Bivariate Trend Calculus.

Showcases:

Gold ounce in USD Vs Brent Crude Oil price.
Gold ounce in USD Vs S&P 500 index.

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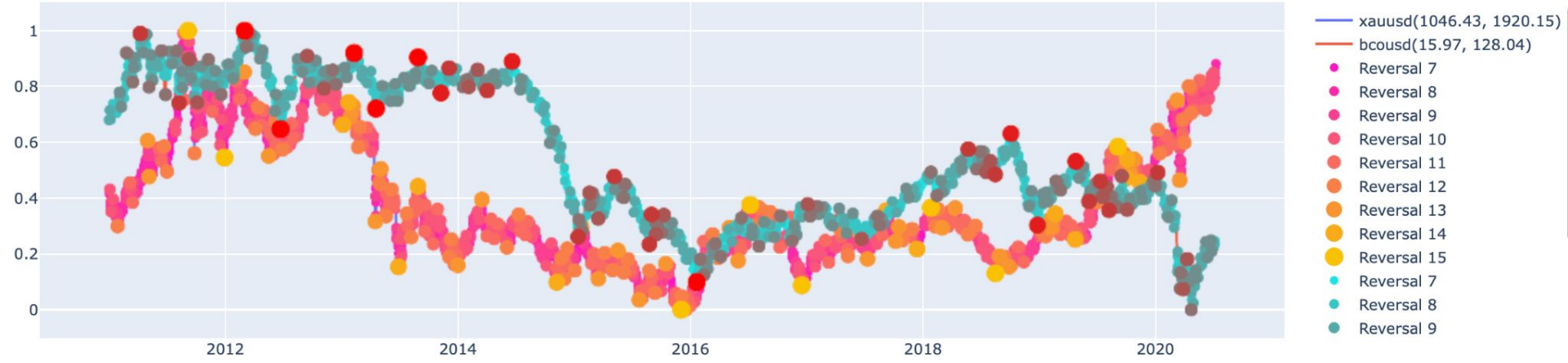
Gold ounce in USD Vs. Brent Crude Oil price (scaled)



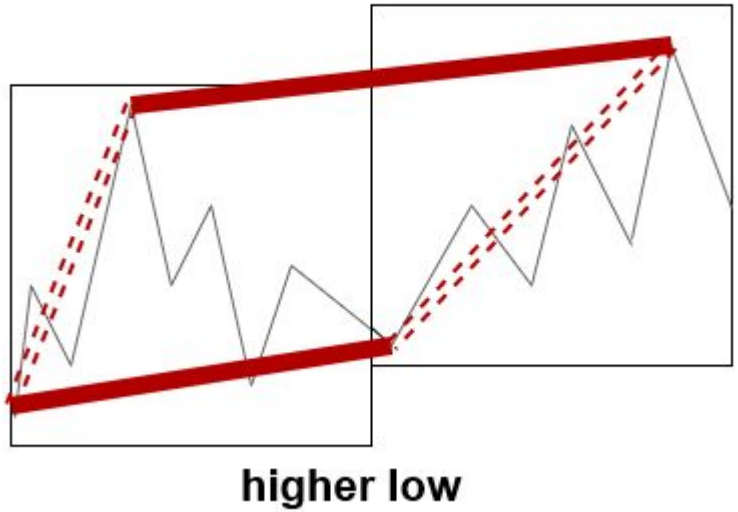
Definitions

Quantifying the definition

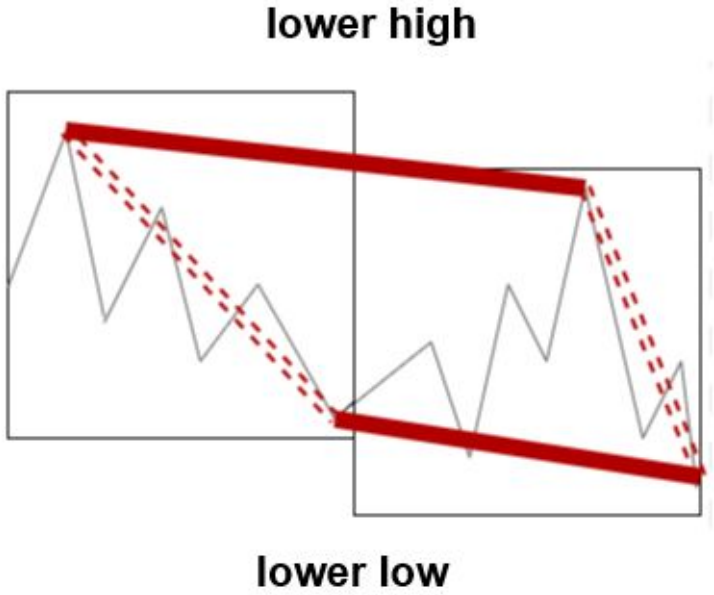
Trend

- Rising: Higher Highs, Higher lows. +1
- Falling: Lower Highs, Lower lows. -1
- Reversal

Rising trend

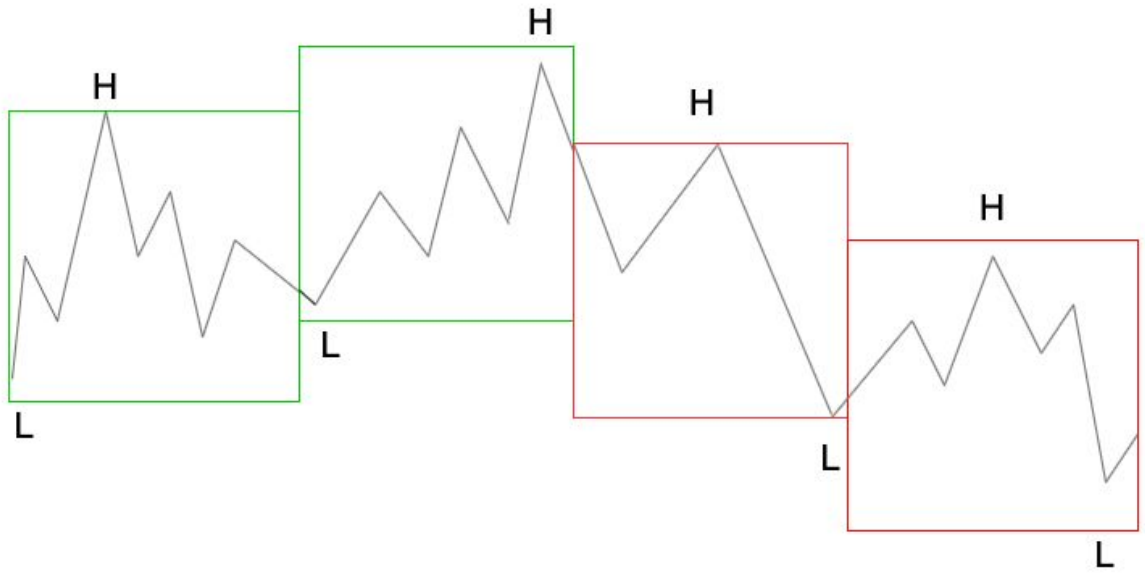


Falling trend



- Stream the data across a fixed window size.
- For each window identify the dated High and Low.
- Summarise each window as rising or falling (Low first, High or High first, Low)
- Compare the summary of the current window to the previous one.

- Illustrate rising windows in green and falling windows in red.



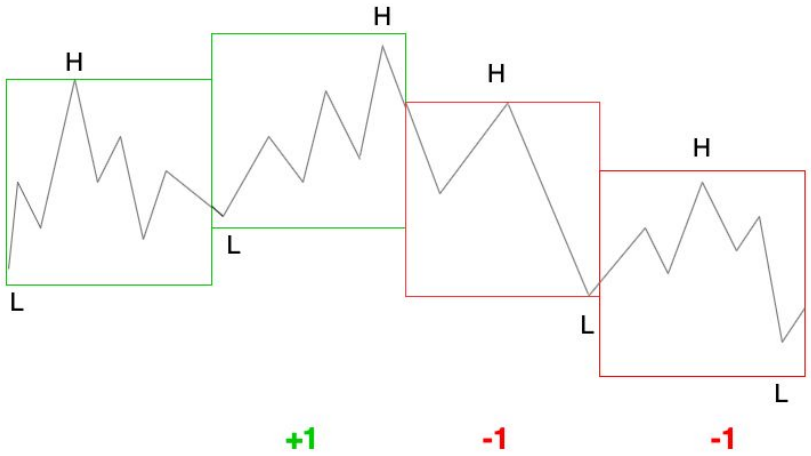
The TrendCalculus equation:

$$sign\left(sign\left(H_{p_i} - H_{p_{i-1}}\right) + sign\left(L_{p_i} - L_{p_{i-1}}\right)\right)$$

where,

- H, L = High and Low
- p_i = current window
- p_{i-1} = previous window

- Given the TrendCalculus equation, assign a sign to each window.



Definitions

Trend

- Rising: Higher Highs, Higher lows.
- Falling: Lower Highs, Lower lows.
- Reversal: A point on the previous window where the trend values flip.

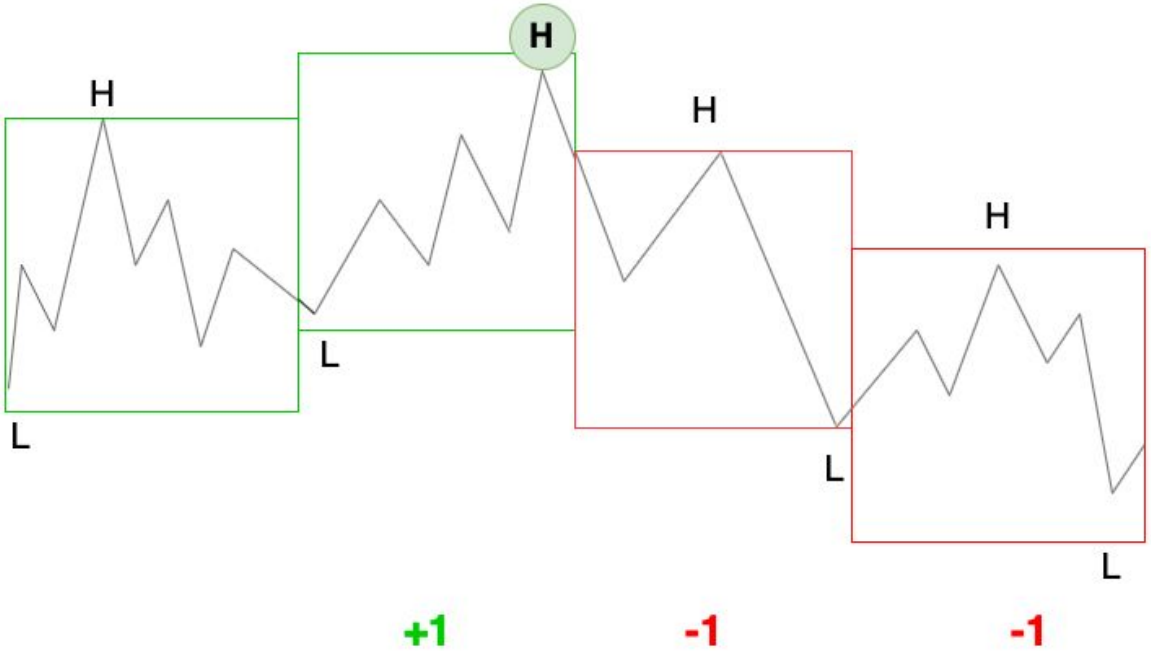
Reversal finding rule

- If the trend moves from +1 to -1 then the previous high is reversal.

- If the trend moves from -1 to +1 then the previous low is reversal.

Output: a new time series that includes just the reversal points.

The circled point is a reversal.



Output: a new time series that includes just the reversal points.

- A time series of trend change points

The returned time series can be used as an input to the algorithm iteratively, in order to find reversals of higher order. This way long term trends can be established.

No information is lost since every higher order reversal is also a lower order reversal.

Data reduction and efficiency of TrendCalculus.

- This stacking of TrendCalculus provides an efficient solution on finding high order reversals. On each iteration performed the data is reduced until no points are available or the required number of points are summarized (all reversals of a given order have been established) .

The main representatives of the large commodity markets

Brent Crude Oil price.

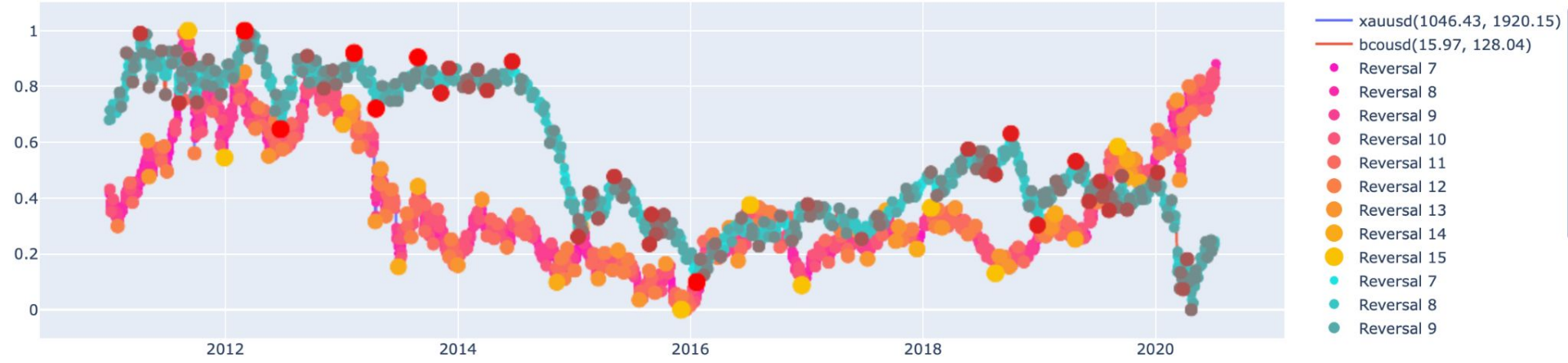
- Increasing oil prices can lead to inflation (according to Research published in 2017 in the journal *Economic Research*).

Gold ounce in USD.

- Gold has been the most effective safe haven in most countries.
- Usually seen as a hedge against inflation by investors.

- Can a change in oil price be a predictor of a change in gold?
- Over the long term, gold prices tend to move up and down in tandem with oil prices (according to OilPrice.com) .

Gold ounce in USD Vs. Brent Crude Oil price (scaled)



Gold ounce in USD Vs. S&P 500 in USD index.

The Standard & Poor 500 index (S&P500) is a stock market index tracking the performance of 500 large companies across all industries in the U.S. .

It includes both growth stocks and values stocks and it is often considered to be one of the best representations of the U.S. stock market.

“Volmageddon” (Volume Armageddon)

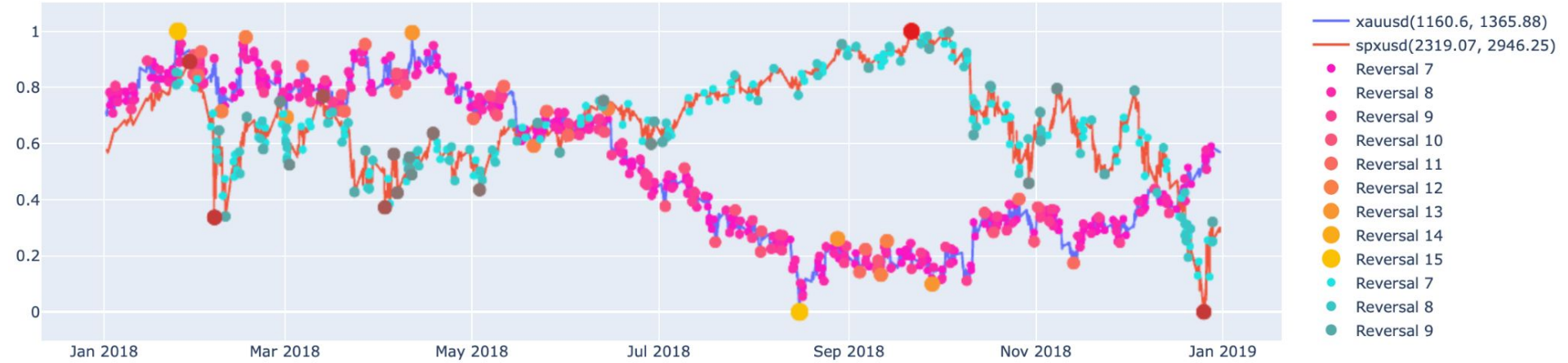
On Monday 5th of February 2018 S&P500 had largest one-day point drop in history (fell by 113.19 points).

Despite the fall of the rest of the stock market indexes, gold improved.

- Stocks tend to benefit from economic growth and stability.

- Gold rises in times of economic distress and crises.

Gold ounce in USD Vs S&P 500 during the stock market crash of February 2018 (scaled)



Historical date usually show that gold performs better than stocks in times of market downturn.

But this is not always the case.

The gold-stock relationship changes over time and there are periods where the two are in a co-movement.

Gold ounce in USD Vs S&P 500 during Covid19 outbreak

- In March 2020 both the stock market and the gold market plunged.

- Both markets rebounded in April 2020.

This co-movement can be seen clearly in the following graph.

Gold ounce in USD Vs S&P 500 during Covid19 outbreak
(scaled)

Improvements in Pathogen

- Created simple example with a few events of how to use the library
- Implemented unit tests to establish that the Rooster and the Sun work as expected.
- Upgraded version to Scala 2.12 and Spark 3.1.2
- Fixed problem with loggers

Sources and References

Andrew's Morgan https://github.com/bytesumo/TrendCalculus/blob/master/HowToStudyTrends_v1.03.pdf

and TrendCalculus library https://github.com/ByteSumoLtd/TrendCalculus-lua .

The historical data https://www.histdata.com for financial time series.

Trend calculus library examples https://github.com/lamastex/spark-trend-calculus-examples.

Antoine Amend's Pathogen library https://github.com/aamend/pathogen .

S&P 500 https://en.wikipedia.org/wiki/S%26P_500

https://www.sunshineprofits.com/gold-silver/dictionary/gold-sp/

https://www.mygoldguide.in/how-does-gold-react-when-stock-market-falls

https://www.tandfonline.com/doi/full/10.1080/1331677X.2017.1305778

https://oilprice.com/Energy/Energy-General/The-Energy-Model-That-Can-Predict-Gold-Prices.html

Appendix

What happens if the equation assigns 0 in a window?

- This special case is also covered from the algorithm .

Data structure: FHLS

F: First of H/L

H: High

L: Low

S: Second of H/L

Handling zeros.

- The Highs and Lows have gaps between them.
- Use an additional FHLS summary to fill in these gaps by using the Second H/L of the previous window and the first H/L of the current window.
- Use this new window as a regular window and find the trend.
- Compare the current window with the new (intermediate) window.
- Find reversals as usual.