Lean Six Sigma & DMAIC Formula Cheat Sheet

IASSC & ASQ Yellow, Green & Black Belt Quick Reference · sixsigmatrainingfree.com

1. The DMAIC Roadmap & Key Deliverables

Phase	Core Question	Signature Tools & Deliverables
Define	What is the problem & scope?	Project Charter, Business Case, VOC → CTQ Tree, SIPOC, COPQ, Stakeholder Map
Measure	How does the process perform today?	Process Map, VSM, X-Y Matrix, FMEA, Data Collection Plan, MSA (Gage R&R), Cp/Cpk, Baseline Sigma
Analyze	What are the verified root causes?	Pareto, Fishbone, 5 Whys, Multi-Vari, Hypothesis Tests (t, ANOVA, Chi-Square), Regression
Improve	Which solution fixes root causes?	DOE (Full & Fractional Factorial), Kaizen, Poka-Yoke, Pilot Run, Pull/Kanban, Simulation
Control	How do we hold the gains?	Control Plan, OCAP Response Plan, SPC Charts (I-MR, Xbar-R, p/u), 5S Audits, Financial Sign-off

2. Core Six Sigma Defect & Yield Formulas

Metric	Formula
DPU	`Defects ÷ Units`
DPO	`Defects ÷ (Units × Opportunities)`
DPMO	`DPO × 1,000,000` (6σ = 3.4 DPMO)
FTY / FPY	`Good Units (1st pass) ÷ Total Entered`
RTY	$FTY_1 \times FTY_2 \times \ldots \times FTY_k$
Yield (Poisson)	$Y = e^{-DPU}$
Sigma Level	1σ=691k | 2σ=308k | 3σ=66.8k | 4σ=6.2k | 5σ=233 | 6σ=3.4 DPMO

3. Lean Flow & Little's Law Formulas

Metric	Formula & Meaning
Takt Time	`Net Available Time ÷ Customer Demand`
Little's Law	`Lead Time = WIP ÷ Exit Rate (Throughput)`
PCE	`Value-Added Time ÷ Total Lead Time`
OEE	`Availability × Performance × Quality`
Staffing	`Operators Needed = Total Work Content ÷ Takt Time`
Touch vs Cycle	Touch = hands-on time; Cycle = interval between outputs

4. Process Capability (Cp, Cpk, Pp, Ppk)

Index	Formula	Notes
Cp	$(USL - LSL) \div (6\sigma_{within})$	Potential spread only
Cpk	$\min[(USL-\mu)/(3\sigma_w), (\mu-LSL)/(3\sigma_w)]$	Actual centered capability
Pp / Ppk	Same using $\sigma_{overall}$	Long-term performance
Benchmarks	Cpk < 1.0 incapable · 1.33 = 4σ standard · 1.67 = 5σ · 2.0 = 6σ	

- **MSA Rule:** %GRR < 10% excellent; 10–30% marginal; > 30% unacceptable; `ndc ≥ 5`.
- **Attribute MSA:** Cohen's / Fleiss' Kappa ≥ 0.75 good; ≥ 0.90 excellent.

5. Project Finance & Prioritization

Formula	Rule
Payback	`Initial Cost ÷ Annual Net Savings`
ROI	`[(Net Benefits − Cost) ÷ Cost] × 100%`
NPV	$\Sigma\ [CF_t \div (1+r)^t] - Initial\ Cost$ (Accept > 0)
FMEA RPN	`Severity (1–10) × Occurrence × Detection`
X-Y Matrix	Rate inputs on `0–1–3–9` vs weighted CTQs
COPQ	Prevention + Appraisal + Internal/External Failure

Practice these formulas free: Interactive 20-Question Green Belt Quiz **Full Printable Exam Pack: gum.co/EKKed →**

6. Hypothesis Testing Quick Selector ("If p is low, the null must go")

Goal / Data Type	Normal (Parametric)	Non-Normal (Non-Parametric)
1 Sample vs. Target	1-Sample Z (σ known) or 1-Sample t (σ unknown)	1-Sample Sign or Wilcoxon Signed-Rank
2 Independent Groups	2-Sample t-Test (Welch or Pooled)	Mann-Whitney U Test
2 Paired / Before-After	Paired t-Test	Wilcoxon Signed-Rank (on differences)
3+ Independent Groups	One-Way ANOVA (+ Tukey post-hoc)	Kruskal-Wallis or Mood's Median Test
3+ Blocked / Repeated	Randomized Block ANOVA	Friedman Test
Comparing Variances	1-Var: Chi-Square · 2-Var: F-Test · 3+: Bartlett's	Levene's Test (robust to non-normality)
Discrete / Attribute Data	1-Proportion Z · 2-Proportion Z · Chi-Square Test of Independence (Contingency Table)	

- **Errors & Power:** Type I (α = false positive, rejecting true H_0); Type II (β = false negative, missing real effect); Power = `1 − β` (target ≥ 80%).
- **Regression:** Correlation `r ∈ [−1, +1]`; `R²` = % of variation in Y explained by X; check residuals for normality, constant variance & independence.

7. Statistical Process Control (SPC) Chart Selector

Data Type	Subgroup Size (n)	Chart to Use	What It Monitors
Continuous (Variable)	n = 1 (individuals)	**I-MR Chart**	Individual values & moving range
Continuous (Variable)	n = 2 to 8	**Xbar-R Chart**	Subgroup mean & range
Continuous (Variable)	n ≥ 9	**Xbar-S Chart**	Subgroup mean & standard deviation
Continuous (Small Shifts)	0.5σ–1.5σ drift	**CUSUM / EWMA**	Cumulative or weighted history
Attribute: Defectives (Pass/Fail)	Varying n	**p-Chart**	Proportion defective
Attribute: Defectives (Pass/Fail)	Constant n	**np-Chart**	Count of defective units
Attribute: Defects (Count/Unit)	Constant area/n	**c-Chart**	Total defects per constant unit
Attribute: Defects (Count/Unit)	Varying area/n	**u-Chart**	Average defects per unit

8. Design of Experiments (DOE) Essentials

- **Full Factorial (2^k):** 2 levels (−1, +1) × k factors = 2^k runs; zero confounding of main effects or interactions.
- **Fractional Factorial (2^{k-p}):** Cuts runs via sparsity-of-effects:
  - **Resolution III:** Main effects aliased with 2-way interactions.
  - **Resolution IV:** Main effects clear of 2-way interactions.
  - **Resolution V:** Main & 2-way interactions all clear.
- **Center Points:** Test for quadratic curvature & pure error cheaply.
- **3 Pillars:** Randomization, Replication, and Blocking.

9. Lean Wastes (TIMWOODS) & 5S

- **T**ransportation · **I**nventory · **M**otion · **W**aiting · **O**verproduction · **O**verprocessing · **D**efects · **S**kills (unused talent).
- **3Ms of Lean:** *Muda* (waste), *Mura* (unevenness), *Muri* (overburden).
- **5S:** Sort (*Seiri*), Set in Order (*Seiton*), Shine (*Seiso*), Standardize (*Seiketsu*), Sustain (*Shitsuke*).
- **Controls:** *Kanban* (pull signal), *Poka-Yoke* (mistake-proofing), *Heijunka* (level scheduling), *SMED* (quick changeover).

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