

RISK CALCULATIONS:

Probability, Impact,
and Expected
Monetary Value



Understand uncertainty. Calculate the impact.

Start with probability & impact

Two inputs. One probability-weighted financial result.

1 Know what each input means

Probability (p)

The chance that the event occurs.

$25\% = 0.25$; $0 \leq p \leq 1$.

Monetary impact (I)

The financial change if it occurs.

Threats: negative. Opportunities: positive.

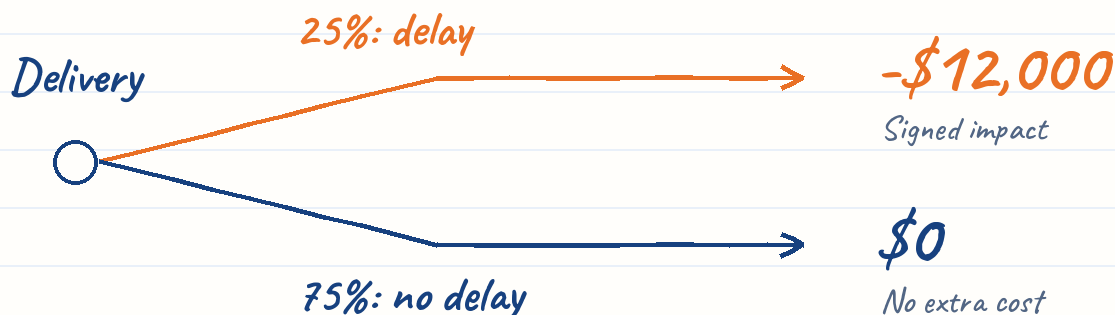
Expected Monetary Value

$$EMV = p \times I$$

For one event, with zero extra impact if it does not occur.

2 Worked example: a supplier delay

A delivery has a 25% chance of delay. A delay adds \$12,000 to project cost; otherwise, the extra cost is \$0.



$$EMV = 0.25 \times (-\$12,000) + 0.75 \times \$0$$

$$EMV = -\$3,000$$

3 Interpret the answer correctly

Actual extra cost in this model: \$12,000 or \$0.

The \$3,000 expected loss is a probability-weighted average, not a guaranteed loss or an automatically sufficient reserve.

Use a real probability and money, not 1-5 risk ratings. Check the size of the possible loss as well as its average.

Define the risk before the number

A useful calculation starts with a clear event, baseline and time horizon.

1 Write a measurable risk statement

Separate the cause, uncertain event and consequence. Specify the period in which the event may happen and the project objective affected.

Record the probability source and estimate only the change from the baseline. Existing committed costs are not automatically additional risk impacts.

Risk statement = Cause $\rightarrow$ Event $\rightarrow$ Consequence

The arrow is a description of the causal chain, not a mathematical equality.

2 Worked example: delivery before installation

Element	Definition
Cause	One supplier has limited production capacity
Event	Delivery misses the agreed installation date
Consequence	Idle crew and expediting add \$12,000
Horizon	The next delivery, due in six weeks
Probability	25%, based on relevant delivery evidence

Signed impact $I = -\$12,000$; $p = 0.25$

$EMV = 0.25 \times (-\$12,000) = -\$3,000$

A different deadline or baseline may require a different estimate.

3 Check the evidence

Use comparable historical data, current supplier information and documented expert judgment. A past frequency is evidence, not a promise about the next event.

Record an owner and review date. Reassess probability after new information or a response changes the situation.

Probability: percentages and complements

Use a number between zero and one in the calculation.

1 Convert before multiplying

$$\text{Probability as a fraction} = \text{Percentage} \div 100$$

$$P(\text{no event}) = 1 - P(\text{event})$$

The event and its complement cannot occur together, and one of them must occur. A “high” rating or a score of 4/5 is not automatically an 80% probability.

Choose a probability scale only when its meaning and evidence are defined.

2 Worked examples

Statement	Probability	Complement
25% chance of delay	0.25	0.75 = 75%
8% chance of rework	0.08	0.92 = 92%
1 chance in 5	0.20	0.80 = 80%

$$\text{For an \$8,000 loss at 8\%: } EMV = 0.08 \times (-\$8,000)$$

$$EMV = -\$640$$

Multiply by 0.08, not by 8.

3 Three quick checks

Every probability must be between 0 and 1. Complete, mutually exclusive outcomes must sum to 1. Estimates must refer to the same event and period.

Do not confuse odds with probability. Odds of 1 to 4 in favor of an event mean $p = 1 \div (1 + 4) = 20\%$, not 25%.

Measure the monetary impact

Keep signs, units and the cost baseline consistent.

1 Use incremental consequences

For this handbook, threats have negative monetary impacts and opportunities have positive impacts. We also show expected loss as a positive cost when comparing response costs.

Signed EMV of a threat = $-p \times \text{Loss amount}$

Expected loss, as a cost = $p \times \text{Loss amount}$

These are two views of the same exposure. Do not mix their signs in one total.

2 Worked example: one delay, two extra costs

Consequence if delay occurs	Incremental cost
Idle installation crew	3 days $\times$ \$2,000 = \$6,000
Extra expediting	One payment of \$4,000
Total additional loss	$L = \$10,000$

At $p = 30\%$: $EMV = -0.30 \times \$10,000 = -\$3,000$

Expected loss = $+\$3,000$

The event impact is \$10,000; the expected loss is \$3,000.

3 Avoid double counting

Do not include the same idle crew charge again under another risk. Exclude costs already included in the baseline unless the event creates an additional charge.

Use one currency and price basis. For cash flows across different dates, convert them to a consistent valuation date before comparing alternatives.

EMV with several outcomes

Weight every mutually exclusive outcome, including no loss.

1 Use the full distribution

$$EMV = p1 \times I1 + p2 \times I2 + \dots + pn \times In$$

$$p1 + p2 + \dots + pn = 1$$

Each outcome must be distinct, and the list must cover all possibilities in the model. The simple $p \times I$ shortcut applies when the other outcome has zero extra impact.

2 Worked example: possible delivery outcomes

Outcome	Probability	Signed impact	Contribution
On time	55%	\$0	\$0
Minor delay	30%	-\$4,000	-\$1,200
Major delay	15%	-\$20,000	-\$3,000

$$EMV = \$0 - \$1,200 - \$3,000 = -\$4,200$$

$$\text{Probability check: } 0.55 + 0.30 + 0.15 = 1$$

A \$4,200 expected loss is not one of the modeled outcomes.

3 Interpret the average

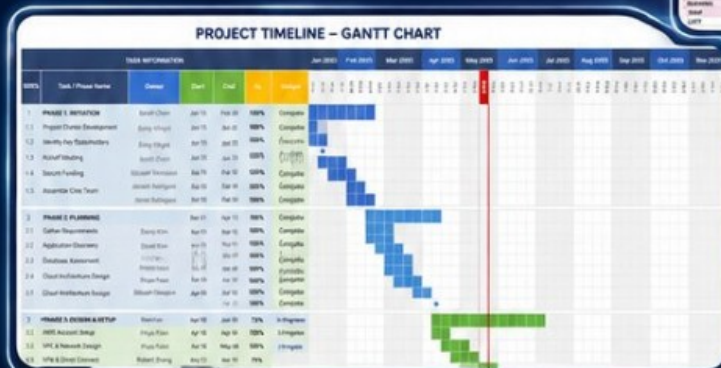
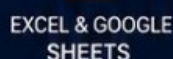
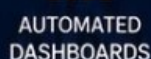
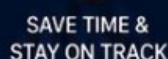
The most likely outcome is no extra cost, at 55%. The expected loss is still \$4,200 because less likely losses affect the weighted average.

If “minor delay” already includes “major delay,” the scenarios overlap. Redefine them before adding probabilities or EMV contributions.

940+ Premium Templates • One Payment • Lifetime Access

SAVE 94%

Worth \$3,300+



GET LIFETIME ACCESS

Add risks without hiding exposure

Show threats and opportunities separately before calculating a net value.

1 Add distinct monetary effects

$$\text{Portfolio EMV} = \text{EMV1} + \text{EMV2} + \dots + \text{EMVn}$$

Expected values add even when risks are dependent, provided the total impact is the sum of correctly modeled effects. Independence is not required for this mean.

Dependence still matters for the distribution of the total loss, including its tail and the reserve needed at a chosen confidence level.

2 Worked example: a small risk register

Risk	Probability	Impact	EMV
A: supplier delay	25%	-\$12,000	-\$3,000
B: rework	20%	-\$8,000	-\$1,600
C: saving opportunity	30%	+\$5,000	+\$1,500

$$\text{Expected threat loss} = \$3,000 + \$1,600 = \$4,600$$

$$\text{Expected opportunity benefit} = \$1,500$$

$$\text{Net EMV} = -\$4,600 + \$1,500 = -\$3,100$$

Keep the \$4,600 threat exposure visible beside the net value.

3 Do not assume the saving will pay for a loss

The opportunity may not occur when the threats occur. Net EMV is not a guaranteed cash balance or a sufficient funding reserve.

If two risks charge for the same consequence, build consistent joint scenarios or allocate that consequence once before summing.

Independent risks: both, either or neither

Only multiply marginal probabilities when independence is justified.

1 Useful formulas for independent events

$$P(A \text{ and } B) = P(A) \times P(B)$$

$$P(\text{neither}) = [1 - P(A)] \times [1 - P(B)]$$

$$P(\text{at least one}) = 1 - P(\text{neither})$$

Independence means that knowing one event occurred does not change the probability of the other. Different risk names do not establish independence.

2 Worked example: A = 20%, B = 30%

Outcome	Calculation	Probability
Both occur	0.20×0.30	6%
A only	0.20×0.70	14%
B only	0.80×0.30	24%
Neither occurs	0.80×0.70	56%

$$\text{At least one} = 1 - 0.56 = 44\%$$

$$\text{Exactly one} = 14\% + 24\% = 38\%$$

20% + 30% = 50% counts the "both" outcome twice.

3 Check for shared causes

The same supplier, weather event or technical failure may connect two risks. Use conditional probabilities or a joint model when independence is not credible.

For any two events: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$. Here "or" means at least one, including both.

Conditional probability and event paths

A shared cause can change the probability of the next event.

1 Multiply along a path; add separate paths

$$P(A \text{ and } B) = P(A) \times P(B \mid A)$$

$P(B \mid A)$ means the probability of B given that A has occurred. It is not necessarily the same as the overall probability of B .

$$P(B) = P(A) \times P(B \mid A) + P(\text{not } A) \times P(B \mid \text{not } A)$$

The two paths to B are mutually exclusive and cover all ways B occurs.

2 Worked example: outage A and rework B

Assume $P(A) = 20\%$, $P(B \mid A) = 60\%$, and $P(B \mid \text{not } A) = 10\%$.

Complete path	Calculation	Probability
A , then B	0.20×0.60	12%
A , then no B	0.20×0.40	8%
No A , then B	0.80×0.10	8%
Neither	0.80×0.90	72%

$$P(B) = 12\% + 8\% = 20\%$$

$P(A \text{ and } B)$ is 12%, not $20\% \times 20\% = 4\%$.

3 Turn paths into money

Attach the full incremental monetary consequence to each complete path, then multiply by that path's probability and add the contributions.

Do not charge an outage cost twice if it is already included in a combined outage-and-rework impact. All four path probabilities sum to 100%.

When the impact is uncertain too

Separate the chance of occurrence from the severity if it occurs.

1 Calculate conditional severity first

Mean loss if event occurs = Sum of ($q_j \times L_j$)

Expected loss = $P(\text{event}) \times \text{Mean loss if it occurs}$

Here q_j is a severity probability conditional on the event occurring. The severity probabilities sum to 1 within the event; they are not the overall event probabilities.

2 Worked example: rework with several severities

Rework occurs with probability 30%. If it occurs, use this severity model:

Loss if rework occurs	Conditional chance	Contribution
\$4,000	50%	\$2,000
\$10,000	30%	\$3,000
\$20,000	20%	\$4,000

Mean severity = $\$2,000 + \$3,000 + \$4,000 = \$9,000$

Expected loss = $0.30 \times \$9,000 = \$2,700$

Signed EMV = $-\$2,700$.

3 Check the complete distribution

The overall probabilities are: no rework 70%; \$4,000 loss 15%; \$10,000 loss 9%; \$20,000 loss 6%. They sum to 100%.

Check: $0.15 \times \$4,000 + 0.09 \times \$10,000 + 0.06 \times \$20,000 = \$2,700$. Do not multiply by 30% again after using these overall probabilities.

Decision trees: compare complete choices

Include certain costs as well as uncertain consequences.

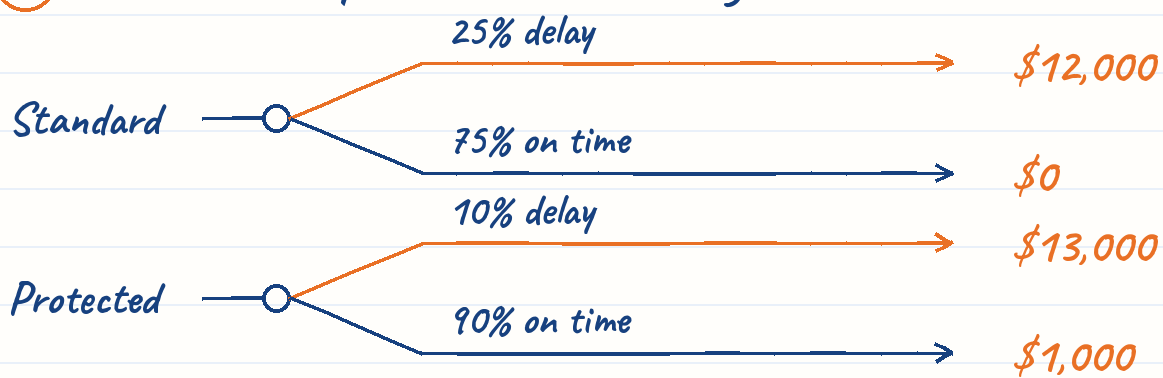
1 Work backward from each outcome

At a chance node, multiply each outcome's value by its conditional probability and add. At a decision node, compare the available choices using the same baseline and horizon.

Expected total cost = Certain cost + Expected extra loss

For cost-only alternatives, a risk-neutral monetary comparison favors the lower expected total cost. For signed net values, it favors the higher expected value.

2 Worked example: choose a delivery method



$$\text{Standard} = \$0 + 0.25 \times \$12,000 = \$3,000$$

$$\text{Protected} = \$1,000 + 0.10 \times \$12,000 = \$2,200$$

$$\text{Expected saving from Protected} = \$800$$

Charge the \$1,000 certain cost once, not only when delay occurs.

3 EMV is one decision input

The lower-mean option can still have an unacceptable worst-case loss, deadline consequence or operational constraint. Check affordability and risk tolerance.

Where consequences cannot credibly be expressed in money, record them alongside the calculation. Do not invent a dollar value merely to force an EMV ranking.

Mitigation: cost, residual risk and benefit

A response is valuable only after its cost and remaining exposure are counted.

1 Compare before and after the response

Before: $E0 = p0 \times L0$

After: $E1 = \text{Response cost } C + p1 \times L1$

Net expected benefit = $E0 - E1$

The response may reduce probability, impact or both. Residual risk is the risk that remains after the response. Include any new risks created by the response.

2 Worked example: reduce the chance of delay

Input	Before	After
Probability	25%	10%
Loss if delayed	\$12,000	\$12,000
Certain response cost	\$0	\$800
Expected residual loss	\$3,000	\$1,200

After-response expected cost = $\$800 + \$1,200 = \$2,000$

Net expected benefit = $\$3,000 - \$2,000 = \$1,000$

The response reduces exposure; it does not eliminate the \$12,000 loss.

3 Use realistic effectiveness estimates

The 10% after-response probability needs evidence. Assign an owner and verify that the action happens in time and actually changes the risk.

If response cost is uncertain, model its expected cost and relevant dependencies. An optimistic response assumption can reverse the decision.

Break-even response calculations

Find the maximum worthwhile cost or the minimum required improvement.

① Solve the same comparison for a threshold

Maximum break-even cost: $C_{\max} = p_0 L_0 - p_1 L_1$

With unchanged loss L : Required reduction in $p = C \div L$

A response has a positive expected monetary benefit when its cost is below $C_{\max}$. These thresholds describe an expected-cost comparison, not every reason to act.

② Worked example: how effective must it be?

Original probability = 25%; loss = \$12,000; proposed response cost = \$800.

Required probability reduction = $\$800 \div \$12,000$

= 0.0667, or about 6.67 percentage points

Break-even remaining probability = 25% - 6.67%

= about 18.33%

At 10% remaining probability, $C_{\max} = \$3,000 - \$1,200 = \$1,800$.

③ Check percentage points and strict inequalities

A fall from 25% to 10% is a 15 percentage-point reduction, or a 60% relative reduction. The two descriptions are not interchangeable.

At a response cost of \$1,800 with $p_1 = 10\%$, expected costs tie. Below \$1,800 the response improves the mean; above it, the mean cost increases.

Transfer: price the retained loss

Transferring a financial consequence does not make the event disappear.

1 Model the payment rule explicitly

$$\text{Expected retained cost} = \text{Premium} + \text{Expected retained loss}$$

Illustrative model: a transfer arrangement pays all loss above deductible D , with no cap, exclusions, payment delay or counterparty failure. Retained loss per event = $\min(L, D)$.

Real terms may differ. Model the actual limit, exclusions and payment conditions.

2 Worked example: a fixed loss and deductible

Input	Value
Probability of loss	25%
Loss if the event occurs	\$12,000
Certain premium	\$900
Deductible retained per loss	\$2,000

$$\text{Without transfer: } 0.25 \times \$12,000 = \$3,000$$

$$\text{With transfer: } \$900 + 0.25 \times \$2,000 = \$1,400$$

$$\text{Expected cost reduction} = \$3,000 - \$1,400 = \$1,600$$

The \$900 premium is paid even when no loss occurs.

3 Check the consequences left with the project

Schedule disruption, administration, uncovered losses and delayed reimbursement may remain. A transfer price can exceed the expected reduction in loss and still reduce an unacceptable large exposure.

For variable losses, calculate the retained amount in each scenario before taking its expected value.

Opportunities: calculate the net gain

Include the cost of making a beneficial event more likely.

1 Use positive benefits and subtract action costs

$$\text{Expected net benefit} = p \times \text{Benefit } B - \text{Action cost } C$$

$$\text{Improvement} = (p_1B_1 - C_1) - (p_0B_0 - C_0)$$

An opportunity is uncertain. Its benefit should be incremental to the baseline, measurable and achievable within the same horizon used for the costs.

2 Worked example: encourage a design saving

Input	No extra action	Enhancement
Chance of saving	30%	50%
Saving if achieved	\$5,000	\$5,000
Certain action cost	\$0	\$400

$$\text{Before: } 0.30 \times \$5,000 = \$1,500$$

$$\text{After: } 0.50 \times \$5,000 - \$400 = \$2,100$$

$$\text{Net expected improvement} = \$2,100 - \$1,500 = \$600$$

The \$2,100 net average is not a guaranteed saving.

3 Keep upside and downside visible

If the saving fails to materialize, the action still costs \$400. If it succeeds, the net benefit is \$4,600. The weighted average is $0.50 \times \$4,600 + 0.50 \times (-\$400) = \$2,100$.

Check that the design change does not introduce additional quality or schedule risks. Include their consequences before approving the action.

Schedule exposure is a different calculation

Expected days and expected money use different impact units.

① Start with finish-date impact, not activity delay

Expected finish delay = Sum of $(p_i \times \text{Finish delay}_i)$

In a simple single-path model, available float can absorb part of an activity delay. A general project schedule requires the network, calendars and all affected paths to be recalculated.

Simple isolated case: $\text{Finish delay} = \max(0, \text{Delay} - \text{Float})$

② Worked example: delay partly absorbed by float

A risk has a 25% probability of adding 8 working days to one activity. It has 3 working days of usable float. Assume no other path or resource constraint changes.

Finish delay if the risk occurs = $8 - 3 = 5$ days

Expected finish delay = $0.25 \times 5 = 1.25$ days

If extra overhead is \$1,000 per working day of finish delay and no other cost changes:

Expected overhead loss = $0.25 \times 5 \times \$1,000 = \$1,250$

Do not call 1.25 days a monetary EMV.

③ Do not add every activity delay to the finish date

Parallel paths, shared resources, calendars and float consumption can make finish-date effects nonlinear. A different path may become critical after a risk occurs.

Use schedule risk analysis for interacting delays. Convert time to money only with a clear cost rule; penalties, thresholds and overtime may not be linear.



**Learn from 350+ top universities
and companies**

I ILLINOIS

Duke
UNIVERSITY

Google



IBM

V VANDERBILT
UNIVERSITY

 **JOHNS HOPKINS**
UNIVERSITY

Invest in your career



Explore new skills

Access 10,000+ courses in AI, business,
technology, and more.

Contingency: choose a confidence level

The mean loss and a funding percentile answer different questions.

1 Read the loss distribution

$P80 \text{ loss} = \text{Smallest amount with } P(\text{loss} \leq \text{amount}) \geq 80\%$

An expected loss is the probability-weighted mean. A percentile is a threshold in the distribution. The mean is not automatically P50, and neither is an automatic reserve rule.

In this example, the base estimate excludes every modeled risk loss. A reserve added to that base can therefore be compared directly with the extra-loss distribution.

2 Worked example: one threat with a large loss

Extra loss	Probability	Cumulative probability
\$0	75%	75%
\$12,000	25%	100%

$\text{Expected loss} = 0.25 \times \$12,000 = \$3,000$

$P80 \text{ extra loss} = \$12,000$

A \$3,000 reserve covers only the \$0 outcome: 75% of cases in this discrete model. A \$12,000 reserve covers all modeled outcomes.

Confidence describes the model; omitted risks can still exceed the budget.

3 Avoid counting risk allowance twice

If the base already contains a risk allowance, reconcile it before adding more. A practical budget comparison is: chosen total-cost percentile minus the relevant current base.

Use organizational policy and risk tolerance to set contingency. Keep contingency for modeled uncertainty distinct from any separately governed management reserve.

Dependence changes the tail

Two models can have the same EMV and very different high losses.

1 Keep the mean separate from the spread

Consider two additive risks. Each has a 20% chance of a \$10,000 loss. The expected total loss is \$4,000 under either model below.

Expected total = $0.20 \times \$10,000 + 0.20 \times \$10,000$
= \$4,000

Dependence changes how often the two losses occur together, even though their individual probabilities remain unchanged.

2 Worked example: independent versus joint occurrence

Total loss	Independent risks	Always occur together
\$0	64%	80%
\$10,000	32%	0%
\$20,000	4%	20%

Independent model: P90 extra loss = \$10,000

Together model: P90 extra loss = \$20,000

Same \$4,000 mean. Different reserve at 90% confidence.

3 Model the common driver

A shared supplier, weather condition or technical failure can link risks. Use conditional probabilities, coherent joint scenarios or a documented dependence model.

Do not add individual P90 values and call the sum the project P90. Calculate the percentile from the total-loss distribution. Simply assuming independence can understate joint losses.

Sensitivity: which assumption matters most?

Test ranges and decision thresholds before trusting a single estimate.

1 Vary one input, then test combined scenarios

Expected loss $E = p \times L$

Change from probability alone = Change in $p \times L$

Change from impact alone = $p \times$ Change in L

One-at-a-time sensitivity helps compare inputs. Combined scenarios reveal what happens when several assumptions move together. The ranges need evidence.

2 Worked example: uncertain probability and loss

Base estimate: $p = 25\%$, $L = \$12,000$, so expected loss = \$3,000.

Test	Low expected loss	High expected loss
$p = 15\%$ to 35% ; L fixed	\$1,800	\$4,200
$L = \$8,000$ to $\$16,000$; p fixed	\$2,000	\$4,000
Both at low / high values	\$1,200	\$5,600

For these particular ranges, probability creates the larger one-at-a-time swing: \$2,400 versus \$2,000.

A larger swing identifies an assumption worth investigating.

3 Do not turn scenarios into probabilities

“Low,” “base” and “high” do not by themselves define a probability distribution. The \$1,200–\$5,600 scenario range is not an 80% confidence interval.

If a response is attractive only under a narrow estimate, collect better data or show the break-even threshold explicitly. Recalculate after new evidence arrives.

Monte Carlo: simulate the full distribution

Sample uncertain inputs repeatedly and record the total outcome.

1 A reproducible two-risk model

Risk A: 20% chance of \$10,000 loss. Risk B: 40% chance of \$6,000 loss. Assume independence and additive costs. Each run uses two separate uniform random draws.

In each run: include A if its draw is below 0.20; include B if its draw is below 0.40; add the losses. Repeat 100,000 times, then calculate the mean and percentiles.

Exact expected loss = $0.20 \times \$10,000 + 0.40 \times \$6,000 = \$4,400$

2 Executed example: Python Random, seed 20261029

Total loss	Exact probability	Observed runs
\$0	48%	48,305
\$6,000	32%	31,854
\$10,000	12%	12,021
\$16,000	8%	7,820

Simulation mean = \$4,364.54; exact mean = \$4,400

Simulation P90 = \$10,000; exact P90 = \$10,000

Random sampling creates estimation error; another seed may change results.

3 Validate the model as well as the software

Check units, distributions, shared drivers and dependence. Compare simple cases with exact calculations and monitor stability as the number of runs increases.

For a sampled percentile, sort the outcomes and select the smallest value at which the empirical cumulative probability reaches the target. Simulation cannot repair missing risks or unsupported inputs.

Integrated example: risk to budget decision

Use one consistent model for the register, response and expected cost.

1 Start with a base that excludes these risks

Base project cost = \$100,000. Treat the three effects below as additive. The opportunity has no extra action cost. All figures refer to the same project period.

Item	Probability	Effect on cost
A: delivery delay	25%	+\$12,000
B: rework	20%	+\$8,000
C: design saving	30%	-\$5,000

$$\text{Expected cost} = \$100,000 + \$3,000 + \$1,600 - \$1,500$$
$$= \$103,100$$

2 Apply the delivery mitigation from page 11

Pay \$800 and reduce A's probability to 10%. Keep B and C unchanged for this example.

$$\text{New certain base} = \$100,000 + \$800 = \$100,800$$
$$\text{Expected remaining threat loss} = \$1,200 + \$1,600 = \$2,800$$
$$\text{New expected total cost} = \$100,800 + \$2,800 - \$1,500$$
$$= \$102,100$$

Expected cost improves by \$1,000; remaining losses are still possible.

3 Separate the forecast from the funding decision

The \$102,100 is an expected cost, not an approved budget or a chosen confidence level. Actual modeled costs range from \$95,800 to \$120,800 if all combinations are possible. Set the reserve from the appropriate total-cost distribution and policy. Record action ownership, assumptions and review triggers; update the register after the response is implemented.

Check your calculations before deciding

Short checks catch errors that a polished spreadsheet can hide.

1 Common errors to prevent

Do not use a 1–5 rating as a probability, mix positive loss costs with signed EMV, omit the no-event case, or treat an average as a guaranteed outcome.

Do not assume independence without evidence, double-count a shared consequence, or add certain response cost only to the adverse branch.

Do not equate EMV with contingency, add individual percentiles, or offset threats with an opportunity without showing both exposures.

2 Three practice questions

1. A 15% chance of a \$20,000 loss: what are signed EMV and expected loss?
2. A \$500 response reduces a \$10,000-loss probability from 20% to 10%: what is the net expected benefit?
3. Independent risks have probabilities 20% and 30%: what is the chance that at least one occurs?

Work out each answer before reading the checks below.

3 Answers and interpretation

1. $EMV = 0.15 \times (-\$20,000) = -\$3,000$; expected loss = \$3,000. Actual loss in this model is \$0 or \$20,000.
2. Before = \$2,000. After = \$500 + \$1,000 = \$1,500. Net expected benefit = \$500.
3. $P(\text{at least one}) = 1 - (0.80 \times 0.70) = 44\%$. Adding 20% and 30% double-counts the 6% joint outcome.

Formula desk reference and sources

Choose the formula that matches the question and the assumptions.

① Core formulas

Signed EMV = Sum of $(p_i \times I_i)$

Expected loss = $p \times$ Mean loss if the event occurs

$P(A \text{ and } B) = P(A) \times P(B | A)$

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Net response benefit = $p_0 L_0 - (C + p_1 L_1)$

For independence only: $P(B | A) = P(B)$. Check units and signs every time.

② A five-step decision check

1. Define the event, baseline, horizon and incremental consequence.
2. Document probability evidence, severity and dependencies.
3. Calculate complete outcomes, certain costs and residual risks.
4. Compare the mean, large losses and relevant confidence levels.
5. Assign an owner, record the decision and update after new evidence.

A useful number is traceable to an explicit model and current evidence.

③ Primary references and further reading

[1] PMI – PMBOK Guide, Sixth Edition errata: EMV correction.

[2] NIST/SEMATECH e-Handbook – probability distributions and CDFs.

[3] U.S. GAO – Cost Estimating and Assessment Guide (GAO-20-1956), Chapter 12: risk and uncertainty analysis.

[4] PMI – Decision tree analysis and risk-averse utility.

Reference titles are clickable in the PDF. Worked examples are original, illustrative models; real inputs require project evidence.