Adrena Asset Ratio Recommendation Framework

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1 Introduction

The liquidity pool's asset composition is the primary parameter that Adrena has at its disposal to affect protocol risk and usage. If asset ratios are unbalanced, then liquidity placement is asymmetrical across assets, leading to market inefficiency. In optimizing asset ratios, Adrena can influence where liquidity is supplied, stabilize the value of the pool, and attract both traders and liquidity providers.

When determining optimal asset ratios, Adrena must balance three key objectives: attracting traders by providing deep, reliable liquidity across assets; accommodating LP preferences for asset exposure; and managing pool risk through appropriate diversification. The careful optimization of these factors creates a robust protocol that serves both traders and LPs while maintaining stable returns.

At the macro level, we see three driving forces that should influence the target asset ratios of the pool:

1. Trader demand.
2. LP (Liquidity Provider) demand.
3. Asset risk.

1.1 Trader Demand

Trader demand for a particular asset is captured by its utilization rate (i.e., the ratio of open interest in that asset to its value in the pool). A high utilization rate indicates a high usage of liquidity, and so a demand for a higher ratio of that asset in the pool.

1.2 LP Demand

LP demand can be inferred from where LPs are choosing to provide liquidity. LPs effectively hold de-leveraged long positions in the pool, since they own the pool's assets while passing some of that long exposure to traders. Therefore, LPs may seek long exposure to specific assets in the pool, driving LP demand.

Consider a scenario in which WBTC has a target ratio of 25%, and a current ratio of 27%. This oversupply indicates the pool is not fulfilling LP demand for WBTC exposure. Therefore, the target ratio of WBTC should be increased.

An alternative strategy for fulfilling LP demand is to charge higher fees for providing liquidity above the target ratio. Such a strategy would force LPs to meet the pool's target ratios. This scenario would be more punitive for LPs, which may result in less liquidity, but would allow Adrena to match trader demand more closely.

1.3 Asset Risk

Asset risk counterbalances both trader and LP demand. The pool has long exposure to every asset it holds. If a large ratio of the pool's value is comprised of a risky asset, then the pool's value will be more volatile, and so liquidity will be less predictable. Therefore, the pool should try to avoid holding too much value in volatile assets.

Asset risk can be quantified by historical volatility, market cap, and lifespan of the asset. Adrena has not yet chosen to service assets with a low market cap (less than $100M) or a short lifespan (less than six months), so those factors do not serve as important risk vectors. Going forward, we will quantify asset risk by historical volatility.

2 Asset Ratio Recommendation Framework

We recommend a three-step process for determining and adjusting target ratios:

1. Analyze trader demand.
2. Analyze LP demand.
3. Simulate pool value at risk (VaR).

2.1 Analyze Trader Demand

First, we will analyze trader demand by examining utilization rates. If trader demand were to be perfectly met, then each asset's open interest (OI) would be proportional to its share of pool value, resulting in identical utilization rates for all assets:

$$\text{Aggregate Utilization Rate (AUR)} = \frac{\text{Aggregate Open Interest (AOI)}}{\text{Assets Under Management (AUM)}} \tag{1}$$

Here, AOI is the sum of both long and short interest. We include short interest in the summation because it is the utilized value of USDC. AUM is the total value of all assets in the pool.

Once AUR is calculated, we can determine the target ratio for each asset, which we will index as asset i. The utilization rate of asset i is the open interest of asset i divided by the value of asset i in the pool. Here, the "value of asset i in the pool" is the target value, which is the independent variable we are solving for.

$$\frac{\text{Open Interest (OI)}_i}{\text{Target Value (TV)}_i} = \text{AUR} \implies \text{TV}_i = \frac{\text{OI}_i}{\text{AUR}} \tag{2}$$

Next, let us write the target value in terms of the target ratio and AUM in order to solve for the target ratio.

$$\text{TV}_i = \text{Target Ratio (TR)}_i \times \text{AUM} \implies \text{TR}_i \times \text{AUM} = \frac{\text{OI}_i}{\text{AUR}} \tag{3}$$

$$\implies \mathrm{TR}_i = \frac{\mathrm{OI}_i}{\mathrm{AUM} \times \mathrm{AUR}} \tag{4}$$

This formula gives us the ratio of asset i in the pool as demanded by traders.

2.2 Analyze LP Demand

Next, we account for LP demand by assessing how current ratios differ from existing targets. If an asset's current ratio is less than the current target ratio, this indicates that LPs are hesitant to provide liquidity for that asset and do not want the target ratio to be increased. Conversely, if an asset's current ratio is greater than the current target ratio, this indicates that LPs are providing excessive liquidity for that asset and want the target ratio to be increased.

We define LP demand as the difference between the current ratio and the current target ratio.

$$\text{LP Demand (LPD)}_i = \text{Current Ratio (CR)}_i - \text{Current Target Ratio (CTR)}_i \tag{5}$$

Then, we can update the target ratio we found from trader demand for each asset by adding the LP demand to the target ratio.

$$\text{Updated Target Ratio (UTR)}_i = \mathrm{TR}_i + \omega \times \mathrm{LPD}_i \tag{6}$$

Where ω is a chosen parameter that determines the weight of LP demand in the updated target ratio. We recommend a default value of $\omega = 1$.

2.3 Simulate Pool Value at Risk (VaR)

To ensure that our updated target ratios do not introduce excessive risk, we simulate the pool's 30-day Value at Risk (VaR) across a range of possible asset ratios. VaR helps us estimate how much the pool could lose over a given period in a "worst-case" scenario, such as the worst 5% or 1% of outcomes.

2.3.1 Build Simulation Asset Ratios

First, we will build our simulation asset ratios. Let us define the difference between the updated target ratios and the current ratios for asset i as:

$$\delta_i = \mathrm{UTR}_i - \mathrm{CR}_i \tag{7}$$

Our difference vector is therefore:

$$\boldsymbol{\delta} = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \vdots \\ \delta_n \end{bmatrix} \tag{8}$$

Where n is the number of assets in the pool. For convenience, define a vector of the current ratios:

$$\mathbf{CR} = \begin{bmatrix} \mathrm{CR}_1 \\ \mathrm{CR}_2 \\ \vdots \\ \mathrm{CR}_n \end{bmatrix} \tag{9}$$

Let h be a chosen step size between 0 and 1 where $1 \bmod h = 0$ and $m = \frac{1}{h}$. Then, we can define the simulation asset ratios for simulation k as:

$$\mathbf{SR}_k = \mathbf{CR} + h \times k \times \boldsymbol{\delta} \quad \text{for} \quad k = 0, 1, 2, \ldots, m \tag{10}$$

Then, the matrix of all simulation asset ratios is given by:

$$\mathbf{SR} = \begin{bmatrix} \mathbf{SR}_0 & \mathbf{SR}_1 & \cdots & \mathbf{SR}_m \end{bmatrix} \tag{11}$$

$\mathbf{SR}_0$ will be the current ratios, and $\mathbf{SR}_m$ will be the updated target ratios, and the rest of the elements will be intermediate steps in between.

2.3.2 Calculate Pool Parameters for Each Simulation

Now, let us define the method for simulating the pool's VaR for each simulation asset ratios $\mathbf{SR}_k$.

First, we will calculate the pool's 30-day asset covariance matrix:

$$\boldsymbol{\Sigma} = \begin{bmatrix} \sigma_1^2 & \rho_{1,2}\sigma_1\sigma_2 & \cdots & \rho_{1,n}\sigma_1\sigma_n \\ \rho_{2,1}\sigma_2\sigma_1 & \sigma_2^2 & \cdots & \rho_{2,n}\sigma_2\sigma_n \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{n,1}\sigma_n\sigma_1 & \rho_{n,2}\sigma_n\sigma_2 & \cdots & \sigma_n^2 \end{bmatrix} \tag{12}$$

Where σ_i is the volatility of asset i, and $\rho_{i,j}$ is the correlation between the returns of asset i and asset j. Volatility and correlations can be calculated based on an arbitrary time period, but we recommend using a 30-day period. Keep in mind that this covariance matrix will not change between simulations, so it only needs to be calculated once.

The volatility of the asset pool for simulation k is then:

$$\sigma_{\text{pool}}^{(k)} = \sqrt{\mathbf{SR}_k^\intercal \; \boldsymbol{\Sigma} \; \mathbf{SR}_k} \tag{13}$$

We also want the mean returns of the asset pool for simulation k, which is a weighted average of mean returns:

$$\mu_{\text{pool}}^{(k)} = \mathbf{SR}_k^\intercal \; \boldsymbol{\mu} \tag{14}$$

Where $\mathbf{SR}_k^\intercal$ are the weights of the assets and $\boldsymbol{\mu}$ is a vector of the mean returns of the assets, and $\mu_{\text{pool}}^{(k)}$ is the mean return of the asset pool for simulation k.

2.3.3 Run Monte Carlo Simulation

Now that we have our volatility and mean return parameters for simulation k, we can run a Monte Carlo simulation. The simulation will generate N samples (we recommend $N = 10,000$) from a normal distribution, t-distribution, or other distribution with mean $\mu_{\text{pool}}^{(k)}$ and standard deviation $\sigma_{\text{pool}}^{(k)}$. These samples represent possible 30-day returns of the asset pool.

For each simulation, sort the returns in ascending order. Denote $R_{1-\alpha}$ as the $1-\alpha$ quantile of returns. For example, if $\alpha = 0.95$, then $R_{0.05}$ is the 5th percentile of returns, which is assumed to be negative.

The Value at Risk (VaR) at confidence level α is then:

$$\text{VaR}_{\alpha}^{(k)} = -R_{1-\alpha} \times \text{Pool Long Exposure (PLE)} \quad (\text{assuming } R_{1-\alpha} < 0) \tag{15}$$

Where PLE = AUM − Open Long Interest is the pool's long exposure. This equation holds because the pool has long exposure to the assets it holds, but passes off that exposure when providing long trades.

The assumption that $R_{1-\alpha} < 0$ makes $\text{VaR}_{\alpha}^{(k)}$ a positive number representing potential loss. To interpret $\text{VaR}_{\alpha}^{(k)}$, we can say that "we are α% confident that the pool's value will not decrease by more than $\text{VaR}_{\alpha}^{(k)}$ over the next 30 days". We repeat this process for $k = 0, 1, 2, \ldots, m$ to determine the pool's VaR at each set of simulation asset ratios $\mathbf{SR}_k$.

2.3.4 Analyze VaR Results

Once we have compiled the VaR values for each $\mathbf{SR}_k$, Anthias will manually assess which asset ratio mix is most prudent from a risk standpoint. In our analysis, we will be aware of the potential trade-offs between minimizing VaR and meeting user demand. Asset ratios that minimize VaR may not provide sufficient liquidity where traders currently or historically need it.

Our analysis will look at increments $h \times k = 0, 0.25, 0.5, 0.75, 1$. These increments will sample the behavior of ratios and VaR as the simulations step from the pool's current ratios to those specified in the updated target ratios. For each increment, we will analyze whether the VaR exceeds acceptable levels and whether the simulation ratios at that increment provide sufficient liquidity to traders' current and historical needs. Based on our results, we will make a final recommendation for Adrena's asset ratios.

This comprehensive analysis will give ADX stakeholders the information needed to make an informed decision about their risk tolerance and desired market positioning. The final choice of asset ratios can then align with Adrena's broader strategic goals.

3 Conclusion

The *Adrena Asset Ratio Recommendation Framework* combines rigorous mathematical analysis with expert human oversight to create a robust decision-making process. The quantitative tools provide data-driven insights into trader demand, LP preferences, and risk metrics, while Anthias's manual review ensures these insights are interpreted within proper market context.

This combination of systematic analysis and human judgment allows Adrena's pool to optimize its asset ratios thoughtfully and dynamically, maintaining sustainable liquidity and prudent risk management as markets evolve.