Let’s Find Mean Reversion Pairs!

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MINDs Lab BRAIN
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Abstract

- We introduce simple ways to find mean-reversion pairs in ML perspective of view.

- Our experiments on 8 years of 23 cryptocurrency dataset show **awesome** results.

Contents

Introduction

Why mean reversion?

Mean reversion(MR) is a simple and effective strategie.

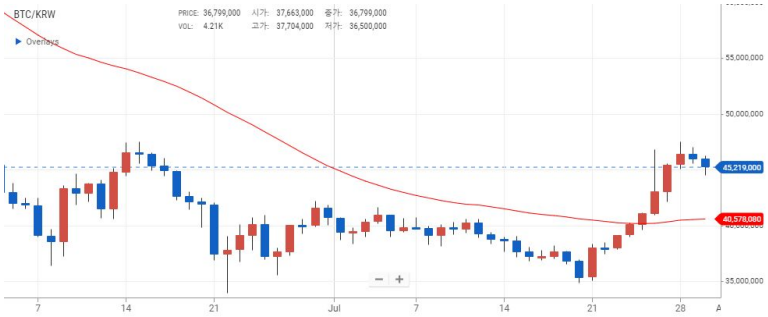

Figure 1.
If the asset reverts to the mean,
MR sells at this moment.

Introduction

Why search MR asset?

In order to utilize the MR strategy,

we need to know which assets revert to the mean.

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In this talk, I provide “ways to find mean-reverting asset”.

Introduction

Approach intuition

Inspired by ‘KRW-USD exchange rate’ and ‘BTC dominance’,

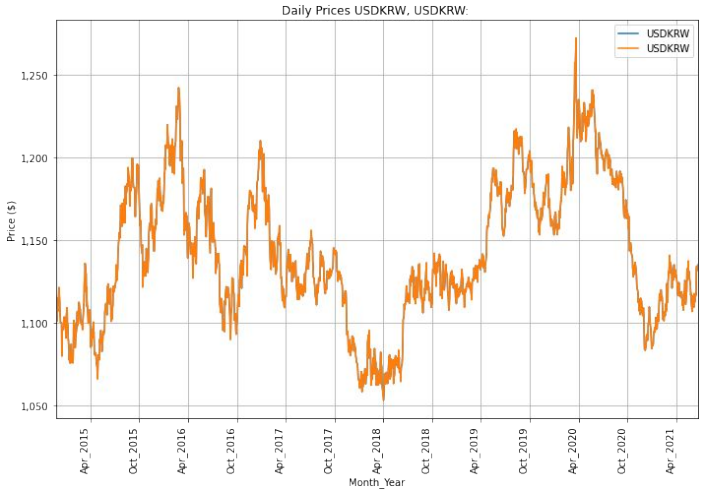

Figure 2. KRW/USD exchange rate.

source: Insik, “Time Series Analysis (mean-reversion)”, June 2021

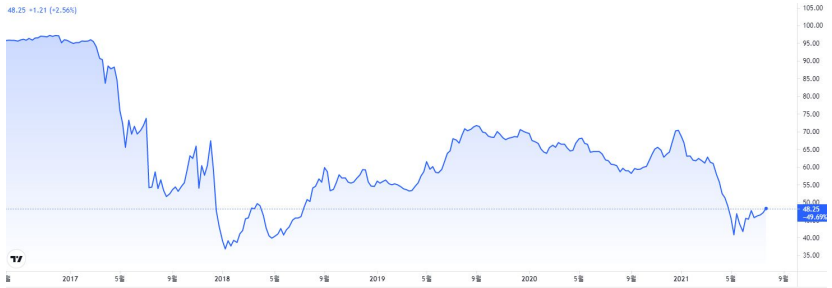

Figure 3. BTC dominance (BTC market cap/Crypt. curr. cap)

image captured from https://kr.tradingview.com/

Introduction

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Assume KRW-USD exchange rate reverts to mean.

Then,

$$KRW/USD = c$$

$$KRW - c \times USD = 0$$

Introduction
Approach intuition

Generalize.

Given asset time series x_{ij}, coefficients a_i and a constant c for $i \in N$ and $j \in T$, if some asset pair reverts to the mean,

$$a_1 \times x_{1t} + a_2 \times x_{2t} + \ldots + a_n \times x_{nt} = c, \forall t \in T$$

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A linear regression can be a solution.

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A linear regression can be a solution.

We experimented a simple MR strategy onto the pairs.

Approach

Given asset time series x_{ij}, coefficients a_i and a constant c for $i \in N$ and $j \in T$, if some asset pair reverts to the mean,

$$a_1 \times x_{1t} + a_2 \times x_{2t} + \ldots + a_n \times x_{nt} = c, \forall t \in T$$

We conducted simple linear regression.

Approach

We experimented a simple MR strategy onto the pairs.

Assuming zero-mean,

$$a_1 \times x_{1t} + a_2 \times x_{2t} + \ldots + a_n \times x_{nt} = 0, \forall t \in T$$

the strategy is

- If $\sum a_i x_{it} < 0$ at time t, hold x_i such that $a_i > 0$.
- If $\sum a_i x_{it} > 0$ at time t, hold x_i such that $a_i < 0$.

Experiment

Dataset

https://www.kaggle.com/sudalairajkumar/cryptocurrencypricehistory

23 cryptocurrencies

April 29, 2013 ~ July 6, 2021

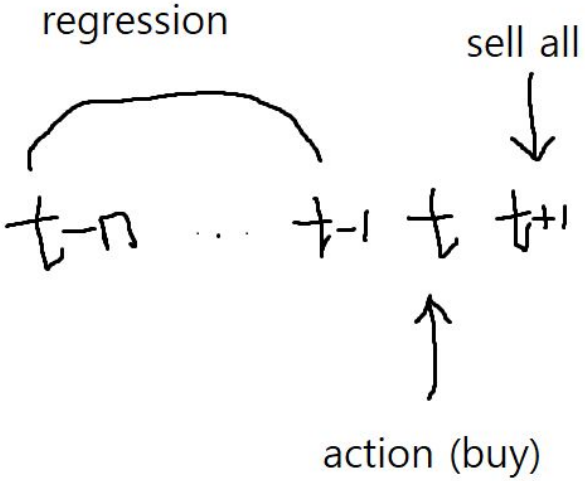
Experiment

Finding pairs

linear model := ax + b

- linear 7 days (linear-7)
- linear 14 days (linear-14)
- linear 30 days (linear-30)

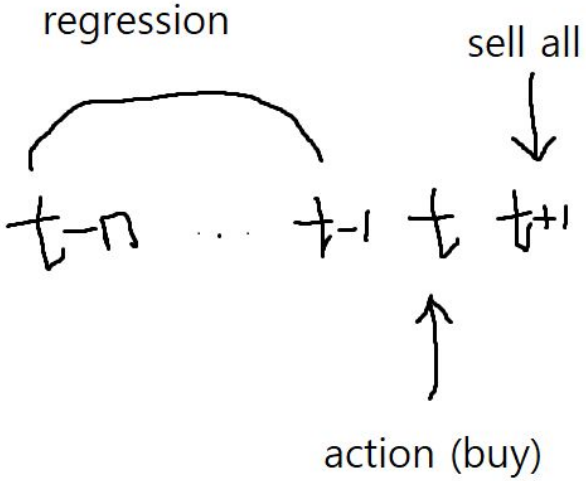
Note, we assume there are always mean-reverting pairs.



Experiment

Training details

- PyTorch lightning
- Epochs: 100
- Adam optimizer
  - lr: 5e-4
- MSE as loss function



Experiment

Results on Apr 2013 ~ Jul 2021

Model	Cumulative Return Pi (1 + return_i)
Nothing	100
Linear-7	45,946
Linear-14	63,765
Linear-30	56,042

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Experiment

Results on June, 2017 ~ Jul 2021

Model	Cumulative Return Pi (1 + return_i)
Nothing	100
Linear-7	5,404
Linear-14	5,445
Linear-30	4,626

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Experiment

Notes

- Random walks for early days.
  - (e.g., Only BTC and ETH on 2013)
- No hyper parameter tuning, no model searching, no efforts on training.
  - Far more ways to go!
- Very small training epoch.
  - I had not enough time to experiment.
  - Having larger epoch results much smaller loss.

Experiment

Notes

- We experimented only once.
  - Each model at time step *t* is independently trained.
  - Total thousands of training are conducted.
- **No transaction cost** is assumed.
- Survivorship bias is implied.

Conclusion

- We introduce simple ways to find mean-reversion pairs in ML perspective of view.

- Our experiments on 8 years of 23 cryptocurrency dataset show **awesome** results.