Contextual Bandit Portfolio Allocation

Evaluating LinUCB contextual bandit for weekly capital allocation across five technology leaders: AVGO, AAPL, TSLA, GOOGL, NVDA.

Test Period

52-week evaluation window from September 23, 2024 to September 22, 2025

Context Features

Lagged returns, volatility, RSI, and relative price/volume signals drive allocation decisions

Benchmarks

Equal-weight portfolio, seeded random arm selection, SPY ETF, and best single ticker performance

LinUCB Architecture Overview

LinUCB feedback loop: feature engineering → state update → UCB policy → realized reward feedback

Feature Engineering

Technical indicators and market signals transformed into context vectors for each asset

State Update

Bayesian parameter estimation updates confidence bounds based on observed rewards

UCB Selection

Upper confidence bound policy balances exploitation of high-performing arms with exploration

Reward Feedback

Weekly returns provide reward signal to refine future allocation decisions

Performance Results

1.91

Ending Value

Portfolio multiplier vs SPY's 2.46x benchmark

90.9%

Total Return
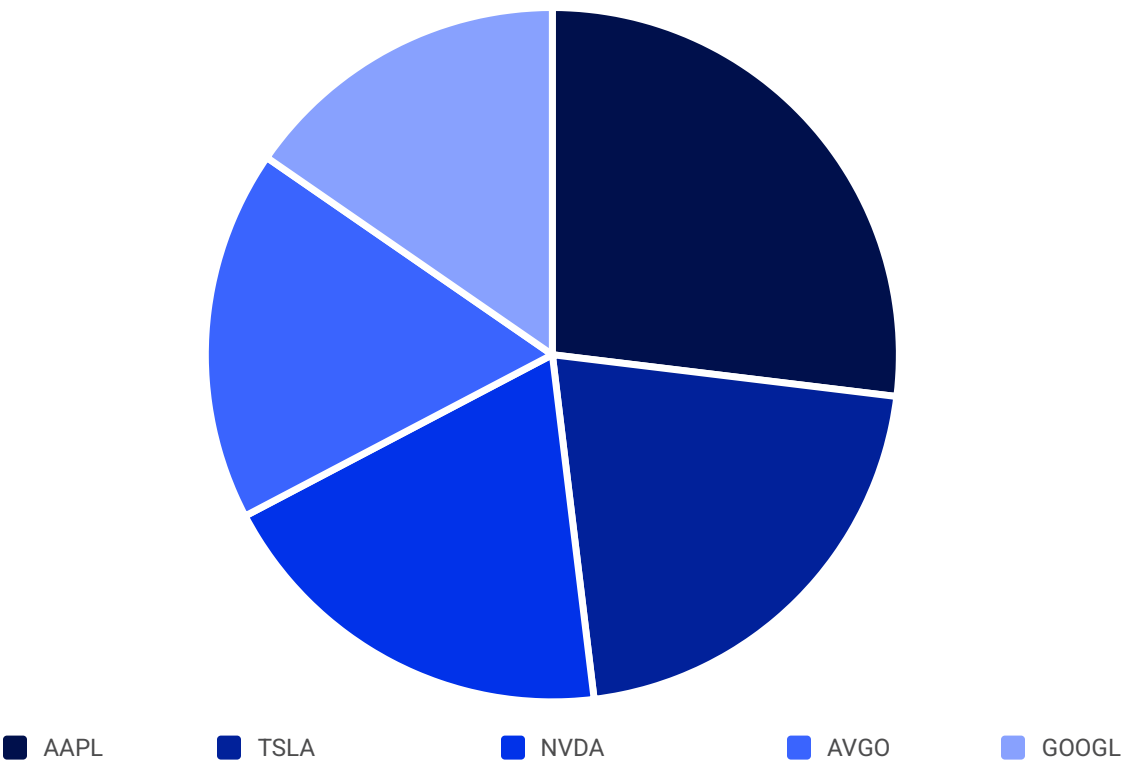
Cumulative performance over 52-week period

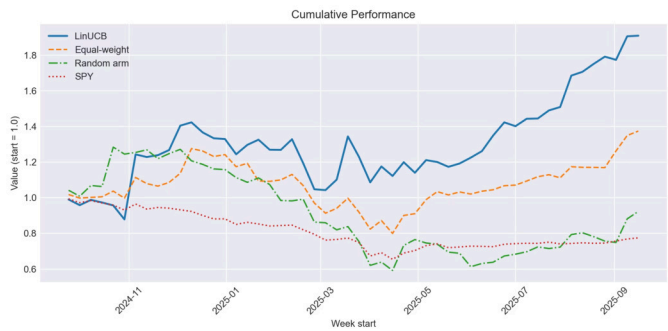**2.06**

Sharpe Ratio

Risk-adjusted return efficiency metric

-26.7%

Max Drawdown

Peak-to-trough decline during test period
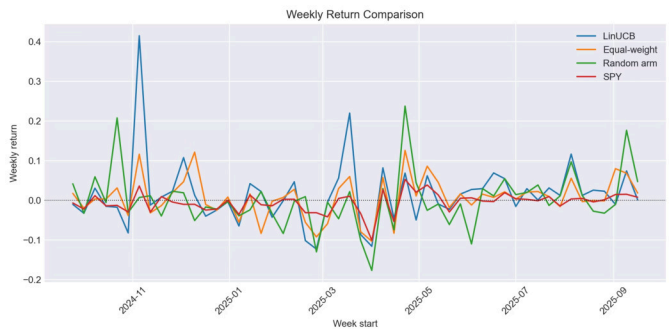

- ■ AAPL
- ■ TSLA
- ■ NVDA
- ■ AVGO
- ■ GOOGL

LinUCB demonstrated balanced exploration across all five assets, with AAPL receiving the highest allocation frequency.

Performance Visualization

Cumulative Performance

Weekly Return Comparison

Cumulative Value

Portfolio growth trajectory compared against baseline strategies and SPY benchmark

Return Resilience

Weekly return distribution showing downside protection and volatility characteristics

Left panel shows cumulative value progression versus baselines | Right panel demonstrates weekly return resilience and risk profile

Key Insight

LinUCB achieved competitive returns with systematic risk management, demonstrating the viability of contextual bandits for tactical asset allocation in concentrated tech portfolios.

Implementation Note

The algorithm's balanced exploration-exploitation trade-off prevented over-concentration while capturing momentum signals across the five-asset universe.