Current Shortcomings of Reinforcement Learnings in Finance Literature

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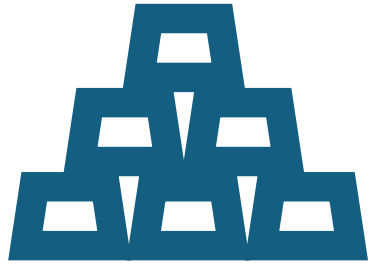
Agenda

- Introduction
- Current approach in literature
- Shortcomings
- Alternative approach
- Conclusion

Introduction: Definitions

Reinforcement Learning: A framework for sequential decision-making (Sutton & Barto, 2018)



Financial markets: Public equity, commodity, currency, cryptocurrency and derivatives markets

Introduction: Data

I reviewed 166 publications for my SLR

Results are preliminary

Introduction: Use Cases

From Hambly et al. (2023)

- Algorithmic Trading
- Portfolio Management
- Market Making
- Optimal Order Execution
- Option Pricing
- Smart Order Routing
- Robo-Advising

Curren Approach: Claims

- Our proposed model x
- Outperforms state of the art models y
- On benchmark z

Current Approach: Methodology

1. Select use case
2. Propose new RL agent configuration and benchmark models
3. Define benchmark protocol
4. Collect historical data
5. Train models on first part of data
6. Test models on second part of data
7. Report results

Shortcomings: Methodology

Specific Problem

- Researchers try to claim superior performance of proposed RL model based on benchmark
- We don’t know if that generalizes to different timeframes or assets

General Problem (Popper, 1934)

- Problem of induction
- You cannot verify that a universal statement is true through observation
- You can only falsify it through an observation

Shortcomings: Assumptions

Necessary Assumptions

- Financial markets have patterns
- RL agents can exploit these patterns

Four Scenarios (MECE)

1. No patterns, no learning
2. No patterns, could learn
3. Patterns, can't learn
4. Patterns, can learn

Both assumptions need to be true to justify the application of RL to financial markets.

But what about all the published successful results?

- Assuming no pattern can be equated to fair coin flip
- Assuming no learning can be equated to random guessing
- Experiment: agent tries to predict heads or tails for 100 iterations
- Under scenarios 1-3, we would expect 50 out of 100 experiments to yield positive results
- Published results could be produced in scenario 4, but also scenarios 1-3
- Observations could be due to chance as well as learning, especially account for survivorship bias

Alternative Approach

Problem

- First assumption is long-debated in Economics
- No theoretical guarantees for second assumptions
- We cannot apply RL to financial data and draw conclusions from that

Solution

- Focus on second assumption
- Use falsification
- Develop theoretical understanding of learning abilities of agents
- Refine understanding when RL can be applied and when not

Conclusion

Current “RL in finance” literature is neither “applied” nor “scientific”

Foundational assumptions are unchecked

Used methodology does not create the evidence required to support claims

New methodology is required

Thank you!