Optimal Selection Model for Arbitrage in Eve Online

Logan Jackson

May 9, 2024

Introduction

Arbitrage in Eve Online is an interesting problem because imagine you were to buy a TV on Facebook Marketplace to sell on Ebay for 20% more but instead of going to pick up the TV and driving home with it there was a high liklihood you get carjacked and robbed on the way home the question then becomes when is it a good idea to go pick up the TV.

Broad Overview

There's four parts to a model for arbitrage in Eve Online first, we need to identify canidates i.e. what are potentially profitable trades? Second there's some amount of time it will take to execute the trade, so we need to have some idea of future price, in Eve trades take quite a while, we can estimate the time given path length n and the rate parameter λ (jumps follow a poisson process) after this we can construct a 98% confidence interval for the price of the asset at time t using the asset's variance retrieved from historic data, monte carlo simulation, and geometric brownian motion. Third we need to calculate the probability of failure, as of right now this is somewhat hard to do it's possible to use machine learning here as a truly accurate picture will need to pull data from the player themselves as it's somewhat difficult to quantify a pilot's skill, so for now I have a fairly generic function $P(F) = P(g) * P(d)$ where g is probability of getting ganked and $P(d)$ is the probability of dying to a gank. Lastly since the result of failure is total loss of all invested capital the problem is somewhat similar to something like gambling, hence I use the kelly criterion here to estimate the maximum ratio of net capital to invest in a given run, plugging in the previous values we calculated: $f^* = (1 - P(F)) - \frac{P(F)}{b}$ where b is our payout in this case expected profit π which is estimated in the second step.

Research Currently Required to Complete the Paper

- At what rate does the security level across null sec change
- What is λ for jumps

Notes

Death function d is related to capital k and gank function γ is related to security level s these two functions we assume are independent i.e. weather or not you get ganked is not related to how likely you are to die to a gank (this is probably not true since both should be dependent on k) I think $\gamma \propto \frac{1}{s}$ and $d \propto -k^2$ I think you can use MLE to estimate d as well with a general shape and some parameters.