Deep Q-Learning and Double Deep Q-Learning in Niche Markets

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CS 234: Reinforcement Learning

Introduction

Problem:
AI dominates major markets, but **niche markets** remain underexplored.

Goal:
Testing and comparing **Deep Q-Learning (DQN) Double-DQN**, DQN with transformer in niche trading environments.

Why it matters:
Niche markets might offer AI-based strategies **higher profitability** and **less competition**.

Approach:
Test algorithms on historical stock data to identify **optimal strategies** and observe their performance.

Method

Algorithms: DQN, Double-DQN, Transformer-based DQN.
(Deng et al, 2016), (Van Hasselt et al, 2016), (Mnih et al, 2013), (Vaswani, A. et al. 2017).

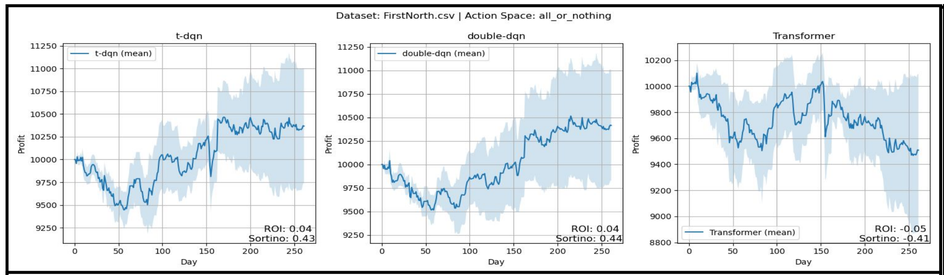
Data: Historical stock prices from Firstnorth (Swedish growth market) and Novotek (Swedish automation company, $30k daily volume)
(Yahoo Finance. 2025), (Nasdaq OMX, 2025).

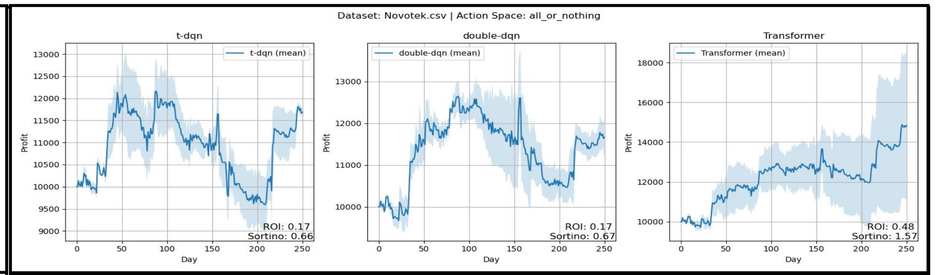
Strategies: "All-or-nothing," Incremental (10% steps), or % of portfolio (0-100%, 10% increments)

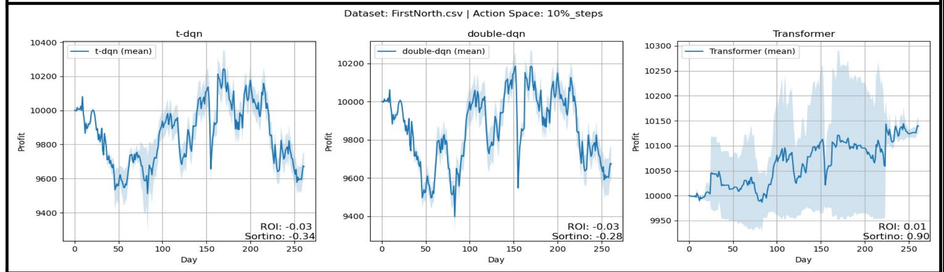
Evaluation: Three runs (n=3), measuring daily profits and portfolio value

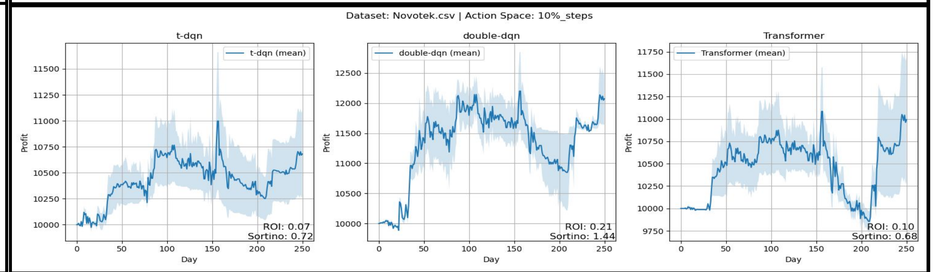
Analysis: Focus on stability and profitability across RL methods

Profit Charts

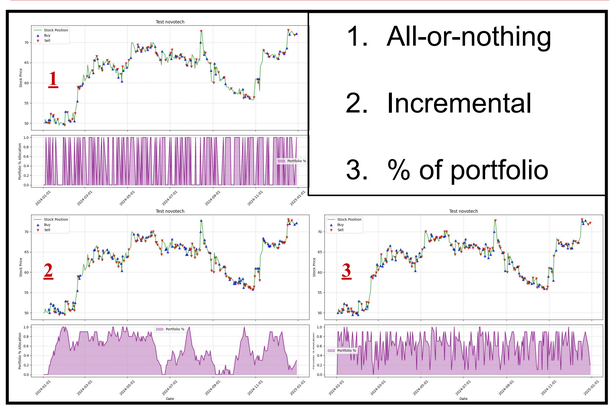








Strategy Charts



1. All-or-nothing
2. Incremental
3. % of portfolio

Discussion

1. **High Variance Across Strategies**: Performance shows significant variability based on market conditions and algorithm settings. There was no clear best algorithm or action space.
2. **Action Spaces Improve Interpretability**: Reducing action spaces enhances understanding of algorithmic decisions and improving the variability.
3. **Market Dynamics Impact Generalization**: Results depend on whether the market is trending up or down, complicating generalization.
4. **Novotek's Arbitrage Opportunities**: As a smaller market, Novotek may present more short-term arbitrage potential.

References

Deng et al. (2016). Deep Direct Reinforcement Learning for Financial Signal Representation and Trading. IEEE TNNLS.

Mnih et al. (2013). Playing Atari with Deep Reinforcement Learning. arXiv:1312.5602.

Van Hasselt et al. (2016). Deep Reinforcement Learning with Double Q-learning. AAAI.

Vaswani, A. et al. (2017). Attention is all you need. Advances in neural information processing systems, 30.

Yahoo Finance. (2025). Novotek AB (NTEK-B.ST) Stock Price, News, Quote & History.

Yahoo Finance. (2025). OMX Stockholm 30 Index Historical Data.

Nasdaq OMX. (2025). First North SEK Index History. Retrieved from Nasdaq OMX.