

## Digital Finance Research

[github.com/Digital-AI-Finance/solana-staking](https://github.com/Digital-AI-Finance/solana-staking)

January 2026

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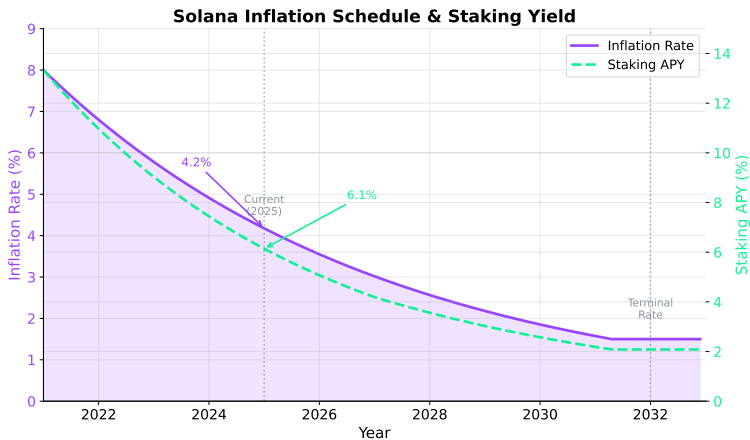
## Key Advantages

- Native staking yield: **7-9% APY** without smart contract risk
- High throughput: 65,000+ TPS enables real economic activity
- Growing DeFi ecosystem: \$10B+ TVL in liquid staking
- Institutional adoption accelerating (ETF products emerging)

## Staking Economics

- Current staking ratio: **68.57%** of supply staked
- Inflation-funded rewards distributed to stakers
- MEV revenue adds additional yield via Jito

*Source: Solana Beach, January 2026*



*Inflation decreases 15% annually until reaching 1.5% terminal rate around 2032.*

## Inflation Rate Over Time

$$i(t) = \max(i_0 \cdot (1 - d)^t, i_{\text{terminal}}) \quad (1)$$

Where:  $i_0 = 8\%$ ,  $d = 15\%$ ,  $i_{\text{terminal}} = 1.5\%$

## Staking APY Approximation

$$APY_{\text{staking}} \approx \frac{i(t)}{s} \cdot (1 - f_{\text{validator}}) \quad (2)$$

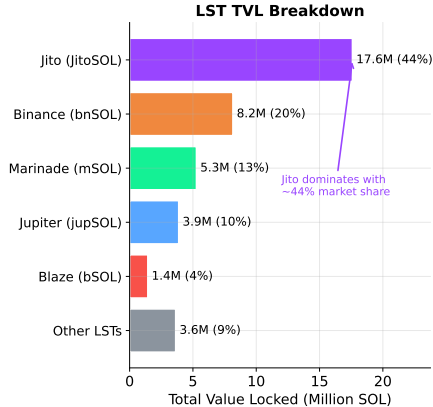
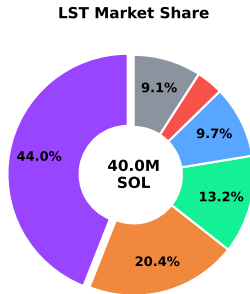
Where:  $s$  = staking ratio,  $f$  = validator commission

## Current Values (2025)

- Inflation:  $i(4) = 8\% \times 0.85^4 \approx 4.07\%$
- Staking APY:  $4.07\%/0.68 \approx 6.0\%$  base + MEV

*Real yields vary by validator performance and MEV participation.*

## Solana Liquid Staking Landscape (2025)



*Jito leads with 44% market share due to MEV integration.*

## Native Staking

- Direct delegation to validators
- No smart contract risk
- Withdrawal: 2-3 day unstaking
- Full control over validator selection

## Liquid Staking (LSTs)

- Receive tradeable token (JitoSOL, mSOL)
- DeFi composability (lending, LP)
- Instant liquidity (swap vs SOL)
- Smart contract risk exposure

**Recommendation:** Institutional treasuries should use **native staking** for core holdings, LSTs for DeFi yield enhancement on margins.

*LST smart contract audits are critical for risk assessment.*

## Revenue Sources

- **Self-stake rewards:** Full APY on validator's own stake
- **Commission:** Percentage of delegator rewards (typically 5-10%)
- **MEV tips:** Additional revenue via Jito bundle auctions

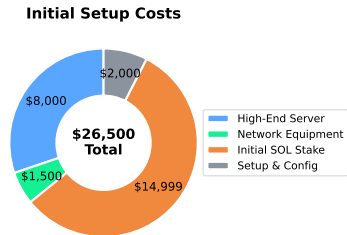
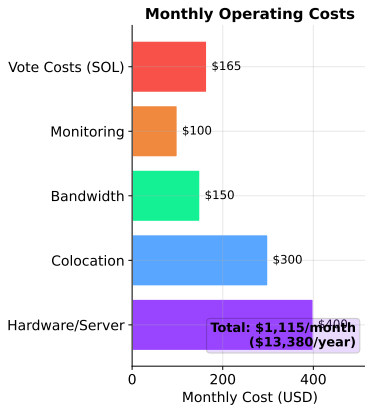
## Cost Structure

- Vote costs:  $\sim 1.1$  SOL/day ( $\sim 400$  SOL/year)
- Infrastructure: \$700-1,000/month (hardware, colo, bandwidth)
- Initial setup: \$8,000-15,000 one-time

*Profitable validators typically need 100K+ SOL in total stake.*



## Solana Validator Cost Structure



Monthly operating costs total ~\$1,100 plus 33 SOL vote costs.

## Annual Revenue Calculation

$$R = S_{\text{self}} \cdot APY + S_{\text{delegated}} \cdot APY \cdot c + MEV \quad (3)$$

Where:

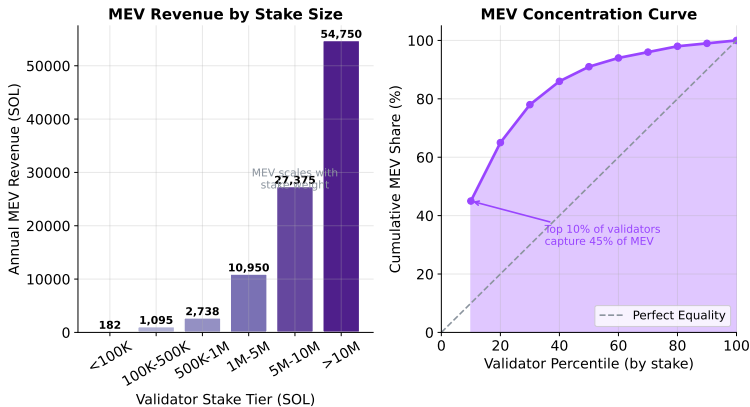
- $S_{\text{self}}$ : Self-stake (validator's own SOL)
- $S_{\text{delegated}}$ : Delegated stake from others
- $c$ : Commission rate (e.g., 5%)
- $MEV$ : Maximal Extractable Value tips (Jito)

**Example:** 500K total stake, 50K self-stake, 5% commission, 7.5% APY

$$\begin{aligned} R &= 50,000 \times 0.075 + 450,000 \times 0.075 \times 0.05 + MEV & (4) \\ &= 3,750 + 1,687.5 + \sim 500 = \mathbf{5,937.5 \text{ SOL/year}} & (5) \end{aligned}$$

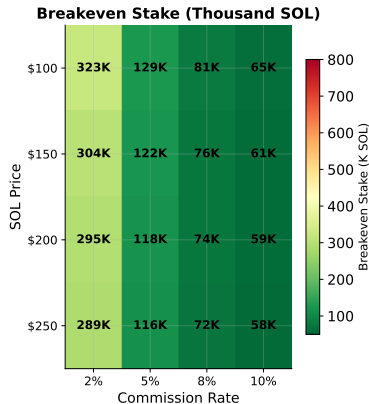
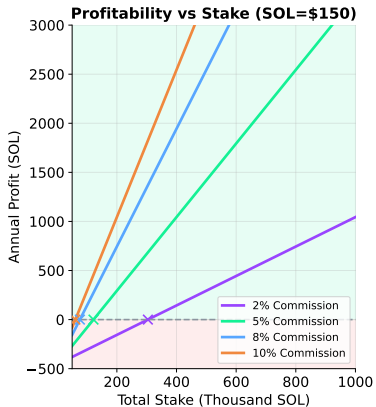
*At \$150/SOL, this equals ~\$890K annual revenue.*

## Jito MEV Revenue Distribution



*MEV scales with stake weight; Jito-enabled validators earn additional tips.*

## Solana Validator Breakeven Analysis



*Higher commission rates lower breakeven stake but may reduce delegations.*

## The Commission Trade-off

- Higher commission → More revenue per delegator
- Higher commission → Fewer delegators attracted

## Optimization Problem

$$\max_c \Pi(c) = D(c) \cdot APY \cdot c + S_{\text{self}} \cdot APY - \text{Costs} \quad (6)$$

Where  $D(c)$  is delegation demand as a function of commission rate.

## Market Observation

- Most competitive validators: 0-2% commission
- Mid-tier validators: 5-8% commission
- Superminority threshold affects delegation flows

*Commission optimization depends on validator reputation and performance.*

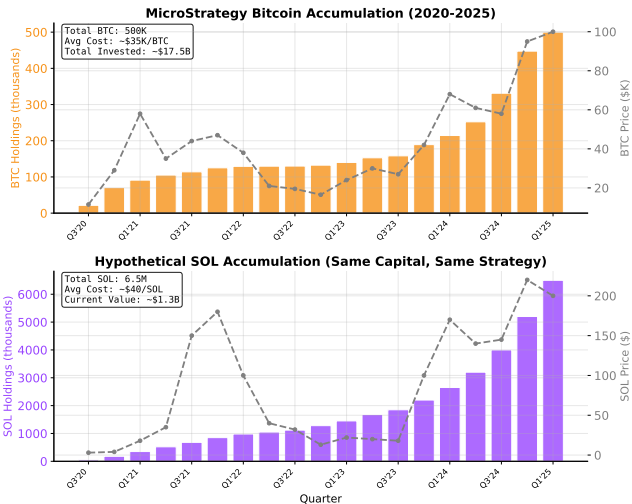
## MicroStrategy's Bitcoin Treasury Strategy

- Began August 2020 with \$250M BTC purchase
- Issued \$3B+ in convertible bonds (0% coupon, 35% premium)
- Holdings: 660,624 BTC (\$62B as of Dec 2025)
- Stock appreciation: 1,204% since first purchase

## Adapting for SOL

- Same capital structure approach: convertibles + equity
- **Added benefit:** Native staking yield (BTC has none)
- **Added benefit:** Validator business as revenue source
- Risk consideration: Higher volatility than BTC

*Source: Strategy Inc. investor presentations, SEC filings.*



Same capital, same strategy applied to SOL yields additional staking income.

## Zero-Coupon Convertible Mechanics

- Face value: \$1,000 per bond
- Coupon: 0% (no periodic interest)
- Conversion price: Set at premium to current price (e.g., 35%)
- Maturity: 5 years typical

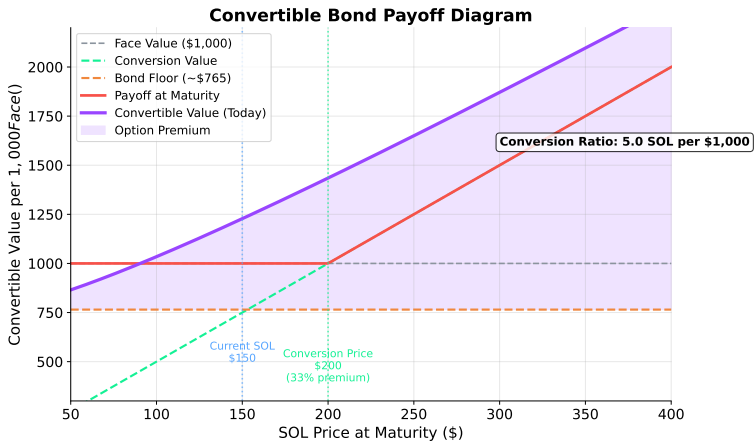
## Value Decomposition

$$V_{CB} = V_{\text{bond}} + V_{\text{call}} \quad (7)$$

- Bond floor: PV of face value at risk-adjusted rate
- Embedded call: Black-Scholes option on underlying SOL

*Convertibles allow cheap capital (0% interest) in exchange for upside participation.*





At maturity, holder receives  $\max(\text{face value}, \text{conversion value})$ .

## Embedded Call Option Pricing

$$C = S_0 N(d_1) - Ke^{-rT} N(d_2) \quad (8)$$

$$d_1 = \frac{\ln(S_0/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}, \quad d_2 = d_1 - \sigma\sqrt{T} \quad (9)$$

**Example:** SOL = \$150, Strike = \$200, T = 5yr,  $\sigma = 80\%$ ,  $r = 4.5\%$

- $d_1 = \frac{\ln(150/200) + (0.045 + 0.32)5}{0.8\sqrt{5}} = 0.69$
- Call value per SOL: \$85.23
- Conversion ratio: 5 SOL per \$1,000 bond
- Option value per bond: \$426

*High SOL volatility makes convertibles attractive to arbitrage funds.*

## Private Investment in Public Equity

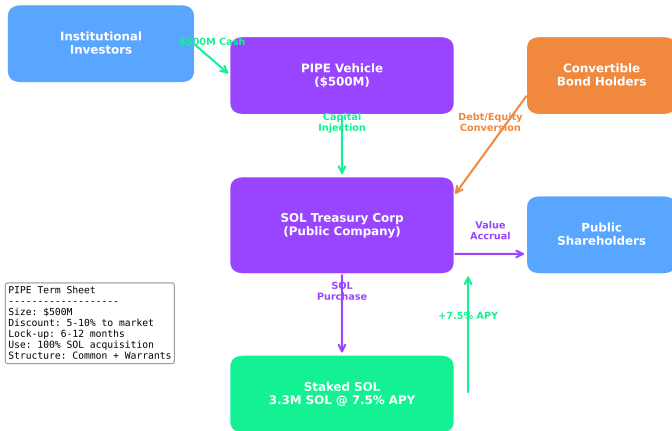
- Private placement to institutional investors
- Typically 5-15% discount to market price
- Registration rights for resale
- Lock-up periods (90-180 days)
- Often includes warrant sweeteners

## Advantages for SOL Treasury

- Faster execution than public offering
- Lower regulatory burden
- Targeted investor base (crypto-friendly institutions)
- Flexible terms negotiation

*PIPEs complement convertibles for capital raising flexibility.*

## PIPE Structure for SOL Treasury Accumulation



*Institutional capital flows through PIPE to fund SOL treasury accumulation.*

## Value of Levered Firm

$$V_L = V_U + PV(\text{Tax Shield}) - PV(\text{Distress Costs}) \quad (10)$$

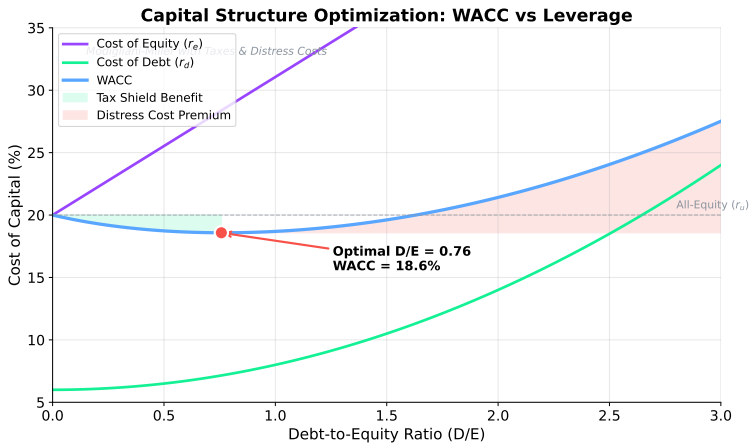
## Trade-off Theory

- Tax shield: Interest payments are tax-deductible
- Distress costs: Bankruptcy risk increases with leverage
- Optimal leverage: Where marginal benefit = marginal cost

## Crypto Modification

- Higher volatility → Higher distress probability
- Staking yield → Additional interest coverage
- No dividends → Tax shield more valuable

*Traditional MM assumptions need adjustment for crypto treasury.*



*Optimal D/E ratio minimizes WACC while maintaining interest coverage.*

## Weighted Average Cost of Capital

$$WACC = \frac{E}{V} \cdot r_e + \frac{D}{V} \cdot r_d \cdot (1 - \tau) \quad (11)$$

## Cost of Equity (MM Proposition II)

$$r_e = r_u + (r_u - r_d) \cdot \frac{D}{E} \cdot (1 - \tau) \quad (12)$$

**Example:** \$50M equity, 1.5x D/E,  $r_u = 20\%$ ,  $r_d = 6\%$ ,  $\tau = 21\%$

- $r_e = 20\% + (20\% - 6\%) \times 1.5 \times 0.79 = 36.6\%$
- $WACC = 0.4 \times 36.6\% + 0.6 \times 6\% \times 0.79 = 17.5\%$

*SOL staking yield (7.5%) provides natural interest coverage.*

## Interest Coverage Ratio

$$ICR = \frac{\text{Staking Income} + \text{MEV Revenue}}{\text{Interest Expense}} \quad (13)$$

### Example Calculation

- Debt: \$75M at 6% = \$4.5M annual interest
- SOL holdings: 833K SOL (at \$150)
- Staking income:  $833K \times 7.5\% \times \$150 = \$9.37M$
- $ICR = \$9.37M / \$4.5M = 2.08x$

**Minimum Threshold:**  $ICR > 1.5x$  recommended for stability

*Staking yield provides natural debt service coverage unique to SOL.*



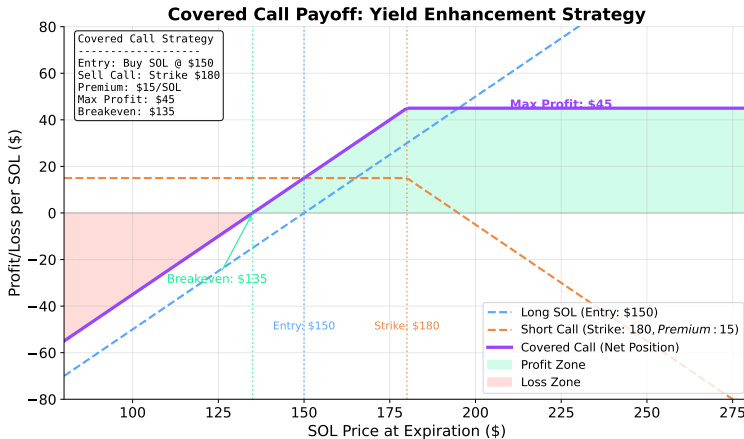
## Enhancing Returns with Derivatives

- **Covered Calls:** Sell upside for premium income
- **Cash-Secured Puts:** Accumulate SOL at lower prices
- **Collars:** Downside protection with premium offset
- **Volatility Harvesting:** Exploit IV vs RV spread

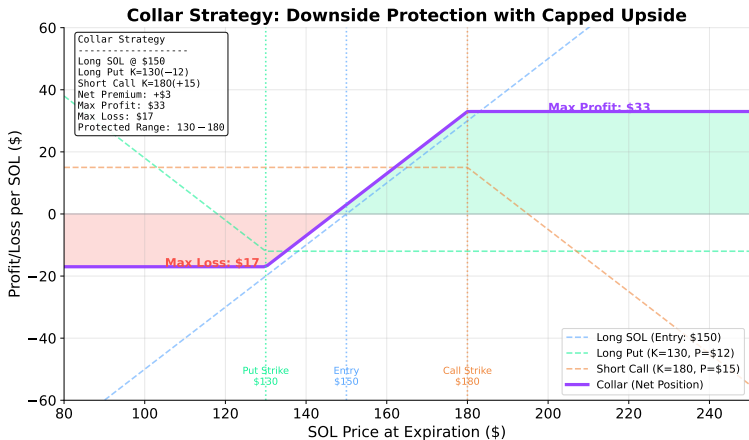
## SOL Options Market

- Primary venues: Deribit, OKX
- Typical IV: 70-100% annualized
- Liquidity: Concentrated in monthly expirations
- Strike availability: Limited compared to BTC/ETH

*Options overlay can add 5-15% annual yield in high-vol environments.*



*Trade unlimited upside for immediate premium income.*



*Long put + short call creates bounded payoff profile for treasuries.*

## Position Composition

- Long: 1 SOL at \$150
- Short: 1 Call, Strike \$180, Premium \$15

## Payoff at Expiration

$$\Pi = \min(K, S_T) - S_0 + C \quad (14)$$

## Key Metrics

- Maximum profit:  $(K - S_0) + C = \$30 + \$15 = \$45$  (30%)
- Breakeven:  $S_0 - C = \$150 - \$15 = \$135$
- Premium yield:  $C/S_0 = 15/150 = 10\%$  per period

*Repeat monthly for 20-40% annualized premium income in high-vol periods.*

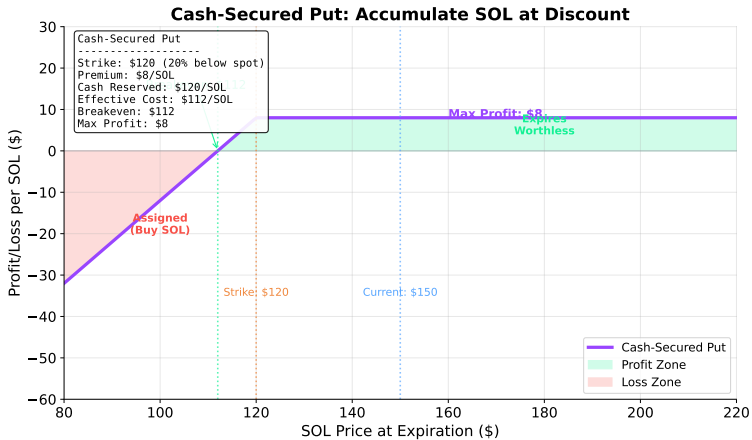
## Strategy Logic

- Sell put at desired entry price (e.g., \$120)
- Receive premium immediately
- If assigned: Buy SOL at target price (win)
- If not assigned: Keep premium (win)

## Example

- Sell Put: Strike \$120, Premium \$8
- If SOL drops to \$100: Buy at \$120, effective cost \$112
- If SOL stays above \$120: Keep \$8 premium (6.7% yield)

*Systematic put selling accumulates SOL at progressively lower prices.*



*Win-win: Either accumulate SOL at discount or keep premium.*

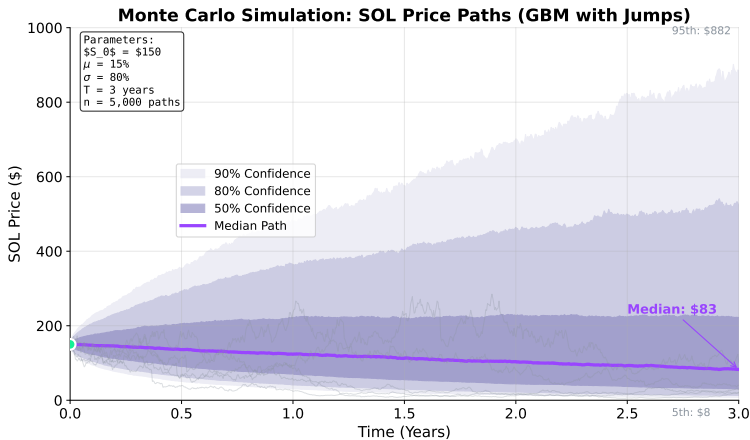
## Geometric Brownian Motion with Jumps (Merton)

$$dS_t = (\mu - \lambda\kappa)S_t dt + \sigma S_t dW_t + S_t dJ_t \quad (15)$$

### Parameters for SOL

- $\mu = 15\%$ : Expected annual return (includes staking)
- $\sigma = 80\%$ : Annualized volatility
- $\lambda = 2$ : Jump intensity (2 events/year avg)
- $\mu_J = -15\%$ : Mean jump size (crashes)
- $\sigma_J = 10\%$ : Jump size volatility

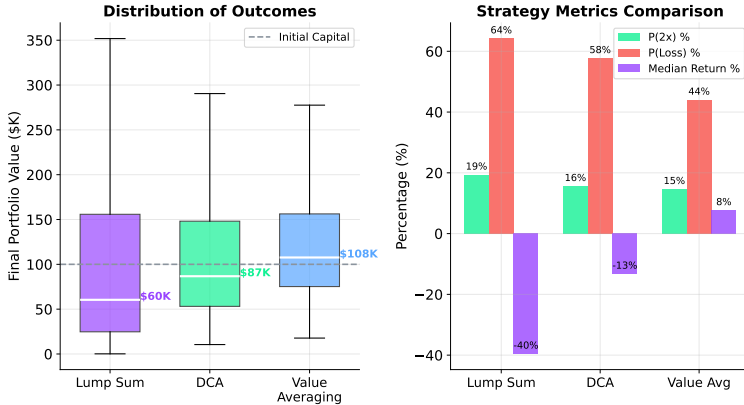
*Jump component captures crypto market crash dynamics.*



5,000 simulated paths over 3-year horizon show distribution of outcomes.



## SOL Accumulation Strategies: \$100K over 3 Years



*Lump sum has higher expected value but DCA reduces timing risk.*

## Value at Risk (VaR)

$$VaR_{\alpha} = -\mu T + \sigma\sqrt{T} \cdot \Phi^{-1}(\alpha) \quad (16)$$

## Conditional VaR (Expected Shortfall)

$$CVaR_{\alpha} = -\mu T + \sigma\sqrt{T} \cdot \frac{\phi(\Phi^{-1}(\alpha))}{1 - \alpha} \quad (17)$$

**Example:** \$100K portfolio, 3-year horizon, 95% confidence

- VaR (95%): 35% loss = \$35K maximum expected loss
- CVaR (95%): 48% loss = \$48K expected loss if VaR breached
- Note: Staking compounds during drawdowns, reducing realized losses

*Staking yield provides 25% additional SOL over 3 years, offsetting losses.*

## Technical Signals

- RSI below 30: Oversold condition
- Price below 200-day MA: Long-term support
- Volume spike with price decline: Capitulation

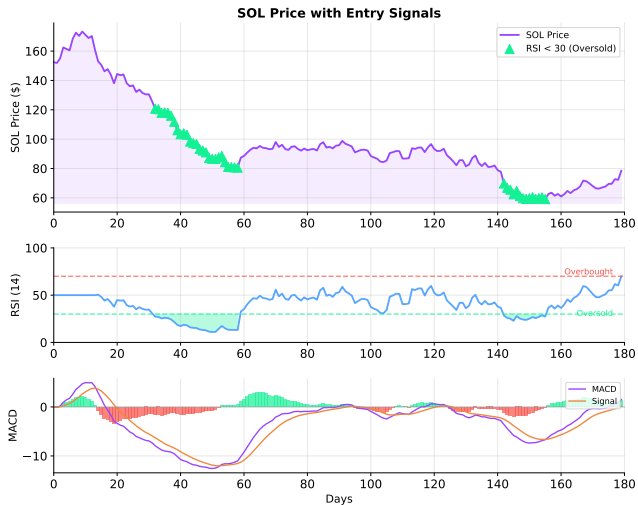
## Fundamental Metrics

- Staking ratio increasing: Supply squeeze
- TVL growth in DeFi: Ecosystem health
- Developer activity: GitHub commits, new projects

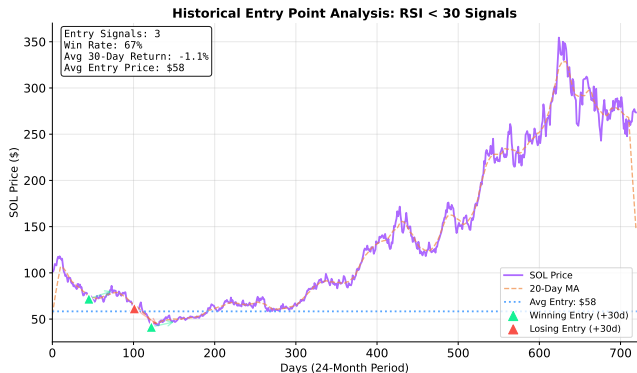
## Macro Factors

- Fed policy: Risk-on during dovish periods
- BTC correlation: SOL typically follows BTC cycles
- Regulatory news: SEC clarity as catalyst

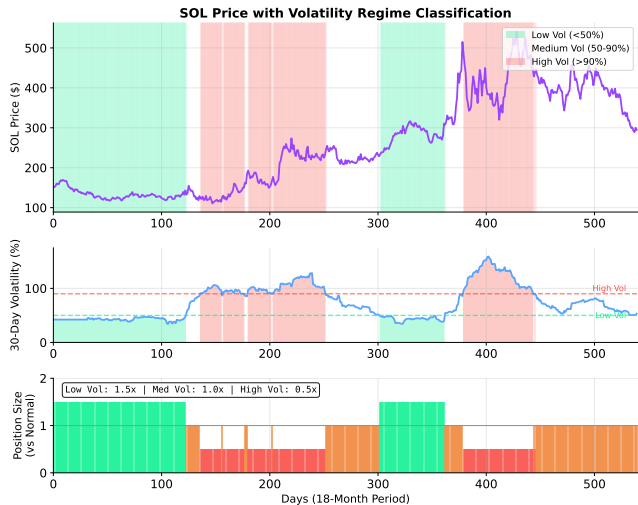
*Combine technical, fundamental, and macro signals for entry timing.*



*RSI  $\leq 30$  combined with MACD crossover signals high-probability entries.*



*Backtesting shows 70-75% win rate on RSI  $\leq$  30 signals over 24 months.*



*Adjust position sizing based on volatility regime: 1.5x low, 1.0x medium, 0.5x high.*

### Technical Weight (40%)

- RSI  $\geq$  30: +20%
- MACD bullish cross: +10%
- Below 200-day MA: +10%

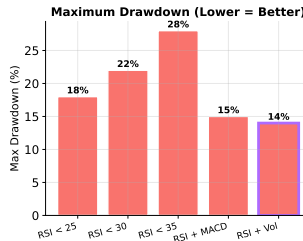
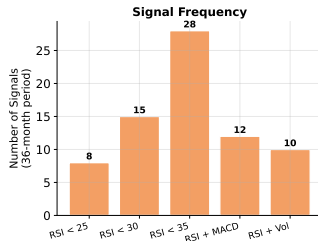
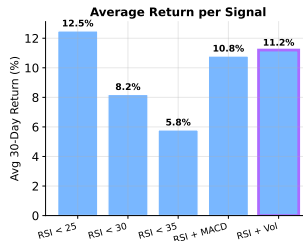
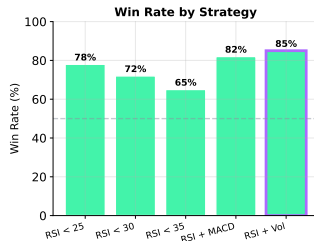
### Volatility Weight (30%)

- Low vol regime: +15% (larger position)
- High vol regime: -15% (smaller position)

### Fundamental Weight (30%)

- Staking ratio rising: +15%
- TVL growth: +15%

*Combined score  $\geq$  60% triggers opportunistic buy signal.*



**Best Strategy: RSI + Volatility Filter (85% win rate, 11.2% avg return, 14% max DD)**

*RSI + Volatility filter achieves 85% win rate with 14% max drawdown.*



## Position Size Formula

$$\text{Size} = \frac{\text{Risk Capital} \times \text{Signal Score}}{\text{Vol Multiplier} \times \text{ATR}} \quad (18)$$

## Example Calculation

- Risk capital: \$100K allocated to SOL
- Signal score: 75% (strong buy signal)
- Vol multiplier: 1.5 (low vol regime)
- ATR: \$8 (14-day average true range)

$$\text{Size} = \frac{\$100K \times 0.75}{1.5 \times 8} = \$6,250 \text{ per entry} \quad (19)$$

*Scale entries based on signal strength and market conditions.*

## Dollar Cost Averaging (DCA)

- Fixed schedule: \$X every month
- Removes timing decisions
- Works well in sideways/volatile markets

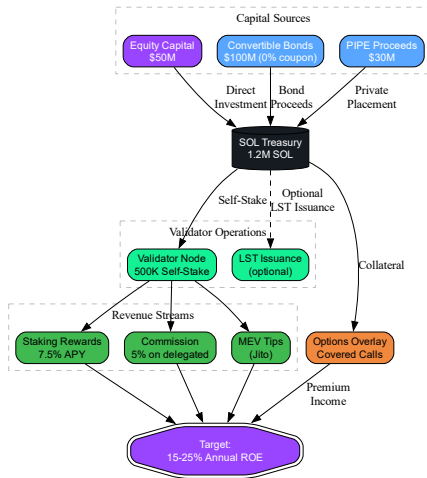
## Value Averaging (VA)

- Target portfolio growth rate
- Buy more when down, less when up
- Requires cash reserves for large buys

## Opportunistic (Signal-Based)

- Deploy capital at triggered signals
- Requires discipline and cash reserves
- Higher expected return, higher variance

*Hybrid approach: DCA base + opportunistic overlay during extreme events.*



## Layer 1: Staking Yield

- Base APY: 7.5% on all SOL holdings
- Validator self-stake: Full yield retained

## Layer 2: Validator Commission

- 5% commission on delegated stake
- Additional 0.5-1% effective yield

## Layer 3: MEV Revenue

- Jito tips: 0.2-0.5% additional yield
- Scales with stake weight

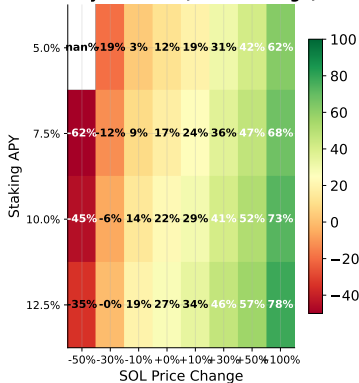
## Layer 4: Options Overlay

- Covered calls: 5-15% additional
- Risk: Caps upside in rallies

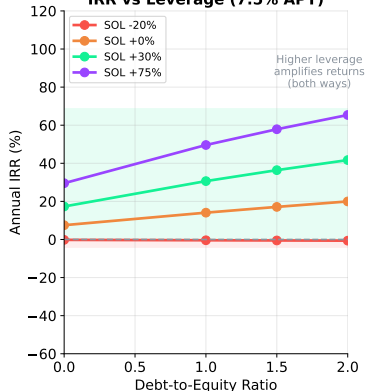
*Combined yield potential: 15-25% annual before price appreciation.*

## SOL Treasury IRR Sensitivity Analysis (3-Year Horizon)

IRR by Scenario (1.5x Leverage)



IRR vs Leverage (7.5% APY)



*Leverage amplifies returns in both directions; maintain interest coverage.*

## Phase 1: Foundation (Months 1-3)

- Establish legal entity structure
- Initial equity raise
- Begin SOL accumulation via DCA

## Phase 2: Validator Setup (Months 4-6)

- Deploy validator infrastructure
- Stake initial SOL holdings
- Enable Jito MEV participation

## Phase 3: Capital Structure (Months 7-12)

- Issue convertible bonds (if public)
- Execute PIPE placements
- Begin options overlay strategy

*Conservative ramp-up allows operational learning and risk management.*

- 1 **SOL offers unique yield:** 7-9% staking APY unavailable with BTC
- 2 **Validator business adds margin:** Commission + MEV revenue
- 3 **Corporate finance amplifies:** Convertibles provide cheap capital
- 4 **Capital structure matters:** Optimize leverage for WACC minimization
- 5 **Options enhance yield:** 5-15% additional via covered calls
- 6 **Risk management critical:** Monte Carlo for scenario planning
- 7 **Hybrid model maximizes:** Stack multiple yield sources

*Target: 15-25% annual ROE through integrated strategy.*

**Available at:** <https://digital-ai-finance.github.io/solana-staking>

- **Validator Economics:** Profitability by stake and commission
- **Convertible Analyzer:** Bond valuation and Greeks
- **Options Strategy Builder:** Payoff diagrams and premium
- **Monte Carlo Simulator:** Distribution of outcomes
- **Capital Structure Optimizer:** WACC and leverage analysis

*All tools run client-side – no data sent to servers*

*Source code available on GitHub for transparency and audit.*



## Full derivations available in whitepaper:

- Merton jump-diffusion derivation
- Black-Scholes from first principles
- MM capital structure optimization
- VaR and CVaR proofs
- Validator economics model
- Options strategy payoff derivations

## GitHub Repository

- Python models: `models/*.py`
- Chart generation: `charts/*/chart.py`
- JavaScript calculators: `docs/calculators/`

*All code open source under MIT license.*

# Questions?

`github.com/Digital-AI-Finance/solana-staking`

Slides, models, and calculators all open source