

# S&P 500 Index ETF VS

## S&P 500 Futures

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Is there an arbitrage opportunity?

### Team 2

Susan Bengo  
Michael Cody  
TJ Wentling  
Tingjun Yang

# Motivation and Summary

- The motivation for this project was directly related rise in popularity of the Micro E-Mini futures.
- E-Mini S&P 500 Index Futures (ES) were first introduced in 1997, followed by the Micro E-Mini (MES) in 2019.
- The most commonly traded S&P 500 Index ETF is the SPY.
- WTI (West Texas Intermediate), was also chosen as it represents a non-correlated financial asset.
- How can we analyze these instruments to find an investment/trading opportunity?

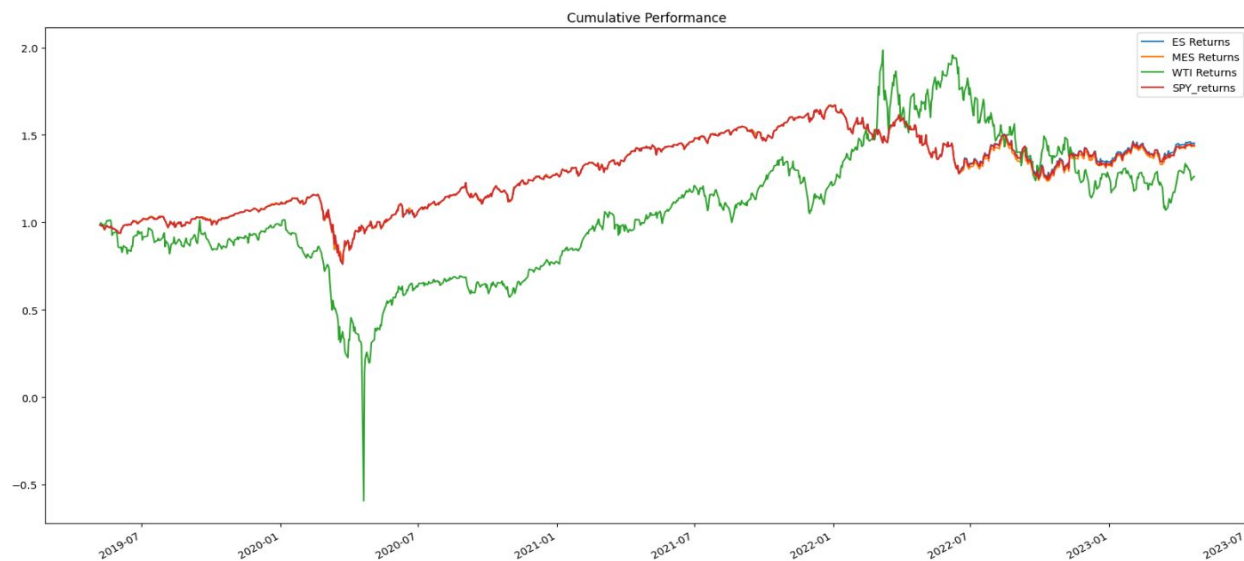
**Arbitrage:** the [simultaneous](#) buying and selling of securities, currency, or commodities in different markets or in derivative forms in order to take advantage of [differing](#) prices for the same asset.

# Questions and Data

1. What is the daily correlation between ES, MES, SPY, and (for fun) WTI Crude Oil?
2. Is there a strong enough, but not too strong correlation, that could be used to profit through arbitrage between the trading instruments?
3. What other financial metrics can be used to glean helpful information?

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1. ES and MES - daily close and volume from Yahoo Finance
  2. SPY - daily close and volume from Alpaca API
  3. WTI - daily close and volume from the EIA (Energy Information Administration)

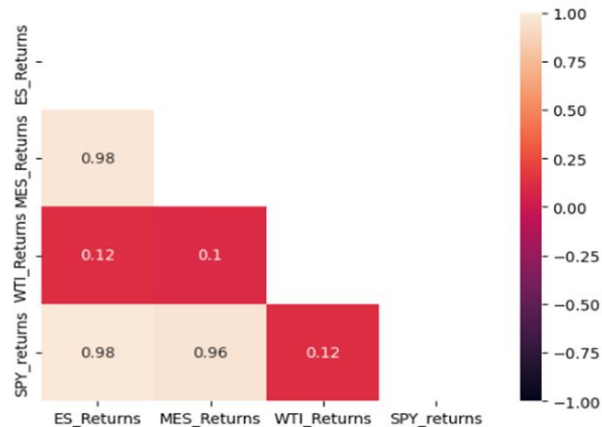
# Data Cleanup & Exploration



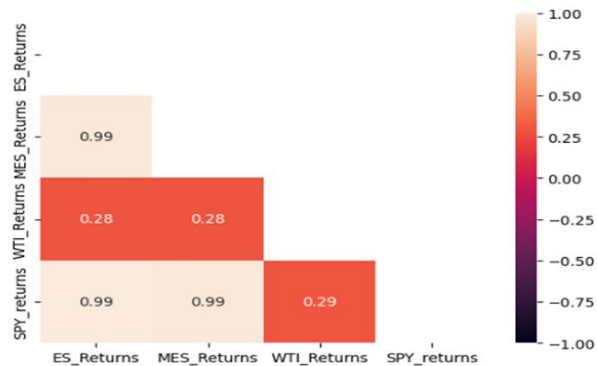
1. Pulled in Prices:
  - a. S&P 500 ETF (SPY) - **Alpaca API**
  - b. WTI Crude Oil - **Energy Information Administration**
  - c. S&P 500 E-mini Index Futures (ES) - **Yahoo Finance**
  - d. S&P 500 Micro E-mini Index Futures (MES) - **Yahoo Finance**
2. Reviewed historical coverage of data
  - a. Cleanliness, consistency, coverage
  - b. WTI crude oil has prices back to 1986!
3. Sanity check once cleaned, reviewed to ensure consistent with our logical understanding of markets (i.e. oil turning negative at height of 2020 supply glut, Covid sell off and subsequent rally, rally in oil, etc.)

# Data Analysis 1

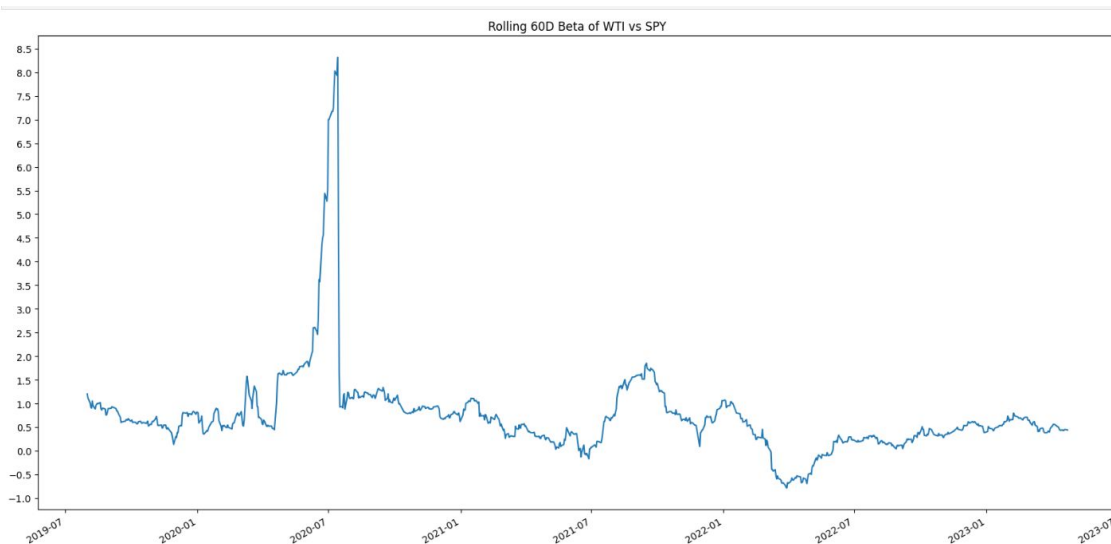
May 2019 - May 2023



November 2022 - May 2023

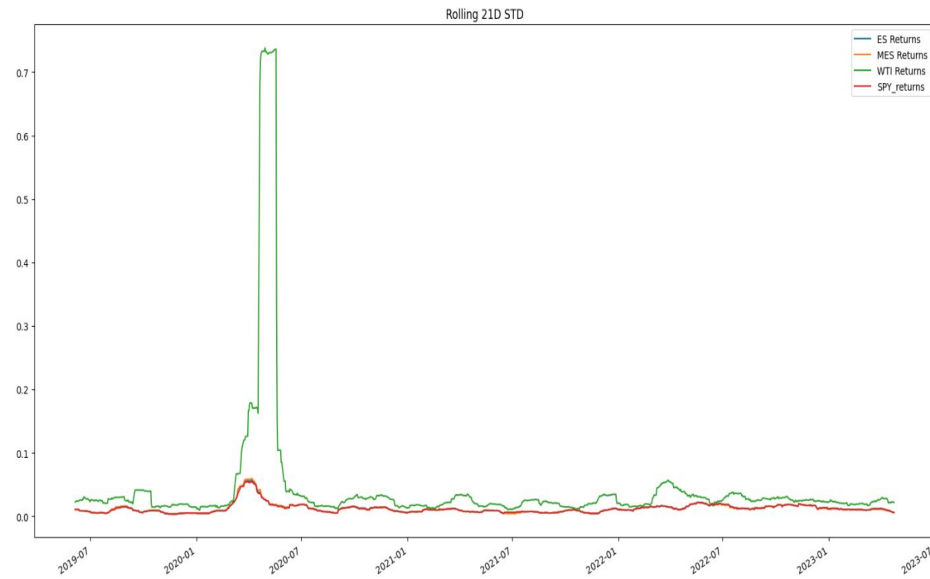
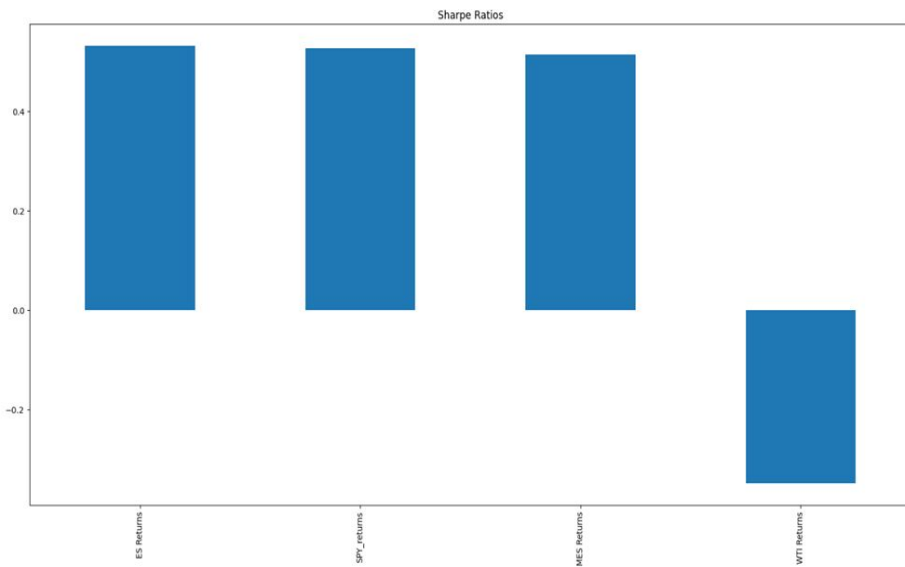


- Over the entire 4 year time period, crude oil exhibited very low correlation with S&P products
- Correlation increased when inflation concerns began materializing in markets but still only resembled a weak correlation
  - Interesting:** for full 4 year time period, WTI crude oil beta was close to 1 relative to S&P 500 ETF. Indicates similar systematic risk but weak linear correlation.



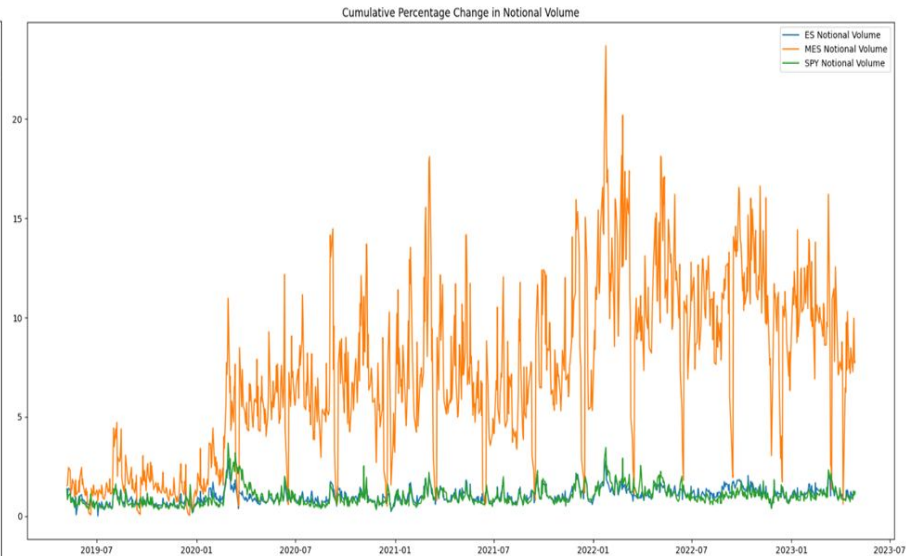
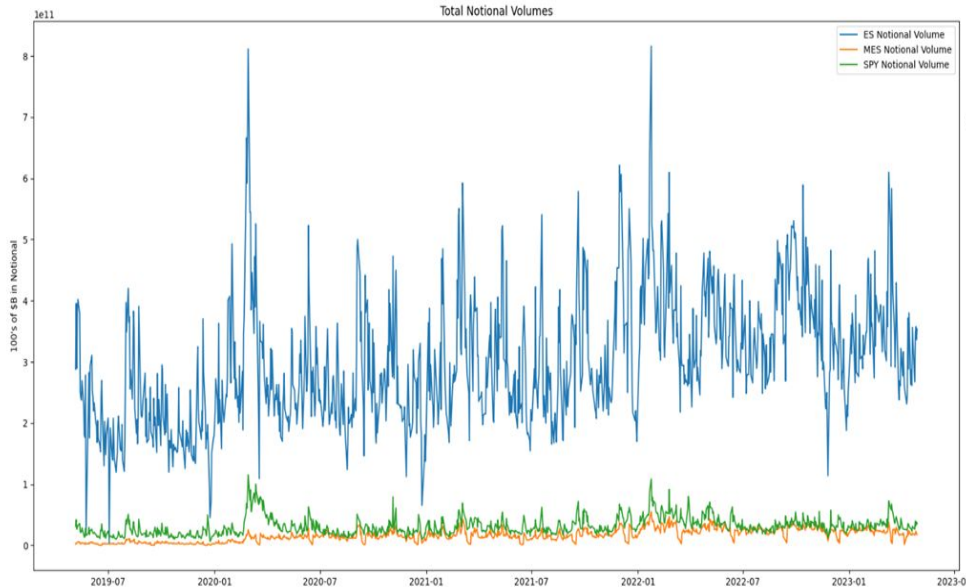
# Data Analysis 2

- Given the S&P products and WTI crude oil are subject to similar systematic risks, the Sharpe Ratio analysis helped us understand that the S&P products are much better risk-adjusted investments than crude
  - Rolling 21D standard deviation exceeded that of the S&P for almost entirety of analysis especially during the supply glut
- However, high correlation across all S&P products (unlikely arb opportunities)



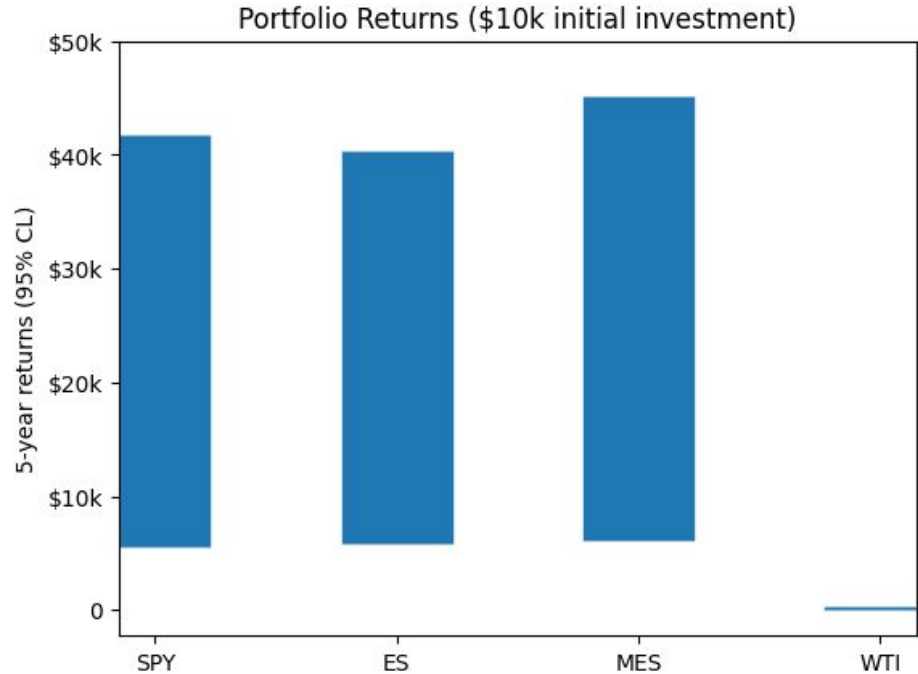
# Data Analysis 3

- E-mini S&P futures contract (ES) volumes outpaced that of the ETF (SPY) and the micro e-mini contract (MES).
  - Logical given ES is primarily used by larger size institutional traders to gain/reduce exposure.
- However, MES has grown the most in terms of cumulative percentage of notional volume.
  - Logical given the increased popularity both of the contracts and retail trading



# MC Simulation

- We ran MC simulation using MCForecastTools.py for the 4 portfolios to predict their 5-year returns.
- The returns for SPY, ES and MES are essentially the same. The returns for WTI are close to 0.
- The results are consistent with the Sharpe ratios.



# Conclusion

Our intuition was correct! There is something about the micro e-mini that proved it a star future. It introduced a new set of traders (mainly non-professional) to futures because of its advantages, which include but are not limited to portfolio diversification for less money, capital efficiency (relatively small initial margin for a meaningful contract), flexible risk management (managing risk associated with stock allocation) highly liquid investment instrument, and around the clock access across the globe.

We also sought to prove a correlation between WTI Crude Oil and the S&P500 and found a weak positive one at best over the years we researched. Our findings seemed to point to some of the below causal explanations:

- - An oil price decline is responsible for most of the economy's woes.
- - Falling oil price impacts include declining earnings, economic performance, and credit in the US.
  - Said differently, lower oil prices reduce the earning for companies in the S&P500; it hammers the economies of significant oil-producing -countries and spikes credit spread in the US.
- - The relationship between stocks and oil is volatile. Swinging between positive and negative values, however, on average, the correlation between stock and oil prices is positive.

Arbitrage? What arbitrage? The MES (micro e-mini) and ES (e-mini) compliment each other. They are fungible. And while the MES (micro-e-mini) appears to be the future of choice for non-professional traders. It is also used by professional trades to extend their risk profile and test trading scenarios across the globe.