

## Volatility-Based Sizing (Formula 14) X-Factor Volatility Stops

$$\text{Notional Exposure} = \frac{R_t \cdot C}{\sigma_i} \quad \text{where} \quad R_t = \text{Target Annual Risk} \quad x = \frac{|\Delta P|}{\sigma} \quad \text{Stop} = P \cdot (1 - x \cdot \sigma)$$

**Units (Unleveraged):**

$$\text{Units} = \frac{\text{Notional Exposure}}{P} \quad \text{or} \quad \frac{R_t \cdot C}{\sigma \cdot P}$$

Used in all Carver models to translate risk into position sizing across markets.

**Use:** Volatility-adjusted risk management that reacts to recent price moves.

*[Insert TikZ chart: X-Factor vs Stop Width]*

## Drawdown Regime Logic

$$\text{Drawdown}_t = 1 - \frac{C_t}{\max(C_{1..t})} \quad (\text{Peak-to-trough decline})$$

**Trigger:** If  $\text{DD} > 20\%$ , reduce  $R_t$ , or risk OFF.

**Regime Tree:**

- Normal  $\rightarrow$  Risk ON
- $\text{DD} > \text{threshold} \rightarrow$  Halve position
- Max DD  $\rightarrow$  Full cash

*[Insert TikZ tree: Regime transitions]*

## Capital & Leverage Calculations

$$\text{Leverage Factor (LF)} = \frac{\text{Notional}}{C} \quad \text{Leverage Ratio} = \text{LF} - 1$$

$$C_t = C_0 + \sum_{i=1}^t \Delta P_i \cdot u_i \quad (\text{PnL-adjusted capital})$$

*Forecasts are scaled to updated capital each time step.*

## Price Unit Volatility (PUV)

$$\text{PUV} = \sigma \cdot P \quad \Rightarrow \quad \text{Units} = \frac{\text{Notional}}{\text{PUV}}$$

High  $\sigma \Rightarrow$  high PUV  $\Rightarrow$  fewer contracts. Low  $\sigma \Rightarrow$  lower PUV  $\Rightarrow$  more size.

**From:** Leveraged Trading, Ch. 4–5

## Forecast Modulation

$$E_i = \frac{f_i}{20} \cdot \frac{R_t \cdot C}{\sigma_i} \quad \text{with} \quad f_i \in [-20, +20]$$

**Forecast Scaling:** Each forecast type is capped to avoid overfitting:

$$f_{\text{scaled}} = \max(\min(f, 20), -20)$$

*Used in: Systematic Trading, Ch. 10*

## Portfolio Volatility Targeting

$$\sigma_p^2 = \sum w_i^2 \sigma_i^2 + \sum_{i \neq j} w_i w_j \rho_{ij} \sigma_i \sigma_j$$

**Constraint:**  $\sigma_p \approx R_t$

**Related to:** Smart Portfolios (Carver) — covariance-based diversification.

## Forecast Models (Carver)

- **Trend:** EWMAC, Donchian breakout
- **Carry:** Roll yield, interest differential
- **Reversion:** Swing indicators, mean pullback
- **Momentum:** Multi-frame strength
- **Skew:** Return asymmetry
- **Acceleration:**  $\Delta$  forecast change

**Aggregate Forecast:**

$$f = \sum w_k f_k \quad \text{where} \quad \sum w_k = 1$$

## Forecast Invariance

- Volatility-normalized forecast execution
- All models constrained to same risk unit
- Forecast clipping prevents overleverage

*Core to Carver's robustness principles.*

## Backtesting Checklist (Systematic)

- Include transaction costs and slippage
- Model fill latency or execution lag
- Parameter decay and overfitting tests
- Evaluate Sharpe degradation over time

*Best practices from Ch. 11, Systematic Trading*

## System Modules (Modular Architecture)

- **Signal Engine** → Forecasts
- **Volatility Engine** → Annualized  $\sigma$
- **Capital Engine** → Realized  $C_t$
- **Risk Engine** → Sizing
- **Execution Filter** → Throttle trades

*[Diagram: Modular Trading Stack]*