Mathematical Modeling of Life Satisfaction and Financial Dynamics in the getHome Simulation Framework

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Abstract

The *getHome* platform leverages a gamified approach to lower the barrier of entry for young adults engaging with financial planning and home ownership. The primary objective is to spark interest and provide a foundational understanding that encourages later deeper future engagement with the topic. To achieve this, the simulation integrates stochastic financial modeling with psychometric satisfaction functions to simulate long-term life planning. This document outlines the core governing equations for the simulation engine.

1 Psychometric Model: Life Satisfaction

Life satisfaction $H(t)$ is modeled as a bounded sigmoid function of a raw aggregate score S_{raw}. This transformation ensures that the final score remains within the bounds $[0, 100]$.

$$H = 50 + 50 \cdot \tanh\left(\frac{S_{\text{raw}}}{\lambda}\right), \quad \text{with } \lambda = 150 \tag{1}$$

The aggregate score S_{raw} is the summation of weighted life factors:

$$S_{\text{raw}} = S_{\text{Wealth}} + S_{\text{Stress}} + S_{\text{Living}} + S_{\text{Social}} + S_{\text{Edu}} \tag{2}$$

The respective factors are computed as follows:

- **Wealth & Stress:** Modeled with diminishing returns and linear penalties.

$$S_{\text{Wealth}} = \min\left(40, \frac{W_{\text{total}}}{5000}\right) \quad \text{and} \quad S_{\text{Stress}} = -0.3 \cdot \sigma_{\text{job}} \tag{3}$$

- **Living Standards:** Modeled as a deviation from optimal living space (35m^2 per person), clamped to a range of $[-20, 20]$ to prevent extreme values.

$$S_{\text{Living}} = \text{clamp}\left(\frac{A_{\text{total}}}{N_{\text{hh}}} - 35,\ -20,\ 20\right) \tag{4}$$

  , where A_{total} is the total area in m^2 and N_{hh} is the household size.

- **Social & Education:** Implemented as discrete bonuses.

$$S_{\text{Social}} = 25 \cdot \mathbb{I}_{\text{married}} + 15 \cdot N_{\text{children}} \quad \text{and} \quad S_{\text{Edu}} = 10 \cdot \mathbb{I}_{\text{high\_edu}} \tag{5}$$

2 Stochastic Financial Dynamics

2.1 Asset Growth Model

The portfolio value V_t evolves according to a discretized exponential model. The annual return r is a random variable following a normal distribution.

$$V_{t+1} = V_t \cdot (1 + r), \quad r \sim \mathcal{N}(\mu, \sigma^2) \tag{6}$$

The simulation includes the following assets with their respective volatilities:

Asset Class	**Mean Return (μ)**	**Volatility (σ)**
Cash Reserves	2.0%	0.0%
ETF Portfolio	7.0%	15.0%
Crypto Assets	10.0%	50.0%

2.2 Household Budgeting Algorithm

The simulation determines the annual change in cash reserves (ΔC) by comparing the user's *target savings* against their *actual ability to pay* for essential living costs.

First, we calculate the **Target Savings** (S_{target}), which is the amount the user *wants* to save based on their chosen savings rate ρ and net income I:

$$S_{\text{target}} = I \cdot \rho$$

Next, we calculate the **Discretionary Balance** (B). This represents the money remaining after paying for rent (R), children (C_K), basic subsistence (C_L), and setting aside the target savings:

$$B = I - R - (N_K \cdot C_K) - S_{\text{target}} - C_L \tag{7}$$

The final change in cash reserves is determined by whether this balance is positive or negative:

- **Surplus ($B \geq 0$):** The user can afford all expenses and the full savings target. The target amount is saved, and the surplus B is assumed to be spent on lifestyle/consumption.
- **Deficit ($B < 0$):** The user cannot afford their planned lifestyle. The deficit is subtracted from the target savings, effectively reducing the amount saved or even requiring a withdrawal from reserves.

$$\Delta C = \begin{cases} S_{\text{target}} & \text{if } B \geq 0 \\ S_{\text{target}} + B & \text{if } B < 0 \end{cases} \tag{8}$$