IQIC - Quantitative Tools

#6: Building a Basic Backtest

What You Need Before You Start

Inputs for a backtest

- **Data:** Adjusted prices, universe membership, corporate actions. Unadjusted data creates fake jumps and false signals.
- **Rules:** Universe, signal, entry/exit, rebalancing, position sizing. Vague rules make a backtest impossible to reproduce.
- **Assumptions:** Starting capital, test period, benchmark, cost model. These determine whether results are realistic or fantasy.
- **Output:** Trades, portfolio values, performance metrics. This is what you will evaluate later.

Calculate the Strategy's Signal

How good is the signal?

A signal is a number that ranks how attractive each asset is. Keep in mind to only use only past data at each decision point, no look-ahead.

Example: 3-month momentum = Price_today / Price_3_months_ago - 1.

Ticker	Price 3M Ago	Price Today	Momentum
AAPL	180	190	+5.6%
MSFT	370	400	+8.1%
NVDA	500	620	+24.0%

From Signal to Portfolio

Turning rankings into buy and sell decisions

- **Rank all assets by signal**, you need a consistent, objective way to compare every stock in your universe.
- **Select top N (or top/bottom N for long-short)**, this single rule defines your entire portfolio and controls concentration.
- **Set target weights**, equal weight (1/N) is simple and avoids overconcentration; signal-weighted can tilt toward stronger signals but adds complexity.
- **Compare target vs. current holdings**, you only trade the difference, which minimizes turnover and transaction costs.
- **Execute at next day's open or close**, never trade on the same price you used to compute the signal; this avoids look-ahead bias.

Calculate Portfolio Returns

The overall profit

- For each holding period, compute each asset's return.
- Portfolio return = weighted sum of asset returns.
- Compound returns over time to get cumulative performance.
- Rebalancing resets weights to target at each rebalance date.

Formula: Portfolio Return = Σ (Weight_i × Return_i)

Trading Isn't Free

Why costs matter and how to model them

- **Commission:** fixed fee per trade, even small fees add up over many trades.
- **Bid-ask spread:** the gap between buy and sell price. You always buy higher and sell lower.
- **Slippage:** price moves against you before execution. Markets don't stand still.
- **Simple model:** 0.1% of trade value (10 bps) per buy and sell, it's easy to apply and realistic enough for a beginner backtest.
- **Deduct costs from portfolio value:** Gross returns are misleading; only net returns matter.

Action	Trade Value	Cost Rate	Cost
Sell AAPL	$10,000	0.1%	$10
Buy NVDA	$10,000	0.1%	$10
Total round-trip cost			**$20**

How Did We Do?

Beyond just total return

- **Total Return:** (Final / Initial) - 1, shows overall profit.
- **Annualized Return:** (1 + Total Return)^(1/Years) - 1, lets you compare strategies over different time periods.
- **Volatility:** standard deviation of returns × √(periods per year), measures how bumpy the ride is.
- **Sharpe Ratio:** (Return - Risk-free Rate) / Volatility. it tells you return per unit of risk.
- **Max Drawdown:** largest peak-to-trough decline, it shows the worst possible loss.
- **Win Rate:** % of profitable trades

Metric	Value
Total Return	+22%
Annualized Return	+44%
Volatility	30%
Sharpe Ratio	1.47
Max Drawdown	-12%
Win Rate	67%

Putting It All Together

A complete tiny backtest from start to finish

- **Universe:** AAPL, MSFT, NVDA.
- **Signal:** 3-month momentum.
- **Rebalance:** Monthly, first trading day.
- **Position:** Top 1 stock, 100% weight.
- **Costs:** 0.1% per trade.

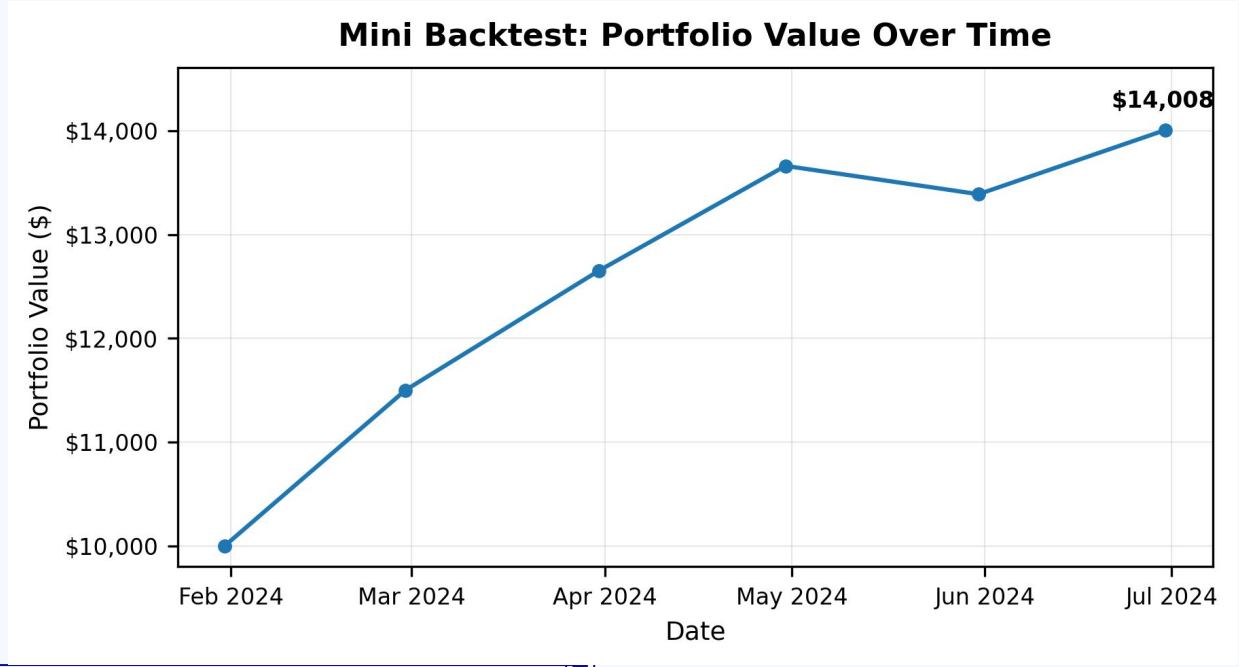
- Define universe and rules with clean data.
- Calculate signal without look-ahead.
- Rank and select.
- Compute returns and Subtract costs.
- Calculate metrics.

Date	Selected	Portfolio Value
Jan 31	NVDA	$10,000 → $11,500
Feb 29	NVDA	$11,500 → $12,650
Mar 31	MSFT	$12,650 → $13,662
Apr 30	MSFT	$13,662 → $13,389
May 31	NVDA	$13,389 → $14,058

*Table shows gross portfolio value. Final value after 0.1% transaction costs = **$14,008** (see chart on next slide).*

Putting It All Together - Visual

A complete tiny backtest from start to finish



Final after costs: ≈ $14,008

Total Return: ≈ +40%

Additional Resources

Where to go next

- **Hudson & Thames Backtest Tutorial: GitHub**
  Free Jupyter Notebooks covering the full pipeline: pulling data, building a vectorized backtest, and incorporating transaction costs. Practical and code-focused, perfect for following along.
- **Strategy Arena Academy: 9 Free Lessons**
  A free, no-signup course that walks from "what is a backtest" to building and testing your own strategy. Lesson 8 covers why strategies fail.