**Data Science Capstone Topic Approval Form**

**Student Name:** Trayvonious Pendleton

**Student ID:** 011205284

**Capstone Project Name:**

**Project Topic**: Reinforcement Learning Agent for SPY Trading

**This project does not involve human subjects research and is exempt from WGU IRB review.**

**Research Question:** *Summarize one question or decision you will address by collecting…*To what extent do historical price movements, technical indicators (such as RSI, MACD, and moving averages), and market volatility affect the decision-making performance of a reinforcement learning agent trading the SPY ETF?

**Hypothesis**: **Null Hypothesis**-. Historical price movements, technical indicators, and market volatility do not significantly impact the reinforcement learning agent’s ability to outperform a buy-and-hold strategy for SPY. **Alternate Hypothesis**-. Historical price movements, technical indicators, and market volatility statistically impact the reinforcement learning agent’s ability to outperform a buy-and-hold strategy for SPY.

**Context:** *Explain why the situation or question would benefit from a data analysis in fewer than 500 words.*Algorithmic trading using AI is a rapidly growing field in finance. The SPY ETF, which tracks the S&P 500, is one of the most actively traded ETFs. This project aims to apply reinforcement learning, a machine learning technique where an agent learns to make decisions by interacting with an environment, to model trading decisions. The goal is to simulate a trading environment where the RL agent can learn to buy, hold, or sell SPY based on market signals and maximize long-term returns. This aligns with real-world financial applications and showcases the practical value of machine learning in investment strategy development.

**Data:** *Identify data you will need to collect that is relevant to the situation or question.*Historical OHLCV data for SPY(Open,High,Low,Close,Volum)Technical indicators such as moving averages RSI MACD Bollinger Bands

*If an existing data set will be used, describe the data set. None*

*Explain who owns the data and why you are allowed to use this data for your capstone project.* Data publicly available from Yahoo Finance

*Note: If you are using restricted information, please have the Third-Party Authorization Form signed by an authorized agent on behalf of the data owner. The data owner's legal name is required on the form.*

**Data Gathering:** *Describe the data-gathering methodology you will use to collect data.*The data will be collected using the yfinance Python library. It will be cleaned, normalized, and transformed to include engineered features and indicators relevant to trading.

**Data Analytics Tools and Techniques**: *Identify the appropriate data-analysis technique you will use to analyze this data.*   
**Reinforcement Learning:** Deep Q-Learning or Proximal Policy Optimization (PPO)

**Tools:** Python, TensorFlow/PyTorch, OpenAI Gym, Stable-Baselines3

**Backtesting:** Backtrader or custom environment

**Visualization:** Matplotlib, Seaborn

**Justification of Tools/Techniques:** *Explain why the data-analysis technique you chose is an appropriate technique to analyze the data collected*. Reinforcement learning is well-suited for sequential decision-making problems like trading. Unlike supervised learning, RL allows the agent to adapt its strategy based on reward signals from the environment. PPO or DQN are commonly used methods for stable and efficient training in financial simulations.

**Project Outcomes**: *List the key anticipated project outcomes and deliverables in fewer than 500 words*.

The anticipated outcome of this capstone project is the development of a trained reinforcement learning model capable of making dynamic buy, sell, or hold decisions when trading the SPY ETF. The agent’s performance will be rigorously evaluated against a traditional buy-and-hold investment strategy using key financial metrics such as cumulative return, Sharpe ratio, and maximum drawdown to assess both profitability and risk-adjusted performance. To support transparency and interpretability, the project will include a comprehensive dashboard or visualization that illustrates the agent’s decision-making over time, including trade points and the evolution of portfolio value. Additionally, the project will produce detailed documentation outlining the modeling approach, hyperparameter tuning, training process, and evaluation results to demonstrate the reproducibility and effectiveness of the methodology.

**Projected Project End Date**: 5/1/2025

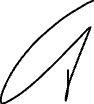
**Sources**:

**Instructor Signature/Date:**

The research is exempt from an IRB Review.

An IRB approval is in place (provide proof in appendix B).

Instructor's Approval Status: Approved



Date: 4/22/2025

Reviewed by:

Comments: Click here to enter text.