Drawdowns

May 25, 2025

1 Reducing Stat-Arb Drawdowns Using a Stop-Loss Mechanism

In the report Statistical Arbitrage, we implemented a strategy that ended up having a roughly $245.00 max-drawdowns. In this brief report, we explore how to integrate a stop-loss mechanism. In traditional statistical arbitrage strategies, positions are entered when the spread deviates significantly from its historical mean and exited once the spread reverts. However, to improve risk management and reduce drawdowns, a stop-loss mechanism is introduced: if the Z-score of the spread exceeds a critical threshold (e.g., ±3 standard deviations from the rolling mean) in the wrong direction, the position is forcefully exited. This protects the strategy from regime shifts or persistent deviations that violate the mean-reversion assumption.

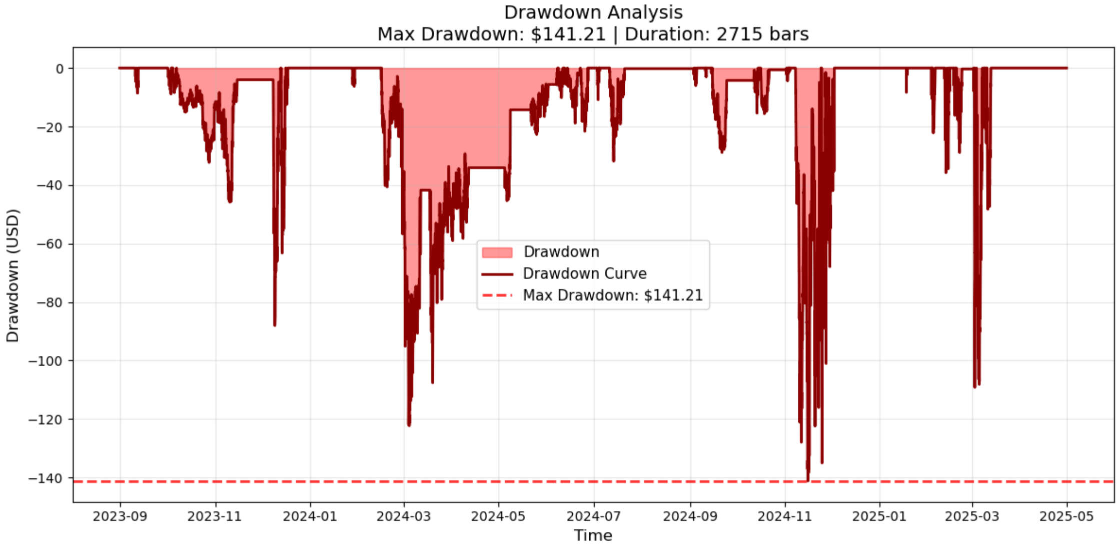
A potential implementation is straightforward and displayed below. If we are currently in a long-position and the spread-series continues to move down beyond -1 x our stop-loss threshold, we exit our position. Similarly, if we are currently in a short position and the spread continues to move up above our stop-loss threshold, we exit our position.

[ ]:

```python
elif position == 1 and z < -stop_z:
    position = 0
    exit_fee = calculate_entry_exit_fees(notional, b1, b2, binance_fee_bps)
    total_fees_paid += exit_fee
    exit_info = {
        "exit_time": time,
        "exit_z": z,
        "exit_index": t,
        "exit_fee": exit_fee,
        "stop_loss": True
    }
    entry_idx = entry_info.get("entry_index", t - 1)
    spread_pnl = (spread_values[t] - spread_values[entry_idx]) * notional
    total_trade_fees = entry_info.get("entry_fee", 0) + exit_fee
    net_pnl = spread_pnl - total_trade_fees
    trade_log.append({**entry_info, **exit_info, "gross_pnl": spread_pnl, "fees": total_trade_fees, "net_pnl": net_pnl})

elif position == -1 and z > stop_z:
    position = 0
    exit_fee = calculate_entry_exit_fees(notional, b1, b2, binance_fee_bps)
    total_fees_paid += exit_fee
    exit_info = {
        "exit_time": time,
        "exit_z": z,
        "exit_index": t,
        "exit_fee": exit_fee,
        "stop_loss": True
    }
    entry_idx = entry_info.get("entry_index", t - 1)
    spread_pnl = (spread_values[entry_idx] - spread_values[t]) * notional
    total_trade_fees = entry_info.get("entry_fee", 0) + exit_fee
    net_pnl = spread_pnl - total_trade_fees
    trade_log.append({**entry_info, **exit_info, "gross_pnl": spread_pnl, "fees":
↪ total_trade_fees, "net_pnl": net_pnl})
```

We see our max drawdown went from around $245 to around $140, which is roughly a 43% improvement using the stop loss mechanism. These risk-management techniques can be very crucial to implement in a live-trading strategy because when we trade a spread in a stat-arb strategy, we are assuming that the statistical properties that indicate the spread is mean-reverting will hold. In other words, when we take a position, we are making a bet that the value of the spread will revert to the mean, which will not be the case if the underlying statistical properties (tested for in the Statistical Arbitrage report) break down in the future.


Drawdown Analysis
Max Drawdown: $141.21 | Duration: 2715 bars
Drawdown (USD)
0
−20
−40
−60
−80
−100
−120
−140
2023-09
2023-11
2024-01
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
Time
Drawdown
Drawdown Curve
Max Drawdown: $141.21