Volume Clustering and Pivot-Based Support / Resistance Systematic Identification.

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Introduction

Motivation

- Support and resistance are widely accepted heuristics in the technical analysis community.
- If sufficiently many market participants act on these levels, price clustering can create statistically persistent patterns.

Objective

- Our aim is to systematically detect support and resistance zones and build a trading strategy to exploit price reversals.
- Positions are initiated based on proximity to statistically significant support/resistance zones derived from volume clustering.

Approach 1: Cumulative Volume Traded

- For each trading day, we apply a rolling window of length *L*, partitioning the price range into *N* equally sized bins.
- For each bin *i*, we compute the exponentially weighted cumulative volume:

$$V_i = \sum_{t=t_{ ext{current}}-L}^{t_{ ext{current}}-1} v_{i,t} \cdot w(t)$$

where $v_{i,t}$ is the volume traded in bin i on day t.

• The exponential weight is defined as:

$$w(t) = \exp(-\lambda(t_{\text{current}} - t)), \quad \lambda = \frac{\ln 2}{h}$$

where h is the half-life.

Approach 1: Cumulative Volume Traded

 Each day, we construct a dynamic volume histogram that summarizes trading activity over the look-back window.

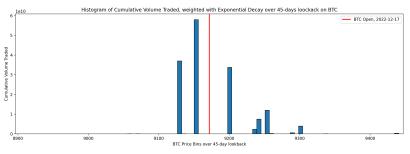


Figure 1: Rolling Histogram of Cumulative Volume Traded

- The histogram updates daily as the rolling window advances.
- High-volume clusters provide a probabilistic basis for support and resistance levels.

Support/Resistance and Signal Generation

Support and Resistance Definition

$$S_t = \text{midpoint of arg max } V_i, \quad R_t = \text{midpoint of arg max } V_i = \sum_{p_i > P_t} P_i$$

Signal Function

$$\mathsf{Signal}_t = \begin{cases} +1, & \mathsf{if} \quad P_t \in [S_t, \ S_t(1+\beta)] \\ -1, & \mathsf{if} \quad P_t \in [R_t(1-\beta), \ R_t] \\ 0, & \mathsf{otherwise} \end{cases}$$

Strategy Parameters

Key parameters used in the strategy:

 Parameters are further optimized using random search to maximize Sharpe ratio.

Approach 2: Pivot-Based Bands

- Based on intraday trading convention: prices oscillate around a central "pivot" level.
- Widely used by discretionary traders; we formalize and implement this using deterministic rules.

Formulas

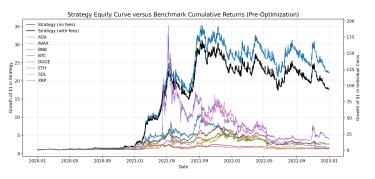
Given previous high H_{t-1} , low L_{t-1} , and close C_{t-1} :

$$C_{t} = \frac{H_{t-1} + L_{t-1} + C_{t-1}}{3}$$

$$R_{t} = 2C_{t} - L_{t-1}$$

$$S_{t} = 2C_{t} - H_{t-1}$$

Training Set Performance (1 Jan 2020 - 31 Dec 2022)





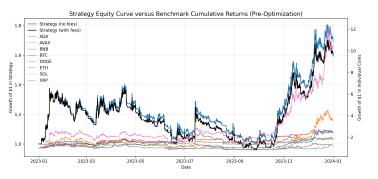
Performance Metrics

Metric	Value
Annualized Return	1.59
Annualized Volatility	0.52
Sharpe Ratio	2.06
Sortino Ratio	2.75
Maximum Drawdown	-0.44
Winning Rate	0.43
Average Holding Period	30 periods
Number of Trades	3698

Parameter Optimization: Heat Map

Sharpe Ratio Sensitivity to Parameters																				
09	1.85	1.85	1.85	1.85	1.85	1.86	1.86	1.88	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
19	1.91	1.93	1.99	1.98	1.95	1.93	1.93	1.93	1.93	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94
62	1.93	1.89	1.89	1.92		1.91	1.91	1.91	1.90	1.90	1.91		1.91	1.91	1.91		1.91	1.91	1.91	
63	1.88	1.88	1.88	1.91	1.92	1.90	1.90	1.90	1.89	1.89	1.89	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
64	1.83	1.86	1.87	1.91		1.93	1.95	1.94	1.93	1.94	1.93	1.93	1.94	1.94	1.94	1.94	1.94	1.95	1.95	1.95
9	1.90	1.89	1.85	1.87	1.88	1.89	1.89	1.91		1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
99	1.85	1.90	1.87	1.89	1.89	1.90	1.89	1.90		1.88	1.89	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
67	1.99	1.93	1.95	1.95	1.95	1.94	1.94	1.94		1.93	1.93		1.93	1.94	1.94	1.96	1.96	1.96	1.96	1.96
89	2.03	2.02	2.03	2.06	2.06	2.06	2.05	2.06	2.06	2.06	2.05	2.05	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
69	2.06	1.97	1.98	1.99	1.99	2.00	2.00	2.00	2.00	2.00	2.00	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
70	2.04	2.04	2.02	2.05	2.07	2.08	2.08	2.08	2.08	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
71	2.02	1.89	1.90	1.93	1.92	1.92	1.93	1.94	1.94	1.94		1.94	1.94	1.94	1.94	1.95	1.95	1.95	1.95	1.95
72	2.02	1.95		1.98			1.98		1.99	1.99	1.98	1.98		1.98	1.98	1.98	1.98	1.98	1.98	1.98
73	1.98	1.92	1.92	1.91			1.91			1.94				1.94	1.94	1.94	1.94	1.94	1.94	1.94
74	1.88	1.93		1.86		1.89			1.89	1.89	1.88			1.89	1.89	1.89	1.89	1.89	1.89	1.89
75	1.95	1.96									1.91								1.92	
76								1.83		1.83					1.83		1.83			1.83
77	1.92	1.86	1.83	1.84		1.82	1.81		1.80	1.80				1.80	1.80	1.80	1.80	1.80		1.80
78	1.80	1.72		1.69		1.68			1.63					1.63	1.63	1.63	1.63	1.63	1.63	1.63
79	1.93	1.92	1.88	1.87	1.88	1.88	1.85	1.85	1.84	1.84	1.84	1.84	1.84	1.85	1.85	1.85	1.85	1.85	1.85	1.85
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1 Shift	0.11 Signal	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.2

Validation Set Performance (1 Jan 2023 - 31 Dec 2023)





Performance Metrics

Metric	Value
Annualized Return	0.59
Annualized Volatility	0.40
Sharpe Ratio	1.34
Sortino Ratio	1.51
Maximum Drawdown	-0.30
Winning Rate	0.47
Average Holding Period	48 periods
Number of Trades	951