# **Pre-Coding Essentials (Component: crates/vm\_pipeline/src/apply\_rules.rs, Version/FormulaID: VM-ENGINE v0) — 55/89**

## **1) Goal & Success**

Goal: Evaluate **legitimacy gates** in fixed order—**Quorum → Majority/Supermajority → Double-majority → Symmetry**—and produce a **LegitimacyReport** with Pass/Fail and reasons.

Success: If **any gate fails**, mark run **Invalid** and instruct pipeline to **skip MAP\_FRONTIER**. Denominators follow Doc 4 rules (approval → **approval rate**).

## **2) Scope**

In scope: Compute national turnout; apply national/optional per-unit quorum; compute national support %; compute affected-region family support; evaluate symmetry & exceptions; assemble **LegitimacyReport**.

Out of scope: Frontier mapping, tie resolution, labeling (later stages).

## **3) Inputs → Outputs (with schemas/IDs)**

Inputs: **AggregateResults** (country + region-level if needed), **ParameterSet** (VM-VARs), optional per-Unit turnout flags.

Output: **LegitimacyReport** with Quorum/Majority/Double-majority/Symmetry sections, raw values & thresholds, and overall **Pass/Fail**.

## **4) Entities/Tables (minimal)**

## **5) Variables (used here)**

## **6) Functions (signatures only)**

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pub struct LegitimacyReport {

pub pass: bool,

pub reasons: Vec<String>,

pub quorum: GateOutcome, // {turnout\_pct, threshold, pass, per\_unit\_flags?}

pub majority: GateOutcome, // {support\_pct, threshold, denom\_policy, pass}

pub double\_majority: Option<GateOutcome2>, // {national\_pct, family\_pct, thresholds, pass, family\_members[]}

pub symmetry: Option<SymmetryOutcome>, // {respected: bool, exceptions?: Vec<Exception>}

}

pub fn apply\_decision\_rules(agg: &AggregatesView, p: &Params, per\_unit\_turnout: Option<&PerUnitTurnout>)

-> LegitimacyReport;

// helpers (pure):

fn compute\_turnout\_pct(agg: &AggregatesView) -> Ratio;

fn compute\_support\_pct(agg: &AggregatesView, p: &Params) -> (Ratio, DenomPolicy);

fn compute\_family\_support(agg: &AggregatesView, p: &Params, scope: QuorumScope) -> (Ratio, Vec<UnitId>);

fn evaluate\_symmetry(p: &Params) -> SymmetryOutcome;

*(Fields follow Doc 5A §3.5 outline.)*

## **7) Algorithm Outline**

**Quorum:** turnout Σ ballots\_cast / Σ eligible\_roll (integer/rational math). Pass iff ≥ **VM-VAR-020**. If **VM-VAR-021 > 0**, compute per-Unit flags and note **021\_scope** effect.

**Majority:** compute national support %. Default denominator = **valid ballots**; if **VM-VAR-007=on** include blanks; **approval ballots** use **approval rate**. Pass iff ≥ **VM-VAR-022**.

**Double-majority:** if **VM-VAR-024=on**, require **national ≥ VM-VAR-022** **and** **family ≥ VM-VAR-023**. Determine family via **VM-VAR-026/027**; if frontier\_mode=none, enforce by\_list/by\_tag. Respect **021\_scope** when excluding failing Units from family if configured.

**Symmetry:** if **VM-VAR-025=on**, verify thresholds/denominators are neutral in both directions; if **VM-VAR-029** non-empty, mark “Not respected” and record rationale list.

**Outcome:** Build **LegitimacyReport** with raw numbers, thresholds, denominators, family members, and Pass/Fail. If any **Fail**, signal **Invalid** and **skip MAP\_FRONTIER**.

## **8) State Flow**

**AGGREGATE → APPLY\_DECISION\_RULES → (if Pass) MAP\_FRONTIER; else skip → RESOLVE\_TIES (only if blocking) → LABEL.**

## **9) Determinism & Numeric Rules**

Exact integer/rational comparisons; **≥** rules for thresholds; **half-even** rounding only where comparisons require (none for simple ratio compare). Offline; stable orders unaffected here.

## **10) Edge Cases & Failure Policy**

**Exact threshold** (e.g., 55.000% vs 55) → **Pass**.

**Include blanks** affects **gates only**; tabulation/allocation remain on valid ballots.

**Missing eligible\_roll** when quorum required → should have failed **VALIDATE**; here, just produce Fail/Invalid per policy.

Do **not** throw on gate failures; return **pass=false** with reasons.

## **11) Test Checklist (must pass)**

**VM-TST-004**: approval, support = **55.0%** vs threshold **55** ⇒ **Pass (≥)**; label later **Decisive**.

**VM-TST-005**: national turnout **48%** vs **50%** ⇒ **Fail Quorum → Invalid**; frontier omitted.

**Weighting flip scenarios** still compute support using the correct denominators (approval rate) regardless of aggregation method.