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Trading Eye: A Game Theory Method for Building Trading Strategies in the Live Stock Market

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הוכן לשם השלמת הדרישות לקבלת

תואר ראשון במדעי הטבע B. Sc.

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המכללה האקדמית להנדסה סמי שמעון

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Project Summary:

The Trading Eye Project introduces a sophisticated application designed to bridge the gap between complex financial data and strategic decision-making. At its core, the project implements a dynamic algorithm that automates the design, testing, and execution of trading strategies. Unlike traditional platforms that rely on simple indicators, this system leverages Game Theory methods to evaluate market stability and risk. By utilizing advanced mathematical constructs, the algorithm identifies the most secure "balance points" in the market, ensuring that strategies are optimized for both performance and protection against volatility.

The application functions by scanning financial markets to identify assets including stocks and currencies that meet defined long-entry signals. Once identified, the system employs probabilistic models trained on past market behavior to simulate potential profit margins. This allows for a data-driven approach to investment, where capital is allocated using weighted distributions across multiple strategies.

A key feature of the Trading Eye App is its interactive visualization layer. Users can simulate strategies against both live and historical data, comparing their performance through clear, intuitive graphs. This capability transforms the trading process from a game of intuition into a systematic, scientific method. Ultimately, the project provides traders with a powerful tool to identify high-probability opportunities and optimize their portfolios through rigorous, data-driven insights.

Abstract:

Financial markets are dynamic systems in which asset prices fluctuate constantly due to the interactions between two key actors: buyers and sellers. These fluctuations are also shaped by external forces such as political events, global crises, pandemics, and macroeconomic instability. Although uncertainty is inherent in stock price behavior, market charts consistently exhibit recognizable upward and downward movements. These patterns make it possible to identify statistically meaningful opportunities for profitable entry signals.

This project introduces Trading Eye, an application that constructs, evaluates, and compares dynamic trading strategies using Game Theory, including Nash Equilibrium curves and MaxMin envelopes. The system scans financial markets in real time and selects the first ten assets—stocks or currencies—that satisfy a predefined long-entry condition. It provides real-time or historical simulations of profit margins, supports multiple strategy models trained on past market behavior, and allocates investments using weighted probability distributions.

The project has two primary goals:
(1) to offer an accessible, intuitive platform enabling users to build trading strategies interactively, even without programming background; and
(2) to conduct empirical research comparing the performance of multiple strategies in order to determine which one produces the most reliable and profitable results.

A family of technical indicators is incorporated, including SMA, EMA, WMA, HMA, HH20, LL20, and ADX, each accompanied by mathematical definitions, explanations, and graphical representation.
Keywords: algorithmic trading, game theory, Nash equilibrium, real-time graphs, historical data, probability-based strategy, technical indicators, portfolio optimization.

1. Introduction:

The stock market consists of publicly traded companies whose prices change continuously. Prices emerge from the real-time interaction of buyers and sellers, and are further influenced by external factors such as political shifts, global health events, economic instability, and unexpected crises. Despite this uncertainty, stock charts exhibit recognizable patterns of rising and falling movement. These fluctuations offer opportunities to design profitable and data-driven entry strategies.

Trading Eye was developed to help traders and researchers take advantage of these natural price movements. The project aims to maximize investor profit while enabling structured comparison among different decision-making methods.

Importantly, the application provides users with the freedom to build customized investment strategies using simple, accessible programming structures, even without prior coding experience. This ensures that the system is usable by beginners, intermediate traders, and advanced analysts alike.

The project has two overarching goals:

1. Develop an intuitive application for constructing and testing algorithmic strategies.

2. Compare multiple trading strategies operating in real market conditions and determine which one performs best.

2. Background:

The Challenges of Modern Investing
The financial markets of the 21st century operate at an unprecedented speed. Every second, a massive volume of data—including price updates, global news, and financial reports—is generated across multiple platforms. For a human investor, this environment creates a state of Information Overload. It is no longer possible for a person to manually process all these variables to make a purely objective decision.

Because of this complexity, many traders fall into the trap of Suboptimal Decision-Making. When there is too much information to handle, people tend to simplify their choices based on incomplete facts or, more dangerously, on Emotional Bias. Decisions driven by fear during a market drop or greed during a peak often lead to significant financial losses. This gap between the vast amount of available data and the human ability to analyze it correctly highlights a critical need for a systematic, computational approach.

The Need for a Strategic Solution
The traditional methods of market analysis often lack the computational rigor required to stay consistent. While many tools exist to show price charts, they rarely provide a clear, automated strategy that balances risk and reward. This is where the Trading Eye Project comes in. The core idea is to move away from guesswork and emotional reactions toward a data-driven framework.

By viewing the market not just as a series of random price movements, but as a Strategic Game, we can apply advanced logic to find a state of Balance. In this strategic context, the goal is to identify points where an investment strategy is most secure—even when the market is volatile.

The Trading Eye Approach
The Trading Eye Project was developed to bridge the gap between complex financial data and practical execution. The system uses a Dynamic Algorithm that relies on precise mathematical formulas, such as ADX, EMA, WMA, and the HULL Moving Average. By calculating these indicators and identifying market boundaries like Highest Highs (HH) and Lowest Lows (LL), the application can filter out market "noise" and focus on high-probability opportunities.

In conclusion, the Trading Eye Project is rooted in the necessity for automation within the fast-paced financial world. Since financial markets are complex systems influenced by constant internal and external forces, traders must rely on precise models and statistical reasoning to manage uncertainty. By integrating technical indicators such as ADX, EMA, and Hull Moving Average, our system successfully extracts structure from noisy price data, highlighting critical trends and momentum. This approach transforms the investment process into a transparent and scientific method, allowing users to move beyond intuition and make decisions based on clear evidence and strategic balance.

3.Related Work:

The Evolution of Technical Analysis Research
The field of algorithmic trading has seen significant growth, with researchers and fintech companies focusing heavily on automating technical analysis. Studies in this area generally focus on the predictive power of trend-following indicators. For instance, much of the existing research has validated that combining multiple moving averages such as the Exponential Moving Average (EMA) and the Weighted Moving Average (WMA) provides a more reliable signal than using a single indicator alone. These studies found that multi-layered filters are essential for reducing "false positives" in volatile markets.

Competitor Approaches and Current Findings
Current market competitors, ranging from retail platforms like Trading View to institutional tools, have developed sophisticated systems for signal detection. Their research primarily revolves around Momentum and Volatility.

Trend Strength Discovery: Many platforms have integrated the Average Directional Index (ADX) to help traders avoid "sideways" markets. Their findings suggest that trading only when the ADX is above a certain threshold (typically 25) significantly increases the win rate of trend-following strategies.

Noise Reduction Techniques: Advanced competitors have explored the Hull Moving Average (HMA) due to its unique ability to reduce lag while maintaining smoothness. Their research confirms that the HMA is superior to traditional moving averages in tracking fast price reversals, which is a core component of modern scalping and day-trading algorithms.

Support and Resistance Modeling: Systems that utilize Highest High (HH) and Lowest Low (LL) logic have discovered that these points act as "psychological barriers" for the market. Competitors use these values to automate Stop-Loss and Take-Profit orders, proving that data-driven boundaries are more effective than fixed-percentage risks.

The Gap: From Reactive to Strategic Trading
Despite these advancements, a significant gap remains in the available solutions. Most existing research and competitor tools are reactive they tell the user what is happening now or what happened in the past. Furthermore, many high-end systems operate as "Black Boxes," where the logic is hidden from the user, making it difficult to trust the strategy during periods of drawdown.

The Trading Eye Project differentiates itself by moving beyond simple signal detection. While competitors focus on isolated indicators, our research integrates these formulas into a unified strategic framework. Unlike many existing platforms that lack transparency, our project emphasizes visualization and strategy comparison, allowing the user to see the "why" behind the trade. By finding the strategic balance between these proven indicators, Trading Eye offers a proactive approach that focuses not just on profit, but on long-term stability and risk mitigation.

4.Methodology:

The system is built from three primary components that work together to achieve dynamic, data-driven trading analysis and strategy evaluation.

The first component is the Market Scanning, which continuously monitors financial assets and identifies the first ten instruments that satisfy predefined long-entry conditions. These conditions are based on a combination of technical indicators, including SMA, EMA, HMA, the HH20/LL20 range, and ADX trend-strength confirmation. This scanning mechanism enables the system to focus on assets with statistically significant movement patterns.

The second component is the Game Theory Strategy Engine, which applies Nash Equilibrium reasoning, MaxMin decision principles, and weighted probabilistic models to evaluate different trading strategies. Each strategy is modeled as an independent decision-making "player" in a payoff environment, allowing direct comparison of performance under varying market conditions. This structure helps determine which strategy remains optimal, stable, or most profitable across different scenarios.

The third component is the Visualization and Simulation Layer**,** responsible for presenting the system's analytical results in a clear and interactive manner. It generates real-time and historical profit simulations, displays trend and indicator-based charts, and provides visual tools that enable users to compare strategies effectively. This layer is designed to support both technical analysis and practical decision-making.

The indicators:

Below are explanations of the indicators integrated into the project:

1.Trend Filtering (Moving Averages): We combine multiple price averages (SMA,EMA, WMA, and HULL) to accurately filter market noise and identify the clear direction of the main trend.

1.1. SMA – Simple Moving Average

A basic trend-following indicator that smooths price data over a chosen number of periods.
Used to identify overall trend direction and reduce market noise.

$$\text{SMA}_n[k] = \frac{1}{n}\sum_{i=1}^{n} P[k-n+i]$$

1.2. EMA – Exponential Moving Average

A moving average that gives more weight to recent prices.
Used to detect trend changes faster and react more quickly to new market movements.

$$\text{EMA}_n[k] = \alpha P[k] + (1-\alpha)\text{EMA}_n[k-1], \quad \alpha = \frac{2}{n+1}$$

1.3. WMA – Weighted Moving Average

A trend indicator where recent prices receive higher importance than older prices.
Used when traders want a balance between smoothness and responsiveness.

$$\mathrm{WMA}_n[k] = \frac{\sum_{i=1}^{n} w[i]P[k-n+i]}{\sum_{i=1}^{n} w[i]}$$

1.4. HMA – Hull Moving Average

A fast and smooth moving average designed to reduce lag significantly.
Used to show the trend direction with minimal delay and clearer turning points.

$$\mathrm{HMA}_n[k] = \mathrm{WMA}_{\sqrt{n}}\left(2 \times \mathrm{WMA}_{\frac{n}{2}}[k] - \mathrm{WMA}_n[k]\right)$$

2.Trend Strength (ADX): The ADX indicator is calculated to precisely measure the strength and momentum of the current trend, ensuring we only enter stable opportunities.

ADX – Average Directional Index

Measures the strength of the trend, not the direction.
Used to determine whether the market is trending strongly, weakly, or not trending at all.

For n time units the initial ADX is defined

$$ADX_n = \frac{1}{n}\sum_{i=1}^{n} DX_i s$$

and the the smoothed ADX is defined

$$ADX_t = \frac{(n-1)\cdot ADX_{t-1} + DX_t}{n}.$$

3.Price Boundaries (HH/LL): We define the market's operating range by calculating the HH (Highest High) and LL (Lowest Low), which set the crucial risk and profit boundaries for every strategy.

3.1. HH20 – Highest High

Shows the highest price reached in the past 20 periods.
Used to identify breakout levels, strong upward movements, or resistance zones.

$$\mathrm{HH}_n[k] = \max\{\mathrm{H}[k], \mathrm{H}[k-1], \ldots, \mathrm{H}[k-n+1]\} = \max \bigcup_{i=1}^{n} \mathrm{H}[k-i+1]$$

3.2. LL20 – Lowest Low

Shows the lowest price reached in the past 20 periods.
Used to identify support levels and potential reversal zones.

$$LLn[k] = \min\{\mathrm{L}[k], \mathrm{L}[k-1], \ldots, \mathrm{L}[k-n+1]\} = \min \bigcup_{i=1}^{n} \mathrm{L}[k-i+1]$$

By integrating the data from all these formulas, the system automatically generates optimized and highly secure trading strategies with a calculated risk-to-reward balance.
In addition, the application allows users to construct their own investment strategies through simple and accessible programming interfaces. This feature makes the system suitable even for users with no prior coding experience, while still offering flexibility and customization for advanced users.

5. Prelimenary Results:

Strategy Generation and Market Stability

The initial phase of testing focused on the algorithm's ability to generate stable trading strategies using the integrated technical indicators, specifically the ADX, EMA, WMA, and Hull Moving Average. Preliminary results indicate that by applying advanced strategic methods, the system successfully filters out market noise that typically leads to false entry signals. The strategies produced demonstrate a significantly higher level of structural stability compared to simple moving average crossovers, particularly during volatile market conditions where traditional models often fail.

Backtesting Performance and Probabilistic Accuracy

Using historical data, the Trading Eye application performed extensive simulations to verify the accuracy of its probabilistic models. The results from these preliminary runs showed that the combination of trend strength analysis and precise price boundaries, like Highest Highs and Lowest Lows, led to a notable reduction in drawdown periods. Furthermore, the real-time processing capabilities of the dynamic algorithm were validated, as the system demonstrated the capacity to scan assets and update profit simulations with minimal latency, proving it can handle live data feeds effectively.

Risk Management through Weighted Distribution

The preliminary results confirm that the weighted investment model effectively balances risk. Instead of a single strategy, the system uses a combination of indicators—including ADX, EMA, and Hull Moving Average—to assign weights to trading signals. By using Highest High (HH) and Lowest Low (LL) as strategic boundaries, the app prevents the heavy losses often caused by simpler, non-adaptive methods. This approach ensures the portfolio stays secure by adapting to different market conditions rather than just chasing profit.

Final Assessment of Initial Findings

Overall, the preliminary findings confirm that the Trading Eye framework is technically sound and provides a scientific basis for investment. The transition from raw price data to strategic models allows for a transparent and data-driven decision-making process. The current visualization tools successfully allow users to compare the performance of various strategies, proving the application's utility as a robust tool for modern traders. Future refinements will focus on expanding the datasets to further optimize the strategic balance of the underlying models.

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