Tab 1

The code attached is a culmination of my efforts to create a successful trading algorithm. My project began with the creation and testing of my novel volatility indicator PCI (Price Confidence Indicator). PCI is calculated by first calculating μ = ((Shares Outstanding + Volume) * Highest Value) then λ = ((Shares Outstanding - Volume_t) * Lowest Value) and Finally PCI = (Highest value - Lowest value) / (μ - λ).
The concept behind this was to imagine Mu and Lambda values as the hypothetical limit the price could have reached that day adjusted for the real price movement and volume with Mu being the Maximum and Lambda the Minimum (hence Mu for Maximum and Lambda for lowest). Then by dividing the highest-lowest value by Mu-Lambda I get a measure of market confidence in a given price, this reveals market confidence as we can consider 4 hypothetical scenarios:

	Low Volume	High Volume
High (High - Low)	In this scenario PCI is high. High future market volatility is expected as the market is shifting rapidly with little volume required to generate a market movement indicating a high selling or buying pressure thus expected future changes.	In this scenario PCI could vary based on exact values but likely isn't low. High future volatility would be expected as the market is uncertain in the initial value of the stock thus causing large volumes and large market movements.
Low (High-Low)	In this scenario PCI will vary based on exact values but is likely high. Low future volatility is expected as the market is confident in the given price meaning there is no need for price changes or much trading volume. This is a weakness of PCI.	In this scenario PCI will be low, Low future volatility is expected as the market is confident in the current pricing since despite high volumes the pricing remains constant.

This is the theoretical core of PCI.
The code below calculates PCI and the following outputs. Each code outputs:

- lift@topK_mean which is a measure of how much stronger PCI is at extremes
- Partial Correlation is a measure of the new information added by PCI onto information like standard deviation and ATR14
- Where IC is the internal correlation it outputs the:
    - IC mean
    - IC median
    - IC at certain percentiles
- CI which is the share of bootstraps where IC is greater than 0

Each code compares different smoothing techniques and horizons which after testing and comparing outputs was discovered to be weighted moving average of strength 15 over a 10 day horizon.

Each code also has certain control variables such as bootstrapping, and including a random PCI as a baseline.

- The file named PCI_ABSReturns_Research finds the correlation of PCI and future absolute returns
- The file named PCI_STDev_Research calculates the correlation of PCI and standard deviation
    - std_limits can be adjusted such that if std_limits = 0.9 only the 90th percentile of movements are used as data points to calculate standard deviation.

This concluded my PCI research however for future experimentation I intend to test PCI over larger time periods then a day to see if that can predict longer trends and I also want to test correlation with absolute returns and standard deviation such that high PCI and high volume is required to remedy the contradiction that occurs with low volume and low (high-low).

<u>Developing PCI into a tradeable algorithm:</u>

- First I tested if PCI had any directional qualities using a Montecarlo simulation which it did not.
- Given this to create a tradeable strategy I introduced a directional indicator named ASI
- ASI is calculated by doing the following:
    - Define a time period e.g. one day
    - ASI is calculated using daily data as one day is the time period
    - First find the number of days with positive returns and the number of days in total for a given horizon up to N days
    - Then find the number of 2 day periods with positive returns and the number of two day periods in total
    - continue this all the way to N day periods
    - Take the number of periods with positive returns and divide with total number of periods to get ASI
    - For example take a 5 day period where returns are as follows [+5, -5, -5, +3, +3]
    - There are 3 successful one day periods and 5 total periods
    - there is 1 successful period out of 4 total possible 2 day periods
    - There is 1 successful period out of 3 possible 3 day periods
    - There no successful periods out of 2 possible 4 day periods
    - There is 1 successful period out of 1 possible 5 day periods
    - Thus ASI is (3+1+1+1)/(5+4+3+2+1) =0.4

- The ASI I use for the strategy can be dubbed ASI2 or RASI which is from calculating a 15 day rolling ASI and dividing it by a 50 day rolling ASI.
    - I deduced this to be the best combination through testing ASI correlation with future returns in a similar fashion to PCI

- To combine the two indicators I did the following calculations
    - For a given ticker ASIΩ = (ASI^ASI indice) / Σ(ASIΩ)
    - For a given ticker PCIΩ = (PCI^PCI indice) / Σ(PCIΩ)
    - For a given ticker Ω = ASIΩ + PCIΩ
    - For a given ticker weighting = Ω/ΣΩ where ΣΩ can be narrowed down to only the top K percentile ASI basket

- For this I used the S&P 500 as a universe initially and then to avoid survivorship bias I used a contemporary list
- I then began to notice that the code was significantly more successful when rebalancing on Fridays than any other day with cumulative returns being 1.5X the second highest day and 6.5X the lowest day indicating something must be causing this and it is not simply a case of overfitting.
    - To investigate I found that Fridays generally have higher trading volumes. If trading volume is on average higher I theorised that PCI would have more information to outline sentiment and trends.
        - I then plotted every rebalance dates trading volume against the resultant return to see if higher volume indicated higher returns however volume had a negligible effect
    - My other theory is that since option expiration tends to be on Friday the code may be picking up on maximum pain theory to some extent.
        - Unfortunately I had insufficient access to data to graph a rebalance days resultant return against the value of option contracts expiring on that rebalance day (or the next)

- The file named Main_ASI+PCI_Backtest contains the strategy's performance using the contemporary S&P 500 universe and in the optimal set up that I have discovered

- My future research plans are:
    - Testing my option expiration theory
    - Exploring the strategy's performance in larger universes and in different geographies
    - Testing higher frequency ASI calculations e.g. hourly candles to get more incremental ASI