PM Formula Cheat Sheet

Helping Project Managers Grow and Master Their Craft

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A quick-reference guide to the essential formulas used in project and program management. Each formula includes a plain-language description, variable definitions, and interpretation guidance.

CATEGORIES

Earned Value Management | PERT & Estimation | Scheduling & CPM | Risk Management | Communication | Cost & Investment | Quality

How to Use This Guide

Getting the most from your formula reference

This guide is organized into eight categories of PM formulas. Each entry includes:

Formula — The mathematical expression, written for quick recognition.

Variables — Plain-language definitions for every symbol — no assumed knowledge.

Description — What the formula measures and why it matters on a real project.

Interpretation — Color-coded guidance: green = on track, amber = caution, red = act now.

★ **Use the digital version for live calculators.** The HTML app at pm-mastery.com includes built-in calculators for 15 formulas — enter your values and get instant results without manual arithmetic.

Quick Reference — All Formulas at a Glance

FORMULA	NAME	CATEGORY
`EV = % × BAC`	Earned Value	EVM
`SV = EV − PV`	Schedule Variance	EVM
`CV = EV − AC`	Cost Variance	EVM
`SPI = EV ÷ PV`	Schedule Performance Index	EVM
`CPI = EV ÷ AC`	Cost Performance Index	EVM
`EAC = BAC ÷ CPI`	Estimate at Completion	EVM
`ETC = EAC − AC`	Estimate to Complete	EVM
`VAC = BAC − EAC`	Variance at Completion	EVM
`TCPI = (BAC−EV)÷(BAC−AC)`	To-Complete Performance Index	EVM
`E = (O + 4M + P) ÷ 6`	PERT Estimate	PERT
`σ = (P − O) ÷ 6`	PERT Std Deviation	PERT
`σ² = ((P−O)÷6)²`	PERT Variance	PERT
`Range = E ± (n × σ)`	Confidence Range	PERT
`TF = LS − ES`	Total Float	Scheduling
`FF = ES(next) − EF(curr)`	Free Float	Scheduling
`EF = ES + Duration − 1`	Early Finish	Scheduling

`LS = LF − Duration + 1`	Late Start	Scheduling
`EMV = Prob × Impact`	Expected Monetary Value	Risk
`CR = Σ EMV`	Contingency Reserve	Risk
`Channels = n(n−1)÷2`	Communication Channels	Communication
`PTA = ((Ceil−TP)÷SR)+TC`	Point of Total Assumption	Cost
`ROI = (Benefit−Cost)÷Cost`	Return on Investment	Cost
`NPV = Σ[CF÷(1+r)^t] − I`	Net Present Value	Cost
`BCR = Benefits ÷ Costs`	Benefit-Cost Ratio	Cost
`Payback = Investment÷CF`	Payback Period	Cost
`DPMO = (D÷(U×O))×1,000,000`	Defects Per Million Opp.	Quality
`% = (Done÷Total)×100`	Percent Complete	General

Earned Value Management (EVM)

Track cost and schedule performance against the plan

EVM provides quantitative, data-driven measures of project performance. The foundation is three values: **PV** (what you planned to spend by now), **EV** (the budget value of work actually done), and **AC** (what you actually spent). All other EVM metrics derive from these three.

Earned Value

The budgeted value of work actually completed to date. The foundation of all EVM metrics — everything else is derived from it.

FORMULA

$$EV = \%\ Complete \times BAC$$

VAR	MEANING
`% Complete`	Percent of scope completed (0.0 to 1.0)
`BAC`	Budget at Completion — the original total project budget

Schedule Variance

Measures schedule performance in dollar terms. A negative value means less work has been completed than planned for this point in time.

FORMULA

$$SV = EV - PV$$

VAR	MEANING
SV	Schedule Variance
EV	Earned Value
PV	Planned Value — the budget planned for work completed by this date

- SV > 0: Ahead of schedule
- SV = 0: On schedule
- SV < 0: Behind schedule

Cost Variance

Measures cost performance. Negative means over budget. This is the most direct indicator of whether the project is spending efficiently.

FORMULA

$$CV = EV - AC$$

VAR	MEANING
CV	Cost Variance
EV	Earned Value
AC	Actual Cost — money actually spent to date

- CV > 0: Under budget
- CV = 0: On budget
- CV < 0: Over budget

Schedule Performance Index

Efficiency ratio for schedule. Tells you how much schedule value you're getting per dollar of planned work. A project at SPI 0.8 is only completing 80% of the planned work rate.

FORMULA

$$SPI = EV \div PV$$

VAR	MEANING
SPI	Schedule Performance Index
EV	Earned Value
PV	Planned Value

- SPI > 1.0: Ahead of schedule
- SPI = 1.0: On schedule
- SPI < 1.0: Behind schedule

Cost Performance Index

Efficiency ratio for cost. The most reliable predictor of final project cost. A CPI established early in a project rarely improves significantly — act early.

FORMULA

$$CPI = EV \div AC$$

VAR	MEANING
CPI	Cost Performance Index
EV	Earned Value
AC	Actual Cost

- CPI > 1.0: Under budget (efficient)
- CPI = 1.0: On budget
- CPI < 1.0: Over budget (inefficient)

Estimate at Completion

Forecasted total project cost based on current performance. Use the CPI version when current efficiency is expected to continue for the remainder of the project.

FORMULA

$$EAC = BAC \div CPI$$

$$\text{alt: } EAC = AC + ETC$$

VAR	MEANING
EAC	Estimate at Completion — forecasted final cost
BAC	Budget at Completion
CPI	Cost Performance Index
AC	Actual Cost to date
ETC	Estimate to Complete

Estimate to Complete

How much more money is needed to finish the project from today. Use this to forecast remaining budget requirements and communicate needs to stakeholders.

FORMULA

$$ETC = EAC - AC$$

VAR	MEANING
ETC	Estimate to Complete
EAC	Estimate at Completion
AC	Actual Cost to date

Variance at Completion

Projected budget surplus or deficit at project completion. Negative VAC is an early warning that the project will overrun its approved budget.

FORMULA

$$VAC = BAC - EAC$$

VAR	MEANING
VAC	Variance at Completion
BAC	Budget at Completion
EAC	Estimate at Completion

- VAC > 0: Expected to finish under budget
- VAC < 0: Expected to finish over budget

To-Complete Performance Index

The CPI you must achieve on ALL remaining work to finish within the original budget. A TCPI above 1.1 is generally considered unrealistic — it means every future dollar must be more efficient than you've ever been.

FORMULA

$$TCPI = (BAC - EV) \div (BAC - AC)$$

VAR	MEANING
TCPI	To-Complete Performance Index
BAC	Budget at Completion
EV	Earned Value
AC	Actual Cost

- TCPI ≤ 1.0: Achievable — budget room remains
- TCPI 1.0–1.1: Tight but possible
- TCPI > 1.1: Likely unrealistic — escalate now

PERT & Estimation

Three-point estimating for uncertainty-aware scheduling

PERT (Program Evaluation and Review Technique) uses three estimates to account for uncertainty in activity durations. Rather than a single-point guess, you capture optimistic, most likely, and pessimistic scenarios — producing a weighted average and a measure of spread.

PERT Estimate

PE

Weighted average estimate giving the most likely scenario four times the weight of the optimistic and pessimistic extremes. More realistic than a single-point estimate for uncertain work.

FORMULA

$$E = (O + 4M + P) \div 6$$

VAR	MEANING
E	PERT Estimate — the weighted average duration
O	Optimistic estimate (best-case scenario)
M	Most Likely estimate
P	Pessimistic estimate (worst-case scenario)

PERT Standard Deviation

PER

Measures the uncertainty in a PERT estimate. A large standard deviation means the spread between best and worst case is wide — the estimate carries more risk.

FORMULA

$$\sigma = (P - O) \div 6$$

VAR	MEANING
σ	Standard Deviation
P	Pessimistic estimate
O	Optimistic estimate

PERT Variance

PERT

The square of the standard deviation. Add variances across tasks on a critical path to determine total path uncertainty. Take the square root of the sum to find the path standard deviation.

FORMULA

$$\sigma^2 = ((P - O) \div 6)^2$$

VAR	MEANING
σ^2	Variance
P	Pessimistic estimate
O	Optimistic estimate

Confidence Range

±

Probability range around a PERT estimate. Use this to communicate scheduling uncertainty to stakeholders in terms they understand — percentages rather than standard deviations.

FORMULA

$$Range = E \pm (n \times \sigma)$$

VAR	MEANING
E	PERT Estimate
n	Number of standard deviations (1, 2, or 3)
σ	Standard Deviation

- E ± 1σ = 68.27% confidence interval
- E ± 2σ = 95.45% confidence interval
- E ± 3σ = 99.73% confidence interval

Scheduling & CPM

Critical Path Method calculations

CPM (Critical Path Method) identifies the longest sequence of dependent activities — the path that determines the minimum project duration. Any delay on the critical path delays the project. Float tells you how much flexibility non-critical

activities have.

Total Float (Slack)

The amount an activity can be delayed without delaying the project end date. Activities on the critical path always have TF = 0. Use total float strategically — consuming it on one task removes it from all tasks sharing that path.

FORMULA

$$TF = LS - ES$$

alt: $TF = LF - EF$

VAR	MEANING
TF	Total Float
LS	Late Start — latest this activity can start without delay
ES	Early Start — earliest this activity can start
LF	Late Finish
EF	Early Finish

- TF = 0: Critical path — zero tolerance for delay
- TF > 0: Float available — use carefully and track consumption

Free Float

The amount an activity can be delayed without affecting the Early Start of any immediate successor. Free float belongs to a single activity — unlike total float which may be shared.

FORMULA

$$FF = ES(next) - EF(current)$$

VAR	MEANING
FF	Free Float
ES(next)	Early Start of the next (successor) activity
EF(current)	Early Finish of the current activity

Early Finish

The earliest an activity can finish, given its early start. Calculated during the forward pass through the network. The '–1' accounts for the activity starting on day 1, not day 0.

FORMULA

$$EF = ES + Duration - 1$$

VAR	MEANING
EF	Early Finish
ES	Early Start
Duration	Activity duration in working days

Late Start

The latest an activity can start without delaying the project. Calculated during the backward pass. Compare with Early Start to determine float.

FORMULA

$$LS = LF - Duration + 1$$

VAR	MEANING
LS	Late Start
LF	Late Finish — latest this activity can finish
Duration	Activity duration in working days

Risk Management

Quantifying and prioritizing project risk

Quantitative risk analysis assigns dollar values to risks, enabling objective prioritization and budget planning. EMV is the foundation — use it consistently across all identified risks to build a defensible contingency reserve.

Expected Monetary Value

E

The dollar value of a risk event, weighted by its likelihood. Positive EMV = opportunity. Negative EMV = threat. Sum all EMVs across the risk register to determine total project risk exposure.

FORMULA

$$EMV = Probability \times Impact\ (\$)$$

VAR	MEANING
EMV	Expected Monetary Value
Probability	Likelihood of occurrence (0.0 to 1.0)
Impact ($)	Financial impact if the risk occurs

Contingency Reserve

The minimum contingency budget recommended by quantitative analysis — the sum of all risk EMVs. Managed by the PM for known risks. Separate from management reserve, which is held by the sponsor for unknown unknowns.

FORMULA

$$CR = \Sigma\ EMV\ (all\ risks)$$

VAR	MEANING
CR	Contingency Reserve
Σ EMV	Sum of Expected Monetary Values across all identified risks

- Contingency reserve: PM-controlled, known risks
- Management reserve: Sponsor-controlled, unknown risks

Communication

Stakeholder and channel planning

Communication Channels

n(n-1

Total potential communication paths in a project team or stakeholder group. Grows rapidly with team size — adding one person to a 10-person team adds 10 new channels. This is the quantitative argument for formal communication planning.

FORMULA

$$Channels = n(n - 1) \div 2$$

VAR	MEANING
Channels	Number of potential communication paths
n	Number of stakeholders or team members

- 5 people = 10 channels
- 10 people = 45 channels
- 20 people = 190 channels — plan deliberately

Cost & Investment

Financial analysis and project selection

These formulas support project selection, business case development, and contract management. Use NPV and BCR for comparing competing projects. Use ROI and payback for executive summaries where simplicity matters.

Return on Investment

Measures profitability as a percentage. Simple and widely understood — useful for executive communication. Does not account for the time value of money; use NPV for longer-horizon comparisons.

FORMULA

$$ROI = (Benefit - Cost) \div Cost \times 100\%$$

VAR	MEANING
ROI	Return on Investment (%)
Benefit	Total financial benefit of the project
Cost	Total project cost

- ROI > 0%: Positive return — generates value
- ROI < 0%: Negative return — destroys value

Net Present Value

Compares the value of money now to the value of future cash flows, discounted by the required rate of return. The gold standard for project selection — accounts for timing of returns.

FORMULA

$$NPV = \Sigma [CF_t \div (1 + r)^t] - Initial\ Investment$$

VAR	MEANING
NPV	Net Present Value
CF_t	Cash flow in period t
r	Discount rate (hurdle rate / required rate of return)
t	Time period (year)
Initial Investment	Upfront cost

- NPV > 0: Project adds value — proceed
- NPV < 0: Project destroys value — reconsider
- When choosing between projects, higher NPV wins

Benefit-Cost Ratio

B

Simple ratio for project selection. BCR > 1 means benefits outweigh costs. Useful for comparing multiple projects when resources are constrained.

FORMULA

$$BCR = Benefits \div Costs$$

VAR	MEANING
BCR	Benefit-Cost Ratio
Benefits	Total quantified project benefits
Costs	Total project costs

- BCR > 1: Benefits exceed costs — favorable
- BCR < 1: Costs exceed benefits — unfavorable
- Higher BCR = better choice when selecting between projects

Payback Period

Payba

How many years to recover the initial investment from annual returns. Simpler than NPV — useful for quick comparisons and stakeholders who prefer concrete timelines over abstract ratios.

FORMULA

$$Payback = Initial\ Investment \div Annual\ Cash\ Flow$$

VAR	MEANING
Payback	Payback Period (years)
Initial Investment	Upfront project cost
Annual Cash Flow	Expected annual return or savings

Point of Total Assumption

In Fixed-Price Incentive Fee (FPIF) contracts: the cost above which the seller assumes all financial risk. Beyond the PTA, cost overruns come entirely out of the seller's pocket — there is no incentive for further efficiency.

FORMULA

$$PTA = ((Ceiling - Target\ Price) \div Share\ Ratio) + Target\ Cost$$

VAR	MEANING
PTA	Point of Total Assumption
Ceiling	Maximum contract price the buyer will pay
Target Price	The agreed target price
Share Ratio	Buyer's share of cost overruns (e.g., 0.80 for 80/20 split)
Target Cost	The agreed target cost

- Seller bears all risk above PTA — negotiate ceiling price carefully

Quality

Six Sigma measurement

Defects Per Million Opportunities

DP

Six Sigma quality metric expressing defect rate in standardized terms. Allows comparison across different processes and scales. 3.4 DPMO represents Six Sigma quality — near-perfection.

FORMULA

$$DPMO = (Defects \div (Units \times Opportunities)) \times 1{,}000{,}000$$

VAR	MEANING
DPMO	Defects Per Million Opportunities
Defects	Total number of defects found
Units	Number of units inspected
Opportunities	Number of possible defect opportunities per unit

- 3.4 DPMO = Six Sigma (99.9997% defect-free)
- 308,537 DPMO = Two Sigma (69.1% quality)
- 66,807 DPMO = Three Sigma (93.3% quality)
- 6,210 DPMO = Four Sigma (99.4% quality)

General

Fundamental project tracking

Percent Complete

% Compl

Basic completeness metric. Simple in theory, problematic in practice. Establish clear, objective criteria for what counts as 'done' before the project starts — verbal estimates of percent complete are notoriously optimistic.

FORMULA

$$\% \text{ Complete} = (\text{Completed Work} \div \text{Total Work}) \times 100$$

VAR	MEANING
% Complete	Percent of work completed
Completed Work	Work units finished (hours, tasks, deliverables, sq ft, etc.)
Total Work	Total planned work units

- Beware the '80% done forever' syndrome — define done objectively
- Best measured against physical deliverables, not effort estimates

Field Tips & Common Mistakes

Hard-earned lessons from real projects

1 CPI established early rarely recovers.

Studies show that once CPI drops below 0.85 by the 20% completion mark, it virtually never recovers above 1.0. Don't wait — investigate and escalate immediately when CPI drops.

2 'Percent complete' is the most dangerous metric.

Unless tied to objective, measurable milestones, percent complete estimates are almost always optimistic. The last 20% consistently takes as long as the first 80%. Use earned value instead.

3 Float is shared — consuming it affects your team.

When two activities share a path, total float belongs to the path, not the individual task. Consuming float on one activity removes it from all subsequent activities on that path.

4 TCPI above 1.1 is a red flag, not a target.

If your TCPI exceeds 1.1, the honest conversation is about re-baselining or descoping — not about working harder. Flag it early and give decision-makers time to act.

5 EMV only works with honest probability estimates.

Risk registers fail when probabilities are assigned by gut feel. Use historical data, expert judgment, and structured workshops. A 10% probability estimate that's actually 40% will cripple your contingency.

6 Communication channels explain most project failures.

A 10-person project has 45 communication channels. A 20-person project has 190. At that scale, informal communication breaks down entirely — invest in formal protocols, not just tools.

7 NPV beats ROI for project selection.

ROI ignores when cash flows occur. A project returning $1M in year 1 and a project returning $1M in year 5 have the same ROI but very different NPVs. Use NPV for decisions that span multiple years.

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