# Ratioque: A Formalism of Topological Ontogenetics

*The Mathematical Law (Ratio) Governing Species Appearance*

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December 3, 2025

**Abstract**

This paper establishes the formal mathematical boundaries of the *Ratioque* architecture. It begins by defining the core variables and equations that constitute the "Ratio" (the hidden law). It then explores the structural purpose of these laws: to provide dimensional guardrails for market mechanics, interpreting financial data not as random numbers, but as biological signals of human trauma and memory retention.

## 1 Nomenclature and Mathematical Core

The following variables and equations constitute the irreducible logic of the system.

### 1.1 Variable Definitions

| Symbol | Definition |
|---|---|
| $\nu_t$ | Rolling volatility of the asset at time $t$. |
| $\Gamma_t$ | The Volatility Gauge (log-normalized stress). |
| $N_{base}$ | Base constant for time horizon (Standard: 720 units). |
| $N_{inst}(t)$ | **Instantaneous Reality**: The time horizon implied by current stress. |
| $N_{eff}(t)$ | **Effective Memory**: The actual time horizon retained by the system. |
| $Z_t$ | Standardized Z-score of volatility at time $t$. |
| $\tau_{base}$ | **Genetic Half-Life**: The baseline rate of memory decay. |
| $S$ | **Trauma Sensitivity**: Genetic susceptibility to shock. |
| $\tau_{adapt}$ | Adaptive Half-Life: The specific decay rate at moment $t$. |
| $\sigma_t$ | **Shear Stress**: The topological distortion between reality and memory. |

### 1.2 Fundamental Equations

**1. The Gauge Transformation**
Normalization of raw volatility to prevent singularities.

$$\Gamma_t = \ln(1 + 2\nu_t) \tag{1}$$

**2. The Instantaneous Horizon**
Defining time as a function of information density.

$$N_{inst}(t) = N_{base} \cdot e^{\Gamma_t} \tag{2}$$

**3. The Adaptive Half-Life**
Modulating the speed of forgetting based on current trauma ($Z_t$) and genetic sensitivity ($S$).

$$\tau_{adapt} = \tau_{base} + (S \cdot Z_t) \tag{3}$$

**4. The Memory Loop (Asymmetric Decay)**
The central mechanism distinguishing panic from healing.

$$N_{eff}(t) = \begin{cases} N_{inst}(t) & \text{if } N_{inst}(t) > N_{eff}(t-1) \quad \text{(Panic Expansion)} \\ N_{inst}(t) + \Delta_{prev} \cdot e^{-\frac{\ln(2)}{\tau_{adapt}}} & \text{if } N_{inst}(t) \leq N_{eff}(t-1) \quad \text{(Trauma Decay)} \end{cases} \tag{4}$$

*Where* $\Delta_{prev} = N_{eff}(t-1) - N_{inst}(t)$.

**5. Shear Stress Topology**
The final metric defining the visible regime (color) of the asset.

$$\sigma_t = \sin\left(\frac{2\pi[N_{eff}(t) - N_{inst}(t)]}{N_{base}}\right) \tag{5}$$

# 2 Structural Guardrails and Human Dimension

## 2.1 The Purpose of the Ratio

The purpose of this formalism is to enforce structural guardrails on the interpretation of market data. Adhering to the Lucretian principle *naturae species ratioque*, we posit that the "Species" (the visible price action) is entirely subordinate to the "Ratio" (the hidden calculation of stress).

These equations do not predict price; they define the biological constraints within which the price exists. By fixing the laws of memory decay ($N_{eff}$) and trauma sensitivity ($\tau_{adapt}$), we create a rigid structure that forces the organic nature of the market to reveal itself.

## 2.2 The Human Dimension of Market Mechanics

Markets are composed of human actors subject to biological limitations. The formalism captures two distinct human behaviors:

1. **The Fear Response (Panic Expansion):** Equation (4) dictates that when current stress ($N_{inst}$) exceeds memory, the system adapts instantly. This mirrors the human survival instinct: fear is immediate and overrides all prior conditioning. There is no lag in panic.
2. **The Trauma Memory (Relaxation):** Conversely, the healing process is governed by Equation (3). The market does not "forget" a crash instantly. The combination of genetic half-life ($\tau_{base}$) and sensitivity ($S$) models the human inability to let go of pain. A high-sensitivity species (like a post-crash market) will "freeze" its memory, refusing to lower its guard even when the danger has passed.

# 3 Taxonomy of Species

The interaction of these variables results in four observable phenotypes. The classification is not arbitrary but is the mathematical result of the genetic parameters $\tau_{base}$ and $S$:

- **Type I: Ephemera** (Low $\tau_{base}$, Low $S$)
  *The Fruit Fly.* The market has no memory of past events and low sensitivity to new ones. It is characterized by high-frequency noise and rapid mean reversion.

- **Type II: Nervosa** (Low $\tau_{base}$, High $S$)
  *The Rabbit.* The market naturally forgets quickly but is highly terrified of new information. It exhibits spasmodic volatility spikes followed by quick collapses.
- **Type III: Tardigrada** (High $\tau_{base}$, Low $S$)
  *The Tank.* The market has a long memory but ignores short-term shocks. It is structurally robust and trends steadily (e.g., Blue Chip Indices).
- **Type IV: Pachydermata** (High $\tau_{base}$, High $S$)
  *The Elephant.* The market has a deep memory and feels pain acutely. Once injured, it retains the "Trauma Load" ($N_{eff} \gg N_{inst}$) for extended periods, resulting in long tails of Shear Stress (Red Regime).