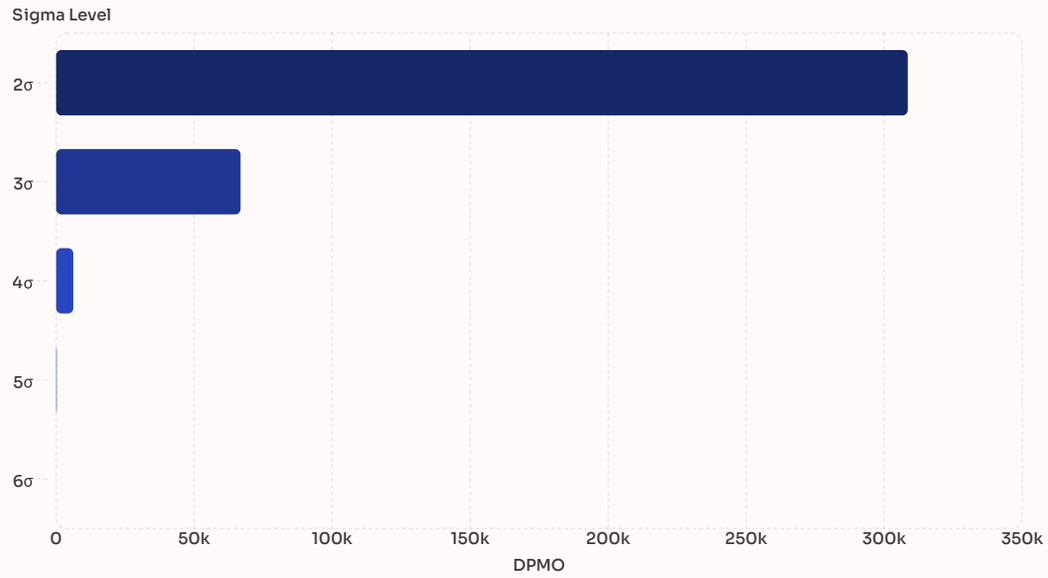
Six Sigma Defect Level in DPMO

3.4 DPMO

Six Sigma performance means only **3.4 defects per million opportunities** — a near-perfect process.

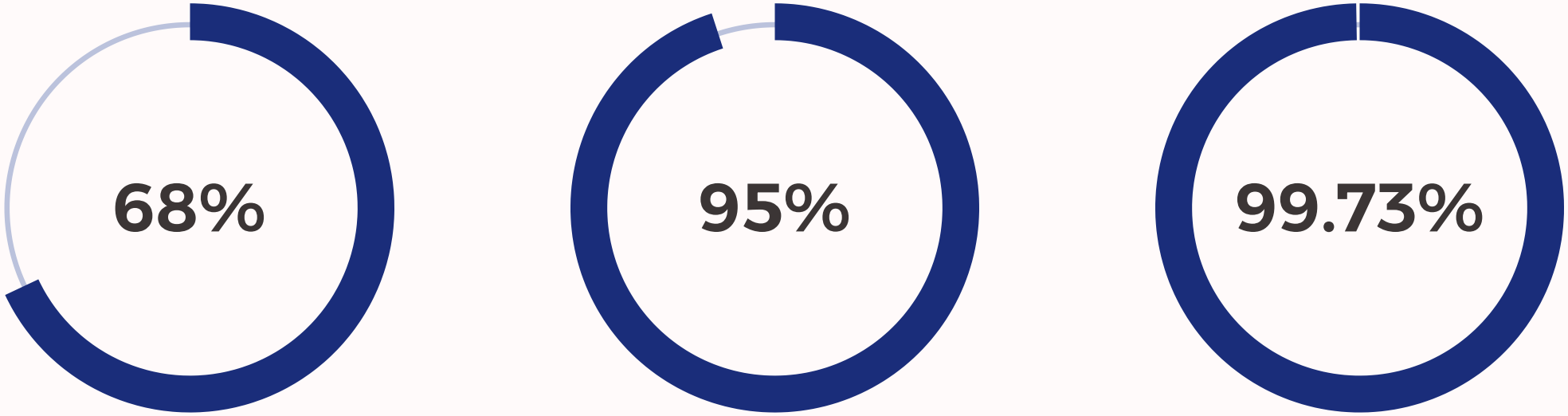
The 1.5 Sigma Shift

In theory, ±6σ captures virtually all variation. In practice, processes shift over time by approximately 1.5 sigma, resulting in the 3.4 DPMO benchmark.



FLASHCARD 24

What % of Data Falls Within ±3σ?



±1 Sigma

Innermost band of data

±2 Sigma

Most data captured

±3 Sigma

Nearly all data points

The empirical rule (68-95-99.7) applies to normally distributed data and is fundamental to understanding process capability.

FLASHCARD 25

Attribute Data vs. Variable Data

Attribute Data

Discrete, categorical — **pass/fail, yes/no, defective/non-defective**. Counted, not measured. Analyzed with proportion tests and chi-square.

Variable Data

Continuous, measured on a scale — **length, weight, time, temperature**. More informative and sensitive. Analyzed with t-tests, ANOVA, regression.

Exam Tip: Variable data provides more information per data point and generally requires smaller sample sizes than attribute data.

FLASHCARD 26

What is a Process Map?

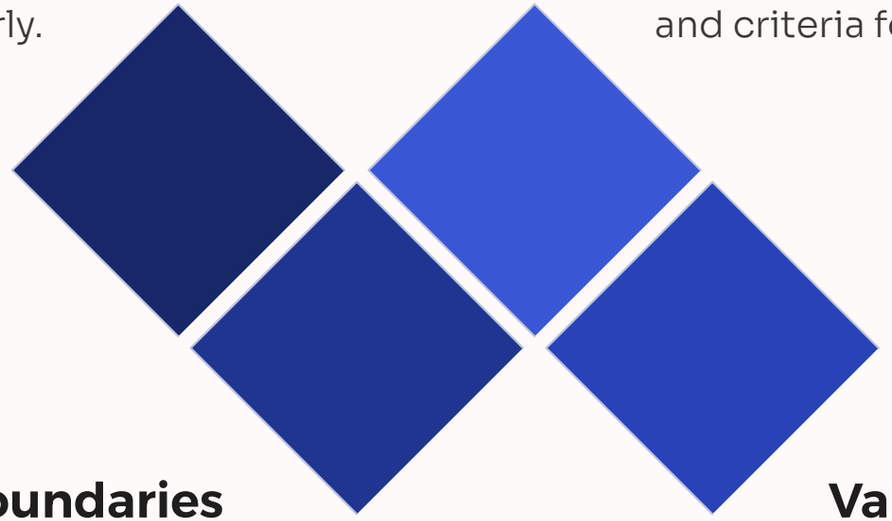
A **visual representation** of process steps, inputs, outputs, and decision points — the backbone of understanding any process in Six Sigma.

Document Steps

List each activity, input, and output clearly.

Add Decision Points

Mark choices, branches, and criteria for paths.



Identify Boundaries

Define start, end, and scope limits succinctly.

Validate Stakeholders

Review map with stakeholders for accuracy.

Process maps expose inefficiencies, redundancies, and bottlenecks that narrative descriptions often hide.

FLASHCARD 27

Three Types of Process Maps

1

High-Level (Flowchart)

Bird's-eye view of major process steps. Used early in Define phase for quick understanding.

2

Detailed (Multi-Level)

Drills into sub-steps, inputs, and outputs. Used in Measure and Analyze for deep investigation.

3

Functional (Swimlane)

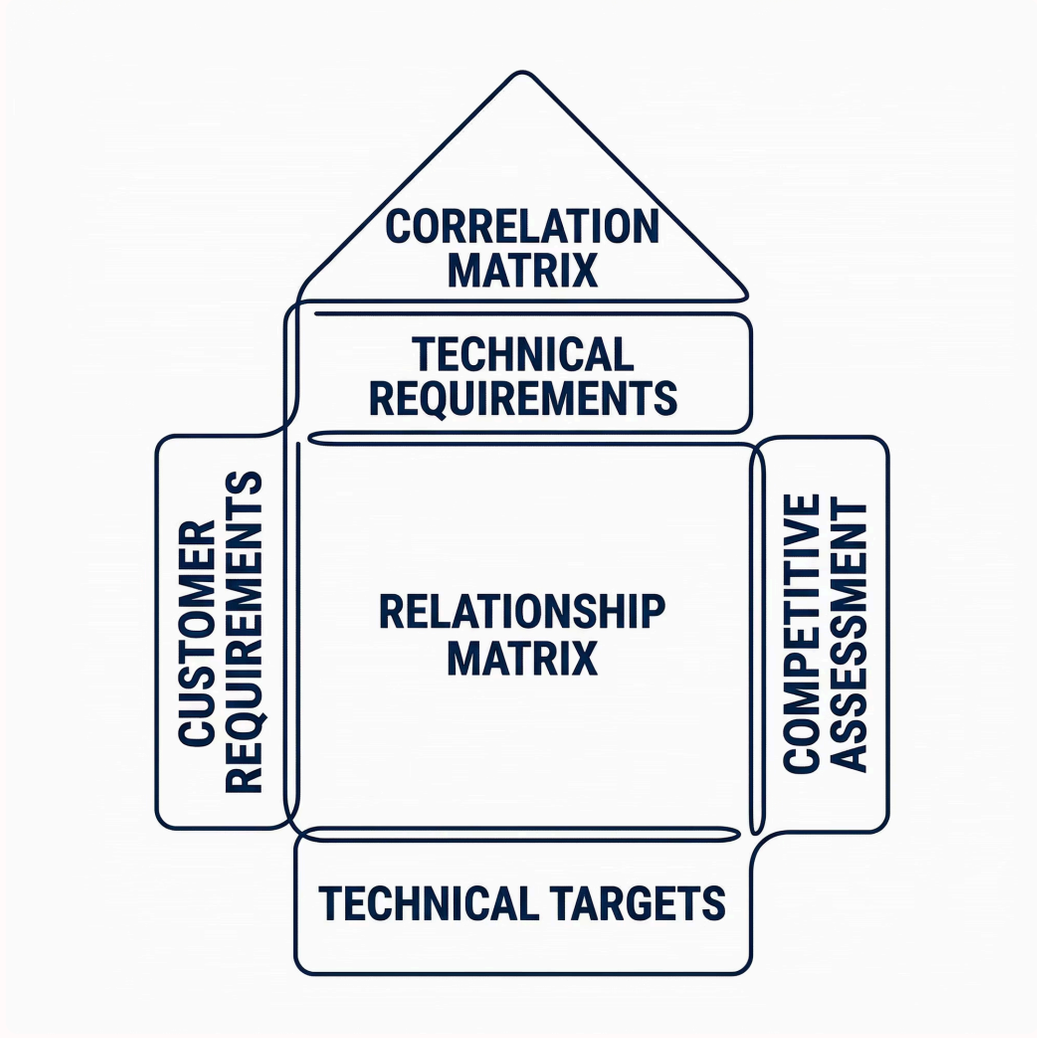
Organizes steps by role or department. Reveals handoff points and responsibility gaps.

FLASHCARD 28

What is Quality Function Deployment (QFD)?

A structured method to translate **customer requirements** (VOC) into **design specifications** and engineering characteristics.

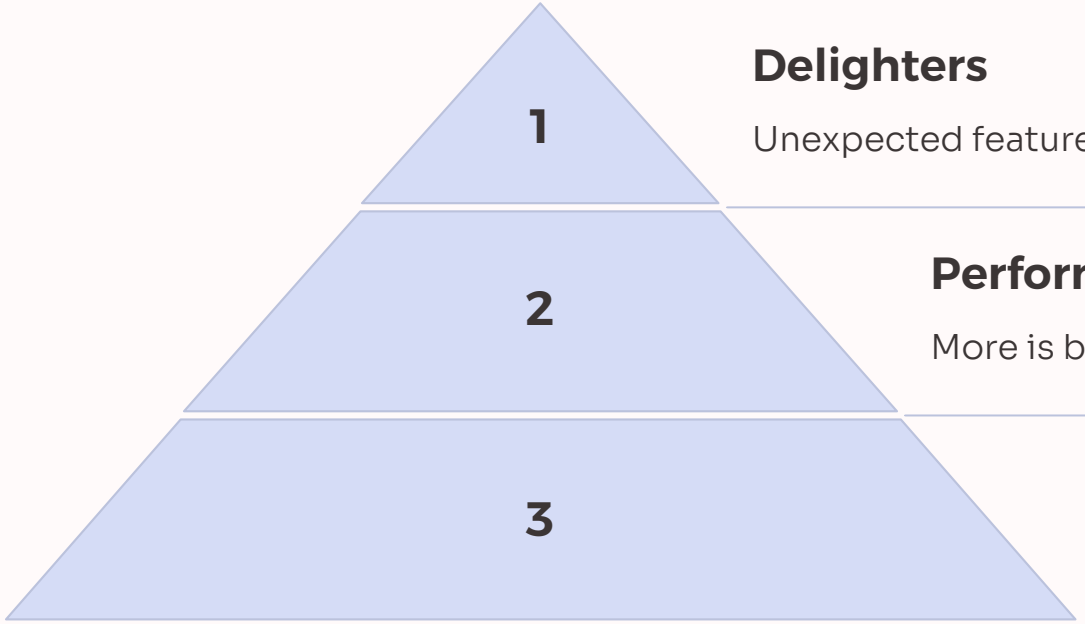
QFD uses the **House of Quality** matrix to systematically prioritize which technical requirements have the greatest impact on customer satisfaction.



FLASHCARD 29

What is the Kano Model?

A framework that classifies customer requirements into three categories based on their **impact on satisfaction**.



Delighters

Unexpected features that excite

Performance

More is better — linear satisfaction

Must-Have

Expected basics — absence causes dissatisfaction

FLASHCARD 30

What is Statistical Process Control (SPC)?

The application of **control charts and statistical analysis** to monitor and control processes in real time, ensuring they remain stable and predictable.

Purpose

Distinguish between common cause and special cause variation

Primary Tool

Control charts ($\bar{X}$-R, $\bar{X}$-S, p, np, c, u charts)

Outcome

Early detection of process shifts before defects occur

FLASHCARD 31

Common Cause vs. Special Cause Variation

Common Cause

Inherent process variation that is always present. Random, predictable within limits. Requires systemic changes to reduce.

Special Cause

Unusual, assignable variation from specific events. Unpredictable and irregular. Must be identified and eliminated individually.

Key Rule: Only address special causes with local fixes. Common cause reduction requires management action on the system itself.

FLASHCARD 32

What is a Hypothesis Test's Alpha (α) Level?

The **significance level** — the maximum probability of committing a Type I error (rejecting a true null hypothesis) that you're willing to accept.

Commonly set at **α = 0.05**, meaning there is a 5% risk of concluding a difference exists when it actually doesn't.

Decision Rule

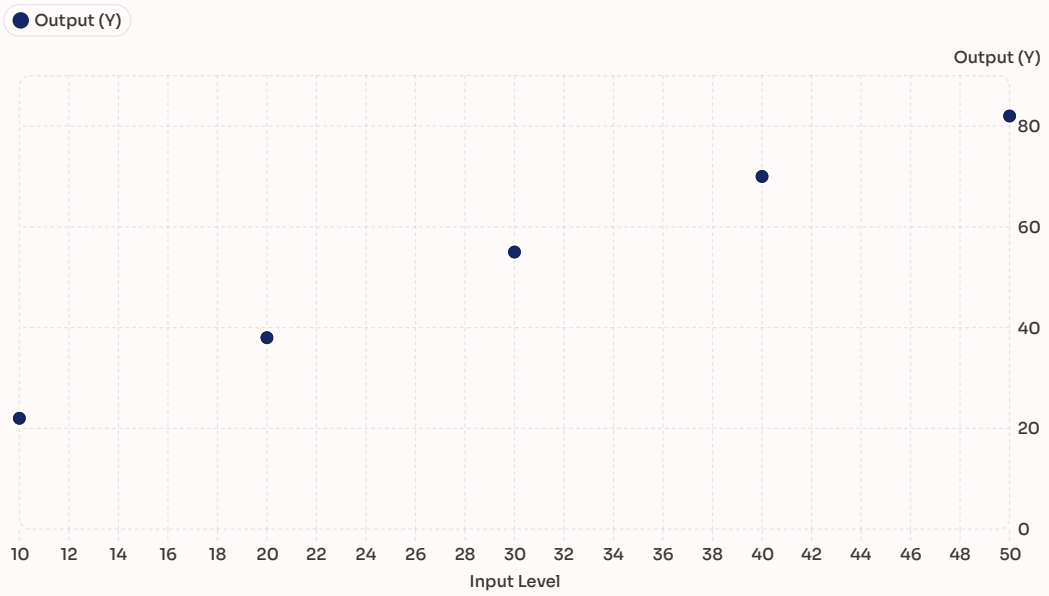
If **p-value ≤ α**:
Reject H_0 — result is statistically significant

If **p-value > α**:
Fail to reject H_0 — insufficient evidence

FLASHCARD 33

What is Regression Analysis Used For?

Modeling the **relationship between dependent and independent variables** to predict outcomes and quantify the impact of key factors.



Types

- **Simple linear** — one X, one Y
- **Multiple** — several X variables
- **Logistic** — binary outcome

Key metric: **R^2** indicates the proportion of variation explained by the model.

FLASHCARD 34

Purpose of a SIPOC Diagram

> Clarify process boundaries and identify key suppliers and customers **before** diving into detailed analysis.

Aligns the Team

Creates shared understanding of process scope and stakeholders

Prevents Scope Creep

Clearly defines where the process starts and ends

Feeds the Charter

Informs the project charter with concrete process context

FLASHCARD 35

Lean vs. Six Sigma

Lean

Focuses on **waste elimination** and optimizing flow. Aims to do more with less by removing non-value-added activities. Tools: Value Stream Mapping, 5S, Kanban.

Six Sigma

Focuses on **reducing variation and defects**. Uses statistical rigor to achieve near-perfect quality. Tools: DMAIC, DOE, Control Charts, Hypothesis Testing.

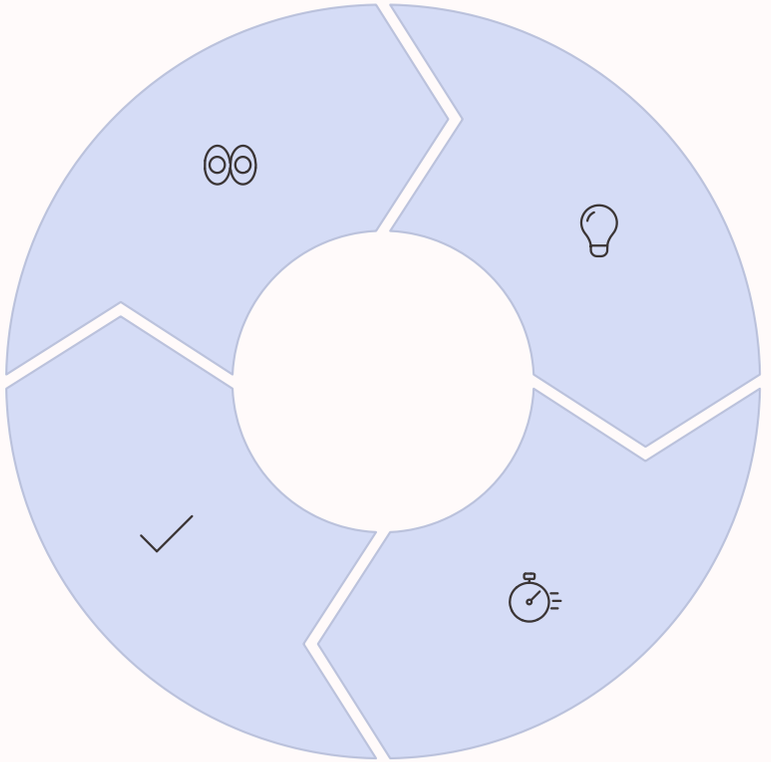
Lean Six Sigma combines both — eliminating waste AND reducing variation for maximum impact.

FLASHCARD 36

What is Kaizen?

改善

Continuous incremental improvement — a Japanese philosophy meaning "change for the better." Kaizen emphasizes small, daily improvements made by everyone in the organization.



Observe

Go to the gemba

Identify

Find improvement opportunities

Sustain

Standardize what works

Act

Implement small changes

FLASHCARD 37

What is a Control Plan?

A **living document** that outlines how to maintain process improvements and monitor key metrics after the project closes.

What	How	Who	When
Key metric (CTQ)	Measurement method	Responsible owner	Frequency
Reaction plan	If out of control	Escalation contact	Immediately

Without a robust control plan, improvements deteriorate — often within weeks.

FLASHCARD 38

Type I vs. Type II Errors

Type I Error (α)

False Positive — rejecting a true null hypothesis. Concluding there IS a difference when there isn't one. Risk level set by α (typically 0.05).

Type II Error (β)

False Negative — failing to reject a false null hypothesis. Missing a real difference that actually exists. Related to statistical power (1 − β).

Memory Aid: Type I = "false alarm." Type II = "missed detection." Increasing sample size reduces both error types.

FLASHCARD 39

What is Process Capability Index (Cp)?

Measures **potential** process capability — how well the process *could* perform if perfectly centered between specification limits.

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

Cp < 1.0

Process is **not capable** — spread exceeds spec width

Cp = 1.0–1.33

Process is **marginally capable**

Cp ≥ 1.33

Process is **capable** — goal for most industries

FLASHCARD 40

What is Process Capability Index (Cpk)?

Measures **actual** process capability, accounting for how far the process mean has shifted from center.

$$C_{pk} = \min\left(\frac{USL - \bar{X}}{3\sigma}, \frac{\bar{X} - LSL}{3\sigma}\right)$$

Cp vs. Cpk

- **Cp** = potential (ignores centering)
- **Cpk** = actual (includes centering)
- Cpk ≤ Cp always

Exam Tip

If Cp is high but Cpk is low, the process is **capable but not centered**. Shift the mean to improve Cpk.

FLASHCARD 41

What is the 5 Whys Technique?

An iterative questioning method — asking **"Why?"** five times to drill through symptoms and reach the true root cause.

Why 1

The machine stopped → a fuse blew

Why 2

The fuse blew → overload on circuit

Why 3

Overload → bearing seized

Why 4

Bearing seized → insufficient lubrication

Why 5

Insufficient lubrication → **no PM schedule**

FLASHCARD 42

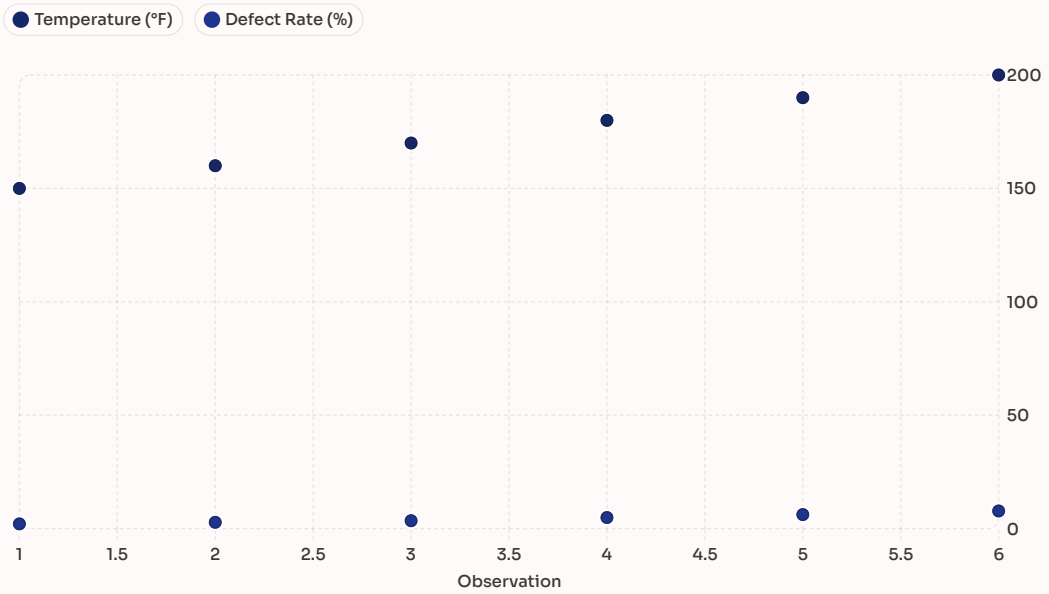
What is an Affinity Diagram?

A management and planning tool used to **organize large amounts of ideas or data** into natural, logical groups based on their relationships.

Particularly useful after brainstorming sessions, VOC data collection, or when the team faces an overwhelming amount of unstructured information.

FLASHCARD 43

What is a Scatter Diagram?

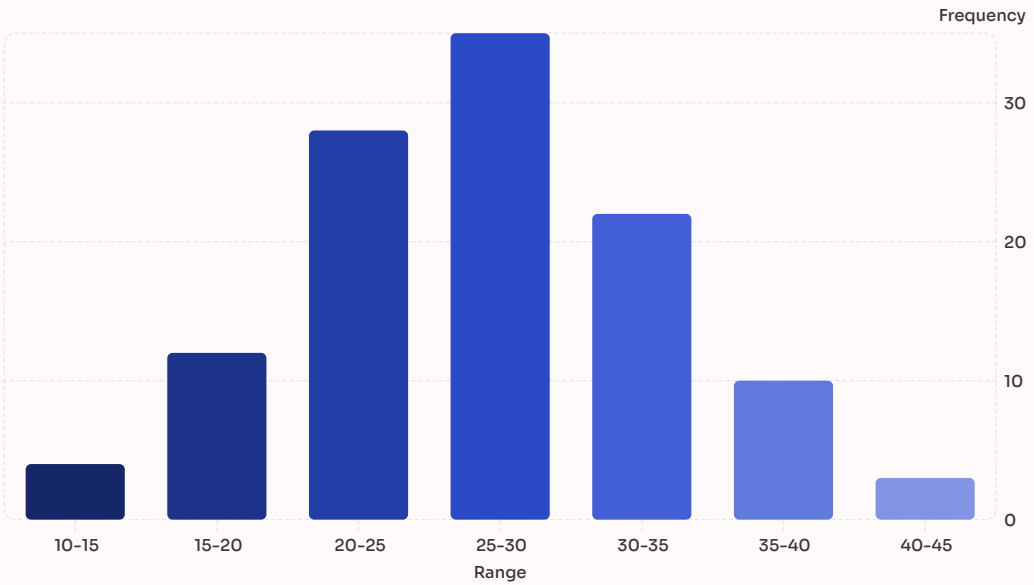


A graph plotting **two variables** to reveal the type and strength of their relationship.

- **Positive correlation** — both increase together
- **Negative correlation** — one increases as the other decreases
- **No correlation** — no apparent pattern

FLASHCARD 44

What is a Histogram?



A bar chart displaying the **frequency distribution** of continuous data, showing the shape, center, and spread of a dataset.

Histograms help identify patterns such as normal distribution, skewness, bimodal distributions, or outliers.

FLASHCARD 45

Population vs. Sample

Population (N)

The **entire set** of items or observations of interest. Parameters include μ (mean) and σ (std dev). Rarely feasible to measure completely.

Sample (n)

A **subset** selected to represent the population. Statistics include $\bar{x}$ (mean) and s (std dev). Used to make inferences about the population.

Exam Tip: Greek letters (μ, σ) denote population parameters. Latin letters ($\bar{x}$, s) denote sample statistics.

FLASHCARD 46

What is a Confidence Interval?

A range of values within which a **population parameter** is estimated to lie with a stated level of probability.

$$\bar{X} \pm Z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}$$

90% CI

Narrower range, higher risk of missing the true value

95% CI

Most commonly used — standard for Six Sigma projects

99% CI

Wider range, greater certainty of capturing the true value

FLASHCARD 47

Purpose of Hypothesis Testing in Six Sigma

To determine whether observed data provides **sufficient statistical evidence** to support a claim about a process or product — removing opinion and gut feeling from decision-making.

Hypothesis testing is used throughout the Analyze and Improve phases to validate root causes and confirm that solutions produce statistically significant results.

FLASHCARD 48

What is the Role of a Six Sigma Black Belt?

Lead Projects

Own and drive complex improvement projects from Define through Control

Mentor Teams

Coach Green Belts and team members in Six Sigma tools and thinking

Apply Statistical Tools

Use advanced analytics — DOE, regression, hypothesis testing — to solve problems

Drive Results

Deliver measurable business impact in quality, cost, and cycle time

☆ YOU'VE GOT THIS

Ready to Ace Your Six Sigma Black Belt Exam?

🔁 Review Regularly

Cycle through these flashcards daily to reinforce retention

🛠️ Apply Concepts

Practice applying tools to real scenarios — not just memorization

🧠 Understand the Why

Focus on when and why to use each tool, not just definitions

> **Success comes from understanding and repetition.** Trust the process — you've already put in the work. Good luck! 🎯
>
> Provided By **Management and Strategy Institute**