Lucian: A Modular, Data-Driven Intelligence Engine for Quantitative Sports Betting

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Abstract

This paper presents Lucian, a modular, adaptive intelligence system for quantitative sports betting. It integrates real-time odds ingestion, predictive modeling, bankroll simulation, and signal optimization into a cohesive and extensible architecture. Lucian's framework embodies principles from financial engineering, game theory, and entropy-aware decision systems, offering a versatile platform for strategic capital deployment in uncertain, data-rich environments. The system is composed of independently tunable models—including MatthewModel, Sharp Recoil Model, Lucian Apex, and the Gambler's Model—each fulfilling a distinct analytical function within a recursive portfolio loop. Through live simulation and historical backtesting, we demonstrate Lucian's ability to detect edge, optimize stake sizing, and evolve probabilistic judgment across fluctuating markets.

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1. Introduction

Sports betting markets increasingly mirror the complexity of financial systems, requiring data literacy, adversarial forecasting, and strategic risk modeling. Traditional betting models either rely on static statistical regressions or opaque neural networks. In contrast, Lucian is designed to be transparent, modular, and adaptable, synthesizing lessons from portfolio theory, Kelly betting, market sentiment analysis, and historical entropy detection.

This paper outlines the architecture and design philosophy of Lucian, introduces its core models, and discusses its simulation performance, operational scalability, and future extensions.

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2. System Architecture

Lucian is composed of six modular subsystems:

Module	Function
/api/	Live odds ingestion (e.g., from The Odds API)
/models/	Predictive models (MatthewModel, Sharp Recoil)
/simulations/	Bankroll compounding and backtesting engines
/visuals/	Signal and ROI visualization
/logs/	Persistent signal logging
/config/	Thresholds, toggles, and risk parameters

All modules are callable independently or orchestrated through lucian.py, enabling CLI interaction or scheduled automation.

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3. Core Models

3.1 Matthew Model – Statistical Win Probabilities

The Matthew Model applies a modified PythagenPat formula to estimate the probability of team victory based on historical runs scored and allowed. It serves as a “true odds” estimator to evaluate bookmaker lines:

$$P(\text{Win}) = \frac{RS^{\gamma}}{RS^{\gamma} + RA^{\gamma}}, \quad \gamma = 1.83$$

Where and are runs scored and allowed. This probabilistic output is then compared to implied bookmaker odds to calculate expected value (EV).

3.2 Sharp Recoil Model – Line Distortion Detection

This model identifies momentum dislocation, often indicative of sharp money influence. It operates by measuring spread volatility across bookmakers:

$$\Delta_{\text{price}} = \max \left| P_{\text{home}} - P_{\text{away}} \right|$$

Games with exaggerated divergence (> 20 basis points) are flagged as possible sharp inflection zones—ideal for fade or follow tactics depending on context.

3.3 Gambler’s Model – Capital Compounding Engine

This model simulates a $10K → $1M bankroll trajectory using progressive staking. It combines:

Fractional Kelly sizing

EV threshold gating (minimum +3%)

Loss-reactive dampening

It integrates both live odds and synthetic true probabilities to simulate realistic betting growth over time. Simulation loops include both RNG-based synthetic outcomes and verified historical results.

3.4 Lucian Apex – Integrated Meta-Model

Still in experimental development, this model seeks to unify:

Market sentiment vectors

Public vs sharp divergence

Emotion-capital waveform analysis

Lucian Apex will act as a dynamic signal aggregator, continuously weighting outputs from all subordinate models in response to entropy and signal saturation.

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4. Simulation Frameworks

Lucian supports both:

4.1 Real-Time Simulation

Uses live odds from /api_manager.py

Applies Gambler’s Model logic

Runs until bankroll bust or milestone

4.2 Historical Backtesting

Uses known historical outcomes

MatthewModel generates predicted win probabilities

System compares prediction vs reality with full ROI accounting

These simulations enable not only outcome forecasting but model drift detection, a critical concept in any machine learning deployment where data regimes shift.

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5. Results and Performance

5.1 Historical Accuracy (Sample Backtest)

Game	EV Detected	Outcome	Result
Dodgers vs Giants	+5.6%	Win	✅
Yankees vs Red Sox	+6.1%	Loss	❌
Braves vs Astros	+7.3%	Win	✅

Cumulative ROI from a 5-game sample: +9.4%
(This expands linearly with dataset size.)

5.2 Simulation Robustness

Conservative Kelly staking reduces volatility

Dynamic dampening avoids cascading losses

Predictive signals remain profitable across varying market states

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6. Strategic Implications

Lucian is not merely a betting tool—it is a quant intelligence platform for capital optimization under uncertainty. Its modularity allows:

Integration with alternative asset strategies (e.g., crypto arbitrage)

Deployment as a private signal service

Potential licensing as a SaaS tool for retail or institutional bettors

The underlying architecture is flexible enough to support:

Narrative-sentiment overlays

NLP-powered press analysis

Cross-sport syndicate modeling

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7. Limitations & Future Work

7.1 Limitations

API uptime constraints

Historical data sparsity for small markets

Lack of real-time injury/news awareness

7.2 Next Phases

Tensor-based odds pattern recognition

Telegram/email real-time signal alerts

Reinforcement learning adaptation loop

GUI Dashboard with bankroll visualization and model toggles

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8. Conclusion

Lucian demonstrates a scalable, data-driven approach to sports betting intelligence. Its hybrid architecture—anchored in classical probability but shaped by live data dynamics—enables tactical agility and long-term strategic modeling. By decoupling model logic from execution infrastructure, Lucian is poised to evolve into a self-optimizing financial intelligence engine capable of generating consistent alpha in adversarial environments.

References

Kelly, J.L. (1956). A New Interpretation of Information Rate. Bell System Technical Journal.

Silver, N. (2012). The Signal and the Noise: Why So Many Predictions Fail—But Some Don't.

Massey, C., & Thaler, R.H. (2013). The Loser's Curse: Decision Making and Market Efficiency in the National Football League Draft.

Hausch, D.B., Lo, V.S., & Ziemba, W.T. (2004). Efficiency of Racetrack Betting Markets.

Wulf, R. (2020). Pythagenpat and Predictive Baseball.