

# Differential Grid Trading over Cointegrated Assets

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M.S. in Computer Science



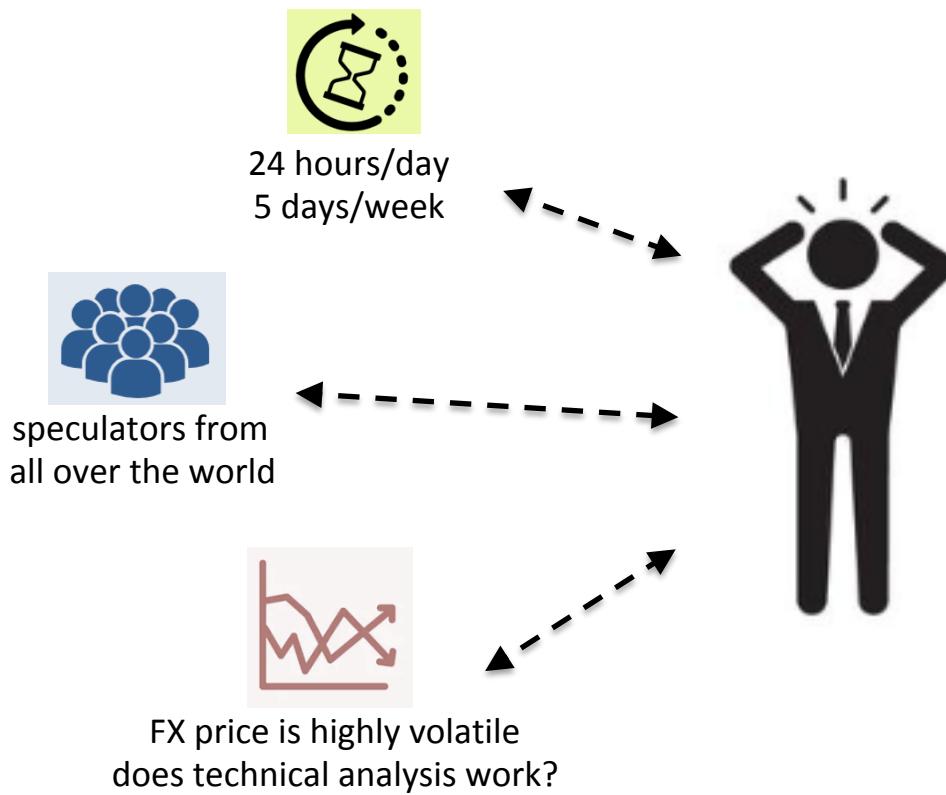
AVA Alpha

# Today's Talk

- **FX Robot trading**
  - FX trading robots using DGC
  - Technology by  AVA Alpha
- **Insight into DGC**
  - Background on FX market
  - Trading strategy and *its conditions*
  - Trading assets and *their risks*

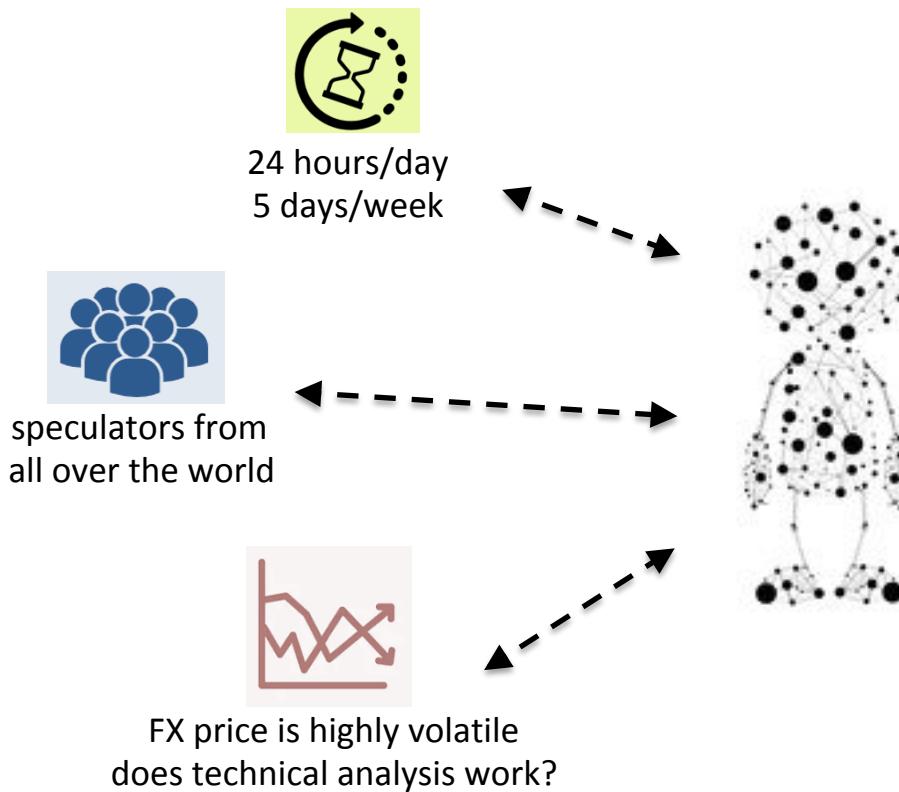
# Nature of FX Market

- (Almost) Perfectly competitive market



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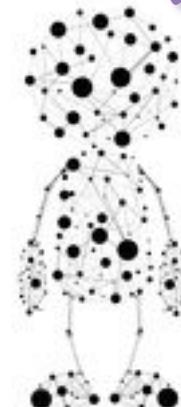
## Robot trading:

- Instant and always-on
- Statistical rather than emotional
- Consistent

# Nature of Machines

- A large set of training data is required
  - Humans have a huge prior knowledge  
Machines **don't**
  - Humans learn from rules (knowledge)  
Machines learn from **raw data**
- Troubles learning from alternative sources
  - Hard to make **far-reaching** inference
  - Hard to learn from **various data sources**

Let me do  
what I'm good at

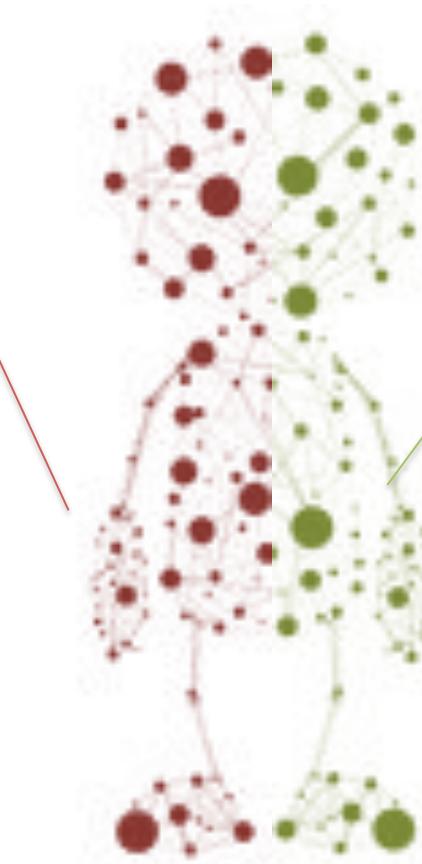


# DGC Trading System

Differential Grid Trading over Cointegrated Assets

Differential Grid

Cointegrated Assets



# Nature of FX Market

- In the big picture, FX price mostly moves within a range
  - Effects on economic growth: imports, exports, ...
  - Government intervention: financial policies, ...



# Nature of FX Market

- Making profits from price-ranging assets
  - Just **BUY** low and **SELL** high
  - What if it goes lower/higher?
- Simple strategy that works: grid trading

Is this low or high?



# Traditional Grid Trading

- **Price levels** provide signals for entries
  - When the price reaches a predefined level, it triggers a trading action
  - Need *reserved cash* for different levels
- **Suitable for assets whose prices are ranging**



# Traditional Grid Trading

- **Problems** with traditional grid trading
  1. High drawdown during short-term downtrends



# Traditional Grid Trading

- **Problems** with traditional grid trading
  1. High drawdown during short-term downtrends
  2. The larger the gap, the less opportunity to make profit



# DGC Trading System

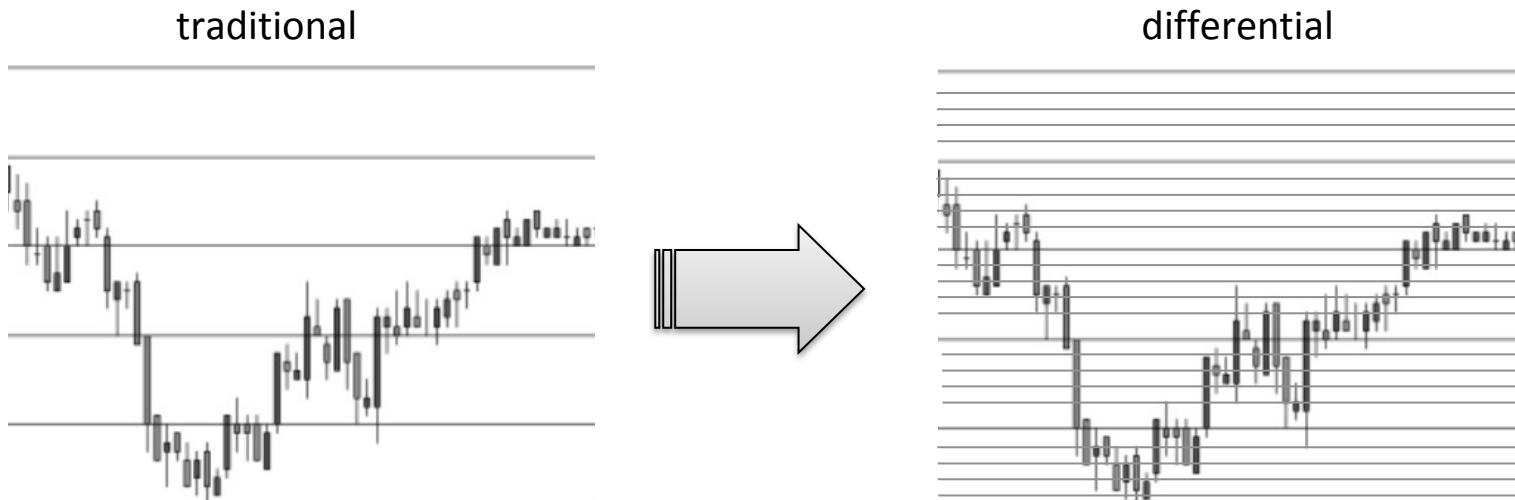
Differential Grid Trading over Cointegrated Assets

**Differential Grid**



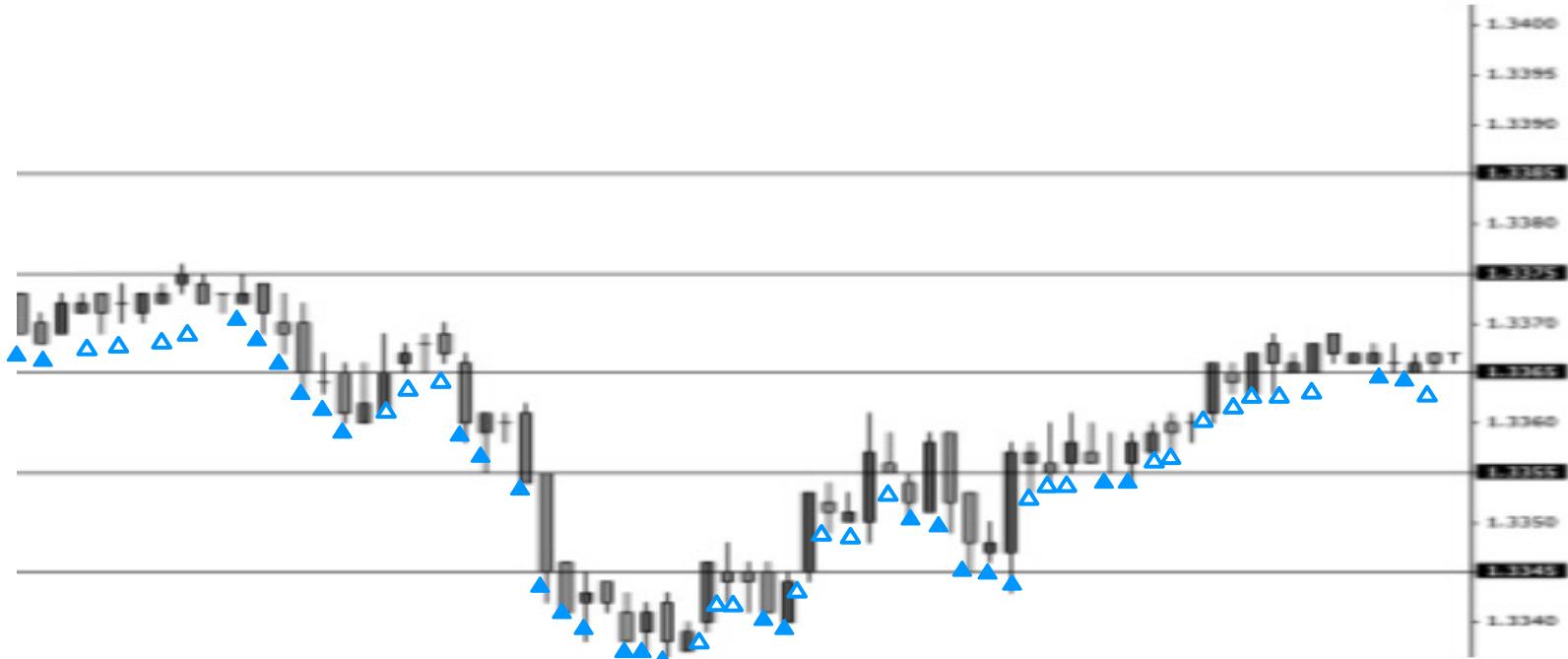
# Differential Grid Trading

- All possible points are price levels
  - Hence, we can take a trading action on ***every tick***
  - Make profitable trades in fluctuating downtrends



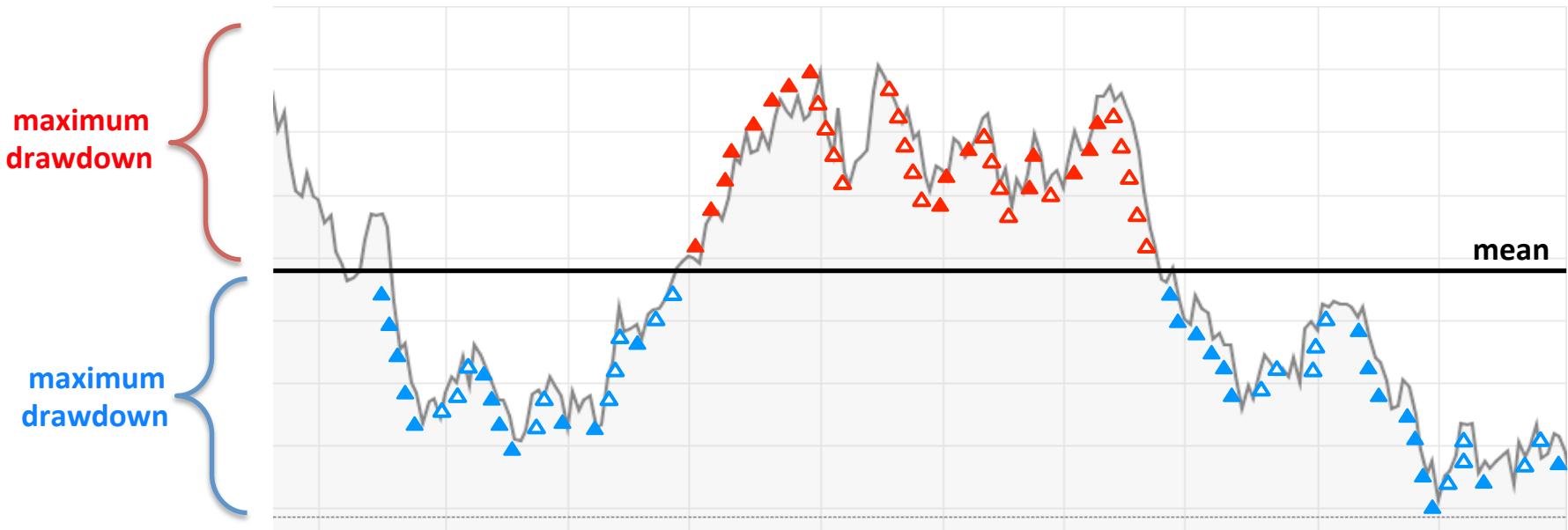
# Differential Grid Trading

- Opportunities are everywhere
  - Robots send trade orders in *less than a second*
  - Position size is calculated through a mathematical framework



# Differential Grid Trading

- Minimize drawdown by opening
  - **LONG** positions when price below the mean (if historically said to range)
  - **SHORT** positions when price above the mean



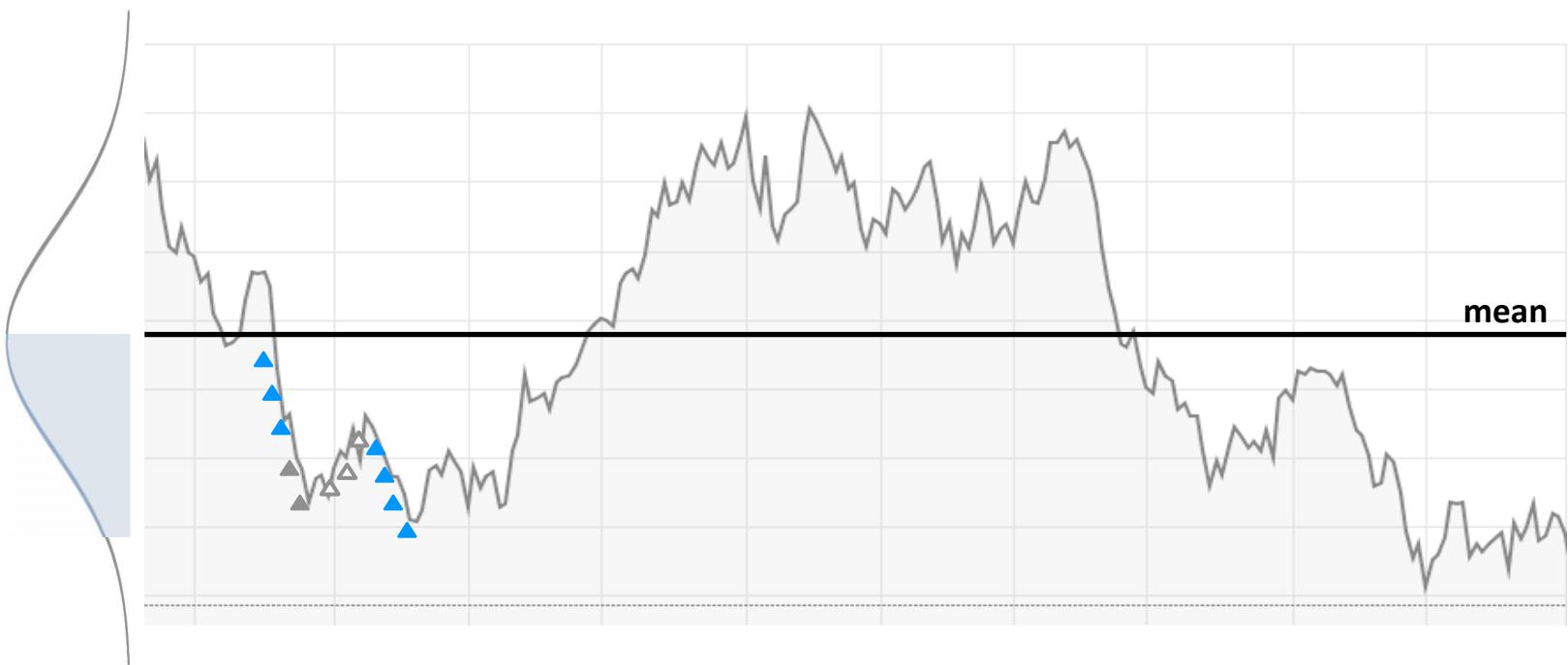
# Differential Grid Trading

- Maximize profitable trades
  - Price tends to fluctuate around the mean (normality assumed)
  - Why not **invest more** around the mean?



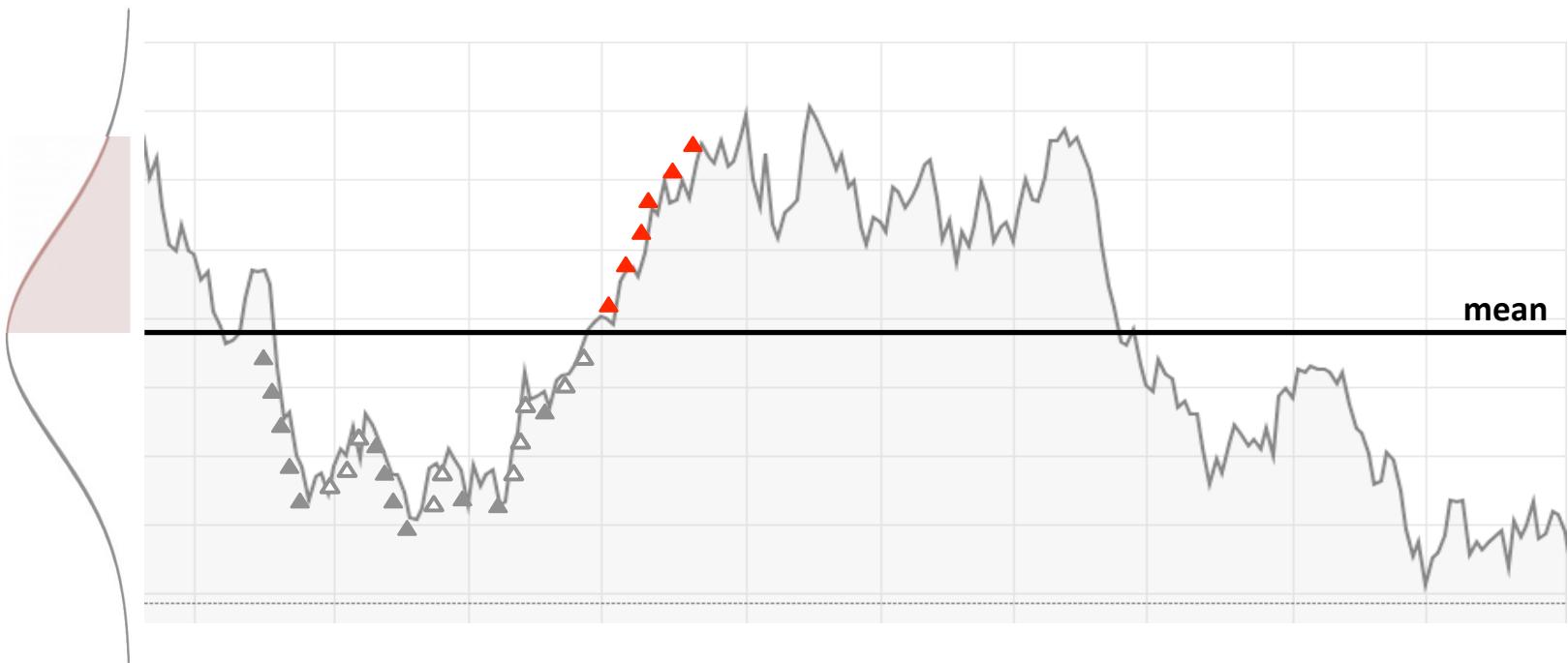
# Differential Grid Trading

- Invest more around the mean
  - Position size proportional to the value of normal distribution
  - Example I: **LONG**



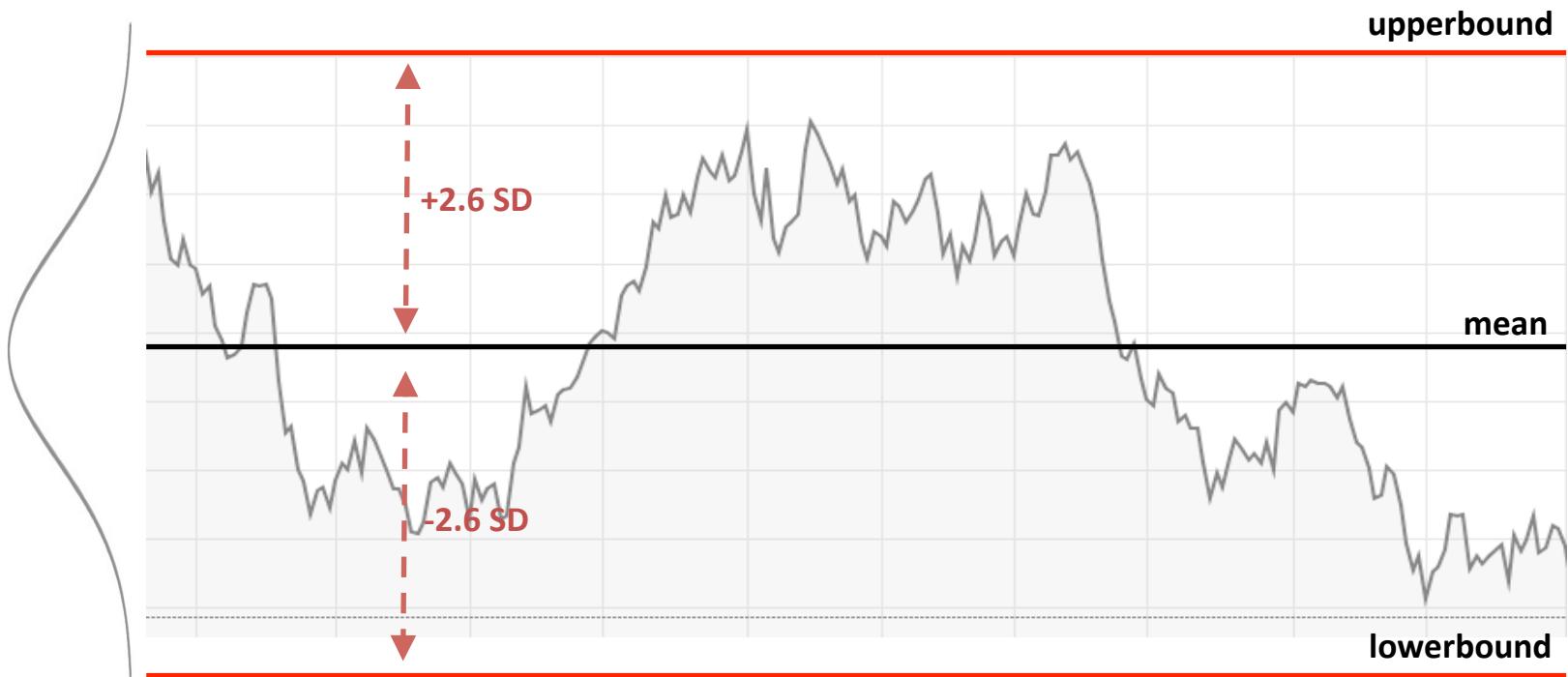
# Differential Grid Trading

- Invest more around the mean
  - Most cash is used for trading instead of *reserving*
  - Example II: **SHORT**



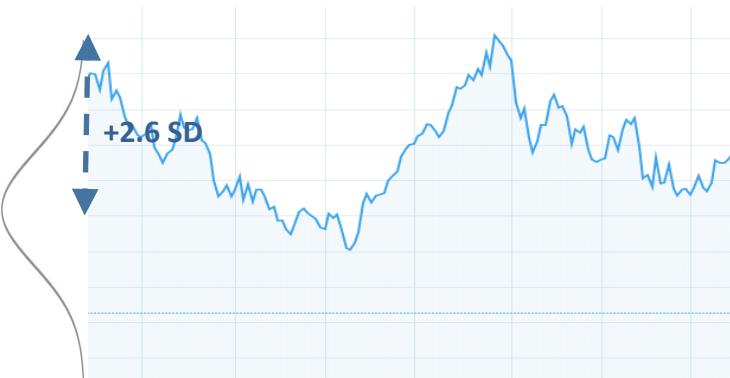
# Differential Grid Trading

- **Limiting Risk:** carefully planned on position size
  - Price should stay within  $\pm 2.6$  SD (corresponds to 99% two-tailed)
  - No margin calls if price stays in the range



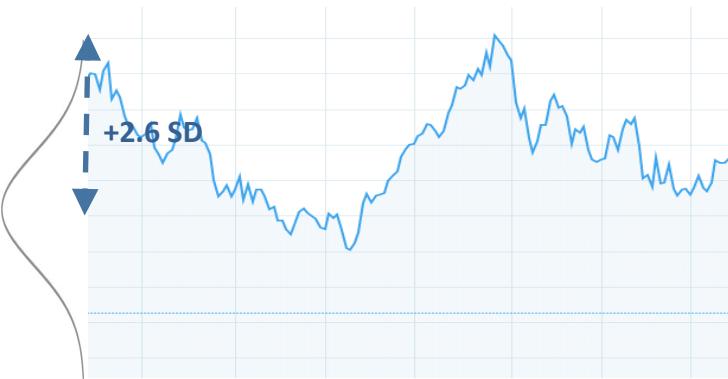
# FX on the Grid

- Does FX price always move within a range?



# FX on the Grid

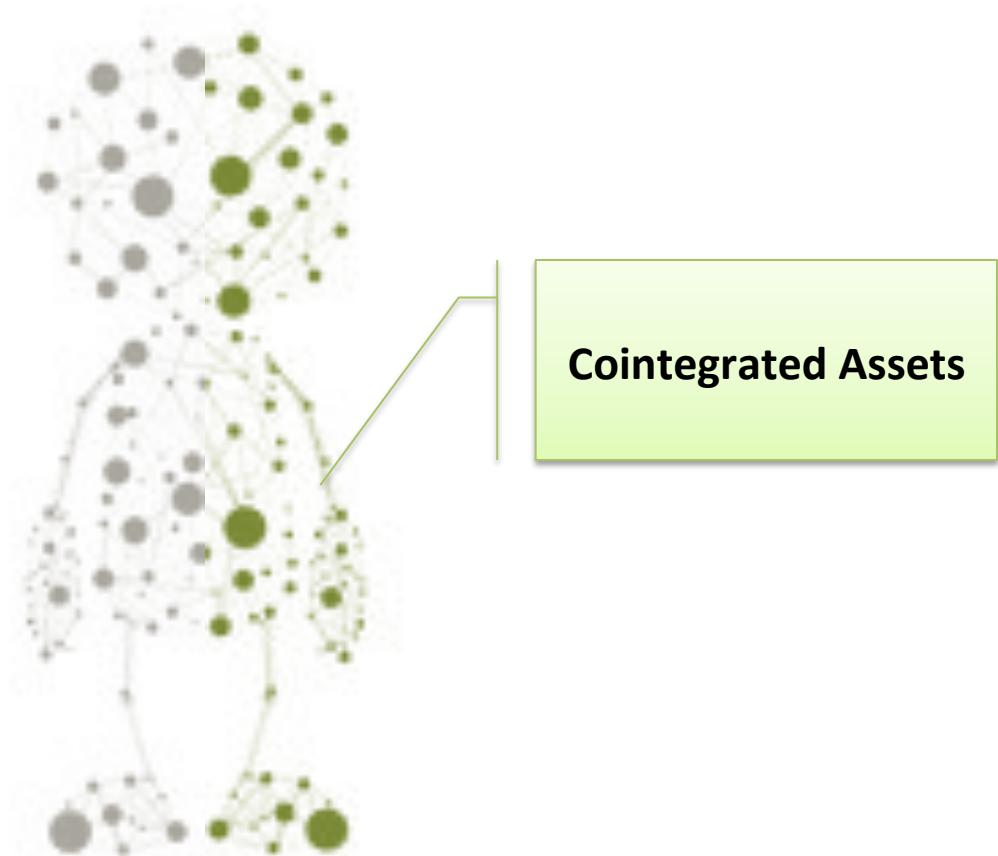
- Does FX price always move within a range?



- In search of assets whose price is *ever-ranging*
  - Can we *create* our own assets to trade upon?
  - Just like SET50 index futures but range !

# DGC Trading System

Differential Grid Trading over Cointegrated Assets



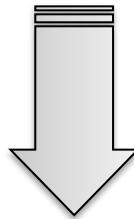
# Cointegrated Assets

Individual assets may not range in a stable way



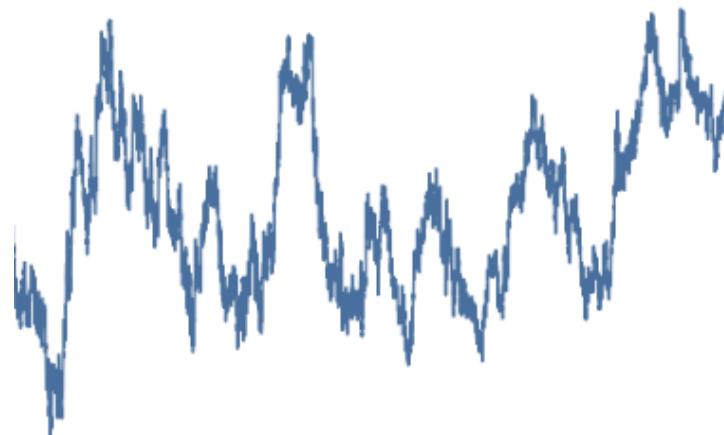
# Cointegrated Assets

Individual assets may not range in a stable way



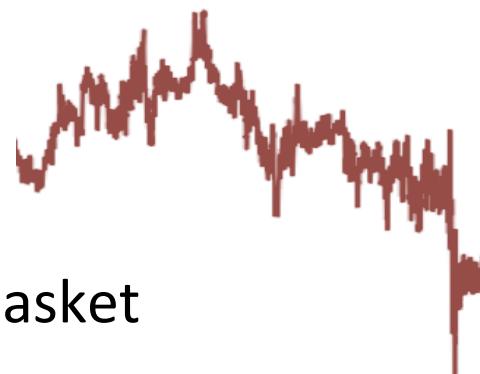
But, their *linear* combination may

**X =**



# Cointegrated Assets

- Cointegration improves ranging stability
- **Intuition:** why does cointegration works?
  - When one currency pair devalues, another rises
  - The *right* combination neutralizes the rate of change



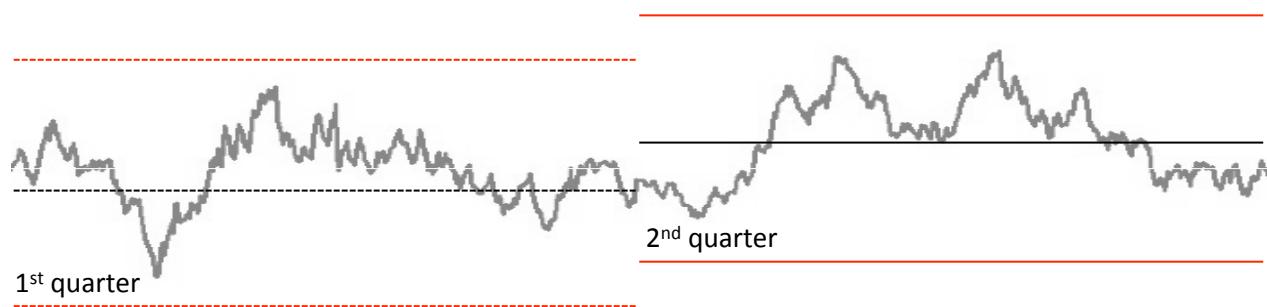
- Circulation of funds within the basket

# Cointegrated Assets

- **Human experts** choose the currencies
  - Macroeconomics: national income, financial policies, ...
  - Machines are *not* (yet) capable
- **Robots** choose the coefficients
  - Optimized using 5-year historical price data
  - Easy for machine to process lots of data

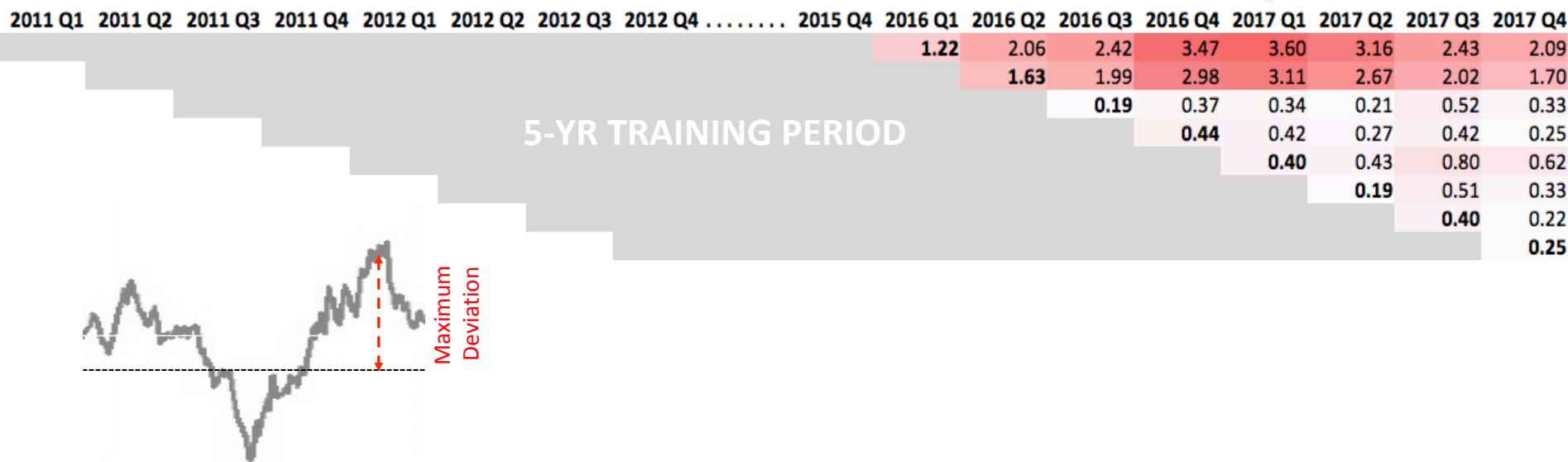
# Does cointegration last long?

- Macroeconomic changes are inevitable
  - Technological advancements, political events, financial policies, ...
  - The mean can shift gradually (*if not suddenly*)
  - The coefficients can change gradually
- Recommended to ***regularly update*** all the parameters
  - To avoid breaking the upper/lowerbounds at  **$\pm 2.6 \text{ SD}$**



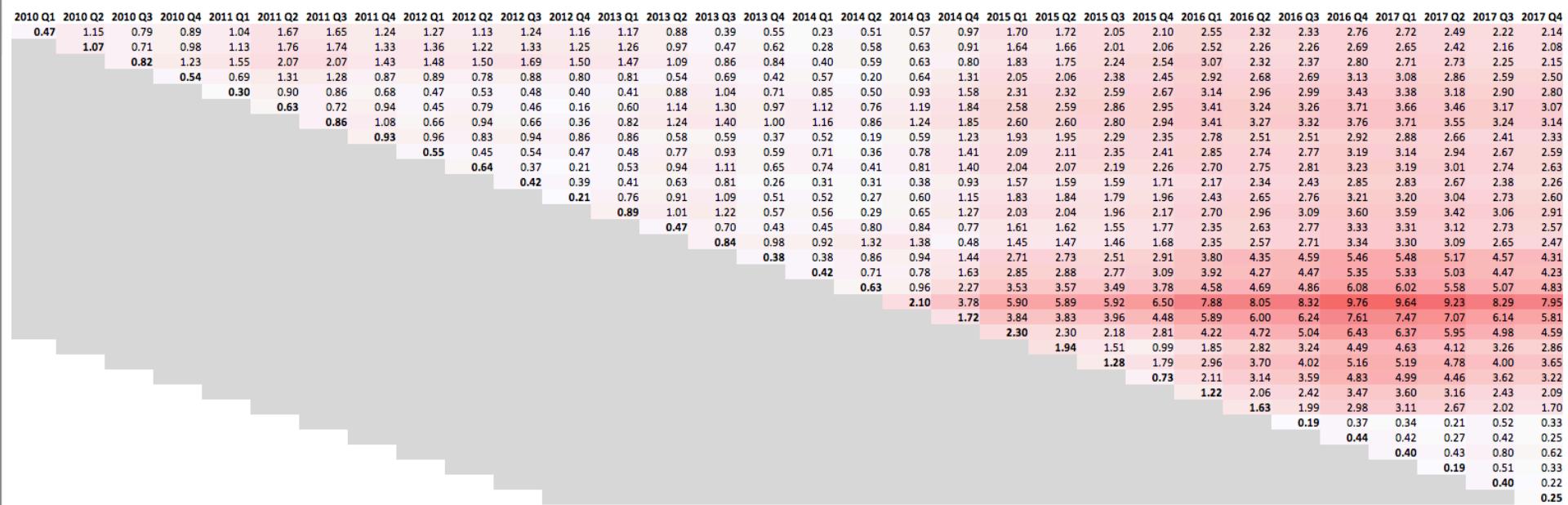
# Does cointegration last long?

- Maximum deviation from 2016 to 2017
  - Never break **2.6 SD** for 8 quarters *if quarterly updated*



# Does cointegration last long?

- Maximum deviation from 2010 to 2017
  - Never break **2.6 SD** since 2010  $\approx$  8 years



# DGC Trading System

Differential Grid Trading over Cointegrated Assets

Differential Grid

Cointegrated Assets

# DGC Trading System

- Trading strategy
  - **Entry/Exit:** Differential Grid Trading
  - **Assets:** Cointegrated Assets
  - **Return:** 20% to 30% per year

Past performance is no guarantee of future results

- Investment universe
  - AUD, CAD, CHF, GBP, JPY, NZD, USD
- Investment universe **for 2019 Q1**
  - AUD, CAD, CHF, GBP, JPY, NZD, USD

# DGC Trading System



Natural resources,  
Coal, Lithium



Giant Tech.,  
Main currency



Softwood,  
Crude oil



Luxury products,  
Futures exchange



Technologies,  
Robotics

# DGC Trading System

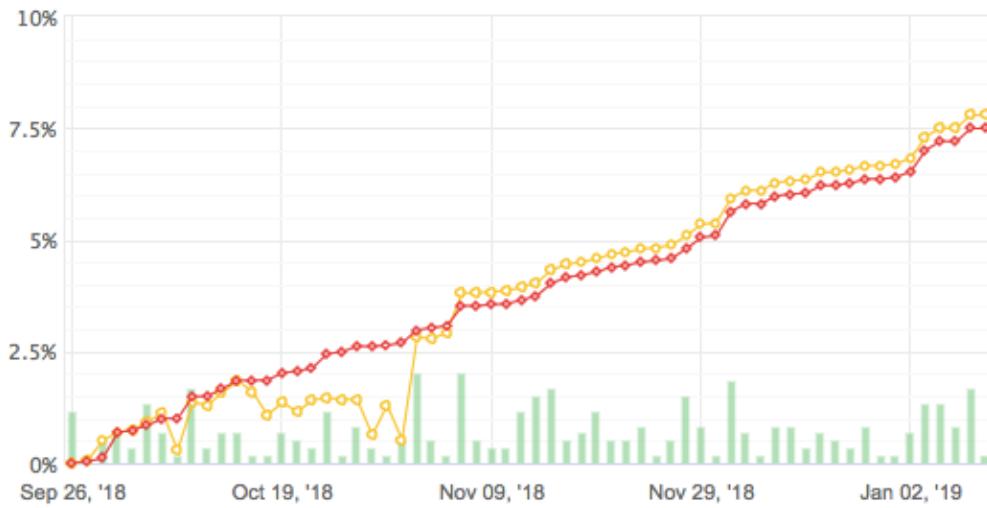
- Back testing on out-of-sample data
  - Initial balance \$300,000 *and compounded quarterly*
  - Test period Jan 2016 – Dec 2018
- Performance



- Balance curve = value *excluding unrealized profits*
- Equity curve = value *including unrealized profits*

# DGC Trading System

- Forward testing
  - Initial balance \$6,000
  - Test period Oct 2018 – Jan 2019
- Performance



- **Balance curve** = value *excluding* unrealized profits
- **Equity curve** = value *including* unrealized profits

Past performance is no guarantee of future results



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