PreCog

Lending and Futures Market Automated Yield Aggregator

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Abstract

Investing and trading has changed a lot over the past decades. More connectivity through the Internet and increased computation have drastically altered the speed at which markets are moving. Starting from this, the introduction and popularization of crypto currency has created a new and chaotic online market with many opportunities. This environment is giving rise to increasingly complicated and fast-paced trading methods. Precog aims to take advantage of these new opportunities using a sophisticated and automated strategy.

1 Background

Crypto lending is a new investment strategy similar to traditional lending. Investors lend their money to a third party which uses that money to do the investment. In return they offer a certain interest rate on the invested amount.

The crypto market is no longer in it's infancy. Similar to the natural progression of any investment class, as the cryptocurrency market matures we are starting to see derivative trading interest also increase.

Derivatives are essential for institutions and funds looking to strategically manage their exposure in the assets they are derived from. The cryptocurrency market has finally matured to the point where some of the largest financial institutions are making public declarations of their interest to gain exposure to this emerging asset class.

2 Introducing PreCog

We propose a new institutional grade financial tool custom built for sophisticated derivative trading strategies.

Precog is a new decentralised protocol that automatically exploits pricing inefficiencies between the spot and futures cryptocurrency markets, bearing participants risk-free future-settled profits.

Similar to a traditional "cash and carry" arbitrage investment strategy, the PreCog smart contract measures the spot and carrying cost of a cryptocurrency then compares that total cost against a future premium. If the future premium value is greater than the value of the spot and carry costs then the smart contract will buy the asset and forward sell that same asset, locking in the value difference between the current and future price. It operates completely autonomous.

2.1 Unpacking the basis trade

Derivatives such as the futures and options markets are financial assets derived from an underlying 'real' asset. For instance one gram of gold is one gram of gold. A futures contract is merely a future price of that same gram of gold realised by a digital contract. This contract is a derived asset or a derivative of gold.

If we were executing these gold trades manually, we would be doing the following:

1. Identify a discrepancy in the current price of gold and a future contract on gold
2. Calculate the cost to acquire that asset and the cost to hold or "carry" until that future time
3. Going long gold (buying the gram of gold) and holding for that predetermined time
4. Selling that same gram of gold via contract due for settlement at that future date
5. Upon settlement we collect our profits

Managing this trade alone is a full time job. Not only is it daunting but you are competing with other people. As happened with yield farmers in the crypto space, eventually it becomes to competitive and profits are inefficiently traded about.

Using Precog you can just deposit your capital and your job is done.

- Precog deploys it's trading sequence simultaneously across a large number of different assets, contracts and platforms
- Precog operates in real time making it impossible for humans to beat it to a trade
- Precog operates 24/7 meaning it will earn while you sleep and never miss an opportunity

3 Sentient (PreCog v2)

Due to market uncertainty, the futures premium is often so high that another opportunity presents itself. If the future premium of an asset is much higher than its current price then savvy investors with access to capital or leverage can scale their profits significantly while maintaining the same risk-less component.

Our advanced Sentient smart contract will identify these market opportunities and then communicate with the available decentralised lending markets to aggregate the best rates. If the calculation is still net positive then PCOG will borrow the capital using the collateral participants hold in the contract, then execute the same arbitrage trade, significantly boosting the dollar value return.

4 Design philosophy

PreCog will be built under the following precepts

ease of use

Investor' participation on PreCog will be off-loaded to our automated investment manager. PreCog will identify opportunities by itself, deciding on the most optimal position size for any given opportunity and determining the right time to enter into trades without any human intervention.

transparency

One of our core tenets is transparency. We aim to ensure that users have enough information to engage in self-decision-making on all matters related to their investments. Through our platform we will provide users various metrics pertaining to PreCog's activities.

optimization

PreCog is constantly learning new strategies based on internal and external data in order to improve its functionality. A variety of performance metrics will be used to analyse the results. The algorithm considers performance strategies of various systems and implements adjustments to itself when it sees fit.

recursiveness

The algorithm is designed to be recursive. The value of recursive systems is that as they evolve and adopt more complexity, they maintain their logical integrity and simplicity. This helps fix errors and design scalable software.

5 Why Cash & Cary works

The following is a complete and strict description of a single Cash & Carry arbitrage trade. The purpose of this is to concretely explain the idea behind the strategy. The spot and futures price of the same asset is used. The operation takes place at two different times, denoted as time 0 and time 1. at t=0 the futures price of this asset is higher than it's spot price. at t=1 both prices are equal.

The following symbols are be used

Symbol	Meaning
N	The amount of money used to buy spot
N_F	The amount of money used to buy futures
$P_{s,0}$	The spot price at t=0
$P_{s,1}$	The spot price at t=1
$P_{f,0}$	The futures price at t=0
$P_{f,1}$	The futures price at t=1
t_{bs}	The transaction cost for buying spot
t_{ss}	The transaction cost for selling spot
t_{bf}	The transaction cost for futures spot
t_{sf}	The transaction cost for selling futures

5.1 Step 1: buying spot and selling futures

The trade starts at t=0. The spot price is lower than the futures price.

$$P_{s,0} < P_{f,0}$$

We simultaneously perform two actions.

- We buy spot for N with a transaction cost of t_{bs} at a price of $P_{s,0}$
- We open a trade as a seller for an amount of N_F with a transaction cost of t_{sf} at a price of $P_{f,0}$

These actions result in us having

- an amount of cryptocurrency equal to $\frac{N}{p_{s0}}(1 - t_{bs})$
- a sell order for an amount of $\frac{N_F}{P_{f,0}}$

By opening the order as a seller, we also gain N_F and pay a transaction cost of $N_f * t_{sf}$ netting us $N_f(1 - t_{sf})$.

5.2 Step 2: selling spot and buying futures

The trade ends at t=1. The spot and futures price are equal.

$$P_{s,1} = P_{f,1}$$

We then perform the opposite actions of t=0.

- We sell spot for $\frac{N}{p_{s,0}}(1 - t_{bs})$ with a transaction cost of t_{ss} at a price of $P_{s,1}$
- We open a trade as a buyer for an amount of $\frac{N_F}{p_{f,0}}$ with a transaction cost of t_{bf} at a price of $P_{f,1}$

These actions result in us having

- an amount of currency equal to $N\frac{P_{s,1}}{p_{s,0}}(1 - t_{bs})(1 - t_{ss})$
- a loss of currency equal to $N_F\frac{P_{f,1}}{P_{f,0}}(1 + t_{bf})$

There are two things that still need to be determined. Firstly we need to determine for how much we want to open a sell order at t=0, this is the amount N_F. Secondly, we need to find out when the difference between spot and futures is high enough to make for a profitable trade.

5.3 Determining the size of the sell order

When determining N_F, we want to make sure that our actions at t=1 will cancel each other out. In other words

$$N\frac{P_{s,1}}{p_{s,0}}(1 - t_{bs})(1 - t_{ss}) = N_F\frac{P_{f,1}}{P_{f,0}}(1 + t_{bf})$$

$P_{s,1}$ and $P_{f,1}$ are equal so they cancel each other out. This equation eventually gives us

$$N_F = N\frac{P_{f,0}}{P_{s,0}}\frac{(1 - t_{bs})(1 - t_{ss})}{1 + t_{bf}} \tag{1}$$

This equation enables us to determine for how much we should open a sell order at t=0 depending on the spot and futures price and the transaction costs.

5.4 Determining the buy threshold

We need to determine when the difference in spot and futures price is high enough for us to start the trade. To this end we set the condition to be that the net profit should be positive. Since the trades at t=1 give a net 0, the profit is determined by the amount that we gain from selling futures at t=0 and the amount that we lose by buying spot at t=0.

$$N_f(1 - t_{sf}) - N > 0$$

By combining this with equation 1 we get

$$N\frac{P_{f,0}}{P_{s,0}}\frac{(1 - t_{bs})(1 - t_{ss})(1 - t_{sf})}{1 + t_{bf}} - N > 0$$

Which eventually gives us that the difference between the spot and futures price of an asset when starting the trade should be at least

$$\frac{P_{f,0}}{P_{s,0}} > \frac{1 + t_{bf}}{(1 - t_{bs})(1 - t_{ss})(1 - t_{sf})}$$

6 Current standing on the algorithm

This section describes the development process of the trading algorithm up until the publishing date of this document. The BTC/BTC-futures pair is used here for illustration. The graph on figure 1 shows the difference between the spot and futures price of Bitcoin on the Bitmex platform between March 15th and July 15th 2021.

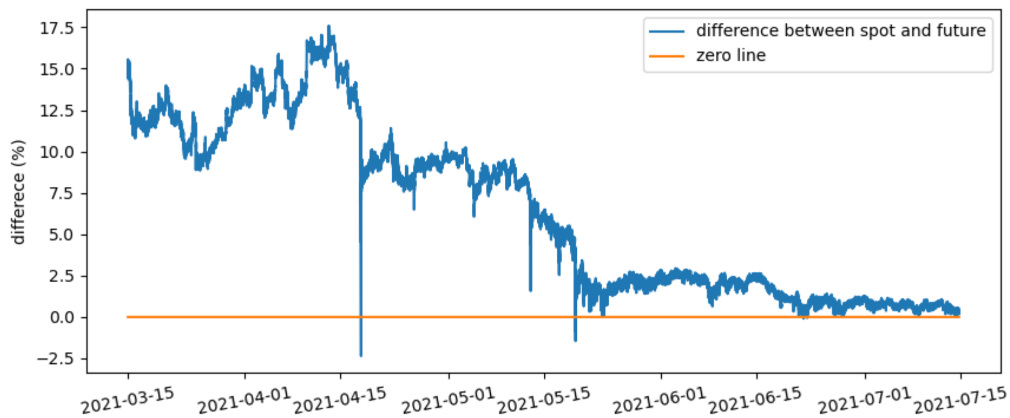

Figure 1: difference between spot and futures price of Bitcoin on the Bitmex platform between March 15th and July 15th 2021.

As a first step we implemented the bare Cash & Cary strategy as described in section 5. Figure 2 shows the times when the bot bought using red vertical lines and the times it sold using yellow vertical lines. The red horizontal line denotes the buy threshold determined by the transaction costs.

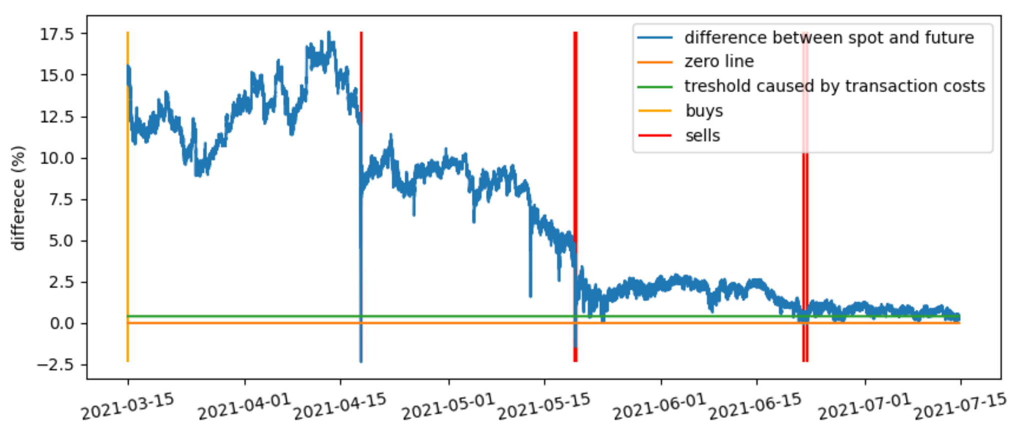

Figure 2: The strategy described in section 5 applied on the BTC/BTC-futures pair on Bitmex.

This strategy is not very effective. It often takes a significant amount of time before the price difference reaches zero. The buy threshold is also too low. In most cases we would have been better off waiting for the price difference to rise further instead of entering the trade when the price difference hits the buy threshold. Clearly we need to adjust the buy threshold and also the sell threshold.

When trying out different buy and sell thresholds, we can see that there are better ways to perform Cash & Carry arbitrage. Figure 3 shows how a good buy and sell threshold can result in good trades.

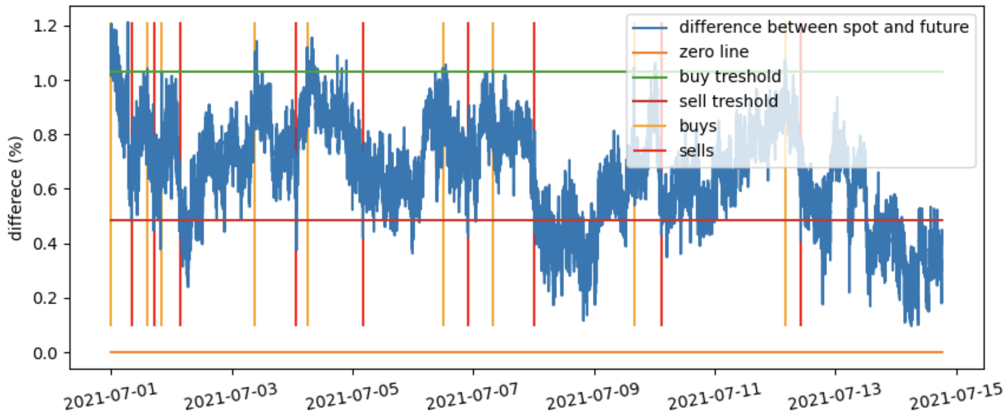

Figure 3: optimal strategy within a certain time window when using one buy and sell threshold for the Cash & Cary strategy.

These thresholds where determined by trying out different values and choosing the ones that give the best results. This is not possible when trading in the real world since we can only use data from the past. A method for determining these thresholds based only on past data is needed. We also want to adjust the thresholds often so we avoid missing certain opportunities like on July 9th on figure 3 where the price difference continued to drop below the sell threshold right after we sold. Fixed thresholds are also only usable for short time windows since the price differences will move out of the sweet spot caused by these thresholds over time.

The next update was to dynamically adjust the buy and sell thresholds as we go, based on past data. Figure 4 shows this strategy in action.

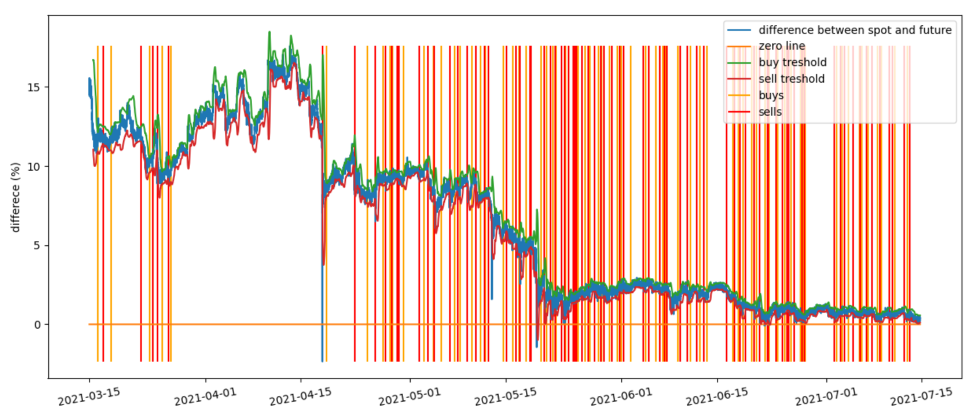

Figure 4: optimal strategy within a certain time window when using one buy and sell threshold for the Cash & Cary strategy.

7 Performance of the algorithm

7.1 Portfolio cumulative returns

Our strategy generates a cumulative return of 35% in a period of four months which significantly exceeds returns achieved by buy-and-hold and yield farming strategies. The graph on Figure 5 shows the difference in cumulative returns between our strategy and buy-and-hold.

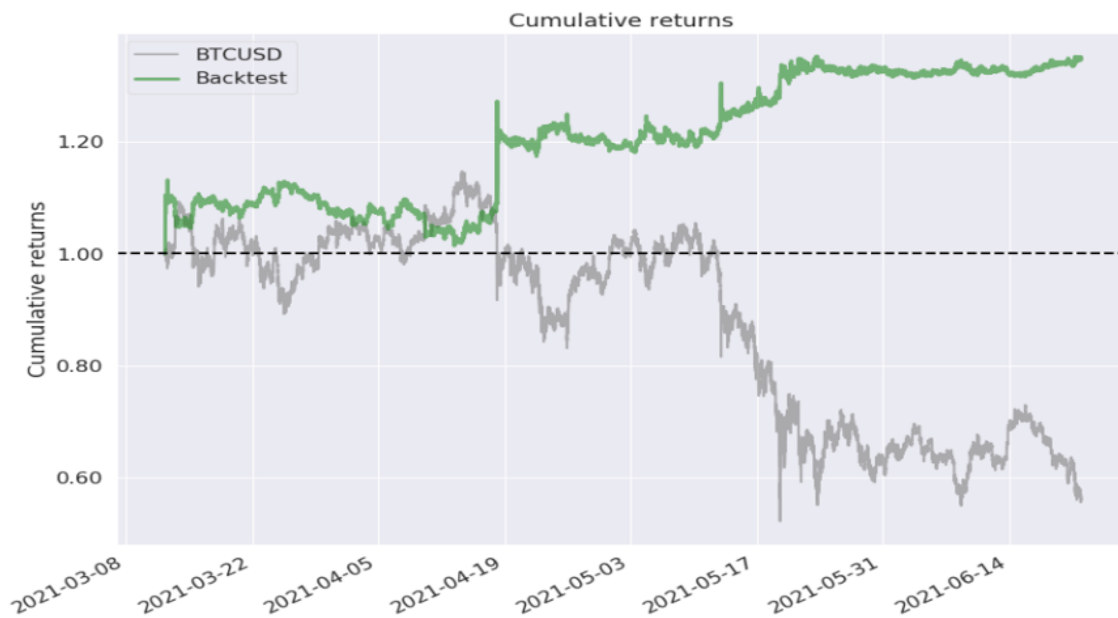

Figure 5: Comparison of the cumulative returns of our strategy and buy-and-hold.

7.2 Volatility

Our strategy provides less volatile returns compared to the spot crypto volatility and oscillates near a 2% rolling volatility demonstrating consistency in the generated returns. This is shown by the graph on figure 6.

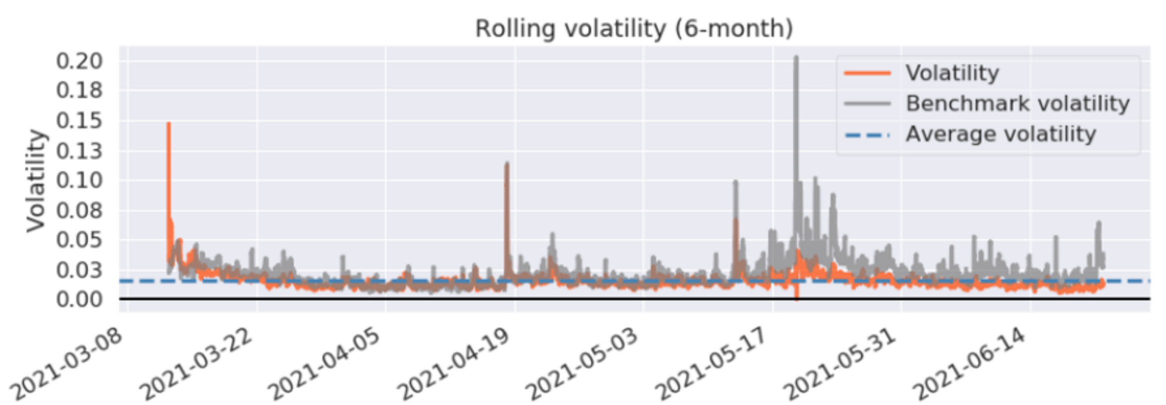

Figure 6: Volatility of our strategy compared to the volatility of the spot crypto prices.

7.3 Drawdowns

The maximum drawdown that happens during the 4-month period used is 10%. This is shown by the graph on figure 7. This is in line with the less risky nature of arbitrage strategies. The directional movement of two assets tend to cancel each other out.

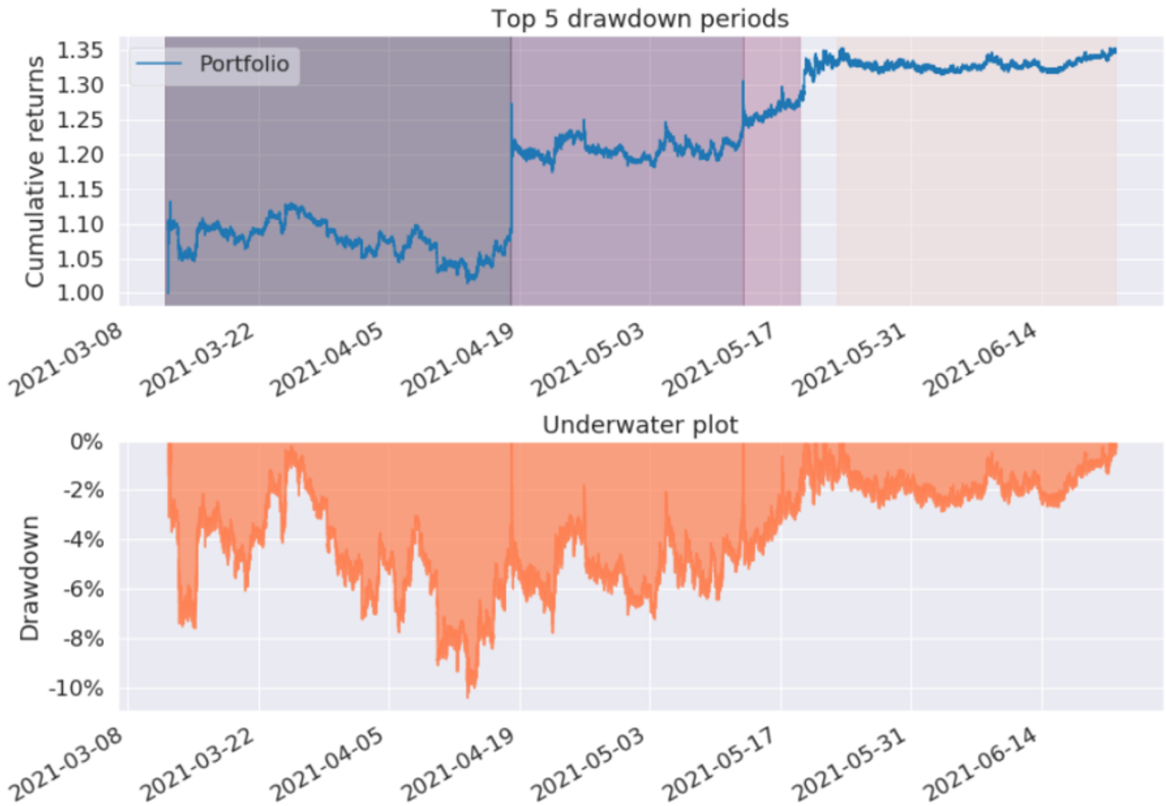

Figure 7: Drawdowns of the strategy over a four month period.

7.4 Longer period returns

The Average monthly returns generated by our strategy over the tested period is approximately 9%. We are achieving highly positive and consistent returns in every tested month. Both weekly and monthly returns demonstrate positive period on period returns providing further confidence in the performance of our strategy across longer time periods. These results are shown in more detail by figure 8.

Figure 8: Insights on the returns generated by our strategy

8 Further developpement

We are currently fine-tuning the algorithm even further. The current version only bases it's thresholds on past data. It also performs a variety of different analyses on the days that preceded the time it's currently trading on.

We are also setting up live tests so we can see the performance of the algorithm when other real-world influences are present (eg. slippage).

The algorithm will also run on different assets and expanding the current strategy to work on different currencies is the next big step.