

*Things that I learned from Entropy research and will consider in Walk Forward:*

- Entropy is the expected value of surprise over a given time period (ie. Entropy = .47 over a year means that our expected surprise for any day that year is .47)
- Entropy formula:  $-\sum P(x_i) * \log(P(x_i))$  \*use log base 2
- We can use entropy to observe future market states: For example if we have low entropy this can indicate a trending market and if we have a high entropy, it can indicate a regressing market.
- Peter Schiff Observations: He has predicted that the stock market will eventually collapse. This is because he has seen constantly increasing chaos in financial products being used in the market.
- Normalize Entropy:  $\text{calculated\_entropy} / \log(\text{lookback\_period})$  # Subtract 1 to get value between 0 and 1
- Find entropy distribution and only use values in walk forward that are extreme in entropy t-test. (Entropy distribution is a curve with the entropy of all different parameters in a given year, use entropy of buy and hold of S&P 500 as base case. )
- Find correlation values between entropy and market states

Creating the PDF:

- Entropy requires the use of probability of an event occurring in our sample data.
- Before we can calculate the entropy of our sample data, we need an effective way to calculate the probability of a given point.
- Instead of

Use of Ordinal Distribution:

- This uses the count of each ordinal pattern in a given time frame divided by the time frame to find the probability of each ordinal pattern.
- Calculate the surprise for each ordinal value and each year, or every 2 years and multiply those surprise values by the probability of the corresponding probability from the pdf. Lastly, sum all those values to get the entropy for that year or 2 years.
- Use minimum entropy for the previous year or two years to selected params for walk forward analysis.

## *Creating Framework:*

### *Entropy Analysis Resources Used:*

- [https://www.youtube.com/watch?v=Quww\\_7ohBNQ](https://www.youtube.com/watch?v=Quww_7ohBNQ)
- <https://www.youtube.com/watch?v=YtebGVx-Fxw> (Statquest)
- <https://www.youtube.com/watch?v=PsQbKJvpGDU> (Ordinal Patterns and permutation Entropy) - > [Research for video is in paper below \(Keller K.\)](#)
- <https://www.investopedia.com/terms/e/entropy.asp>
- ([Finding the distribution](#)) -> “Finally, although it is not strictly part of information theory, it is interesting to dedicate a few words to the maximum entropy principle (MEP). MEP tries to show a procedure to estimate the unknown distribution of a random variable with the minimum hypotheses about the underlying likelihood function, making inferences with limited and insufficient data.”

### *Steps of Calculation in Python:*

- If we are calculating entropy based on RORs for the previous year...
- Find what bin ROR[i] is in.
- Ror[i] -> if in bin1, take the size of bin1 and divide by 252 for probability.
- Sum = 0
- Sum += probability[i] \* log2(probability[i])
- Return sum

\*Create a formula to calculate amount of bins, `math.ceil(sqrt(days))`