



NEXUS QUANTITATIVE ENGINE

COMPLETE MATHEMATICAL & ALGORITHMIC SPECIFICATION

OFFICIAL ARCHITECTURE v3.4.2

Target Symbol: XAUUSD (Gold)
Platform: MetaTrader 5 / Python Core
Classification: Quantitative Internal

1. Instrument Geometry & Microstructure Mathematics

NEXUS operates primarily on spot Gold (XAUUSDm / XAUUSD). Because financial instruments differ across broker digit precisions, point sizes, and contract dimensions, every calculation begins with strict physical microstructure normalization.

1.1 POINT DIMENSIONS & TICK VALUATION

$$\Delta P = |P_{\text{Ask}} - P_{\text{Bid}}|$$

$$\text{Spread}_{\text{points}} = \frac{\Delta P}{\text{Point Size}}, \quad \text{where Point Size} = 0.001 \text{ (3 Digits)}$$

$$\text{Cash Point Value} = \text{Point Size} \times \text{Contract Size} \times \text{Volume}$$

For Gold (XAUUSDm), 1 Standard Lot represents 100.0 Troy Ounces ($C = 100.0$). A 1-dollar move on 0.01 lots produces exactly \$1.00 USD in realized cash profit/loss ($0.01 \times 100 \times 1.00 = 1.00$).

1.2 REAL-TIME SPREAD AUTO-CALIBRATION

$$\bar{S} = \frac{1}{N} \sum_{i=1}^N \left(\frac{P_{\text{Ask},i} - P_{\text{Bid},i}}{\text{Point Size}} \right), \quad N = 5 \text{ samples over } 2.5\text{s}$$

$$S_{\text{Limit}} = \lfloor 1.5 \times \bar{S} \rfloor$$

At boot and session open, NEXUS samples live broker liquidity 5 consecutive times. If live spread $S_{\text{live}} > S_{\text{Limit}}$, all market order dispatches are strictly vetoed until toxic broker widening subsides.

2. Capital Allocation & Dynamic Position Sizing Engine

NEXUS does not trade fixed lot sizes. To ensure mathematical capital preservation across accounts of any size (from 100 to 1,000,000), position volume is calculated dynamically from the exact stop loss distance and current account equity.

2.1 PURE RISK-BASED POSITION SIZING EQUATION

$$V_{\text{raw}} = \frac{E \times \left(\frac{R_{\text{eff}}}{100} \right)}{\Delta_{\text{SL}} \times C}$$

Where E = Account Equity, R_{eff} = Effective Risk Percentage, $\Delta_{\text{SL}} = |P_{\text{Entry}} - P_{\text{SL}}|$ (in dollar points), and $C = 100.0$ (Contract Size).

2.2 SESSION-ADJUSTED RISK BUDGET & AGGRESSIVE AI BOOST

$$R_{\text{session}} = \begin{cases} 2.0\%, & \text{Asian Session (00:00 -- 07:00 UTC)} \\ 2.5\%, & \text{London / New York (07:00 -- 21:00 UTC)} \\ 0.0\%, & \text{Rollover Blackout (21:00 -- 23:00 UTC)} \end{cases}$$

$$R_{\text{eff}} = \begin{cases} \min(R_{\text{base}} \times 2.0, 5.0\%), & \text{if AI Confidence} \geq 0.65 \text{ (Sharp Aggressive)} \\ R_{\text{session}}, & \text{otherwise} \end{cases}$$

When the AI Reversal or Trend Model detects an elite high-conviction pattern ($\geq 65\%$ probability), lot risk is multiplied by $2.0\times$ up to a hard session ceiling of 5.0% .

2.3 VOLUME STEP QUANTIZATION & BROKER CLAMPING

$$V_{\text{quant}} = \text{round}\left(\frac{V_{\text{raw}}}{V_{\text{step}}}\right) \times V_{\text{step}}$$

$$V_{\text{final}} = \max\left(V_{\text{min}}, \min(V_{\text{quant}}, V_{\text{max}})\right)$$

Enforces strict broker compliance with standard 0.01 lot increments ($V_{\text{step}} = 0.01$). If V_{min} produces an actual forced risk exceeding 5.0% , the trade is automatically rejected by the Risk Shield.

3. Market Structure & Technical Indicator Formulation

3.1 WILDER'S RELATIVE STRENGTH INDEX (RSI 14)

$$\Delta_t = C_t - C_{t-1}$$

$$U_t = \text{EMA}\left(\max(\Delta_t, 0), \alpha = \frac{1}{14}\right), \quad D_t = \text{EMA}\left(\max(-\Delta_t, 0), \alpha = \frac{1}{14}\right)$$

$$RS_t = \frac{U_t}{D_t} \implies \text{RSI}_t = 100 - \left(\frac{100}{1 + RS_t}\right)$$

Evaluated across M5 (scalp execution) and H1 (macro bias). Uses Wilder's exponential coefficient $\alpha = 1/N$ without lag adjustment.

3.2 AVERAGE TRUE RANGE (ATR 14) & VOLATILITY SCALING

$$TR_t = \max\left(H_t - L_t, |H_t - C_{t-1}|, |L_t - C_{t-1}|\right)$$

$$\text{ATR}_t = \text{EMA}\left(TR_t, \alpha = \frac{1}{14}\right)$$

Measures physical dollar volatility per 5-minute candle. Used directly to pad Stop Losses ($1.0 \times \text{ATR}$ to $1.5 \times \text{ATR}$) and trailing thresholds.

3.3 AVERAGE DIRECTIONAL INDEX (ADX 14) & REGIME STATE CLASSIFIER

$$+DM_t = \begin{cases} H_t - H_{t-1}, & \text{if } H_t - H_{t-1} > L_{t-1} - L_t \text{ and } > 0 \\ 0, & \text{otherwise} \end{cases}$$

$$-DM_t = \begin{cases} L_{t-1} - L_t, & \text{if } L_{t-1} - L_t > H_t - H_{t-1} \text{ and } > 0 \\ 0, & \text{otherwise} \end{cases}$$

$$+DI = 100 \times \frac{\text{EMA}(+DM)}{\text{EMA}(TR)}, \quad -DI = 100 \times \frac{\text{EMA}(-DM)}{\text{EMA}(TR)}$$

$$DX = 100 \times \frac{|+DI - -DI|}{+DI + -DI} \implies \text{ADX} = \text{EMA}\left(DX, \alpha = \frac{1}{14}\right)$$

State Classifier: When $\text{ADX} < 20.0$, state shifts to `[ASIAN-LOWVOL]` or `[RANGE]` (breakout engines disabled). When $\text{ADX} \geq 25.0$, state shifts to `[TREND]`.

3.4 BOLLINGER BANDS & NORMALIZED BANDWIDTH SQUEEZE

$$\mu_{20} = \frac{1}{20} \sum_{i=0}^{19} C_{t-i}, \quad \sigma = \sqrt{\frac{1}{20} \sum_{i=0}^{19} (C_{t-i} - \mu_{20})^2}$$

$$\text{BBU} = \mu_{20} + 2\sigma, \quad \text{BBL} = \mu_{20} - 2\sigma$$

$$\text{BandWidth} = \frac{\text{BBU} - \text{BBL}}{\mu_{20}}, \quad \text{BW}_{\%} = \frac{\text{BandWidth} - \min_{100}(\text{BandWidth})}{\max_{100}(\text{BandWidth}) - \min_{100}(\text{BandWidth})}$$

`BB_BREAKOUT` requires $\text{BW}_{\%} < 0.15$ (lowest 15th percentile squeeze over 100 candles) before authorizing an expansion breakout entry.

3.5 POINT OF CONTROL (POC) — VOLUME-WEIGHTED HISTOGRAM MODE

$$P_{\text{typical}} = \frac{H_t + L_t + C_t}{3}$$

$$\text{Bin Counts}(k) = \sum_{j \in \text{Bin}_k} \text{TickVolume}_j, \quad k \in [1, 50]$$

$$\text{POC} = \frac{E_{\max} + E_{\max+1}}{2}, \quad \text{where } \max(\text{Bin Counts})$$

Discretizes recent price distribution into 50 equal bins weighted by tick volume. The modal peak defines institutional Fair Value.

4. AMDA Tri-Pillar Execution Defense (Falling Knife Shield)

The **Adaptive Momentum Deceleration & Absorption (AMDA)** engine prevents premature counter-trend entries into momentum freefalls.

4.1 PILLAR 1: 2-BAR RSI VELOCITY DELTA (FREEFALL DETECTOR)

$$\Delta \text{RSI}_{2\text{-bar}} = \text{RSI}_{t-2} - \text{RSI}_{t-1}$$
$$\text{IsFreefall} = \left(\Delta \text{RSI}_{2\text{-bar}} > 15.0 \right) \wedge \left(\text{RSI}_t < \text{RSI}_{t-1} \right)$$

If RSI drops by more than 15.0 points over 2 candles and is still declining, buying is strictly vetoed ([RSI-WAIT]).

4.2 PILLAR 2: ABSORPTION WICK RATIO

$$\text{Lower Wick}_{\%} = \frac{\min(O_t, C_t) - L_t}{H_t - L_t} \geq 0.25 \quad (\geq 0.35 \text{ during waterfall})$$
$$\text{Upper Wick}_{\%} = \frac{H_t - \max(O_t, C_t)}{H_t - L_t} \geq 0.25$$

Demands at least 25% to 35% of the total candle range be left as a rejection shadow to confirm order absorption.

4.3 PILLAR 3: RELATIVE VOLUME ABSORPTION

$$\text{Vol}_{\text{ratio}} = \frac{\text{TickVolume}_t}{\frac{1}{20} \sum_{i=1}^{20} \text{TickVolume}_{t-i}} \geq 1.0$$

Confirms institutional liquidity absorption by requiring current candle volume to match or exceed the 20-period moving average.

5. Dynamic Position Management & Adaptive Profit Shields

5.1 DYNAMIC BREAK-EVEN (BE) LOCK & FEE PADDING

$$\text{Progress}_{\text{TP}} = \frac{|P_{\text{current}} - P_{\text{entry}}|}{|P_{\text{TP}} - P_{\text{entry}}|} \geq 0.55 \quad (55\%)$$
$$\text{Fee Buffer} = \min \left(\frac{|\text{Commission}| + |\text{Swap}|}{C \times V}, 0.50 \right)$$
$$P_{\text{BE}} = \begin{cases} P_{\text{entry}} + \text{Fee Buffer}, & (\text{BUY}) \\ P_{\text{entry}} - \text{Fee Buffer}, & (\text{SELL}) \end{cases}$$

Locks Stop Loss to absolute risk-free break-even with commission coverage once 55% of the target distance is reached.

5.2 ADAPTIVE 3-TIER DYNAMIC PROFIT SHIELD

Tier	Guard Name	Trigger Formula	Stop Loss Action
Tier 1	Climax Blow-Off Spike	$\text{Wick}_{\%} \geq 35\% \wedge \text{RSI} \geq 70 \text{ (or } \leq 30)$	$P_{\text{SL}} = \text{Candle Extremum} \mp \max(0.20, 0.10 \times \text{ATR})$
Tier 2	75% TP Milestone Lock	$ P_{\text{curr}} - P_{\text{entry}} \geq 0.75 \times \Delta_{\text{TP}}$	$P_{\text{SL}} = P_{\text{entry}} \pm (0.50 \times \Delta_{\text{TP}})$ (Locks 50% TP in pure profit)
Tier 3	Momentum Stagnation	$ H_t - H_{t-2} \leq 0.30 \wedge \Delta \text{RSI} < -2.0$	$P_{\text{SL}} = \text{Shelf Extremum} \mp 0.20$

5.3 VOLATILITY-SCALED ATR TRAILING STOP

$$P_{SL, \text{trail}} = \begin{cases} \text{Bid} - (2.5 \times \text{ATR}_{14}), & (\text{BUY}) \\ \text{Ask} + (2.5 \times \text{ATR}_{14}), & (\text{SELL}) \end{cases}$$

Activated once floating profit exceeds \$7.50 (7.50 dollar points). Trails continuously behind price at a dynamic distance of $2.5 \times \text{ATR}$.

6. Multi-Engine Strategy Mechanics

6.1 SMC ORDER BLOCK (OB) & FAIR VALUE GAP (FVG)

$$\text{Displacement Leg} \geq \max(0.50, 0.40 \times \text{ATR}_{14})$$

$$\text{Bullish FVG} = \text{Low}_i - \text{High}_{i-2} > 0, \quad \text{Bearish FVG} = \text{Low}_{i-2} - \text{High}_i > 0$$

Identifies the origin candle before institutional displacement. Validates mitigation order placement upon 50% retest.

6.2 SMC CHANGE OF CHARACTER (CHOCH)

$$P_{SL, \text{BUY}} = \text{OB}_{\text{Bottom}} - (1.0 \times \text{ATR}_{14})$$

$$P_{SL, \text{SELL}} = \text{OB}_{\text{Top}} + (1.0 \times \text{ATR}_{14})$$

$$P_{TP} = \max \left(P_{\text{HTF Pivot Target}}, P_{\text{Entry}} \pm (\Delta_{SL} \times 1.5) \right)$$

Selects dynamically between Direct Market Execution (if breakout momentum $\text{ADX} \geq 28$) and Retest Limit Orders at the order block origin.

6.3 LIQUIDITY SWEEP (BSL / SSL EQUAL HIGHS/LOWS)

$$\text{Proximity Cluster: } \frac{|P_1 - P_2|}{P_1} \leq 0.0008 \quad (0.08\%)$$

$$\text{Sweep Condition: } \text{High}_t > \text{BSL} \wedge \text{Close}_t < \text{BSL} \quad (\text{False Breakout})$$

Filters stale pools using an invalidation distance of $\max(3.0, 1.0 \times \text{ATR})$. Requires confirmed closed-candle failure back inside the range.

7. Risk Management Circuit Breakers

7.1 PROP-FIRM DAILY DRAWDOWN GUARD

$$\text{Total Daily PnL} = \text{ClosedPnL}_{\text{today}} + \text{FloatingPnL}_{\text{open}}$$

$$\text{Daily Loss} = |\min(0.0, \text{Total Daily PnL})|$$

$$\text{Daily DD}_{\%} = \left(\frac{\text{Daily Loss}}{E_{\text{Daily Start}}} \right) \times 100$$

If $\text{Daily DD}_{\%} \geq 20.0\%$, the bot triggers an immediate **Global Emergency Liquidation**, closes all open market deals, cancels all pending orders, and locks the terminal until the 00:00 MT5 server day rollover.

8. Performance & Statistical Analytics

8.1 PROFIT FACTOR & EXPECTANCY

$$\text{Profit Factor} = \frac{\sum \text{Gross Realized Profit}}{|\sum \text{Gross Realized Loss}|}$$

$$\text{Expectancy} = (\text{Win Rate} \times \overline{\text{Win}}) - (\text{Loss Rate} \times \overline{\text{Loss}})$$

$$\text{Sharpe Ratio} = \frac{\overline{R_d} - R_f}{\sigma_d} \times \sqrt{252}$$

Measures institutional risk-adjusted return. Minimum operational benchmark: Profit Factor ≥ 1.50 , Expectancy > 0 .