Damion Marshall

Quantitative Trading and Research

linkedin.com/in/damion-marshall-4a9598274 · github.com/damion-m/Quantitative-Strategies · Portfolio and live agent replays: claude.ai/artifact/PcqFrDyEpoeih1R4DbSS9k

EDUCATION

Columbia University · BA, Mathematics–Statistics

CURRENT RESEARCH

Anomaly detection to predict regime change in options and equity markets
Mathematics · Statistics · Market Microstructure · Quantitative Strategies

PROJECTS

Regression strategies

Python · statsmodels · scikit-learn

- Built and backtested **five S&P 500 direction models** (OLS, Lasso, logistic regression, unpruned and grid-searched decision trees) on 1-, 5-, 15- and 20-day momentum features, 2000–2026.
- Prevented look-ahead with a **chronological 70/30 split, train-only scaling and date-ordered cross-validation**; tuned Lasso alpha with LassoCV and tree depth and leaf sizes with GridSearchCV on ROC-AUC.
- Converted forecasts into long/flat strategies and compared them with an equal-weighted benchmark on growth, drawdown, Sharpe and calendar-year returns.
- No model beat the benchmark out of sample (2018–2026): Lasso grew $1 to **$3.27 vs $3.45**; best hit rate **52.1%** and AUC **0.51**, with results driven by time in the market (Lasso was long 90% of days).

Time-series features

pandas · Plotly

- Engineered **trend, band, momentum and volatility features** for AAPL (Mar 2020–Aug 2024): 20/50-day moving averages, Bollinger Bands, Wilder 14-day RSI, and price and annualized return volatility.
- Built reusable **Plotly chart builders** (candlestick and volume, moving-average spread, Bollinger Bands, indicator panel, animated price path) on a shared dark theme.
- Delivered the **seven-feature, 1,124-day dataset** that forms the RL agent's state; AAPL rose **240%** and closed above its 50-day average on **62%** of days.

DQN trading agent

Keras · reinforcement learning

- Designed a **deep Q-network trader** for AAPL with position-aware states (seven feature changes plus three position features), a daily mark-to-market reward net of 5 bp costs, action masking and a five-share cap.
- Stabilized learning with **experience replay, a target network** synced every 200 steps and exploration decaying from 100% to 2% over 80% of training.
- Diagnosed and fixed a **collapsed policy** that bought every day and never sold; built a backtester, FIFO trade log and post-trade analytics.
- On 338 unseen days the best checkpoint earned **$301 vs $308** for buy-and-hold; the final model had the smallest drawdown (**$64 vs $163**) but earned $130.
- Ported the trained network to **JavaScript for a live in-browser replay** that matches the notebook's trades to the cent.

GBM options agent

Black-Scholes · Monte Carlo · DQN

- Fitted **geometric Brownian motion** by maximum likelihood and measured where fat tails and negative skew break it, with Q-Q plots and forecast-range calibration tests.
- Forecast 21-day SPY volatility walk-forward with **historical, EWMA, GARCH(1,1), HAR-RV and VIX** models, scored on QLIKE; implied volatility exceeded realized on **85%** of days.
- Built a **Black-Scholes pricer, Greeks and Monte Carlo engine** with antithetic variates, verified against each other (Greeks to 1e-6, exact put-call parity).
- Trained a DQN to **buy and sell calls and puts** under bid/ask costs, Reg-T-style margin with forced buy-backs, contract and short caps, and a crash filter, logging every trade with its Greeks, IV and model edge.
- Final training episode returned **+59% on a $100k account** (Sharpe 0.74, 20% max drawdown) vs SPY's +80% (0.76, 25%) from late 2021; 168 trades at a 79% win rate. Across three episodes the agent learned to **sell puts**, moving from −44% to +59%.

Anomaly detection & regime change

change-point · HMM · optimal transport

- Building a **walk-forward research environment** that tests whether market anomalies predict regime change: about 24 causal signals from GARCH residuals, CUSUM and Bayesian change-point detection, HMM and jump models, correlation fragility, options-implied volatility and Wasserstein and signature methods, fused into one probability of a drawdown within 21 days.
- Results to follow after research completes.

Risk parity

portfolio construction

- Backtested **inverse-volatility risk parity** across S&P 500 e-mini, gold and 10-year T-note futures (2015–2025) using a 36-day volatility window.
- Removed a **look-ahead bias** by lagging weights one day; added configurable daily, weekly or monthly rebalancing, turnover costs and a T-bill risk-free rate.
- Grew $1 to about **$1.61 vs $2.36** for equal weight, with a similar ~16% drawdown in 2022 when bonds fell alongside stocks.

Shared library

func_lib.py

- Wrote a **1,500-line Python library** (data, date-safe splits, backtests, agents, pricing, volatility models, charts) used by all seven notebooks.
- Refactored the original notebooks, fixing **data-leakage bugs** (scalers fitted on test data, shuffled cross-validation, unlagged weights).
- Verified every numerical routine independently, including **Monte Carlo vs Black-Scholes** and account equity reconciled to the cent; all seven notebooks run end to end.

TECHNICAL SKILLS

Languages and libraries: Python, NumPy, pandas, SciPy, scikit-learn, statsmodels, Keras, Plotly; HTML, CSS, JavaScript
Methods: time-series and volatility modeling (GARCH, HAR-RV), Black–Scholes and Monte Carlo pricing, deep reinforcement learning (DQN), walk-forward backtesting, risk parity, change-point detection and regime models