

Technical Note: Stochastic Models in Algorithmic Environments

Yoboa Research Lab

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1 Introduction

The objective of this whitepaper is to establish the mathematical foundation for the automated systems deployed at Yoboa. We focus on the application of mean-reverting stochastic processes to high-frequency data sets.

2 The Ornstein-Uhlenbeck Process

In the context of algorithmic execution, we model the state variable X_t using a stochastic differential equation (SDE) that accounts for mean reversion. The model is defined by:

$$dX_t = \theta(\mu - X_t)dt + \sigma dW_t \quad (1)$$

Where $\theta > 0$, μ , and $\sigma > 0$ are parameters, and W_t is a standard Wiener process.

3 Computational Implementation

To implement this model in a Python-based environment, we must discretize the process using the Euler-Maruyama method. For a given time step Δt , the discrete approximation is:

$$X_{n+1} = X_n + \theta(\mu - X_n)\Delta t + \sigma\sqrt{\Delta t}\epsilon_n \quad (2)$$

where $\epsilon_n \sim N(0, 1)$. This allows for the programmatic simulation of price paths and the calculation of optimal entry and exit thresholds based on the stationary distribution:

$$X_\infty \sim N\left(\mu, \frac{\sigma^2}{2\theta}\right) \quad (3)$$

4 Conclusion

By anchoring our automation in rigorous mathematical theory, we ensure that our data analysis remains objective and statistically significant.