RETIREMENT PROJECTION METHODOLOGY

Technical methodology and model disclosures

Beyond budgeting. Designed for freedom.

Document version: 2026.06.10
App build: 1.0 (100)
Review status: Internal audit complete (2026.06.10); external CFP review pending
Last updated: June 10, 2026

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Important Notice

Nalu Money is educational software. It does not provide personalized financial, investment, tax, legal, insurance, or accounting advice. Projections are estimates based on user inputs, assumptions, and planning-oriented models. Actual results may differ materially. Users should verify important decisions with appropriately licensed professionals.

Purpose of This Document

This document explains the mathematical models, assumptions, data sources, implementation choices, and known limitations used in Nalu Money retirement projections. It is published to support transparency, public scrutiny, and technical review by users, financial planners, and the FIRE community.

The document is versioned alongside the application. Material changes to retirement math, tax logic, Social Security rules, required minimum distribution calculations, healthcare assumptions, or Monte Carlo methods are recorded in the methodology version history.

How to Read the Results

Nalu Money projections are planning estimates rather than guarantees. A displayed probability of success represents the percentage of modeled scenarios that satisfy the Nalu viability rule under the selected assumptions. It does not represent certainty, a promise of future returns, or a personalized recommendation.

Topics Covered

1. Monte Carlo simulation and the Nalu viability rule
2. Retirement goal and financial-independence calculations
3. Return, inflation, and portfolio assumptions
4. Advanced risk modeling and spending curves
5. Withdrawal strategies and tax-aware sequencing
6. Federal taxes, state taxes, RMDs, Medicare, IRMAA, and ACA subsidies
7. Social Security calculations and limitations
8. Portfolio assumptions, asset location, and tax-loss harvesting
9. Known limitations and planning approximations
10. Data sources, update schedule, and references
11. Methodology governance and version history

Recent material changes (2026.06.10)

- **WEP/GPO repeal (Social Security Fairness Act, PL 118-273).** Windfall Elimination Provision and Government Pension Offset no longer apply to benefits payable Jan 2024+. Engine, UI, and tests updated; legacy tax-profile fields decode only.

- **ACA subsidy cliff restored for 2026.** ARPA/IRA enhanced subsidies expired 2025-12-31; ApplicablePercentages_2026.json now uses the statutory table with linear interpolation and a hard cliff at 400% FPL.
- **Monte Carlo bucket withdrawal tax gross-up.** Deficit withdrawals in tax-bucket mode now iterate gross-up so sequenced pre-tax draws fund their own tax (previewSequencingTax fixed-point loop).
- **LTC probability semantics.** probabilityOfNeed = 0 means never (was inverted); legacy JSON without the key decodes to 1.0.
- **Joint Life RMD scope.** Per-pool householdRMDAmount applies Joint Life to the IRA-aggregated pool only; employer plans use Uniform table (conservative).
- **2026 PIA bend points corrected.** PlanningConstants now carries the official SSA 2026 bend points ($1,286 / $7,749, previously $1,279 / $7,708).
- **OBBB senior bonus phaseout, per-spouse.** The $6,000 senior bonus deduction (2025–2028) is now applied **per eligible person 65+** (e.g. $12,000 for an MFJ couple both 65+) and **phases out at 6% of MAGI** above $75,000 single / $150,000 MFJ, data-driven from Federal/2026.json. MAGI proxy is modifiedAGIForNIIT ?? grossIncome — using gross income overstates MAGI, so the bonus errs **conservative** (more tax). See §6.
- **Social Security COLA SSOT.** The long-run COLA assumption (2.2%) is a single constant (TaxYearConstants.SocialSecurity.averageCOLA) referenced by all benefit, income-stream, and withdrawal paths; previously five independent literals.
- **Savings snapshot (onboarding estimate).** Onboarding can capture a household total-savings estimate before real accounts exist. The **unallocated remainder** (max(0, estimate − Σ real account balances)) feeds Monte Carlo's starting balance as a pre-tax bucket (conservative) and auto-retires as real accounts are added. See §1.

Methodology version table (governance)

Methodology version	App build	Review window	Scope	Panel status
2026.06.10	1.0 (100)	—	WEP/GPO repeal, ACA 400% FPL cliff, MC bucket gross-up, LTC prob fix, Joint Life IRA-only, 2026 PIA bend points, senior bonus phaseout/per-spouse, COLA SSOT, savings snapshot	Not reviewed — internal CFP-panel evaluation doc only
2026.05.29	1.0 (100)	—	Additional/senior SD, TLH planning hook, bootstrap lens, Medicare schedule, multi-sleeve CF, must-spend floor, portfolio manual-first, on-device onboarding metrics, iPad Retire split, accessibility v1.0	Not reviewed — internal CFP-panel evaluation doc only
2026.05.26	1.0 (100)	—	SSOT consolidation, spending tiers, calendar retirement date	Not reviewed

This table tracks **material methodology releases**. It does **not** claim CFP sign-off until a formal review cycle completes and a row is updated with dates and reviewer scope.

Annual law-currency checklist (governance)

Run every Q4 (and after any major federal legislation) before the next plan-year release. The WEP/GPO repeal sat unnoticed ~17 months because no such process existed; this checklist is the corrective control.

#	Source	What to verify	Where it lands in code
1	SSA	PIA bend points, COLA, earnings-test limits, FRA cohorts, WEP/GPO status	PlanningConstants, SocialSecurityCalculatorService
2	ACA / HHS	Applicable-percentage tables, FPL values, enhanced-credit expiry status	Resources/ACA/ApplicablePercentages_*.json, ACASubsidyService
3	IRS Rev. Proc.	Brackets, standard deduction (incl. senior/additional), AMT, contribution limits	Resources/TaxData/Federal/*.json, AnnualTaxKernel
4	CMS	Part B/D premiums, IRMAA tiers and thresholds	MedicarePremiumPolicy, TaxYearConstants.IRMAA
5	SECURE / RMD	RMD start-age cohorts, life-expectancy tables, excise-tax rates	RMDCalculatorService, Pub. 590-B tables
6	State tax	Bracket/deduction updates for supported states	Resources/TaxData/States/, taxConfigService
7	Persisted JSON watchlist	New fields decode backward-compatibly	Scripts/audit-persisted-codable.py manifest

Sign-off: record the review date and reviewer in the methodology version table above before tagging a plan-year release.

This document describes the mathematical models, assumptions, and data sources used in Nalu Money's Monte Carlo retirement projections. It is intended for public audit by the FIRE community, financial planners, and anyone who wants to verify our math before trusting it with real decisions.

Independent CFP review (governance, not a substitute for personal advice)

Nalu Money is **educational software**, not personalized financial, tax, or legal advice. Users should consult a licensed professional for their own situation.

How we use CFP reviewers: For **material** changes to retirement math, tax logic, Social Security rules, RMD tables, or Monte Carlo assumptions, we follow a **written review checklist** (accuracy vs. code, sources, edge cases, disclosure of limitations). The target operating model is a **standing panel of up to seven independent CFP credential-holders** (e.g., retirement income, taxation, insurance/Medicare, Monte Carlo methods) who may rotate by release. Reviewers are **external to day-to-day engineering** when feasible.

What this document does *not* claim: This repository does **not** assert that a specific panel of seven individuals completed a named review on a given date, or that any reviewer endorses outcomes for a particular user. When a formal review cycle completes, we may publish a **version table** (methodology doc version, app build, review date range, scope) in release notes or a separate governance log.

This methodology file is updated whenever those models change. Primary citations and URLs are collected in **Section 11 (References)**.

In-app summary (Settings → Methodology): User-facing retirement topics (spending tiers, survivor mode, healthcare planner, lump sums, persisted-settings safety) are maintained in code as RetirementPlanningMethodology and must stay aligned with this document on material changes.

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1. Monte Carlo Simulation

Nalu Money projects retirement outcomes using Monte Carlo simulation — running thousands of randomized market scenarios to estimate the probability that a retirement plan succeeds.

Simulation Parameters

Parameter	Default	Range	Source
Simulation runs	1,000	1,000–50,000	Minimum 1,000 for statistical validity
Expected return	6% nominal	2–12%	Vanguard VCMM 2024; see Section 2
Volatility (std dev)	11%	5–30%	Ibbotson SBBI 1926–2024 (60/40 portfolio)
Inflation mean	3%	0–8%	BLS CPI-U 1926–2024 average
Inflation volatility	1%	0–3%	Historical CPI-U standard deviation
Annual management fee	0.5%	0–3%	User-configurable; default assumes moderate fees

Single-pool vs multi-sleeve: The 6% nominal expected return and 11% volatility defaults apply to **legacy single-pool** Monte Carlo and align with in-app **Finance Defaults** and Simulation Settings. **Multi-sleeve** mode uses separate expected returns per sleeve (user-configured); portfolio outcomes follow target weights (Section 2).

Success Definition (Nalu Viability Rule)

A simulation run is marked as **successful** if ALL of the following hold:

1. Portfolio balance never reaches $0
2. Balance exceeds 1 year of expenses after year 15 of retirement
3. Withdrawal rate does not exceed 15% for 5+ consecutive years

This is referred to as the **Nalu viability rule** throughout the app. It is more conservative than the common "never hits $0" standard. It flags plans that are technically solvent but functionally unviable — for example, a portfolio with $5,000 left against $60,000 in annual spending.

Withdrawal rate calculation note: The withdrawal rate used in condition 3 is calculated as withdrawal / (balance + withdrawal), where balance is the post-withdrawal portfolio value. This is equivalent to withdrawal / pre-withdrawal balance because balance + withdrawal reconstructs the pre-withdrawal amount. We use this form because the simulation deducts the withdrawal before checking failure conditions, so the pre-withdrawal balance is not stored separately.

Probability Calculation

```
Success Probability = Successful Runs / Total Runs
```

No artificial caps are applied. If the math says 100%, we show 100% (with a disclaimer that certainty is impossible).

When **Must / Like / Legacy** tiers are enabled, the **headline** success probability on Retire and the Dashboard uses **must-tier** annual spend for the viability rule above; **lifestyle** success (total tiers) is shown in a footnote from the **same** run set. See § Spending tiers below.

Life expectancy (planning horizon — single resolver)

Monte Carlo, the Retire tab charts, income coverage, and financial reports share **LifeExpectancyResolver** with policy **preferProfileWithDefaultsFloor**:

- If the household **profile life expectancy** (Person.taxProfile.lifeExpectancy) is set to a positive age, that age is the planning end age for those paths (the Monte Carlo **planning bonus years** setting is **not** added on top of the profile number).
- If the profile field is **unset or zero**, the horizon uses **FinanceDefaults.defaultLifeExpectancy + MonteCarloSettings.planningLifeExpectancyBonusYears** (0–25). Bonus years are a stress overlay on that default; they do not change stored personal records.

Tax Strategy and other flows that choose **cohort table** or **explicit** horizons use the resolver's other policies and are labeled separately where shown.

Retirement timing (planning SSOT)

All planning math reads **Person.effectiveRetirementAge** (helper: PersonRetirementTiming.effectiveRetirementAge). When the user has set a calendar retirementDate on the person, that calendar date drives effectiveRetirementAge; otherwise the integer taxProfile.retirementAge slider age is used as the fallback. Author-side slider commits clear retirementDate so the integer wins after a manual edit.

This SSOT is honored by CalculateRetirementProbabilityUseCase, HouseholdRetirementTimeline, FinancialReportGenerator, DecisionPromptService, FinancialHealthService, TaxBucketBalancesBuilder, RetirementTimeline, the FI Timeline, Tax Strategy, the Roth conversion engine, Purchase Impact, the Dashboard, and the Weekly Check-in. The single intentional exceptions are the slider author paths (RetirementViewModel / TaxStrategyViewModel / HouseholdView) and the data import/export round-trip, which need the integer.

Monte Carlo input parity (Retirement Overview vs Compare Scenarios)

The Retirement Overview headline success % and the Compare Scenarios base-plan success % must agree for the same household. Both screens compose Monte Carlo inputs through a single shared use case, **BuildScenarioMonteCarloInputsUseCase**, which wraps CalculateRetirementExpensesUseCase and the time-bounded-expense → lump-sum mapping. The shared composer guarantees:

1. **Spending corpus.** Same 4-tier hierarchy (see §1A).
2. **Permanent vs time-bounded split.** A 10-year tuition line is modeled as a per-year lump-sum withdrawal, not a permanent spending level — preventing the simulator from charging it as 25× of permanent spending.
3. **Scenario one-time events.** Property sale, inheritance, major purchase, etc. flow as inflation-aware lumps with sign preserved.

Both screens also agree on:

- **Retirement age.** The household withdrawal phase begins on the primary person's age axis at the later of the two modeled retirement ages — **HouseholdRetirementTimeline.effectiveHouseholdRetirementAgeOnPrimaryTimeline**. Contributions continue until both spouses have stopped work (Kitces-style household consensus).

- **Annual contributions.** Sum across all retirement and investment accounts, using the per-account linked person's salary (or the primary's salary as a fallback for unlinked accounts).
- **Medicare enrollment.** ComputeMedicareEnrollmentUseCase shared by both paths.

Prior to this consolidation, the two screens fed the simulator different retirement ages, different spending bases, different contribution totals, and different Medicare anchors — producing visible 20+ point success-probability gaps for dual-earner households. The use case + household timeline pair closes that gap.

Savings snapshot (onboarding estimate — unallocated remainder)

Onboarding can capture a rough household total-savings estimate (RetirementSavingsSnapshot on FinanceDefaults) before any real accounts exist, so a new user lands with a credible success probability instead of an empty model.

- **Derived, never stored.** The unallocated remainder is always computed as max(0, originalEstimate − Σ real retirement account balances) through one helper (RetirementSavingsSnapshot.remaining(givenRealBalanceTotal:) / SavingsSnapshotReconciler) — every surface (Dashboard, Retirement, completion screen) reads the same number, so accounts plus the active snapshot always total the **estimate**, never estimate + accounts (no double counting).
- **Tax treatment (conservative).** The remainder enters Monte Carlo as a **pre-tax** bucket, so its withdrawals are taxed at ordinary rates — the worst-case assumption until real account types are known.
- **Contributions.** An optional monthly contribution estimate is included while the snapshot is active and retires with it.
- **Lifecycle.** The snapshot auto-retires when real balances reach the estimate or the remainder falls within 5% of it; the user can also manually clear the remainder ("everything's entered"). While active, a reconciliation surface lists each real account as a debit against the estimate, and contributing totals are labeled as including an estimated amount.

1A. Retirement goal vs FI Number (two deliberately distinct numbers)

Nalu Money exposes **two** "how much do I need" numbers because each answers a different question. Both source the safe withdrawal rate from FinanceDefaults.safeWithdrawalRate (default 4%, clamped 1–10%).

Gap-based retirement goal (CalculateRetirementGoalUseCase)

- **Formula:** Goal = max(0, annual spending − guaranteed income) / SWR
- **Used by:** Retirement Overview goal prompt, Onboarding suggested target, scenario required-savings PMT
- **Rationale:** Bengen's 4% rule applies to the **portfolio-funded** portion of retirement spending. Social Security and pensions reduce the amount the portfolio must support. Total-spending × 25 was the prior (incorrect) implementation; it ignored guaranteed income and overstated the target.
- **Stress-test override:** When guaranteed income already covers spending (gap ≤ 0), the goal prompt falls back to a gross **spending / SWR buffer** ("what if Social Security were cut?") so the headline number is grounded and never zero.

FI Number (CalculateFIMetricsUseCase)

- **Formula:** FI Number = annual expenses / SWR (no guaranteed-income subtraction)
- **Used by:** FI Timeline, FISnapshot, Coast FI math, Years-to-FI projection, FIRE-community comparisons
- **Rationale:** The FIRE movement uses total-spending × 25 as a portfolio threshold for "work becomes optional." It is intentionally larger than the gap-based goal — that conservatism is the point.

Every UI surface labels which number it is showing. The FI Timeline and FI Number Explainer cards state "expenses / SWR"; the Retirement goal prompt and Customize sheet show the gap breakdown explicitly.

4-tier retirement spending hierarchy (CalculateRetirementExpensesUseCase)

Both numbers above use the same retirement-spending estimate. It is resolved in this priority order:

1. **Spending Tiers** — when Must / Like / Legacy is enabled and total > 0, the tiered annual sum is used. Headline success is computed against must-tier only (essentials covered); lifestyle success uses the total.
2. **Custom override** — FinanceDefaults.expectedRetirementMonthlySpending × 12, when the user has set an explicit retirement budget.
3. **Base Plan curated expenses** — RetirementScenario.retirementMonthlySpending(adjustmentFactor:), when a Base Plan exists and has qualifying lines. Curated expenses beat unfiltered tracked totals (Pfau goals-based-budgeting).
4. **Tracked recurring × adjustment factor** — recurringMonthlyTotal × FinanceDefaults.retirementSpendingAdjustmentFactor (default 80%). Reflects the CFP-standard 70–80% income-replacement band for households without a curated plan.
5. **Income fallback** — householdAnnualIncome × 0.50 × adjustmentFactor. Last-resort estimate when no tracked expenses and no plan exist (used during Onboarding before data entry).

Every Monte Carlo entry point, the Retirement Overview, the Dashboard probability hero, the Onboarding probability tile, and FinancialReportGenerator route through this single use case. The previous Retirement ViewModel mirror and Dashboard/Onboarding inline 0.50 × spendingFactor shortcuts have been removed.

Required savings PMT (CalculateRequiredSavingsUseCase)

The "monthly savings needed" headline on Retirement Overview and Onboarding delegates to a single use case:

```
PMT = (FV − PV·(1+r/12)^n) · (r/12) / ((1+r/12)^n − 1)
```

where FV is the gap-based goal, PV is current portfolio balance, r is FinanceDefaults.defaultReturnRate (default 6% nominal), and n is months to retirement. Monthly compounding. The use case clamps to non-negative, returns zero when the goal is already met by current-balance growth, and falls back to straight-line (goal − balance) / months when the rate is near zero.

The Scenarios screen's required-annual-savings number uses an annual PMT plus an existing-contribution roll-up (ScenarioAnalysisService.calculateRequiredSavings); this is a deliberate periodization difference for the scenario "gap to close" UX and is documented in the audit doc.

2. Return Assumptions

Default: 6% Nominal (60/40 Portfolio)

Why 6% instead of the historical ~8%:

The historical average return for a 60/40 US stock/bond portfolio from 1926–2024 is approximately 8% nominal (Ibbotson SBBI Yearbook). However, forward-looking estimates are lower due to elevated equity valuations and lower bond yields.

Sources:

- Vanguard Capital Markets Model (VCMM) 2024: 10-year median for 60/40 is approximately 5.5–6.5% nominal
- Ibbotson SBBI Yearbook (1926–2024): Historical 60/40 ~8% nominal, ~10.5% volatility
- Research Affiliates (2024): Expected real return for 60/40 ~3–4%

We default to 6% as a conservative forward-looking estimate. Users can adjust to 7–8% if they prefer historical averages. The setting is prominently displayed on the dashboard probability card.

Return Distribution: Cornish-Fisher (Default)

Real market returns are not normally distributed. They exhibit:

- **Negative skewness**: Crashes are larger than rallies (-0.5 skew parameter)
- **Fat tails (excess kurtosis)**: Extreme events occur more often than a bell curve predicts (1.0 excess kurtosis)

We use the **Cornish-Fisher expansion** to generate returns with realistic tail behavior.

Source: Cornish, E.A. & Fisher, R.A. (1938). "Moments and Cumulants in the Specification of Distributions." Revue de l'Institut International de Statistique.

Parameters: | Parameter | Value | Calibration Source | |-----------|-------|--------------------| | Skewness | -0.5 | S&P 500 monthly returns 1926–2024 | | Excess kurtosis | 1.0 | S&P 500 monthly returns 1926–2024 |

Alternative distributions available:

- Normal (Gaussian): Standard bell curve
- Log-Normal: Prevents negative prices

Optional: Multi-Sleeve Portfolio (Cash / Nominal Bonds / TIPS / Equities)

When enabled in Simulation Settings, the engine maintains up to **four sleeves** with user-defined **target weights** (summing to 100%): cash, **nominal** bonds, optional **TIPS-style** inflation-linked bonds, and equities. Each year the simulation:

1. Draws a **correlated four-dimensional Gaussian** shock (Cholesky decomposition of the user's correlation matrix, with PSD fall back to uncorrelated shocks if the matrix is numerically invalid).
2. Applies nominal mean/vol to cash, nominal bonds, and equities; applies **real** mean/vol to the TIPS sleeve, then maps TIPS to a **nominal** return for that year using the **same** simulated CPI shock (\pi_t) used to update cumulative plan inflation: ((1 + r^{TIPS}_{real,t})(1 + \pi_t) - 1) (Fisher-style compounding). Regime-switching adds the full equity-style modifier to cash/bond/equity means and **half** that modifier to the TIPS **real** mean (TIPS are less equity-cyclical; still an approximation).

3. Applies optional **volatility clustering** by scaling all sleeve volatilities off a long-run portfolio (\sigma) that treats TIPS nominal risk with (\sqrt{\sigma^2_{TIPS,real} + \sigma^2_{\pi}}) (ignores correlation between real TIPS noise and inflation; conservative documentation in code comments).
4. **Rebalances** to target weights after annual returns (and again after any modeled rebalancing bonus and management fee).

Optional TIPS-first withdrawal: When expenses exceed income, the user may fund the withdrawal by liquidating sleeves in order **TIPS → nominal bonds → cash → equities** instead of proportional slices. **RMD-only** years (income covers expenses) still use **proportional** withdrawals. Annual rebalance to targets still runs after returns, so this is a **simplified bucket/decumulation hint**, not a full non-rebalancing TIPS ladder.

Legacy single-pool mode (default) continues to support **Cornish–Fisher** fat tails on one aggregate portfolio return. **Multi-sleeve mode** applies the same Cornish–Fisher skew/kurtosis transform to each independent standard-normal shock **before** Cholesky correlation when returnDistribution is Cornish–Fisher; Normal and Log-Normal distribution settings still use Gaussian per-sleeve shocks in multi-sleeve mode.

Sources (conceptual): Cholesky factorization for correlated normals; portfolio variance with correlations (Markowitz mean–variance framework); TIPS instrument overview from TreasuryDirect (see Section 11).

Optional glide path (multi-sleeve)

When **glide path** is enabled in Simulation Settings, the engine **interpolates target sleeve weights** between a start age and end age (typically toward lower equity through the glide window), then **rescales** cash, nominal bonds, and TIPS so weights sum to 100%. Each simulated year uses the targets for that **attained age** for: initial allocation, accumulation-year contributions and returns, surplus splits in retirement, and post-return rebalancing. This is a **deterministic age-based glide** (not volatility- or funding-ratio-triggered). Implementation: MonteCarloSimulationService.sleeveTargetWeights.

Qualified charitable distributions (QCD) vs. RMD in Monte Carlo

Deficit years (spending exceeds income): portfolio shortfall is grossed up for draw taxes (MonteCarloWithdrawalStrategyMath.grossUpBucketModeShortfall / legacy flat-rate path). The **statutory RMD is not added on top** of that shortfall — it satisfies part of the cash need via the RMD **floor** (max(grossedShortfall, RMD)), matching WithdrawalSequencingService RMD-first semantics. Implementation: MonteCarloWithdrawalStrategyMath.deficitYearRequiredWithdrawal.

Surplus years: gross RMD is withdrawn from pre-tax, ordinary tax applies to the taxable portion (with QCD reducing taxable income when configured), and the after-tax remainder is reinvested into taxable.

QCD does **not** flow through full Form 1040 AGI modeling in Monte Carlo; surplus-year QCD reduces taxable RMD income only. Deficit-year sizing uses the portfolio shortfall alone.

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3. Advanced Risk Modeling

Regime Switching (Enabled by Default)

Markets alternate between bull and bear regimes. Our model uses a two-state Markov chain:

Regime	Duration	Return Modifier	Volatility Modifier
Bull	~6 years avg	+2.5% return	-20% volatility (×0.8)

Regime	Duration	Return Modifier	Volatility Modifier
Bear	~2 years avg	-7.5% return	+40% volatility (×1.4)

Zero-centered: 75% bull × (+2.5%) + 25% bear × (−7.5%) = 0% net bias.

Source: NBER business cycle data; Black, F. (1976). "Studies of Stock Price Volatility Changes."

Volatility Clustering (Optional)

Markets exhibit GARCH-like volatility clustering — periods of high volatility tend to persist.

Model: GARCH(1,1)-inspired with parameters:

- omega = 0.05 (long-run variance weight)
- beta = 0.85 (persistence of past volatility)
- alpha = 0.10 (reaction to recent shocks)

Source: Bollerslev, T. (1986). "Generalized Autoregressive Conditional Heteroskedasticity." Journal of Econometrics.

Mean Reversion (Default Strength: 0.25)

Over long horizons, returns tend to revert toward historical averages.

Source: Poterba, J.M. & Summers, L.H. (1988). "Mean Reversion in Stock Prices." Journal of Financial Economics.

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4. Spending Curves

Spending Smile (Default)

Research shows retirement spending is not constant. It follows a "smile" pattern:

Age Range	Spending Factor	Phase
65–74	100%	Go-go years (active travel, dining)
75–84	85%	Slow-go years (reduced activity)
85+	90%	No-go years (healthcare costs offset decline)

Source: Blanchett, D. (2014). "Estimating the True Cost of Retirement." Morningstar Investment Management.

Other curves available: Flat (100% throughout), Declining, Custom age bands.

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5. Withdrawal Strategies

Fixed Spending (Default)

Withdraw the planned spending amount each year, adjusted for inflation. No behavioral adjustments based on portfolio performance.

Guard Rails (Guyton-Klinger Style)

Adaptive strategy that adjusts spending based on portfolio performance:

- **Ceiling rule**: If withdrawal rate exceeds 5% of portfolio, cap spending at 5%
- **Floor rule**: If withdrawal rate drops below 3%, spending can increase (informational)

Source: Guyton, J.T. & Klinger, W.J. (2006). "Decision Rules and Maximum Initial Withdrawal Rates." Journal of Financial Planning.

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6. Tax Engine

Federal Income Tax

- Progressive brackets sourced from IRS publications
- Standard deductions by filing status, plus optional **additional standard deduction** (age 65+/blind) from federal JSON when kernel inputs specify conditions
- **Senior bonus deduction (OBBB, 2025–2028):** $6,000 **per eligible person 65+** (seniorBonusEligiblePersons count — $12,000 for an MFJ couple both 65+), **phasing out at 6% of MAGI** above $75,000 (single / MFS / HoH) or $150,000 (MFJ). Thresholds, rate, and amount are data-driven from Federal/2026.json (additionalStandardDeduction.seniorBonus*). **Planning-grade approximation:** the phaseout MAGI proxy is modifiedAGIForNIIT ?? grossIncome; gross income ignores pre-tax deductions, overstating MAGI, so the bonus errs conservative (toward more tax). Withdrawal sequencing infers eligibility from modeled filer ages ≥ 65.
- Tax year support: 2025, 2026+ (configuration files updated annually)
- Long-term capital gains: 0%, 15%, 20% brackets (income stacking method)
- Net Investment Income Tax (NIIT): 3.8% surtax above MAGI thresholds
- **Alternative Minimum Tax (AMT):** Parameters load from the federal JSON (amt) using a **Form 6251–style** exemption (with phase-out), two-rate tentative minimum tax on taxable excess (26% / 28% with the IRS breakpoint offset), and **AMT owed** = max(0, TMT − regular federal income tax on ordinary + preferential components before AMT). **AMTI is simplified** (aligned with the same taxable-income proxy used for bracket stacking in the engine, plus optional amtAdjustmentItems on CalculateTaxLiabilityUseCase.Input). The model does **not** refigure capital gains under Form 6251 Part III, ISO spreads, or all preference items. **Source:** Instructions for Form 6251. Bundled dollar amounts follow the instructions year carried in Federal/2026.json until IRS publishes the next year's figures.
- Additional Medicare tax: 0.9% above thresholds

State Taxes

- All 50 states supported
- Types: Progressive, Flat, None
- **Deduction basis:** each state applies its own standard deduction by filing status where tabulated (now honored for **flat** states too, e.g. North Carolina). **Rolling-conformity** states whose tax starts from **federal taxable income** (flagged conformsToFederalTaxableIncome, e.g. **Colorado**) subtract the

federal standard deduction before the state rate. Where a state has neither a tabulated deduction nor federal conformity configured, the state base does not subtract a deduction (planning-grade — may overstate that state's tax until tabulated).

- Source URLs and verification dates tracked per state

Required Minimum Distributions (RMDs)

- SECURE 2.0 Act compliant
- **Birth-date** cohort start ages (preferred — see RMDCalculatorService.rmdStartAge(birthDate:)):
  - **July 1, 1949 – Dec 31, 1950 → 72**
  - **Jan 1, 1951 – Dec 31, 1958 → 73**
  - **1959 → 73** (per final IRS regulations / CRS cohort summary)
  - **Jan 1, 1960 and later → 75**
- Birth-**year** fallback used when only year is available (rmdStartAge(birthYear:)):
  - 1950 or earlier → 72
  - 1951 – 1959 → 73
  - 1960 or later → 75
- **Out of scope:** Anyone born before July 1, 1949 (historic 70½ rules). The API returns 72 for these cohorts as a documented fallback; we do not model the 70½ age or related legacy distribution mechanics.
- **IRS Uniform Lifetime Table** (Pub. 590-B Table III) — used for most owners.
- **IRS Joint Life and Last Survivor Table** (Pub. 590-B Table II) — used when the spouse is the sole primary beneficiary AND the owner is **more than 10 years** older than the spouse. In Monte Carlo per-pool aggregation (householdRMDAmount), Joint Life applies to the **IRA-aggregated pool only**; employer plans use the Uniform table (conservative) until per-account beneficiary attestation ships. Single-account calculateRMD and withdrawal-sequencing aggregate paths still use a household-level spouse-age heuristic when the gap exceeds 10 years. Per-account beneficiary tracking is **not** fully modeled; implementation: RMDCalculatorService.distributionPeriod(ownerAge:spouseAge:) and householdRMDAmount.
- **IRS Single Life Expectancy Table** (Pub. 590-B Table I) — used to compute SECURE Act "ghost RMDs" for non-spouse inherited IRAs whose original owner had begun their own RMDs. Implementation: RMDCalculatorService.singleLifeDivisor(age:).

Qualified Charitable Distributions (QCDs) in the deterministic sequencing path

The Monte Carlo path has long modeled QCDs (QCDQualifiedDistributionCalculator); as of this release, the deterministic WithdrawalSequencingService (used by the report path and the Roth-conversion ladder) also reduces the **taxable** portion of each year's RMD by the eligible QCD amount via the same shared calculator (SSOT). Pass a QCDPolicy(annualAmount:startAge:annualCap:) on WithdrawalSequencingInput.qcdPolicy to opt in.

- Default age gate: **whole-age modeling floor** (commonly **70**); IRC statutory eligibility uses **70½**. Edge taxpayers near age boundaries should verify eligibility outside the app.
- Default annual cap: **$108,000** (2025 indexed per IRC § 408(d)(8); configurable per dev-rules).

- Effect: total traditional withdrawal still satisfies the gross RMD (account-level effect identical to no-QCD); only the ordinary-income stack drops by qcdAppliedThisYear. MAGI for IRMAA also drops by the same amount.

SECURE Act 10-year rule for non-spouse inherited IRAs

Per IRS 2024 **final regulations** (Treas. Reg. § 1.401(a)(9)-9), non-eligible designated beneficiaries follow one of two distribution tracks within the 10-year window:

1. **Ghost-RMD track** — when the original owner had **already begun RMDs at death** (i.e. died on/after their Required Beginning Date), the beneficiary must take **annual RMDs in years 1–9** using the **Single Life Expectancy Table** at the beneficiary's age in **year 1**, decremented by 1 each subsequent year (the "subtract one" / fixed-term annuity method). Year 10 distributes the remaining balance.
2. **Level-depletion track (legacy)** — owner died **before** their RBD: the beneficiary owes only a full balance drain by **year 10** (no annual ghost RMDs in years 1–9). The engine uses a PMT-style annuity schedule.

Eligible Designated Beneficiaries (spouse, minor child, disabled, chronically ill, not more than 10 years younger than decedent) **bypass** the 10-year rule entirely. To enable the ghost-RMD branch, set InheritedIRAPlanningInput.originalOwnerHadBegunRMDs = true and supply beneficiaryAgeInFirstDistributionYear.

Still-working exception (IRC § 401(a)(9)(C))

Participants who are still working past their RMD start age may **defer** RMDs from their **current employer's** qualified plan only (401(k), 403(b), 457(b), TSP, Solo 401(k)) — **not** IRAs (Traditional / SEP / SIMPLE), and **not** prior-employer plans. **5%+ owners** (per IRC § 416(i)) are statutorily disqualified.

Nalu Money models this by:

- A planning-grade toggle only — **controlled-group attribution**, uncommon sponsor structures, and multi-employer facts beyond “same sponsoring employer” are **not** modeled; CPA verification applies whenever stakes span affiliated employers.
- A new account-level flag RetirementAccount.stillWorkingExceptionEligible (default false, additive Core Data attribute on RetirementAccountEntity).
- A new tax-profile gate TaxProfile.isFivePercentOwner (default false, persisted via the existing TaxProfile blob — no Core Data migration).
- The builder TaxBucketBalances.build exposes the eligible balance as stillWorkingExceptionPreTaxBalance (a slice of preTaxBalance).
- The Monte Carlo engine **excludes** this slice from the RMD base while ageThisYear < retirementAge, then folds it back into the base once the participant reaches their retirementAge.
- Deterministic WithdrawalSequencingService consumes the same ratio via stillWorkingExceptionFraction on WithdrawalSequencingInput (derived from TaxBucketBalances.stillWorkingExceptionFraction — SSOT with TaxBucketBalances.build). The annual RMD divisor balance is reduced by balance × fraction while plan-year age **age < retirementAge**. When this fraction is **positive** and currentAge < retirementAge, the sequencing horizon begins at approximately **max(currentAge, rmdStartAge − 3)** instead of only after retirement age so those working-year bars align with Monte Carlo’s overlap rules without modeling unrelated decades early in adulthood.

The slice is tracked as a **fraction** of preTaxBalance so year-on-year growth and new contributions automatically scale the dollar exclusion proportionally (mass-conserving — no per-year bookkeeping required).

April 1 first-RMD delay election (IRC § 401(a)(9)(C)(ii))

Owners may elect to defer their **first** RMD from the year they reach rmdStartAge (year 1) to **April 1 of the following year** (year 2). This stacks **two RMDs in one calendar year**, which can push the household into a higher marginal bracket.

- Opt-in via WithdrawalSequencingInput.firstRMDDelayElected = true (default false).
- Year-1 RMD-driven traditional withdrawal: **zero** (deferred).
- Year-2 traditional withdrawal: **year-1 deferred + year-2 normal RMD**, both flowing through that year's ordinary-income stack.
- RMDCalculatorService.compareDelayElection(rmdStartAge:lifeExpectancy:initialBalance:expectedReturn:) returns (noDelay, delayed) LifetimeRMDSummary pairs so the Tax Strategy screen can show a side-by-side tax impact (Holistiplan / eMoney-style comparison).

Citations (verify annually):

- IRS Pub. 590-B (Tables I, II, III; ghost-RMD; April 1 election)
- Treas. Reg. § 1.401(a)(9)-9 (Single Life "subtract one" / fixed-term annuity)
- IRS Final Regulations on Required Minimum Distributions (89 Fed. Reg. 58886, July 19, 2024)
- IRC §§ 401(a)(9), 408(d)(8), 416(i)

RMD base (which balance the divisor is applied to). When TaxBucketBalances are supplied to the Monte Carlo engine (the standard path for both the chart and the probability calculations), the annual RMD is computed against the **pre-tax bucket only** (Traditional IRA / 401(k) and similar). Roth and after-tax brokerage assets do **not** generate an RMD, so they are excluded from the divisor base. If buckets are not supplied (legacy callers), the engine falls back to the total simulated balance — a conservative approximation kept for backward compatibility.

IRA pool vs. per-employer-plan pools (May 2026). RMDPoolBuilder groups **all Traditional IRAs** into one **IRA aggregate pool** (single divisor on combined IRA balance per IRS aggregation rules). Each **employer plan** (401(k), 403(b), etc.) remains its own pool. RMDCalculatorService.householdRMDAmount sums pool-level RMDs. Monte Carlo seeds TaxBucketBalances.initialRMDPools so year-over-year RMD pressure scales with the same pool structure. This is planning-grade — not per-custodian Form 5498 sourcing.

Excess accumulation excise tax (planning-grade). When simulated withdrawals fall short of the annual RMD floor, WithdrawalSequencingService and the Monte Carlo bucket path apply the IRC §4974 excise tax on the shortfall (SSOT: RMDExciseTax). Per **SECURE 2.0 Act of 2022 §302** the rate is **25%** statutory, reduced to **10%** when the shortfall is corrected within the IRS correction window. The engines model the conservative **25%** by default; the **10% timely-correction path** is available via WithdrawalSequencingInput.assumeTimelyRMDCorrection and surfaced in the year notes. Not a full Form 5329 reconstruction.

Inherited IRAs inside the pre-tax bucket (Monte Carlo simplification). When inherited IRA balances are included in the same **household pre-tax pool** the engine uses for the divisor, mandatory inherited schedules (10-year / ghost-RMD tracks described above) contribute to that **aggregate** RMD pressure. This is a **pool-level** planning approximation — not account-by-account IRS sourcing across every institution. The Tax Strategy withdrawal appendix can still reflect schedule detail when you enter inherited-IRA planning inputs there.

RMD treatment in surplus years (income covers expenses). Required distributions are a **tax event**, not a spending event. When other income (Social Security, pensions, annuities, etc.) already covers the year's expenses, the simulator:

1. Withdraws the gross RMD from the **pre-tax** bucket.

2. Applies the marginal **ordinary-income tax rate** to the (post-QCD) taxable RMD remainder. QCDs already netted out of taxable RMD continue to apply (see "Qualified charitable distributions" above).
3. **Reinvests the after-tax remainder into the taxable (brokerage) bucket**, where it continues to grow with the rest of the portfolio.

This matches industry-leading retirement planning tools (e.g., RightCapital's "spend vs. reinvest unsaved RMD" assumption) and the financial planning literature (Kitces, "How RMDs are calculated and managed in retirement"). It eliminates the artifact where a healthy retiree's chart trended steadily down at age 73 even when their guaranteed income covered all spending — the prior model implicitly assumed the RMD was lost rather than redirected to taxable savings.

Deficit years (income does not cover expenses) continue to use the standard withdrawal-sequencing logic (WithdrawalSequencingService): the RMD floor is enforced first against pre-tax balances, then any additional withdrawal needed to meet the spending shortfall draws from taxable → traditional → Roth in order, applying account-appropriate tax rates as it goes.

Limitations. Inside Monte Carlo, the engine does **not** model:

- The downstream taxability of Social Security caused by the additional ordinary income from the RMD (i.e., **provisional income / SS taxation cascade**).
- **IRMAA** Medicare premium surcharges that an RMD-bumped MAGI may trigger two years later.
- **NIIT** (3.8%) cascading onto reinvested gains in subsequent years.
- The **Additional Medicare tax** (0.9%) cascade.

These cross-effects require tax-return-grade income stacking and are explicitly out of scope for the simulation overlay; they remain handled in the standalone tax engine for single-year calculations only.

IRMAA (Medicare Premium Surcharges)

What IRMAA is (plain language): People with Medicare who have **higher income** may pay **more** for Part B and Part D through an income-related adjustment. The income test is based on **tax return data** from an **earlier year** (often **two calendar years before** the premium year). Brackets and dollar amounts are **updated by CMS/Medicare**; do not treat in-app numbers as a promise of your bill.

Where Nalu Money uses IRMAA today:

- Roth conversion and related planning flows may reference **fixed** threshold and surcharge values for education (see TaxYearConstants.IRMAA in code and MedicarePremiumPolicy for tier tables).
- **Household annual surcharge** math for a stated MAGI is centralized in MedicarePremiumPolicy so Roth and Monte Carlo overlays stay aligned.

Where Nalu Money does *not* fully model IRMAA:

- We do **not** reconstruct your full federal **MAGI** each year inside Monte Carlo, and we do **not** implement the **two-year lag** against simulated portfolio withdrawals by default. That requires tax-return–grade income stacking (SS taxation, RMDs, basis, etc.) and is explicitly out of scope for the optional Monte Carlo overlay described below.

Authoritative references (verify annually): see **Section 11** (Medicare.gov IRMAA overview, CMS fact sheets, Medicare costs PDF, IRS Topic 551 for MAGI context).

Pre-Medicare private premium bridge (Monte Carlo)

Single source of truth for inputs: FinanceDefaults/preMedicareHealthBridge (Retirement Planning settings). Values are copied into each Monte Carlo run as a **runtime-only** field on MonteCarloSettings — they are **not** duplicated inside Monte Carlo persistence JSON.

Behavior: When enabled (and not marked as already included in base retirement spending), the engine adds monthlyCostNominal × 12, inflated by the **same cumulative inflation factor** as other retirement expenses, for simulated ages **from household retirement start until every modeled adult reaches Medicare**. When Household birthdates exist, the bridge continues while **any** adult is still pre-Medicare (staggered spouse timing); otherwise the primary person's age vs. the configured eligibility age (default 65) is used. The planner offers an illustrative household benchmark when monthly premium is unset.

ACA premium tax credit in Monte Carlo (May 2026; cliff restored June 2026). When applyACASubsidy is enabled on the bridge, annualAdditiveExpenseNetOfACA reduces the pre-Medicare cash need using a **MAGI proxy** (household income vs. federal poverty level) and the configured SLCSP benchmark — planning-grade, not a full Form 8962. **2026 statutory table:** ARPA/IRA enhanced subsidies expired 2025-12-31; the **400% FPL cliff** is restored — households above 400% FPL receive no premium tax credit. Applicable percentages interpolate linearly within FPL brackets (2.1%–9.96%). Caps apply; verify annually against CMS/IRS tables.

Also out of scope: HSAs, COBRA pricing rules, and household-specific underwriting. Use the **"already counted in spending"** toggle if retirement spending already embeds marketplace premiums.

Relationship to Tax Strategy: The bridge adjusts **Monte Carlo** cash needs only; deterministic withdrawal sequencing paths continue to use retirement spending from CalculateRetirementExpensesUseCase unless separately extended.

Survivor projection mode (Monte Carlo)

When **Survivor after first death** is enabled, after survivorFirstDeathAge the engine models **single filing** (bracket path) and adjusts income via BuildSurvivorAdjustedIncomeStreamsUseCase: non-SS spouse income drops by survivorIncomeDropRate; Social Security for the surviving primary uses **max(own benefit, deceased benefit × survivor fraction)** per SocialSecurityWindfallProvisionCalculator (simplified early-claim ramp). Assumes the **primary** (.self_) survives — not which spouse dies first. Heuristic only; not a full household estate model.

Spending tiers and plan success (May 2026)

When **Must / Like / Legacy** tiers are enabled (FinanceDefaults.spendingTiers), **simulation cash flows** use **total** tier spend (must + like + legacy). The **headline success probability** uses **must-tier** spend only ("essentials covered"). Lifestyle success is higher than or equal to must-tier success for the same seed set.

In-app disclosure (May 2026): When tiers are on, Retire and the Dashboard hero show a footnote with **both** percentages from the **same** Monte Carlo run (essentials headline + full lifestyle plan). Configure tiers under **Planning → Healthcare & Care Costs** or Finance Defaults.

Healthcare & care costs planner (UI entry)

Planning → Healthcare & Care Costs (HealthcareCostPlannerView) is the user-facing SSOT for:

- Pre-Medicare health bridge and optional ACA premium tax credit (FinanceDefaults.preMedicareHealthBridge)
- Must / Like / Legacy spending tiers (FinanceDefaults.spendingTiers)
- Long-term care additive expense (FinanceDefaults.longTermCarePlan), optional **probability of need** per Monte Carlo path (Bernoulli draw at path start; 0 = **never** applies, 1 = always/deterministic — fixed June 10, 2026. Legacy JSON without the key decodes to 1.0 to preserve prior always-on behavior)

- Per-person Medicare start years from Household birthdates, Part B/D planning defaults (CMS 2026 figures), and premium estimates in today's dollars
- Medicare premium overlay toggles, bracket-mode Part B/D, and IRMAA tier sensitivity (runtime copy from MonteCarloSettings; deep knobs in Simulation Settings)

Edits use **Cancel** (discard) and **Done** (save to Finance Defaults + Monte Carlo settings). One-time lump sums remain on **Retire → Overview**.

Optional Medicare premium overlay (Monte Carlo)

Defaults: Overlay toggle **off**; Part B/D use CMS-style 2026 planning figures in MedicarePremiumPolicy (including a national-average Part D placeholder). **Enrollment timing** uses each adult's birthdate from Household when available so a younger spouse's Medicare start can lag the primary by several years.

Standard Part B/D bases apply for **active enrollees** in each simulated year when the overlay is on **or** when bracket taxes are on and modelStandardPremiumsInBracketMode is true (default). Amounts: standardPartBMonthlyPerPerson and partDBaseMonthlyPerPerson × 12 × active enrollee count, inflated with the plan CPI series.

Dynamic IRMAA (bracket-tax path): When useBracketTaxes is enabled, **IRMAA surcharges** use simulated **MAGI from a two-year lookback** and scale with the **active enrollee count** that year (Roth conversions, relocations, and draw sequencing feed MAGI). Static planningIRMMAaTierLevel applies only on the **flat-rate** tax path.

Flat-rate path: Optional fixed IRMAA tier (1…5) for sensitivity when bracket taxes are off.

Double-count warning: Use **"premiums already in spending"** on the overlay or the pre-Medicare bridge toggle if retirement spending already embeds health costs.

Second-opinion / review expectation: Because IRMAA interacts with real tax returns, Roth conversions, and claiming strategies, **material** changes to Medicare premium modeling are explicitly flagged for **independent CFP / tax professional review** before we treat them as "settled" behavior — see the governance statement at the top of this document.

Capital Gains Tax

Each taxable investment account stores a user-editable **unrealized gain percentage** (default: 50%). When projecting withdrawals from taxable accounts, capital gains tax is calculated as:

```
Capital Gains = Withdrawal Amount x Unrealized Gain Percentage
Tax = Capital Gains x Applicable LTCG Rate (0%, 15%, or 20%)
```

Users can set the unrealized gain percentage per account based on their brokerage statement (Net Worth > Edit Account > Cost Basis). A 20-year buy-and-hold index fund position might be 70% gains, while a recently purchased bond fund might be 5%.

This matches the approach used by CFP-grade planning tools (e.g., RightCapital) — per-account ratios rather than lot-level tracking.

Roth conversion planning sensitivity (Tax Strategy appendix vs. Retirement Monte Carlo)

Tax Strategy exposes **two** complementary lenses:

1. **Deterministic Roth net-benefit sensitivity (appendix PDF + primary Roth table)**
   Each row varies one planning input (within bounds tied to Simulation Settings bumps), then **fully re-evaluates** the Roth conversion ladder kernel. The plotted quantity is lifetime **planning net benefit** = modeled **future taxes avoided on Roth-funded growth − taxes paid today on conversions** (RothConversionService.performSensitivityAnalysis → evaluateConversionKernel). Treat this as rigorous

for that **deterministic tax-benefit** measure — not shorthand math that scales the baseline outcome without recomputing conversions.

2. **Optional Retirement Monte Carlo "plan context" (in-app, Pro)**
   The same reduced-run **SensitivityAnalyzerService** tornado used under **Retirement** can be surfaced from Tax Strategy Roth. It reports **Δ probability of plan success** (Nalu viability rule / Monte Carlo success definition) versus a baseline stochastic run built from consolidated household Retirement inputs. Monte Carlo paths **do not** embed modeled Roth conversions in the stochastic engine yet; interpret this tornado as **how market and spending shocks move your headline Retirement probability**, contextualizing the Roth appendix — **not** a second read on the appendix's deterministic net-benefit dollars.

Roth conversion window and per-year kernel

The Roth conversion planner (RothConversionService.calculateOptimalPlan) sizes year-by-year conversion amounts inside a **dynamic window** rather than a hardcoded age cap. Two methodology updates shipped in May 2026:

Expanded window. The conversion window now spans **currentAge + 1 → rmdStartAge − 1** (Slott-style full pre-retirement modeling) instead of the prior hard cap of age 62. The lower bound prevents retroactive sizing for the current calendar year; the upper bound stops conversions the year before forced RMDs begin. The 15-year cap that previously truncated long windows has been replaced by a per-year **expected-value gate** (below) — gate plus available cash plus traditional-balance depletion bound the plan naturally.

Per-year state kernel. When the household has set plannedMoveYear for a planned retirement relocation, each modeled year selects the **current-state** or **target-state** kernel depending on whether the conversion happens before or after the move year. This matches the existing compareConversionTiming lens that already used per-leg kernels and removes the prior single-kernel asymmetry. State tax kernels come from TaxConfigurationService.loadStateConfig(state:year:).

Per-year expected-value gate. A conversion in year *t* is permitted only when the **current marginal rate at the conversion size** is less than or equal to the **future RMD-year marginal rate plus a 1pp tolerance**. The current-rate side uses the active state kernel for that year (per above); the future-rate side uses the RMD-year kernel with projected income. The gate naturally skips conversions for households in higher-tax-now states until after a planned move, and stops once future rates fall below current rates.

IRMAA two-year lookback preserved. The cap on conversions at ages 63 and 64 — irmaaThreshold − incomeAtAge (stay below tier 1) — is unchanged. SSOT for the threshold is **TaxYearConstants.IRMAA.firstMarggiThreshold(filingStatusKey:)** (the same source used by IRMAA tier classification, education copy, and MedicarePremiumPolicy). For ages 65+, IRMAA is enforced annually through the tax kernel rather than a sizing cap.

Recommendation honesty. When the gate and bracket-fill produce an empty plan, the recommendation is downgraded to .doNotConvert with an explanatory buildExplanation body, instead of showing "Convert Aggressively" alongside a $0 plan.

Pension data SSOT (legacy rule fields vs pension amounts)

Two surfaces store pension-related data; they are deliberately **not** duplicates:

- Legacy **TaxProfile.socialSecurityNonCoveredPensionAnnual** and **socialSecurityGovernmentPensionMonthly** are retained for decode compatibility only. WEP and GPO were **repealed** by the Social Security Fairness Act (PL 118-273, signed Jan 2025; effective benefits payable Jan 2024+). They are **not** applied in projections.

- **RetirementIncomeEntity** rows with incomeType = .pension carry the authoritative pension **amounts** consumed by CalculateGuaranteedIncomeUseCase, the Monte Carlo income streams, the bridge analysis, and PDF reports. This is the SSOT for pension dollars.

Never duplicate the dollar amount between the two surfaces. The Income Hub collects pension income rows. The audit doc records this contract.

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7. Social Security

- Full Retirement Age (FRA) calculation by birth year
- Benefit adjustment by claiming age (62–70)
- COLA: 2.2% average (configurable)
- **Retirement earnings test (claiming while working):** For beneficiaries receiving **retirement** benefits before FRA, Nalu Money can reduce modeled benefits using the SSA **annual** retirement earnings test. Calendar-year exempt amounts and the **$1 for** $2 ** (under FRA for the whole year) and **1 for $3** (year of FRA attainment, earnings counted only through the month before FRA) rules are loaded from SocialSecurityEarningsTest.json (embedded fallbacks in SocialSecurityEarningsTestConfiguration.embeddedDefaults). Implementation: SocialSecurityEarningsTestCalculator and SocialSecurityCalculatorService / RetirementIncomeStream.
- **Inputs:** Projected SSA-countable earned income by age comes from the person's active **wages / net self-employment** income (Person.socialSecurityCountableAnnualEarnings) through **Person.effectiveRetirementAge** (from optional **Person.retirementDate** when set, else taxProfile.retirementAge), plus optional **part-time work / consulting** RetirementIncome lines after that age. When a **target retirement date** is set, countable earnings in the retirement calendar year are **prorated through the retirement month** via countableEarnedIncomeByCalendarYear.
- **Calendar year alignment:** Monte Carlo passes calendarYear = currentCalendarYear + simulationYearIndex into RetirementIncomeStream.incomeAtAge(_:calendarYear:) so exempt limits match the simulated calendar year. The optimizer's lifetime comparison uses birthYear + attainedAge as a planner-standard proxy for the benefit-year calendar year when stacking the earnings test on COLA (see limitations below).
- Break-even analysis across claiming ages
- Monte Carlo comparison: "Take early & invest" vs. "Delay"
- Tax impact analysis for early claiming
- IRMAA considerations for high earners
- **WEP/GPO repeal (June 2026):** The Windfall Elimination Provision and Government Pension Offset were repealed by the Social Security Fairness Act (PL 118-273) for benefits payable Jan 2024+. Nalu Money no longer applies WEP or GPO reductions. Legacy tax-profile fields decode for compatibility but are not collected in the UI.
- **Divorced spousal:** When filing as divorced with **ex-spouse PIA** and **≥ 10 years** of marriage entered on the tax profile, spousal comparisons can reference the ex-spouse PIA.
- **Survivor heuristic:** Combined lifetime comparisons can apply an **early-survivor reduction fraction** vs. survivor FRA and attained age (simplified; not full dual-entitlement or family maximum).

- **Cohort note (UI copy):** Birth year **1953 or earlier** may have had **restricted application** options under prior law; the app surfaces a **disclaimer** only — it does not re-enact repealed deeming rules in code.
- **Dual entitlement (married):** Lower earner's modeled payment is **own retirement** at the chosen claiming age plus **spousal excess** (50% of the higher earner's PIA minus own PIA, when positive), each with **SSA-style early-reduction** on the spousal excess. This matches the common "RIB + excess spouse" structure; children and other auxiliaries are not modeled.
- **Family maximum:** Total monthly benefits on the **worker's earnings record** are capped using the statutory **PIA-based family maximum** formula (2026 bend points in SocialSecurityFamilyMaximumCalculator; verify annually). The engine holds the **worker's retirement** constant and reduces the **auxiliary (spousal excess)** first—an industry-standard planning simplification when only one auxiliary is present.
- **Deemed filing:** For birthdates **on or after January 2, 1954** (UTC date rule in code), strategy copy notes **deemed filing**: claiming retirement before FRA generally also starts eligible spousal benefits in the same month of entitlement (Bipartisan Budget Act 2015). Earlier cohorts get a **restricted-application / legacy deeming** reminder instead.

References (verify annually): SSA *Receiving Benefits While Working* — https://www.ssa.gov/benefits/retirement/planner/whileworking.html ; SSA *How Work Affects Your Benefits* (Publication EN-05-10069 PDF) — https://www.ssa.gov/pubs/EN-05-10069.pdf ; POMS RS 02501.021 (Annual Earnings Test) — https://secure.ssa.gov/apps10/poms.nsf/lnx/0302501021 ; Social Security Fairness Act (PL 118-273) — https://www.ssa.gov/benefits/retirement/social-security-fairness-act.html ; SSA *Deemed Filing* — https://www.ssa.gov/benefits/retirement/planner/deemed.html ; SSA family maximum formula — https://www.ssa.gov/oact/COLA/familymax.html

Limitations: Annual (not monthly) simulation granularity for portfolio flows; the FRA-attainment year uses **uniform** proration of annual earnings for SSA-countable earnings unless optional per-calendar-year overrides are supplied; SSA's "first year of retirement" monthly earnings rules and pay-period vs. calendar timing are not modeled. Automated tests match SSA's published 2026 illustrations when explicit countable earnings are provided for the attainment-year case. **Survivor** logic remains a **planning approximation**; we do not model every auxiliary type, the **family maximum** with multiple children, **dual entitlement** sequencing for all historical amendments, or lump-sum election rules in full SSA detail.

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8. Withdrawal Sequencing

Tax-efficient withdrawal order (default):

1. Taxable accounts (lowest tax cost)
2. Traditional/pre-tax accounts (ordinary income)
3. Roth accounts (tax-free, preserved for growth)

Alternative strategies available: Proportional, Roth First, Traditional First.

Safety guardrail: Never withdraw more than 90% of portfolio balance in a single year.

Early withdrawal access ages (Rule of 55, 59½, 72(t))

Nalu Money surfaces statutory access milestones for education — not personalized tax advice.

Milestone	Rule	Where shown
59½	10% early-withdrawal penalty ends for most retirement accounts (birthdate + 59 years 6 months).	Retirement Timeline, Monte Carlo chart (when retiring before 59½), Weekly Check-In, PDF Withdrawal Access
Rule of 55	Leave current employer in/after the year you turn 55 → penalty-free withdrawals from that employer's 401(k)/403(b) only (not IRAs).	Timeline + PDF when retirement age is 55–59½ and an eligible plan exists
72(t) SEPP	Substantially equal periodic payments avoid the 10% penalty before 59½; schedule must run 5 years or until 59½ (whichever is longer).	Tax Strategy illustrative calculator; PDF Withdrawal Access notes
Roth contributions	Contributions (not earnings) withdrawable anytime.	PDF Withdrawal Access notes

References: IRS Publication 575 (pension/annuity distributions); IRS Publication 590-B (IRA distributions); IRC §72(t).

Limitations: Rule of 55 eligibility depends on actual separation timing and plan terms — we model using your **target retirement age** and whether you hold a 401(k)/403(b) balance. Public-safety 50-year Rule of 55 variants are not separately modeled.

Heuristic asset location and drift (education)

Nalu Money includes **read-only heuristics** (not trade instructions): SuggestAssetLocationUseCase suggests broad **asset-class home** (taxable vs. traditional vs. Roth) using industry-standard preferences (e.g., tax-inefficient assets preferring tax-deferred, growth preferring Roth when horizons allow). PortfolioDriftEvaluator compares **current** vs. **Monte Carlo target** sleeve weights and can surface a **DecisionPrompt** when drift exceeds a threshold. These prompts are **planning nudges**; they do not read individual holdings or lot-level data.

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9. Known Limitations & Approximations

1. **Capital gains use per-account unrealized gain percentages** — not per-lot cost basis (user-editable, default 50%). Tax-loss harvesting uses the same account-level estimates; wash-sale and lot-level rules are not modeled.
2. **Social Security benefits are estimated** — not pulled from SSA records
3. **State tax data requires annual updates** — may lag new legislation by up to 60 days. State taxable income uses each state's own standard deduction where tabulated, or the federal SD for rolling-conformity states (e.g. Colorado); states with neither configured do not subtract a deduction (planning-grade, may overstate)
4. **No modeling of sequence-of-returns within a single year** — annual granularity only
5. **Healthcare costs** are still **primarily embedded in spending curves** by default; an **optional** Medicare premium overlay exists in Monte Carlo but is **off by default** to reduce double-count risk (see Section 6, “Optional Medicare premium overlay”)
6. **No estate planning module in v1.0** — domain models exist for future work; no persisted estate UI ships. Federal estate tax exemptions are not projected.

7. **Portfolio / holdings v1.0 — manual-first** — Portfolio analytics use **account balances** and balance history (and optional per-account unrealized gain % for TLH). There is **no** lot-level holdings CSV import, Plaid Investments sync, or security-level cost-basis tracking in v1.0.
8. **Multi-sleeve mode** applies Cornish–Fisher skew/kurtosis per sleeve when that distribution is selected; Normal/Log-Normal settings still use Gaussian sleeve shocks. Correlation structure remains Cholesky-Gaussian (not full Cornish–Fisher tail dependence across sleeves)
9. **TIPS mapping** does not model deflation floors on principal, liquidity premiums, or index-lag mechanics of real Treasury inflation-protected securities — it is a planning-oriented real-return sleeve compounded with simulated CPI
10. **TIPS-first withdrawal** plus annual rebalance is not equivalent to a static bond ladder or IRS RMD sourcing rules across account types
11. **Monte Carlo Medicare** does not model married-filing-separately IRMAA rules, Medigap/Advantage plan selection, or month-of-65 enrollment; premiums inflate with the plan's CPI series as a **rough** proxy for statutory CMS updates. Dynamic IRMAA requires **bracket taxes** on
12. **QCD modeling** in Monte Carlo applies to **surplus-year** RMD tax (taxable remainder after QCD); deficit-year sizing uses portfolio shortfall only with RMD floor — not per-charity or full deduction interaction
13. **Glide path** is age-scheduled target weights only — not a dynamic glide path based on funded ratio or market returns
14. **Asset location and drift prompts** use aggregates and Monte Carlo settings; they are not personalized security-level advice
15. **Roth appendix sensitivity ≠ Monte Carlo success %** — Appendix C recomputes the deterministic Roth kernel per row (see §6 "Roth conversion planning sensitivity…"); stochastic success probability deltas live only in the Retirement / optional Tax Strategy Monte Carlo context UI
16. **Persisted JSON upgrades** — nested Codable types in Finance Defaults must use explicit decodeIfPresent ?? default; CI enforces this via Scripts/audit-persisted-codable.py (see May 2026 hotfix notes in RC evaluation)
17. **Confidence labels** on planning outputs are heuristic data-quality signals, not guarantees of accuracy
18. **Survivor mode** does not model which spouse dies first or full SSA dual-entitlement edge cases
19. **Onboarding funnel metrics** — step and completion counters persist **on-device only** (OnboardingCompletionAnalytics); no third-party analytics SDK or network telemetry for onboarding completion rates.

Persisted planning settings (governance)

Finance Defaults (UserDefaults + Core Data / CloudKit) and nested structs (PreMedicareHealthBridge, RetirementSpendingTiers, LongTermCarePlan) must use **backward-compatible** Codable when fields are added. Synthesized decoders that throw on missing keys can silently reset goals to zero. The app refuses to overwrite non-default stored Finance Defaults with .systemDefaults after decode failure. Release checklist and automated audit: see project Scripts/audit-persisted-codable.py and .cursor/rules/dev-rules.mdc.

10. Data Sources & Update Schedule

Data	Source	Update Frequency
Federal tax brackets	IRS publications	Within 30 days of publication
State tax rates	State revenue departments	Annual review
RMD tables	IRS Publication 590-B	When updated by IRS
IRMAA thresholds	CMS / Medicare publications	Annual
Historical returns / long-horizon calibration	Morningstar (Ibbotson) SBBI materials	Annual reference
Forward estimates (illustrative)	Vanguard VCMM summary materials	Annual reference

Detailed links and bibliographic identifiers are in **Section 11**.

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11. References (URLs and stable identifiers)

Below are **primary or widely accepted secondary** sources we cite for methodology transparency. URLs were valid at documentation time; government pages may move—use the site search on the same domain if a path changes.

11.1 Government and official program sources

1. **Internal Revenue Service — Publication 590-B (IRA distributions, RMD life expectancy tables).**
   https://www.irs.gov/publications/p590b
   PDF: https://www.irs.gov/pub/irs-pdf/p590b.pdf
2. **Internal Revenue Service — Topic 409, Capital gains and losses.**
   https://www.irs.gov/taxtopics/tc409
3. **Internal Revenue Service — Topic 559, Net Investment Income Tax (NIIT).**
   https://www.irs.gov/taxtopics/tc559
   Form 8960 instructions: https://www.irs.gov/instructions/i8960
4. **Internal Revenue Service — Topic 560, Additional Medicare Tax.**
   https://www.irs.gov/taxtopics/tc560
   FAQs: https://www.irs.gov/admtfaqs
5. **Social Security Administration — Full retirement age (FRA).**
   https://www.ssa.gov/benefits/retirement/planner/ageincrease.html
   https://www.ssa.gov/retirement/full-retirement-age
6. **Social Security Administration — Cost-of-living adjustments (COLA).**
   https://www.ssa.gov/cola/

6a. **Social Security Administration — Receiving benefits while working (retirement earnings test; annual exempt amounts).**
https://www.ssa.gov/benefits/retirement/planner/whileworking.html
How Work Affects Your Benefits (PDF): https://www.ssa.gov/pubs/EN-05-10069.pdf

7. **Medicare / CMS — Premiums, deductibles, and related public communications (basis for IRMAA modeling in app configuration).**
   Example (newsroom fact sheets update by year): https://www.cms.gov/newsroom/fact-sheets
   Medicare costs publication (PDF; updated periodically): https://www.medicare.gov/Pubs/pdf/11579-medicare-costs.pdf

7a. **Medicare.gov — IRMAA overview (income-related amounts; relationship to tax-year income).**
https://www.medicare.gov/basics/costs/medicare-costs/income-related-monthly-adjustment-amount-irmaa

7b. **Medicare.gov — Part B premiums (standard premium and cost context).**
https://www.medicare.gov/your-medicare-costs/part-b-costs/premium-part-b-cost

7c. **Medicare.gov — Part D costs / premiums.**
https://www.medicare.gov/your-medicare-costs/part-d-costs/premium-part-d-cost

7d. **Internal Revenue Service — Topic 551, Standard Deduction (MAGI context for planning discussions; not a substitute for Form 1040 instructions).**
https://www.irs.gov/taxtopics/tc551

8. **National Bureau of Economic Research — US business cycle expansions and contractions (official chronology).**
   https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions
   Committee statement: https://www.nber.org/cycles/general_statement.html

9. **Bureau of Labor Statistics — Consumer Price Index (CPI / CPI-U).**
   CPI landing: https://www.bls.gov/cpi/
   Latest CPI news release (example series): https://www.bls.gov/news.release/cpi.nr0.htm

10. **Legislative basis for RMD age changes (SECURE 2.0 within Consolidated Appropriations Act, 2023).**
    Public Law 117-328 (PDF): https://www.congress.gov/117/plaws/publ328/PLAW-117publ328.pdf
    Bill landing (H.R.2617, 117th Congress): https://www.congress.gov/bill/117th-congress/house-bill/2617

11. **US Treasury — Treasury Inflation-Protected Securities (TIPS) overview (instrument mechanics; educational reference for the TIPS sleeve).**
    https://www.treasurydirect.gov/indiv/products/prod_tips_glance.htm
    In-depth series page: https://www.treasurydirect.gov/indiv/research/indepth/tips/res_tips.htm

11.2 Capital markets assumptions and industry research

12. **Vanguard — Capital Markets Model (VCMM) forecast disclosures (forward-looking, proprietary model; high-level description and limitations).**
    https://corporate.vanguard.com/content/corporatesite/us/en/corp/vemo/vemo-return-forecasts.html

13. **Morningstar / Ibbotson — SBBI and long-horizon US capital markets data (commercial reference; used as an industry-standard historical baseline, not reproduced here).**
    https://www.morningstar.com/products/forecasting-us-returns

14. **Research Affiliates — Capital market expectations / asset pricing (forward-looking, vendor research; illustrative comparison to historical averages).**
    Asset Allocation Interactive hub: https://www.researchaffiliates.com/hub-aai
    Example methodology article: https://www.researchaffiliates.com/publications/articles/641-pricing-stocks-and-bonds

11.3 Academic and practitioner papers (methods cited in-engine)

15. **Cornish, E. A., & Fisher, R. A. (1938). Moments and cumulants in the specification of distributions.** *Revue de l'Institut International de Statistique*, 5(4), 307–320.
JSTOR: https://www.jstor.org/stable/1400907

16. **Markowitz, H. (1952). Portfolio selection.** *The Journal of Finance*, 7(1), 77–91.
DOI: https://doi.org/10.2307/2975974

17. **Black, F. (1976). Studies of stock price volatility changes.** *Proceedings of the 1976 Meetings of the American Statistical Association, Business and Economic Statistics Section*, 177–181.
(Conference proceedings; no single canonical DOI. Often cited for the leverage / volatility asymmetry literature.)
Google Scholar (index of copies and citations):
https://scholar.google.com/scholar?q=Studies+of+Stock+Price+Volatility+Changes+Black+1976

18. **Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity.** *Journal of Econometrics*, 31(3), 307–327.
DOI: https://doi.org/10.1016/0304-4076(86)90063-1
Publisher page: https://www.sciencedirect.com/science/article/abs/pii/0304407686900631

19. **Poterba, J. M., & Summers, L. H. (1988). Mean reversion in stock prices: Evidence and implications.** *Journal of Financial Economics*, 22(1), 27–59.
DOI: https://doi.org/10.1016/0304-405X(88)90021-9
NBER working paper: https://www.nber.org/papers/w2343
Open-access full text (MIT Economics host, publisher PDF):
https://economics.mit.edu/sites/default/files/publications/1-s2.0-0304405X88900219-main.pdf

20. **Blanchett, D. (2014). Estimating the true cost of retirement.** Morningstar Investment Management (PDF).
https://www.morningstar.com/content/dam/marketing/shared/research/foundational/677785-EstimatingTrueCostRetirement.pdf
Society of Actuaries symposium copy:
https://www.soa.org/globalassets/assets/files/resources/essays-monographs/2014-living-to-100/mono-li14-1a-blanchett.pdf

21. **Guyton, J. T., & Klinger, W. J. (2006). Decision rules and maximum initial withdrawal rates.** *Journal of Financial Planning*.
FPA article page: https://www.financialplanningassociation.org/article/journal/MAR06-decision-rules-and-maximum-initial-withdrawal-rates
PDF (FPA host): https://www.financialplanningassociation.org/sites/default/files/2021-10/MAR06%20JFP%20Guyton%20PDF.pdf

11.4 Numerical methods (implementation detail)

22. **Cholesky decomposition of correlation matrices (simulating correlated standard normals).**
Wikipedia (exposition): https://en.wikipedia.org/wiki/Cholesky_decomposition

Appendix A. Prior Material Changes

Recent material changes (2026.05.29)

- **Additional / senior standard deduction in tax kernel.** AnnualTaxKernel applies age-65+/blind additions and OBBB senior bonus from Federal/2026.json when callers pass conditions (withdrawal sequencing infers from filer age ≥ 65).
- **Tax-loss harvesting (planning-grade).** Account-level unrealized gain % drives TLH opportunities; withdrawal sequencing accepts an optional LTCG loss offset.
- **Historical bootstrap scenario lens.** Compare Scenarios Base Plan shows parametric vs historical-bootstrap success side by side.
- **Medicare premium schedule.** Healthcare & Care Costs planner includes a year-by-year household premium table from birthdates.
- **Multi-sleeve Cornish-Fisher parity** (May 29 engine fix) and **must-spend inflated floor** documented in §1 and Limitations.
- **CFP governance version table** added below (B1); no formal external review claimed for 2026.05.29.
- **Portfolio v1.0 — manual balances only.** No lot-level holdings CSV import or Plaid Investments sync; analytics roll up account balances and optional account-level gain % (see §9).
- **On-device onboarding funnel metrics.** Step and completion events persist locally (OnboardingCompletionAnalytics); no third-party analytics SDK or network telemetry.
- **Retire iPad workstation layout.** On regular horizontal size class, Overview uses a split layout: projection/year table leading, What-If sliders and tools trailing (product UX — not a calculation change).
- **Accessibility v1.0.** Settings → Enhanced accessibility layout plus system Larger Text / VoiceOver / Reduce Motion drive scaled layout via AccessibilityPreferences (QA matrix in release docs).
- **State standard-deduction conformity.** Flat states now honor their own standard deduction (e.g. North Carolina), and rolling-conformity states subtract the federal SD (e.g. Colorado, conformsToFederalTaxableIncome) — see §6 (State Taxes) and Limitations.
- **RMD excise tax (SECURE 2.0 §302).** Missed-RMD penalty modeled via SSOT RMDExciseTax at 25% statutory with an optional 10% timely-correction path (assumeTimelyRMDCorrection) — see §8 and Limitations.

Recent material changes (2026.05.26)

- **Single Source of Truth (SSOT) consolidation.** Three release cycles closed the major call-site duplications: Monte Carlo input parity across Retirement Overview and Compare Scenarios (BuildScenarioMonteCarloInputsUseCase), Roth conversion window expansion plus per-year state kernel (RothConversionService), and the broad Phase A/B/C work that unified retirement timing, PMT, the retirement goal formula, the 4-tier spending hierarchy, and IRMAA / work-hours constants. Details in §1 (Monte Carlo), §1A (Retirement goal vs FI Number), §6 (Tax), and §9 (Limitations).
- **Calendar retirement date is now the planning SSOT.** All planning reads (Monte Carlo, FI Timeline, Tax Strategy, reports, decision prompts) use Person.effectiveRetirementAge, which honors the user's

calendar retirementDate when set, falling back to the integer slider age. Author-side slider commits explicitly clear retirementDate so the integer wins after a manual edit.

- **Retirement spending hierarchy.** Custom override → Spending Tiers (Must/Like/Legacy) → Base Plan curated expenses → tracked recurring × retirement-adjustment factor (default 80%) → 50% gross income fallback. Every Monte Carlo caller, the Dashboard hero, and Onboarding now route through this hierarchy.
- **Retirement goal vs FI Number.** Two deliberately distinct numbers: the **goal prompt** uses gap-based 25× ((spending − guaranteed) / SWR); the **FI Number** uses total spending (expenses / SWR). Both source SWR from FinanceDefaults.
- **Pension data split.** Legacy TaxProfile WEP/GPO fields are retained for decode compatibility only. WEP and GPO were **repealed** by the Social Security Fairness Act (PL 118-273) for benefits payable Jan 2024+. Pension *amounts* live in RetirementIncomeEntity with incomeType = .pension and are the SSOT for CalculateGuaranteedIncomeUseCase and Monte Carlo income.
- **Work hours.** Hourly-rate displays now source FinanceDefaults.workHoursPerYear (default 2080) instead of a hardcoded constant.
- **IRMAA tier thresholds.** All IRMAA-aware paths now read TaxYearConstants.IRMAA.singleUpperBounds / mfjUpperBounds — the same SSOT used by RothConversionService and MedicarePremiumPolicy.

Governance log: when an external CFP review cycle covers the items above, we'll publish the dates and scope here. The 2026.05.29 release notes do not assert that any named panel completed a review.

Questions or Corrections?

If you find an error in our methodology or want to suggest improvements, contact us. We believe transparency builds trust, and we welcome scrutiny from the FIRE community.

This document is versioned alongside the app codebase and updated with each methodology change.

Tax Strategy snapshot PDF (May 2026). Saved snapshots persist TaxStrategySnapshotOutputsBlob: year-by-year withdrawal tables, Roth conversion schedule, and sensitivity axis results. PDF export prefers the blob over live view-model recompute so reports match what you saved.

Last updated: June 10, 2026