# **Pre-Coding Essentials (Component: schemas/parameter\_set.schema.json, Version/FormulaID: VM-ENGINE v0) — 16/89**

## **1) Goal & Success**

Goal: JSON Schema for **ParameterSet** capturing the full, immutable snapshot of VM variables (VM-VAR-###) used for a run.

Success: Validates PS: ID, enforces domains/default shapes for all outcome-affecting variables (Docs 2A…2C + Annex A), and is strict (additionalProperties: false). Loader can build a typed map with zero ambiguity.

## **2) Scope**

In scope: Top-level metadata, variables{VM-VAR-###: value}, enums/ranges for ballot/allocation/gates/weighting/frontier/ties/MMP, optional notes.

Out of scope: Derivations (labels, results), cross-entity checks (done in pipeline), Formula ID computation (Annex A handles that).

## **3) Inputs → Outputs**

Inputs: parameter\_set.json.

Outputs: Pass/fail against schema; on pass, a frozen ParameterSet object used by all pipeline stages and echoed into RunRecord.

## **4) Entities/Fields (schema shape to encode)**

**Root object**

id **(required, string)** — PS:<name>:v<semver>

variables **(required, object)** — keys VM-VAR-### with constrained values (see §5)

notes *(optional, string)*

**SemVer pattern**: ^v?(0|[1-9]\d\*)\.(0|[1-9]\d\*)\.(0|[1-9]\d\*)(?:[-+][A-Za-z0-9.-]+)?$

## **5) Variables (domains to encode in schema)**

All percentages are **integers** 0..100. Booleans are modeled as enums on|off to keep serialization explicit.

### **A) Ballot (001–007)**

### **B) Allocation & MMP (010–017)**

### **C) Gates / Thresholds / Families (020–029)**

### **D) Aggregation / Weighting (030–031)**

### **E) Frontier & Contiguity (040–048)**

### **F) Ties & RNG (050–052)**

### **G) Labels (060–062) *(if used)***

Optional integers % 0..100 for any label margin thresholds the report might show. If absent, engine uses built-in defaults.

### **H) Executive toggle (073) *(if used)***

073 executive\_enabled — enum: on off.

**Conditional rules to encode with if/then/else:**

If ballot\_type="score" ⇒ require 002/003; allow 004.

If ballot\_type="ranked\_condorcet" ⇒ require 005.

If ballot\_type="ranked\_irv" ⇒ 006 must equal reduce\_continuing\_denominator.

If allocation\_method="mixed\_local\_correction" ⇒ require 013–017.

If double\_majority\_enabled="on" ⇒ require 022, 023, 026; if 026=by\_list ⇒ require 027 non-empty.

If weighting\_method="population\_baseline" ⇒ pipeline will require Unit baseline fields (schema note only).

If tie\_policy="random" ⇒ require 052 (64-hex).

## **6) Functions**

(Schema only.)

## **7) Algorithm Outline (schema authoring steps)**

$schema: JSON Schema 2020-12; set $id.

$defs for: Percent, BoolEnum, Hex64, SemVer, enums for each family (ballot, allocation, etc.), and the **VariableMap** where each VM-VAR-### has its own subschema.

Root: type: object, required: ["id","variables"], additionalProperties: false.

id: pattern for PS:<name>:v<semver>.

variables: type: object, additionalProperties: false, with explicit properties for each VM-VAR-### listed above.

Encode **cross-field conditionals** with allOf blocks (e.g., seed required when ties are random).

Include non-normative $comment about canonical JSON (UTF-8, LF, sorted keys) and that unspecified variables use **doc defaults** (but recommend explicit inclusion for reproducibility).

## **8) State Flow**

Loader validates → builds typed Params → echoed into RunRecord and referenced by Report. Pipeline reads these to drive **Tabulate / Allocate / Aggregate / Gates / Frontier / Ties** in fixed order.

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

All thresholds are integers; **no floats**.

Approval gate denominator is **fixed** by spec (valid ballots); schema pins 029 accordingly.

Requiring rng\_seed when tie\_policy=random ensures reproducible tie outcomes.

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

Missing mandatory variables for chosen modes (e.g., MMP without 013–017) ⇒ **schema fail**.

Invalid hex for rng\_seed or wrong length ⇒ **schema fail**.

Inconsistent frontier bands (overlap, out-of-order) ⇒ **pipeline fail** (schema checks only bounds/shape).

pr\_entry\_threshold\_pct > 10 ⇒ **schema fail** (per spec cap).

If double\_majority\_enabled="on" with empty family when by\_list ⇒ **schema fail**.

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

**Happy path:** approval + Sainte-Laguë with defaults (001=approval, 010=proportional\_favor\_small, 012=0, 020=50, 022=55, 023=55, 024=on, 025=on, 030=population\_baseline, 031=country, 050=status\_quo) → **pass**.

**Score mode:** set 001=score, 002=0, 003=5, 004=off → **pass**; 003 ≤ 002 ⇒ **fail**.

**IRV:** 001=ranked\_irv, 006 must equal reduce\_continuing\_denominator; any other value ⇒ **fail**.

**Condorcet:** 001=ranked\_condorcet, 005 present; missing 005 ⇒ **fail**.

**MMP:** 010=mixed\_local\_correction with 013..017 supplied → **pass**; omit any ⇒ **fail**.

**Random ties:** 050=random with valid 052 (64-hex) → **pass**; missing or malformed seed ⇒ **fail**.

**Frontier bands:** bands with min\_pct ≤ max\_pct pass; overlapping bands accepted by schema but later **fail** in pipeline validation.