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Gnosis formula for LMSR

below is the Gnosis formula for LMSR AMM which we take the invariant equal to 1:

$$invariant = 2^{-\frac{Yes\_shares}{funding}} + 2^{-\frac{No\_shares}{funding}}$$

in above funding indicates the liquidity and Yes_shares and No_shares are the numbers of each share in the liquidity pool. this formula is the base of our work in this document. which other functions has been written base on this formula.

how Pricing, Buying and Selling functions work?

the logic behind these functions is simple.

Pricing

Yes and No shares are priced as follows:

$$Yes\_price = 2^{-\frac{Yes\_shares}{funding}}$$

$$No\_price = 2^{-\frac{No\_shares}{funding}}$$

it is easy to find out that prices are exactly sum up to 1.

Buying

the buying function gets two input:
1-money for trading
2-which share the trader wants to buy

for example consider amount of money be M_{tr} and trader wants to buy yes shares and also suppose Yes_share and No_shares be the number of each share in the pool. so by paying money number of each share in the pool gets $Yes\_shares + M_{tr}$ for yes shares and $No\_shares + M_{tr}$ for no shares.(this is because M_{tr}\$ of money is minted to M_{tr} of yes shares and M_{tr} of No shares and this shares are added to the pool.) so we give back the trader x of Yes shares. x is computed as follows:

$$1 = 2^{-\frac{Yes\_shares+M_{tr}-x}{funding}} + 2^{-\frac{No\_shares+M_{tr}}{funding}}$$

so x equals to:

$$x = \frac{\ln\left(1 - 2^{-(No\_shares+M_{tr})/funding}\right)}{\ln(2)} * funding + Yes\_shares + M_{tr}$$

Selling

The selling function is somehow similar to the buying function. this function gets two inputs:
1- number of shares to be sold
2- which share trader want to sell
for example consider trader wants to sell some of yes shares. and N_{Yes} be number of yes shares that trader wants to sell. and consider y be the amount of money that should be paid to the trader. so at first we have:

$$1 = 2^{-\frac{Yes\_shares}{funding}} + 2^{-\frac{No\_shares}{funding}}$$

then after paying money to the trader we get:

$$1 = 2^{-\frac{Yes\_shares+N_{Yes}-y}{funding}} + 2^{-\frac{No\_shares-y}{funding}}$$

after doing some simplifying we get below for y:

$$y = -\frac{\ln\left(2^{-\frac{Yes\_shares+N_{Yes}}{funding}} + 2^{-\frac{No\_shares}{funding}}\right)}{\ln(2)} * funding$$

Adding Liquidity, Initial Seeding, Remove Liquidity

Adding Liquidity

also this section contains formula and explanations

Initial Seeding

also this section contains formula and explanations

Remove Liquidity

also this section contains formula and explanations