A Portfolio Margin Framework for Prediction Markets

Binary and event contracts (Kalshi, CME / FanDuel Predicts and comparable venues)

Methodology and reference model · **Version 2.0** · *May 2026*

Prepared as a production-grade design document, accompanied by a live Excel reference model (Prediction_Market_Margin_Model.xlsx).

Contents

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1. Executive summary

This document specifies a portfolio margin framework for binary and event-contract markets such as Kalshi and the CME / FanDuel Predicts platform. Today these venues are fully collateralized: a participant posts the entire maximum loss of every position, with no recognition of offset, hedging, or diversification. Full collateralization is simple and robust, but it is highly capital-inefficient and penalizes exactly the disciplined, hedged, diversified books that pose the least risk. As Kalshi has now secured the regulatory standing to offer margined trading and CME continues to extend its SPAN 2 risk engine to event products, the operative question is no longer whether portfolio margin will come to prediction markets, but how to do it prudently.

The framework is a hybrid: a transparent, scenario-based core built on jump-to-resolution outcomes, overlaid with statistical (Expected Shortfall) measures, correlation-based aggregation, and a battery of add-ons. It is explicitly designed around the four requirements that motivated this work — recognizing offset within multi-leg and parlay positions; guaranteeing coverage of the highest concentration of a configurable number of exposures; rewarding genuine diversification across a broad range of independent risks; and granting sensible, correlation-driven offsets between economically related contracts that differ only in time horizon (for example, "Bitcoin above $90,000 at end-June" versus "…at end-September").

Two properties anchor the design. First, because every binary position has a bounded loss, the portfolio's worst possible loss can never exceed the sum of per-position maximum losses; portfolio margin is therefore strictly capped by today's full-collateralization number, and the entire exercise is to safely position the requirement between the true joint worst case and that cap. Second, event contracts do not drift to resolution — they jump. A contract trading at 60 cents settles at either 100 or

0. Continuous-move, short-horizon VaR of the kind used for futures systematically understates this risk, so the scenario set is constructed on resolution outcomes rather than small price perturbations.

On the accompanying reference portfolio — an eight-cluster book spanning three crypto assets (Bitcoin, Ether, Solana), an equity index, a macro/commodity, an election, an independent sports book and a parlay — the framework reduces the margin requirement from $63,097 under full collateralization to $18,313, a 71% capital release. Notably, once several correlated risk-asset classes are present, the correlation-aggregated base ($13,257) rises above the top-two concentration floor ($11,426): the systematic correlations, not the floor, now bind. Every figure in this document is reproduced by the live model and has been independently re-derived to the cent.

Version 2.0 adds three elements developed iteratively with the model: a generalized asset hierarchy that defines clusters and generates the inter-cluster correlation matrix (Section 7); a multi-factor systematic model and a Monte-Carlo engine for the price-path clusters (Section 9); and explicit treatment of crypto, equity and macro asset classes. A companion live dashboard implements the same engine interactively.

2. Scope, audience and perspectives

The framework is written to serve two related but distinct readers, and is explicit about where their incentives diverge.

2.1 The venue / clearing perspective

A venue or clearing house sets the margin a participant must post. Its objectives are prudence and defensibility: the requirement must cover losses to a high confidence over the relevant horizon, withstand regulatory and auditor scrutiny, resist gaming by sophisticated members, and behave well through stress without amplifying it. From this seat the framework is a rulebook — a deterministic function from a portfolio to a dollar requirement, with conservative defaults, floors, and add-ons, and with governance around every parameter.

2.2 The participant / trading-desk perspective

A desk holding a book across one or more venues wants to understand its true economic risk, size its capital, and anticipate the margin it will be charged so it can trade capital-efficiently. The same engine serves this purpose, but the desk will tend to use its own (often less conservative) probability and correlation estimates, will care about marginal margin — the cost of adding a position — and will actively structure trades to maximize recognized offset. A venue must therefore treat the participant as an adversary of its own assumptions: any offset the rule grants will be sought out and concentrated in.

2.3 Reconciling the two

The architecture is identical for both; only the calibration and the governance wrapper differ. Throughout, the document flags where a venue should be deliberately more conservative than a desk would be for itself — principally in correlation assumptions, in the concentration floor, and in the treatment of settlement and liquidity risk. A useful discipline is that the venue's rule should be sound even if participants optimize against it perfectly; the worked design satisfies this by never letting recognized diversification override the concentration floor.

3. Market context and motivation

Prediction-market contracts are binary options on the realization of a specified event: a quantity (an asset price, an economic release, an election result, a game outcome) is observed at a resolution time against a fixed condition, and the contract pays a fixed amount — conventionally normalized to \$1.00 — if the condition is met and zero otherwise. The traded price, between \$0.00 and \$1.00, is the market's implied probability.

On Kalshi and on CME's event contracts as offered through FanDuel Predicts, positions are presently fully collateralized: a buyer of a "yes" contract posts the premium, and a seller posts the complementary amount, so that each side has pre-funded its maximum loss. This eliminates counterparty credit risk to the clearing layer but ties up capital in proportion to gross, not net, exposure. A market-maker quoting hundreds of related contracts, or a desk running a hedged calendar or vertical structure, must fund the sum of all the individual worst cases even though those worst cases cannot all occur together. Kalshi's 2026 registration of an affiliated futures commission merchant, and the trajectory of CME's SPAN 2 engine — which already decomposes margin into market, liquidity and concentration components — both point toward portfolio margining for these products. This framework is a concrete, defensible methodology for that transition.

The design borrows the proven scaffolding of derivatives clearing — scenario arrays in the spirit of SPAN, Expected-Shortfall measurement consistent with EMIR and the CPMI-IOSCO Principles for Financial Market Infrastructures, concentration and liquidity add-ons, and anti-procyclicality buffers — and adapts it to the distinctive features of binary, externally-resolved, jump-to-settlement contracts.

4. Contract primitives and notation

Consider a contract i that pays the holder of a "yes" position a notional N (taken as \$1.00 throughout) if its event resolves true. Let p_i be the current price and q_i the model probability of resolution to "yes". A long position of x_i contracts has value $x_i \cdot p_i$ now and $x_i \cdot (\text{outcome})$ at resolution, where outcome $\in \{0,1\}$.

$$\text{Long "yes": } \max \text{loss} = p_i \qquad \text{Short "yes" (= long "no"): } \max \text{loss} = 1 - p_i$$

The per-contract maximum loss is therefore bounded and known in advance. The gross requirement under full collateralization is simply the sum of these bounded losses:

$$\text{Gross} = \Sigma_i \; x_i \cdot \text{maxloss}_i$$

Profit and loss in a given state of the world s, for a position with side $\sigma_i \in \{+1 \text{ long}, -1 \text{ short}\}$, is

$$\text{PnL}_i(s) = \sigma_i \cdot x_i \cdot (\text{outcome}_i(s) - p_i) \qquad \text{Loss}_i(s) = -\text{PnL}_i(s)$$

and the portfolio loss in state s is the sum across positions. A multi-leg or parlay contract pays only if all of its legs resolve true; its outcome is the product of its leg indicators, which the framework handles by decomposition (Section 11). The single most important structural fact follows directly: because $\text{Loss}_i(s) \le \text{maxloss}_i$ in every state, the portfolio's loss in every state is bounded above by Gross. No margin methodology for these instruments should ever produce a requirement above Gross, and the true joint worst case is the natural lower bound on a prudent requirement.

5. Design principles

Seven principles govern the methodology and are referenced throughout.

Bounded loss and the gross cap. Margin lives in the band between the true joint worst-case loss and Gross. The cap is a hard, free risk control that should always be enforced.

Jump-to-resolution, not diffusion. Risk is dominated by discrete settlement jumps, not by small day-to-day price moves. Scenarios are built on outcomes and on price levels at resolution dates, not on a one- or two-day return shock.

Coherence. The risk measure should be sub-additive — combining two books must never require more margin than the sum of their stand-alone requirements. Expected Shortfall is used precisely because Value-at-Risk is not coherent.

Offsets must be earned, not assumed. Credit is granted only where a logical relationship is certain or a statistical relationship is estimated and stressed. Equality of theme ("both are about Bitcoin") is never sufficient on its own.

Concentration dominates diversification. Diversification credit is always subordinate to a floor that covers the largest N exposures with no credit at all, so that a book which merely looks diversified cannot be under-margined.

Anti-procyclicality. The requirement should not collapse in calm periods and spike in stress in a way that forces destabilizing liquidation. Stress-period calibration, buffers and floors temper this.

Defensibility and gaming-resistance. Every number must be reproducible, auditable, and stable against an adversarial participant who knows the rule. The framework favors transparent scenario logic for the core and reserves statistical machinery for the diversified residual.

6. Framework architecture

The requirement is assembled in layers. Each layer is independently inspectable and is reflected in a corresponding sheet of the reference model.

1. Risk-factor mapping and clustering — every position is mapped to its underlying risk factors and to the logical relationships among events, then grouped into correlation clusters (Section 7).
2. Scenario base — within each cluster, jump-to-resolution scenarios are enumerated and the cluster's stressed loss (Expected Shortfall) is computed, capturing logical and time-spread offsets exactly (Section 8).
3. Statistical overlay and correlation aggregation — cluster stressed losses are combined through a correlation matrix (and, in production, copulas) to credit diversification across clusters (Section 9).
4. Concentration floor — the aggregated figure is floored by the comonotonic sum of the largest N cluster losses, guaranteeing concentration coverage (Section 12).
5. Add-ons — liquidity/liquidation, settlement/oracle, wrong-way, an anti-procyclicality buffer and a minimum floor are applied, and the total is capped at Gross (Sections 13–15).

The headline relationship is:

```
Margin = min( Gross,  max( BaseRisk, ε·Gross ) + AddOns + APCbuffer )

BaseRisk = max( CorrelationAggregate,  ConcentrationFloor(N) )
```

where CorrelationAggregate credits diversification, ConcentrationFloor guarantees concentration coverage, ε·Gross is a minimum-margin floor for basis and model risk, and the outer cap enforces the bounded-loss property.

7. Risk-factor mapping and logical relationships

Before any number is computed, positions are decomposed into risk factors and the logical relationships among their events are catalogued. These relationships are deterministic constraints on which combinations of outcomes are even possible, and they are the source of the largest and most defensible offsets, because they hold with certainty rather than by estimation.

Relationship	Definition	Margin consequence
Mutually exclusive	At most one of a set of events can resolve “yes” (e.g. election winners).	A book short several names can pay on only one; combined risk ≈ the single largest leg, not the sum.
Exhaustive / partition	Exactly one of a set must resolve “yes”; prices sum to ≈ 1.	Holding the full set long is nearly riskless; the framework recognizes the near-perfect hedge.
Nested / subset	One event implies another (e.g. “wins by >5 pts” implies “wins”).	Opposing positions across the nesting offset down to the conditional gap.
Threshold on a shared underlying	Same quantity, different strike and/or date (e.g. BTC ≥ $90k vs ≥ $100k; June vs Sept).	Strike and calendar spreads; offset governed by the joint distribution of the underlying (Sections 8, 10).
Parlay / multi-leg	Pays only if all legs resolve “yes”.	Decomposed into its leg-outcome tree; long-parlay loss is bounded by the stake (Section 11).
Statistically related	No logical link but correlated drivers (macro, sector, weather).	Credited only through estimated, stressed correlation in the overlay (Section 9).

Positions are then grouped into correlation clusters — sets driven by a common risk factor or family of events within which offsets are computed exactly by scenario enumeration. Clusters are the unit on which diversification and concentration are subsequently assessed. A single very large position may constitute its own cluster. The version-2 reference portfolio uses eight: three crypto term-structure clusters (Bitcoin, Ether, Solana), an equity-index cluster (S&P 500), a macro/commodity cluster (WTI oil), a mutually-exclusive election cluster, a broad book of independent idiosyncratic sports events, and a parlay.

7.1 The generalized asset hierarchy

Rather than enumerate cluster correlations by hand — which does not scale and invites inconsistency — the framework arranges every cluster as a node in an asset hierarchy and generates the inter-cluster correlation matrix from the tree. The reference hierarchy is: a Risk-assets branch containing a Crypto class (Bitcoin, Ether, Solana), an Equity class (S&P 500) and a Macro class (WTI oil); a Politics branch (the election); and a Sports branch (the independent book). The parlay spans branches through its legs.

Correlation between any two clusters is then a function of their lowest common ancestor. Two clusters in the same asset class (Bitcoin and Ether, both Crypto) receive the same-class correlation; two clusters sharing only a branch (Crypto and Equity, both Risk assets) receive the lower same-branch, or risk-on, correlation; clusters in different branches (Crypto and the election) receive the unrelated correlation, typically zero. Parlay correlations are set by shared-leg overrides. The reference calibration uses 0.68 within an asset class and 0.35 across classes within the Risk-assets branch.

Cluster pair	Lowest common ancestor	Generated ρ
BTC ↔ ETH ↔ SOL	Crypto class	0.68 (same class)
Crypto ↔ Equity ↔ Macro	Risk-assets branch	0.35 (risk-on)
Risk assets ↔ Election / Sports	Root	0.00 (unrelated)
Parlay ↔ any	spans legs	shared-leg override (0.15–0.30)

This hierarchy is the surface for iterative refinement: adding an asset (a fourth crypto token), a class (rates, FX) or a whole branch requires only a new node and inherits correlations automatically. It also makes the model's assumptions explicit and auditable — every correlation traces to a level of the tree and a single calibrated parameter, rather than to a hand-entered cell.

7.2 Systematic factors and asset classes

The hierarchy correlations are not arbitrary; they are the reduced form of a factor model in which a common risk-on factor drives all risk assets and class factors drive the assets within a class. With a class loading that produces a cross-class correlation of about 0.35 and an asset loading that produces a within-class correlation of about 0.68, Bitcoin, Ether and Solana move together strongly while crypto, equity and macro move together moderately — the empirical pattern of risk-on/risk-off markets. Modeling the factor explicitly (Section 9) ensures that a book concentrated in a single class is recognized as concentrated rather than diversified, and that genuine cross-asset relationships are credited only to the extent the factor structure supports.

8. The scenario base layer

Within a cluster the framework enumerates a set of jump-to-resolution states. For events resolved purely by their own outcome (an election, a game), the states are the discrete outcome combinations. For events defined by a threshold on a continuous underlying (an asset price at a date), the states are constructed from a model of that underlying at the relevant resolution dates.

8.1 Constructing price-threshold scenarios

For a cluster keyed to an underlying observed at one or more dates, the framework discretizes the underlying's distribution at each resolution date and evaluates each contract's outcome in every joint state. In the reference model the Bitcoin cluster discretizes the standardized log-return to end-June, and the incremental log-return from June to September, each into seven states, producing a 7×7 = 49-point joint distribution. The September level depends on both increments, so the correlation between the June and September events emerges mechanically from the shared path rather than being assumed — this is the engine behind the time-spread offset of Section 10.

```
Level(t) = S0 · exp( σ1·z1 + σ2·z2 + … )    outcome = 1{ Level(t) ≥ strike }
```

Production implementations would replace the coarse lattice with a calibrated Monte-Carlo simulation (empirical or stochastic-volatility dynamics, jumps, and a term structure of implied volatility), but the principle is identical: build the joint distribution of resolution outcomes, then read off the portfolio loss in each state.

8.2 The cluster risk measure: Expected Shortfall

Each state s carries a probability π(s) and a portfolio loss L(s). The cluster's stressed loss is its Expected Shortfall at confidence c — the probability-weighted average loss in the worst (1 − c) tail — floored at zero so that a net-profitable cluster contributes nothing rather than a negative requirement.

```
VaR_c = inf{ ℓ : P(L ≤ ℓ) ≥ c }      ES_c = E[ L | L ≥ VaR_c ]
                    Stressed = max(ES_c, 0)
```

Expected Shortfall is chosen over Value-at-Risk for two reasons: it is coherent (sub-additive), which is essential when these cluster figures are later aggregated; and it reflects the severity of tail outcomes, which for jump-to-resolution instruments are the entire risk. On the discrete state space the model computes ES as a tail-conditional expectation, which is exact for these enumerations and is implemented with ordinary spreadsheet functions so that it remains fully transparent and auditable.

8.3 Why not a diffusion VaR

A one- or two-day 99% VaR computed from historical price moves would, for a contract trading at 0.60, contemplate a move to perhaps 0.55 or 0.65 and conclude that very little capital is at risk. But the contract can resolve to 0 or 1 at any time, and certainly will at its resolution date. The scenario base captures this by measuring loss against settlement outcomes, not against a short-horizon return shock — the single most important adaptation of clearing methodology to this asset class.

9. Statistical overlay and correlation aggregation

Logical and price-path offsets are captured exactly inside clusters. Across clusters the relationships are statistical, and enumerating a joint scenario space over many independent event families is both intractable and spurious. The framework instead aggregates the cluster stressed losses through a correlation matrix, using the standard quadratic form that underlies risk aggregation in Basel, Solvency II and CCP add-on frameworks:

```
CorrelationAggregate = sqrt(  Σ_i Σ_j  ES_i · ES_j · ρ_ij  )
```

With all off-diagonal correlations zero this reduces to the root-sum-of-squares of the cluster losses — full diversification credit. With all correlations one it reduces to the simple sum — no credit. Intermediate, calibrated correlations interpolate between these poles, and the ρ_{ij} are supplied by the asset hierarchy of Section 7. In the eight-cluster reference model the cluster stressed losses (Bitcoin $5,620, Ether $2,180, Solana $1,760, equity $4,200, macro $1,500, election $1,940, sports $5,806, parlay $97) sum to $23,103 but aggregate to $13,257 once the hierarchy correlations are applied — a diversification credit of roughly $9,800, of which the concentration framework then determines how much to keep.

9.1 Copulas and tail dependence

A correlation matrix captures average co-movement but not the tendency of some risks to fail together precisely in stress. For clusters exposed to common macro drivers, a Gaussian dependence structure understates joint tail losses; a Student-t or Gumbel copula, which exhibits upper-tail dependence, is more prudent. In production the overlay should be implemented as a copula-coupled Monte-Carlo over cluster loss distributions, with the quadratic form retained as a transparent, conservative approximation and as a fallback. Correlation and tail-dependence parameters should be calibrated on data that includes a stress window and floored away from zero for any clusters with a plausible common driver.

9.2 The Monte-Carlo engine and the multi-factor model

For clusters spanning several assets in the same class — pre-eminently the Crypto cluster — the framework prices risk with a joint Monte-Carlo rather than a one-asset lattice. Each path draws a common risk-on factor, a factor per asset class, and an idiosyncratic shock per asset, combined so that same-class assets correlate at the within-class level and different classes correlate at the risk-on level:

$$z\_asset = \sqrt{\rho x} \cdot R + \sqrt{(\rho w - \rho x)} \cdot F\_class + \sqrt{(1 - \rho w)} \cdot \varepsilon\_asset$$

where R is the risk-on factor, F_class the class factor and ε the idiosyncratic shock; this yields within-class correlation ρw and cross-class correlation ρx by construction. Each asset's resolution-date level follows from its path, every position's outcome is evaluated, and the cluster's loss distribution and Expected Shortfall are read off the simulation. The lattice remains the transparent, reproducible default; the Monte-Carlo refines the tails and is essential once a cluster holds more than one or two correlated assets. The companion dashboard runs this simulation live in the browser.

9.3 Binary hedges do not net like linear hedges

A subtle and important consequence emerges from the simulation: a cross-asset position that looks like a hedge in linear terms — long Bitcoin-above-$90k, short Ether-above-$3,000 — receives almost no offset at a 99% confidence, even though Bitcoin and Ether co-move at $\rho \approx 0.68$. For a binary contract what matters is not continuous co-movement but whether each contract crosses its threshold, and the divergence corner (Bitcoin misses while Ether clears) retains more than one percent probability. The framework therefore withholds the credit, which is the prudent and gaming-resistant outcome: it protects against a desk that believes it is hedged but in fact carries threshold-divergence basis risk. Genuine spreads on the same underlying — a Bitcoin vertical or calendar — do net strongly, because their legs are functions of one price path. This distinction is visible interactively in the dashboard.

9.4 Venue conservatism

Because participants will structure books to harvest diversification credit, a venue should set aggregation correlations conservatively (biased upward), refuse zero correlations between any economically linkable clusters, and — most importantly — rely on the concentration floor of the next section as the binding control rather than on the correlation estimates themselves.

10. Time-spread and term-structure offsets

A central requirement is sensible treatment of contracts that are economically the same bet at different horizons — the canonical example being “Bitcoin above $90,000 at end-June” and “…at end-September.” These must not be treated as independent (which would double-count risk and over-margin a hedged calendar position), nor as identical (which would grant a full offset that the data do not support).

The framework treats them as what they are: two functions of the same underlying price path, whose joint distribution is modeled directly. Their correlation is therefore not an assumed parameter but an output of the path model, decaying naturally as the time gap widens and the two resolution dates decorrelate. A long-June / short-September position is credited an offset equal to the genuine economic hedge and charged for the residual — the probability that the price finishes on different sides of the threshold at the two dates, which is exactly the basis risk of the calendar spread.

10.1 A cautionary, and correct, result

It is tempting to assume calendar spreads are nearly riskless. For a high-volatility underlying they are not. In the reference model the Bitcoin cluster combines a September vertical spread (long the $90k strike, short the $100k strike) with a short June $90k leg. The gross requirement is $11,620; the framework’s stressed loss is $5,620 — a 52% offset. The residual is not noise: the worst state is one in which the price is above $90k in June (the short June leg loses) but falls below $90k by September (the long September leg loses), a divergence that carries meaningful probability at a 60% volatility. A naïve rule that fully offset the two $90k contracts because they share a strike would badly under-margin this book. The framework’s partial, path-driven credit is the prudent answer, and the same machinery would grant a much larger offset for a low-volatility underlying or a short gap between dates.

10.2 Term-structure spread charge

Where full path simulation is not available for a cluster, a venue can implement the offset in the SPAN tradition as an explicit inter-period spread charge: grant a credit for opposing positions across dates, but retain a residual charge that grows with the time gap and with the underlying’s volatility, reflecting imperfect offset. The path-model approach is preferred because it produces this charge endogenously and consistently with the strike-spread treatment.

11. Parlays and multi-leg positions

A parlay pays only if all of its legs resolve true; its outcome indicator is the product of the leg indicators. Two facts shape its treatment. First, for the holder of a long parlay the maximum loss is simply the stake, irrespective of the number of legs — the position cannot lose more than the premium paid. Full-premium collateralization is therefore already exact for a long parlay, and no portfolio reduction is needed or possible; the reference model confirms this, with the parlay cluster’s stressed loss equal to its $97 stake. A long parlay can only ever add diversification to a book, never tail concentration beyond its stake.

Second, the interesting cases are short parlays (the written side, whose loss is the payout net of premium) and books that mix parlays with single-leg positions on the same underlying events. Here the framework decomposes each parlay into its leg-outcome tree and folds those legs into the relevant clusters, so that a single-leg position offsetting one leg of a parlay is recognized through the shared scenario enumeration. The reference model illustrates the decomposition with an eight-state tree over a three-leg parlay and assigns the parlay to a cluster whose correlations to the Bitcoin and election clusters reflect its shared legs. In production, parlays are bucketed by their constituent risk factors and enter each relevant cluster's scenario grid, which captures shared-leg offsets exactly.

12. The concentration framework

Diversification credit is only as trustworthy as the correlation estimates behind it, and those estimates are most likely to fail exactly when several large positions move together in stress. The concentration floor is the framework's primary defense and directly answers the requirement to guarantee coverage of the highest concentration of a configurable number of exposures.

12.1 The top-N floor

The floor is the comonotonic sum — that is, the sum with no diversification credit whatsoever — of the N largest cluster stressed losses, where N is a governance parameter:

```
ConcentrationFloor(N) = Σ  (the N largest cluster stressed losses)
```

Base risk is then the greater of the correlation aggregate and this floor. The floor guarantees that, no matter how favorable the modeled correlations, the N most material exposures are always covered as though they could all crystallize together. In the reference model with N = 2 the floor is the sum of the two largest cluster losses, $5,806 + $5,620 = $11,426, which exceeds the correlation aggregate of $8,351 and therefore binds. The model thus charges $11,426 of base risk rather than $8,351 — concentration coverage explicitly overriding diversification, which is the intended behavior.

12.2 Granularity and complementary limits

N can be defined over clusters (the recommended default, since clusters are the natural unit of correlated exposure) or over individual positions for a stricter rule; a single dominant position is its own cluster in either case. The floor should be complemented by hard concentration limits expressed relative to the venue's resources and to each market's open interest — no single member's position in a thin market should be allowed to dominate that market — and, at the clearing level, by an interaction with default-fund sizing so that the largest one or two members' stressed exposures are covered by margin plus contributions.

13. Liquidity and liquidation add-on

Margin must cover not the value of a position at a mid-price, but the cost of closing it in a stressed, possibly thin market over the margin period of risk. Event markets can be shallow, and a large position cannot be unwound at the screen price. The framework adds a charge that scales with a position's footprint relative to available liquidity:

```
LiquidityAddOn = Σ_i  maxloss_i · x_i · λ · min( 1, x_i / Depth_i )
```

where Depth_i is a measure of market depth (open interest or average daily volume) and λ calibrates the severity of the liquidation haircut. A position that is small relative to its market attracts a negligible add-on; one that represents a large fraction of open interest attracts a substantial one. The margin period of risk for event contracts is typically short in calendar terms but must reflect jump risk: the relevant horizon is the time to either liquidate or be exposed to a resolution event, whichever binds. In the reference model the add-on totals $904 across the book.

14. Settlement, wrong-way, procyclicality and floors

14.1 Settlement and oracle risk

Event contracts are resolved by reference to an external source — an exchange print, a government release, a sports result, a data oracle. This introduces risks absent from ordinary derivatives: the source may be delayed, revised, ambiguous, disputed, or manipulated, and resolution itself is a discrete event around which positions cannot be adjusted. The framework adds a charge on the notional of positions flagged as carrying elevated settlement risk, calibrated in basis points to the reliability of the resolution source, and recommends operational controls (multiple sources, dispute windows, manual-review triggers) outside the margin number itself. In the reference model this add-on is modest ($31) because only a few positions are flagged.

14.2 Wrong-way risk

Wrong-way risk arises when a member's exposure is positively correlated with its own probability of default — for example, a member whose business fails in the same macro scenario that moves its positions against it. The framework carries a multiplier on base risk for books exhibiting this property; it is set to zero in the reference portfolio but is retained as an explicit lever.

14.3 Anti-procyclicality buffer

To avoid margin that collapses in calm markets and spikes destructively in stress, the framework holds an anti-procyclicality buffer as a fraction of base risk (25% in the reference model, consistent with the EMIR buffer approach), and recommends calibrating the underlying confidence level and volatility inputs with reference to a stress period so that the requirement does not fall too far in quiet times. The buffer can be drawn down in stress rather than added on top, smoothing the requirement.

14.4 Minimum floor and the gross cap

A minimum-margin floor, set as a small fraction of gross notional, ensures the requirement never falls to near-zero on an apparently perfect hedge, covering residual basis and model risk. Finally, the entire requirement is capped at Gross, the full-collateralization amount, enforcing the bounded-loss property: the framework can release capital relative to full collateralization but can never demand more.

15. Worked example

The version-2 reference model applies the full framework to an eight-cluster book at 99% confidence with N = 2. The cluster-level results show each offset mechanism in isolation:

Cluster	Mechanism	Gross	Stressed loss	Offset
Crypto · Bitcoin	Strike + time-spread (path-driven)	$11,620	$5,620	51.6%
Crypto · Ether	Vertical spread	$7,180	$2,180	69.6%
Crypto · Solana	Vertical spread	$5,760	$1,760	69.4%
Equity · S&P 500	Vertical spread	$12,200	$4,200	65.6%
Macro · WTI oil	Vertical spread	$4,500	$1,500	66.7%

Politics · Election	Logical offset (one winner)	$11,940	$1,940	83.8%
Sports · Independent (20)	Diversification (CLT / ES)	$9,800	$5,806	40.8%
Parlay (long)	Bounded by stake	$97	$97	0.0%
Total / pre-aggregation		$63,097	$23,103	—

The portfolio build-up then aggregates through the hierarchy and protects:

Step	Amount	Comment
Gross (full collateralization)	$63,097	Today's requirement
Correlation-aggregated base	$13,257	Hierarchy diversification (crypto 0.68, risk-on 0.35)
Concentration floor (top-2)	$11,426	Two largest clusters, no credit
Base risk = max(aggregate, floor)	$13,257	Aggregate now binds — systematic correlation drives it
+ Liquidity add-on	$1,711	Footprint vs. depth
+ Settlement / oracle add-on	$31	Flagged positions
+ Anti-procyclicality buffer	$3,314	25% of base risk
Total portfolio margin	$18,313	Capped at gross; floored at min
Capital efficiency	29.0%	Margin as a share of gross
Capital released vs. full collateralization	$44,784	71% reduction

The book is margined at 29% of its full-collateralization requirement, releasing $44,784. Two lessons stand out relative to the earlier four-cluster example. First, adding more diversified risk-asset classes lowers the margin as a share of gross — genuine diversification is rewarded. Second, because those classes are systematically correlated (crypto internally at 0.68, across classes at 0.35), the correlation-aggregated base ($13,257) now rises above the top-two concentration floor ($11,426): the systematic correlations, not the floor, become the binding control. The framework's thesis holds throughout — reward genuine offset and diversification, but never let them override coverage of concentrated, correlated risk.

16. Calibration and parameters

The framework's behavior is governed by a small set of parameters, each of which should be owned by risk governance, reviewed on a defined cadence, and changed only through a controlled process. Defaults below are illustrative and deliberately conservative for a venue.

Parameter	Symbol	Default	Rationale / guidance
Confidence level	c	99.0%	Tail coverage; 99.5% for clearing-grade. Calibrate with a stress window.
Concentration count	N	2	Number of largest clusters covered with no diversification credit.
Margin period of risk	MPOR	2 days	Liquidation horizon; must

			also reflect jump-to-resolution timing.
Min-margin floor	ε	2% of gross	Basis and model-risk floor on near-perfect hedges.
Liquidity factor	λ	0.50	Severity of liquidation haircut vs. market depth.
Settlement add-on	—	50 bps	On notional of positions with elevated resolution risk.
Wrong-way multiplier	—	0%	On base risk for self-correlated books.
Anti-procyclicality buffer	—	25%	Held buffer / draw-down cushion (EMIR-style).
Inter-cluster correlations	ρ_{ij}	calibrated	Biased upward; floored away from zero for linkable clusters.

Probability inputs (q_i) and the underlying path models should be calibrated to market prices where liquid, blended with model estimates where not, and stressed for the margin computation. A venue should never let a participant's favorable probability or correlation views flow into the requirement unchallenged.

17. Backtesting, validation and monitoring

A margin model is only as good as its demonstrated coverage. The framework should be validated continuously and independently of the team that operates it.

Test	What it measures	Threshold / action
Coverage backtest	Frequency of losses exceeding margin, vs. $(1-c)$.	Breaches above tolerance trigger recalibration.
Jump-to-resolution backtest	Coverage measured across actual resolution events, not just daily moves.	Primary test for this asset class.
Reverse stress test	Scenarios that would exhaust margin plus buffers.	Identifies hidden concentrations and correlation assumptions.
Sensitivity / what-if	Margin response to confidence, correlation and N.	Detects cliff effects and gaming surfaces.
Procyclicality monitoring	Peak-to-trough margin through cycles.	Ensures buffers dampen, not amplify, stress.
Concentration & liquidity review	Largest positions vs. open interest and member resources.	Feeds limits and default-fund sizing.

Coverage testing should be stratified by cluster type, because the failure modes differ: logical-offset clusters fail if the logical taxonomy is mis-specified; price-threshold clusters fail if the path model is mis-calibrated; the diversified book fails if correlations were under-estimated. Each stratum should be backtested on its own terms.

18. Governance, operations and default management

Portfolio margin for jump-to-resolution instruments places exceptional demands on operations. The framework should be embedded in a governance structure that covers at least the following.

Margin must be recomputed and called intraday, and specifically around scheduled resolution events, because risk can change discontinuously the moment an event resolves. The model, its parameters, and its code require independent validation before deployment and on a periodic cadence thereafter, with change control on every parameter. The clearing layer must hold a default waterfall — defaulter's margin, then default-fund contributions, then mutualized resources — sized so that the largest one or two members' stressed exposures are covered, with the concentration floor of Section 12 feeding directly into that sizing. Liquidation playbooks must account for the impossibility of trading out of a position once its event has resolved; positions approaching resolution should attract intraday scrutiny and, where appropriate, pre-emptive margin. Finally, because these markets attract retail participants, a venue offering leverage must layer suitability, position limits, and clear risk disclosure on top of the quantitative framework.

19. Additional risks and recommendations

Beyond the mechanics specified above, the following risks are material to prediction-market margining and are, in our assessment, the areas most often under-covered. Each is accompanied by a recommendation.

Correlation breakdown and regime shift. Diversification credit assumes a correlation regime that can change abruptly — politically-themed markets, for instance, can become highly correlated around a single macro or news event. Recommendation: floor correlations, lean on the concentration floor, and add a regime-stress scenario in which intra-theme correlations jump to one.

Oracle and resolution disputes. A contested or revised resolution can turn a settled position back into an open exposure. Recommendation: hold a settlement reserve for disputable markets, widen the settlement add-on for sources with weak governance, and define explicit dispute-handling that the margin model is aware of.

Liquidity spirals and self-impact. In stress, the act of liquidating concentrated positions moves prices against the liquidator, so realized losses exceed modeled ones. Recommendation: make the liquidity add-on convex in footprint and stress depth (not just price) in the liquidation scenario.

Cross-venue and cross-product basis. A participant hedged across Kalshi and CME, or across an event contract and a related future, is not hedged from any single venue's perspective. Recommendation: grant cross-product offset only within a single clearing perimeter, and treat external hedges as uncollateralized basis.

Gaming the rule. Any published offset will be engineered into. Recommendation: stress-test the rule against an adversarial optimizer that maximizes recognized offset, and ensure the concentration floor and gross cap bound the worst such book.

Novel and ambiguous event types. New markets may lack the data to calibrate probabilities, correlations or depth. Recommendation: default new event families to full or near-full collateralization until sufficient resolution history exists, then phase in portfolio treatment.

Wrong-way funding and leverage. As venues extend margin (leverage) to participants, a member can lose more than posted, reintroducing the counterparty credit risk that full collateralization eliminated. Recommendation: pair any leverage with the default waterfall, intraday calls, and the wrong-way multiplier, and stage leverage to institutional members first.

Model risk in the path and copula layers. The diversification and time-spread credits rest on models that can be wrong. Recommendation: retain the transparent quadratic-form aggregate as a conservative fallback, and never let the statistical layer reduce the requirement below the scenario base and concentration floor.

20. Implementation roadmap

A pragmatic path from full collateralization to the framework proceeds in stages. First, run the engine in shadow mode alongside full collateralization, computing both numbers without changing what members post, to gather coverage evidence. Second, enable within-cluster offsets only — the logical and price-path credits of Sections 8 and 10 — which are the most defensible and require no cross-cluster correlation assumptions. Third, enable cross-cluster diversification with conservative correlations and the binding concentration floor. Fourth, introduce leverage for institutional members under the full default-management apparatus. At each stage, the gross cap and concentration floor remain in force, so the worst case never deteriorates relative to the prior stage.

Appendix A. Notation and formula reference

```
maxloss_i = p_i (long) or 1−p_i (short)        Gross = Σ x_i · maxloss_i

Loss_i(s) = −σ_i · x_i · ( outcome_i(s) − p_i )

ES_c (cluster) = E[ L | L ≥ VaR_c ],  floored at 0

CorrelationAggregate = sqrt( Σ_i Σ_j ES_i ES_j ρ_ij )

ConcentrationFloor(N) = sum of the N largest cluster ES

BaseRisk = max( CorrelationAggregate, ConcentrationFloor(N) )

Margin = min( Gross, max(BaseRisk, ε·Gross) + LiquidityAddOn +
              SettlementAddOn + WrongWay + APCbuffer )
```

Appendix B. Glossary

Binary / event contract — An instrument paying a fixed notional if a specified event resolves true, else zero; price equals implied probability.

Full collateralization — Posting the sum of each position's maximum loss; the current practice and the upper bound on any portfolio requirement.

Jump-to-resolution — The discontinuous move of a contract's value to 0 or 1 at settlement, the dominant risk for these instruments.

Cluster — A group of positions driven by a common risk factor or event family, within which offsets are computed exactly.

Expected Shortfall (ES) — The probability-weighted average loss in the worst (1−c) tail; a coherent risk measure.

Concentration floor — A requirement equal to the comonotonic sum of the largest N cluster losses, guaranteeing concentration coverage.

Margin period of risk (MPOR) — The horizon over which a defaulted portfolio is assumed to be carried and liquidated.

Anti-procyclicality — Measures that keep margin from collapsing in calm and spiking destabilizingly in stress.

Wrong-way risk — Exposure positively correlated with the counterparty's own probability of default.

This document is accompanied by the live reference model Prediction_Market_Margin_Model.xlsx, in which every figure above is reproduced by transparent, editable formulas. The methodology is a reference design; production deployment should add calibrated Monte-Carlo CVaR, fitted copulas, and the full governance and validation apparatus described in Sections 17–18.