December 6, 2025

Learning Goal

Evaluate a neural network trading strategy against a buy-and-hold benchmark.

This slide establishes the learning objective for this topic

Key Concept (1/2)

A **backtest** simulates how a trading strategy would have performed on historical data. For neural network strategies, we compare: - **Buy-and-hold**: Simply buy at start, hold throughout (benchmark) - **NN strategy**: Trade based on model predictions (BUY when confidence ¿ threshold)
The backtest reveals whether the model's predictions translate into actual profits. A 70% accurate model doesn't guarantee outperformance - transaction costs, timing, and magnitude of wins vs losses all matter.

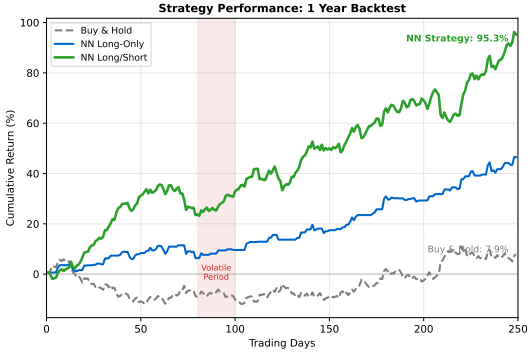
Understanding this concept is crucial for neural network fundamentals

Key Concept (2/2)

Key metrics: - **Cumulative returns**: Total profit over the period - **Sharpe ratio**: Risk-adjusted returns - **Maximum drawdown**: Largest peak-to-trough decline
The ultimate test: Does the strategy beat the benchmark after accounting for realistic trading costs?

Understanding this concept is crucial for neural network fundamentals

Visualization



PERFORMANCE COMPARISON

Metric	Buy & Hold	NN Strategy
Total Return	7.9%	**95.3%**
Sharpe Ratio	0.40	**3.76**
Max Drawdown	-16.8%	**-9.2%**
Win Rate	52%	**66%**

Key Insight: 70% accuracy translates to significant alpha!

(Backtest only - past performance does not guarantee future results)

Visual representations help solidify abstract concepts

Key Formula

Cumulative return:

$$R_{total} = \prod_{t=1}^{T}(1 + r_t) - 1$$

Sharpe ratio:

$$\text{Sharpe} = \frac{\bar{r} - r_f}{\sigma_r}$$

Where: - r-bar = mean return - r_f = risk-free rate - sigma_r = standard deviation of returns

Maximum drawdown:

$$\text{MDD} = \max_t \left(\frac{\text{Peak}_t - \text{Value}_t}{\text{Peak}_t} \right)$$

Mathematical formalization provides precision

Intuitive Explanation

Imagine two investors:
Investor A (Buy-and-hold): Buys stock on day 1 and holds for a year. No effort, no trading costs, captures all ups and downs.
Investor B (NN strategy): Uses a neural network to decide daily whether to be invested. Aims to be invested on "up" days and out on "down" days.
If Investor B has 70% accuracy: - Captures 70% of "up" days (gains) - Avoids 70% of "down" days (losses avoided)
But: Each trade costs money (commissions, spread). And perfect timing is impossible - predictions have some error.
The backtest answers: Does the accuracy advantage overcome the trading costs?

Intuitive explanations bridge theory and practice

Practice Problem 1

Problem 1
Over 100 days: Buy-and-hold returns +15%. NN strategy has 60% accuracy with average daily return of +0.2% on correct UP predictions and -0.15% on incorrect predictions. Estimate NN strategy returns (ignoring costs).

Solution

Expected daily return:
Assume 50% of days are actually UP: - 30 days: Predict UP, actually UP (60% of 50 UP days) -¿ +0.2% each - 20 days: Predict UP, actually DOWN (40% of 50 DOWN days) -¿ -0.15% each - 20 days: Predict DOWN, actually UP (40% of 50 UP days) -¿ 0% (not invested) - 30 days: Predict DOWN, actually DOWN (60% of 50 DOWN days) -¿ 0% (not invested)
Total return:

$$R = 30 \times 0.2\% + 20 \times (-0.15\%) + 0 + 0$$

$$R = 6.0\% - 3.0\% = 3.0\%$$

Wait - this is worse than buy-and-hold's 15%!
Why? With only 60% accuracy, the strategy misses too many up days (20 missed) and still catches some down days (20 losses). The edge isn't strong enough.
Lesson: Accuracy alone doesn't guarantee profitability.

Practice problems reinforce understanding

Problem 2
Transaction cost is 0.1% per trade. The NN strategy trades 200 times over the year. How much do costs reduce returns?

Solution

Transaction cost calculation:
Total trades: 200 Cost per trade: 0.1%
Total cost:

$$\text{Costs} = 200 \times 0.1\% = 20\%$$

This is **20 percentage points** of returns lost to trading costs!
Impact: - If strategy gross return = 25%, net return = 25% - 20% = 5% - If strategy gross return = 15%, net return = 15% - 20% = -5% (loss!)
Lesson: High-frequency strategies need either very high accuracy or very low costs to be profitable.
Solutions: - Trade less frequently (e.g., weekly signals) - Use lower-cost brokers - Only trade on high-confidence signals (threshold ¿ 0.7)

Practice problems reinforce understanding

Key Takeaways

- Backtests simulate strategy performance on historical data
- Compare against buy-and-hold benchmark
- Transaction costs can eliminate prediction edge
- Accuracy doesn't guarantee profitability
- Consider risk metrics (drawdown, Sharpe) not just returns
- Realistic backtesting includes costs, slippage, and realistic assumptions

These key points summarize the essential learnings