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Seminar #2
Trading 101 - Options Market
Rudy Osuna

Can we outperform the S&P 500 (US market)?

Announcements!

*** As to the overwhelming interest in Joining Quant League and Representing UCSD ***

- **Applications are now live!**
  - *We understand that many of you may not have prior experience with quantitative algorithm development, and that's perfectly fine! We're looking for passionate individuals eager to learn and grow in this area.*
- Since experience isn't a requirement, we've provided key resources/prerequisites to help you prepare for joining the board:
  - QuantConnect A-Z Bootcamp*
  - Strategy Implementation project*

*** Perks of joining TQT Board as an Quant Algorithmic Trader/Developer: ***

- Represent UCSD at a National Level
- Get Recognition from top recruiters!
- Interviews with top firms
- Prize money ($1,000+ prize pool per quarter)

*If you get stuck at any point during the tutorial or algorithmic development process, feel free to reach out to me LinkedIn: Rudy Osuna (Alt QR code link: QuantConnect League Interest)

Agenda

01
Basics

Roth IRA, Index Funds, S&P 500, drawdown

02
Options Terminology

Option contract meaning, **Greeks**, leverage, IV

03
Selling Options

Covered calls, premium, risk management, Black-Scholes model

04
Code algo. implementation

Backtesting, options analysis, and automating strategies

Disclaimer: this is not financial advice

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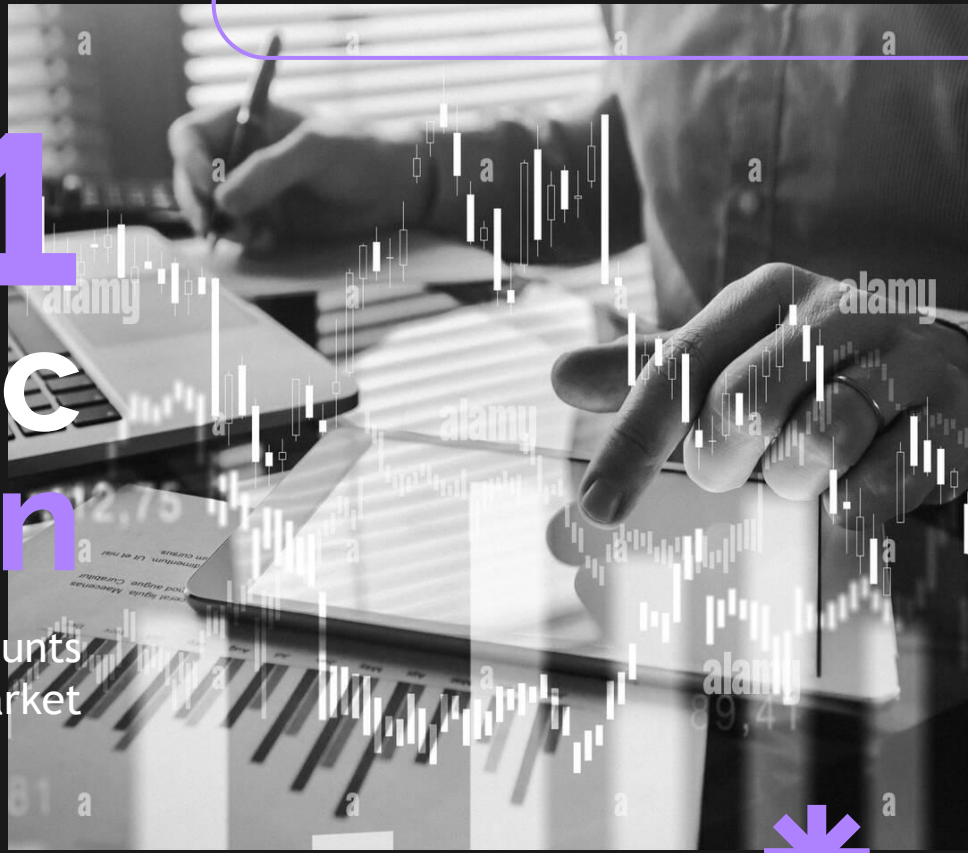
01 Basic Foundation

Laying the groundwork: Retirement Accounts and the Stock Market



Basic Summary:

- **Roth IRA: A retirement account where contributions are made after taxes, allowing for tax-free withdrawals after age 59½. Ideal for long-term investment due to the tax-free growth.**
- **Index Funds: Investment vehicles that pool money to track a specific index, such as the S&P 500. They provide diversification and lower fees than actively managed funds.**
  - Simple Moving Average (SMA): Simple way to see if the underlying asset (the index fund) is going up
    - Bull Market: $\mathbf{SMA}_{short}(t) > \mathbf{SMA}_{long}(t)$ (crossover)
    - Bear Market: $\mathbf{SMA}_{short}(t) < \mathbf{SMA}_{long}(t)$

$$\mathrm{SMA}_n(t) = \frac{1}{n}\sum_{i=0}^{n-1} P(t-i)$$

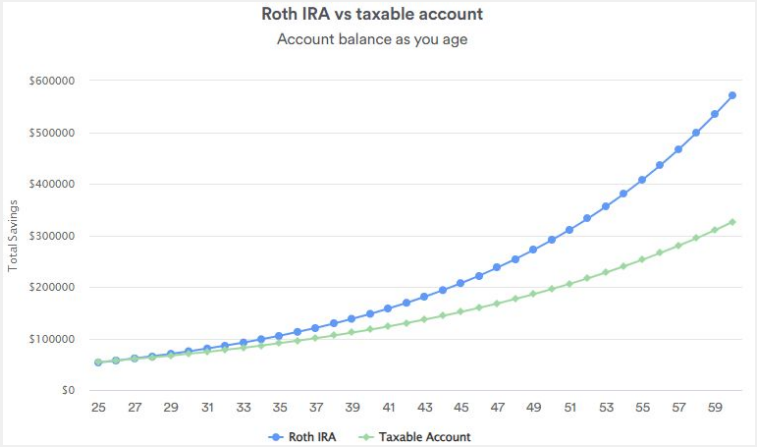
- P(t) represents the price at time t
- n is the period (e.g., 50 days or 200 days).
- $\mathbf{SMA}_n(t)$ is the average price of the asset over the last n candles (period)

Continued

- **S&P 500 ($SPY): A stock market index representing 500 of the largest publicly traded companies in the U.S. It's often considered a benchmark for overall stock market performance.**
  - Very hard to consistently outperform the S&P 500: Historically 7-10% annual return (after inflation -2%)

- ***Drawdown***: The peak-to-trough decline in an investment's value before a new peak is reached. It measures downside risk and helps investors understand the volatility and risks in long-term investing.
  - Drawdowns give an idea of investment risk—how much the investment can lose in a downturn.

- Assume you were buy 100 shares of SPY at 25 years old and hold until retirement (60)
  - RothIRA: $571,726 by retirement
  - Traditional Acc: $326,356
- +$245,370 (+54.65%) in a Roth IRA
- *How much better can we do from here?*



Drawdown?

- The huge Problem of Drawdowns example:
- A simple Idea to outperform the S&P 500 will be to Leverage it through leveraged ETFs:
  - 1:3 leverage (for every $1 invested it represents $3)
- In a leveraged ETF, when the SPY falls, the loss is magnified. For instance, if the SPY drops by 10%, a 3x leveraged ETF would drop by approximately 30%.
- ***One bad bear market could completely destroy your portfolio* (2020, 2008, 2000 dot-com, etc)**

EXAMPLE: Assume SPY moves +10% on Day 1 and -10% on Day 2. If you start with **$100**:

SPY returns: After Day 1, you have $110. After Day 2, you're down 10% of $110, leaving you with **$99**.
3x leveraged ETF: After Day 1, you have $130 (3x the 10% gain). After Day 2, you lose 30% of $130, leaving you with **$91**. A larger loss than the unleveraged SPY despite the movements netting out to zero on paper.

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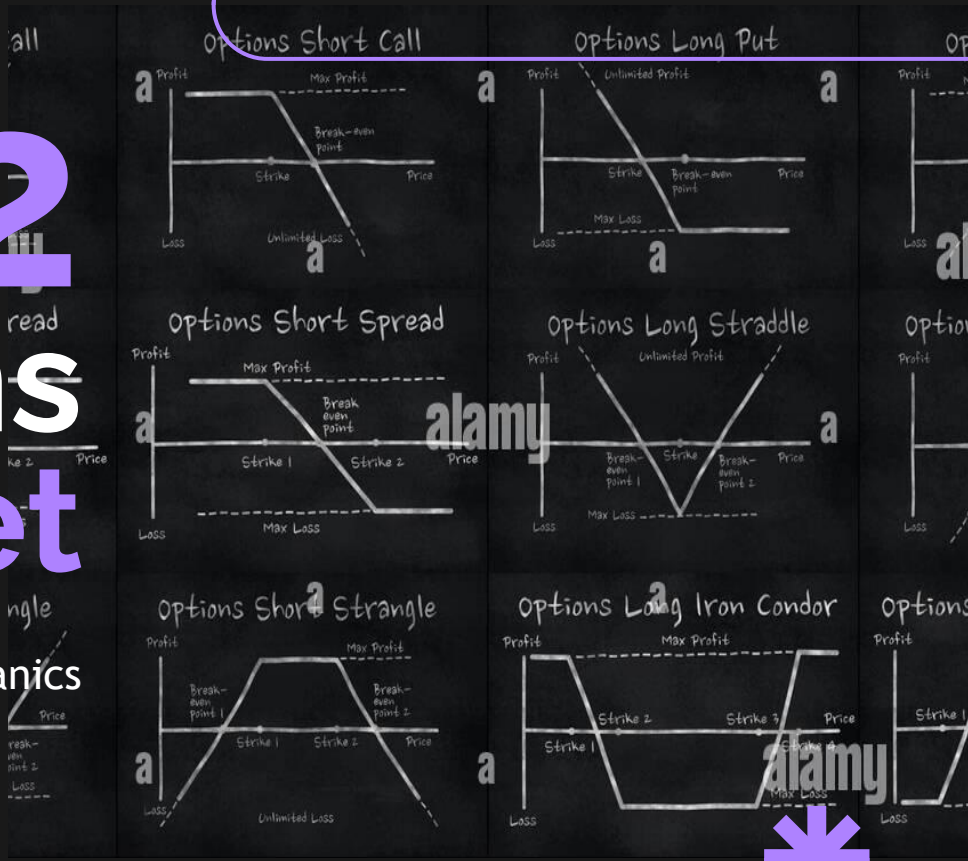
02 Options Market

Understanding Options and Their Mechanics



Options and The Greeks

Options (Rights, but Not Obligations):

- **Definition**: An option is a financial derivative that gives the buyer the **right, but not the obligation**, to buy or sell an asset (like a stock) at a predetermined price (strike price) before or on a specific date (expiry date).
- **Two Types of Options**:
  - **Call Option**: The right to buy a stock at a certain price.
  - **Put Option**: The right to sell a stock at a certain price.
- **Key Points**:
  - Options are used for **hedging** or **speculation**.
  - **Covered calls** (which you'll discuss later) involve selling call options on stocks you already own.

The Greeks - Quantifying Options Risk:

- **Delta (Δ)**: Measures the **sensitivity of the option's price** to changes in the price of the underlying stock. A Delta of 0.5 means the option's price will change by $0.50 for every $1 change in the stock price.
- **Theta (Θ)**: Measures the **rate of time decay** of an option. As expiration approaches, the option loses value (for *most* options). *KEY POINT*
- **Gamma (Γ)**: Measures the **rate of change of Delta**. It tells you how much the Delta will change for a $1 move in the underlying stock.
- **Vega (ν)**: Measures the option's sensitivity to changes in **implied volatility**. Higher volatility increases the option's value.
- **Rho (ρ)**: Measures the sensitivity of the option's price to changes in **interest rates**.

Deeper Dive

Implied Volatility (IV):

- **IV reflects the market's expectations of future volatility, which affects the pricing of the option. Higher IV means the market expects larger price movements, increasing option premiums.**
  - **Implied Volatility** is not directly calculated with a single formula; rather, it is derived by **reverse-engineering the Black-Scholes model** to find the volatility input that matches the market price of the option.

How are options priced?: <u>Black-Scholes Model</u>

Call Option (C):

$$C = S_0 N(d_1) - K e^{-rT} N(d_2)$$

Put Option (P):

$$P = K e^{-rT} N(-d_2) - S_0 N(-d_1)$$

Where d_1 & d_2:

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r + \frac{\sigma^2}{2}\right) T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

- Such that:
  - C: Call option price
  - S_0: Current stock price
  - K: Strike price
  - r: Risk-free interest rate (e.g., treasury bond rates)
  - T: Time to expiration (in years)
  - $N(d_1)$ and $N(d_2)$: Cumulative standard normal distribution values for d_1 and d_2
  - σ: Volatility (annualized standard deviation of returns)

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03 Selling Options

Covered Calls for Income and Risk Mitigation

Uses Delta & Theta to our Advantage:

Probability of Expiring in the Money (using Delta)

- **Recall: Delta (Δ)** Represents the sensitivity of an option's price to changes in the price of the underlying asset. For example, a delta of 0.50 means the option price will change by 50% of the stock price move.
- **Formula for Delta of a Call Option (using Black-Scholes):** $\Delta_{\text{call}} = N(d_1)$

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

Probability of Expiring in the Money:

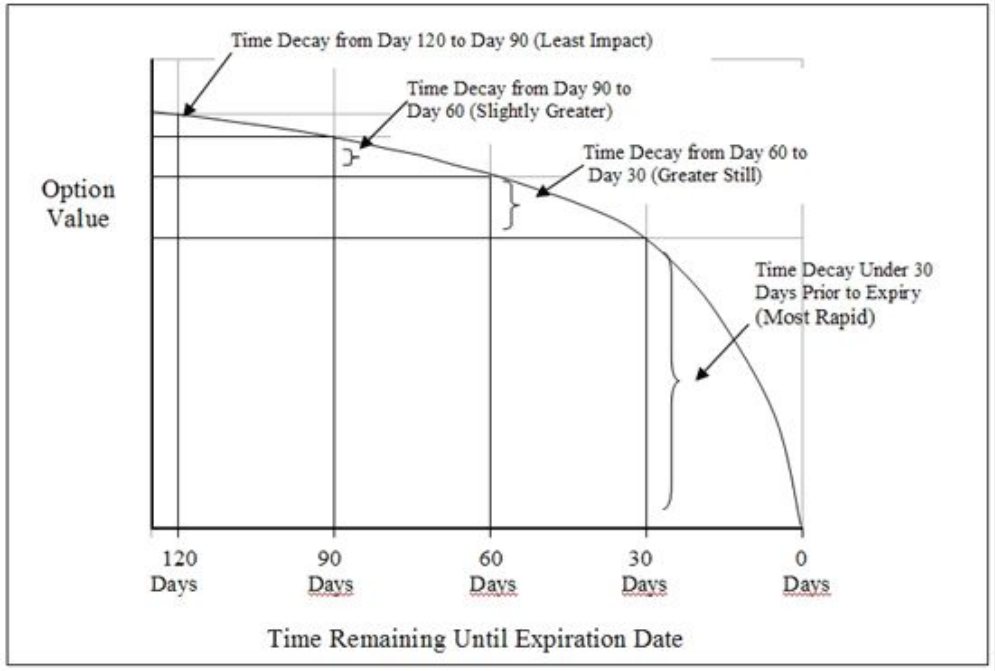
- For **call options**, **Delta** roughly represents the probability that the option will expire **in the money (ITM)**. For example, if the delta is 0.30, there's a 30% chance the call will expire ITM.
- Traders use Delta to estimate the likelihood of an option expiring ITM, helping them assess the risks and rewards of the position.
- For **put options**, the probability is given by **(1 - Delta)**.

Theta (Θ) - Time Decay?:

- When you sell covered calls, **Theta works in your favor**. As time decays, the option loses value, benefiting the seller because you get to keep the premium.
- This is especially useful in **short-term, monthly covered call strategies**, where Theta decay is more pronounced as expiration approaches.

Theta *Continued*

- $$\Theta = -\frac{S_0 \sigma N'(d_1)}{2\sqrt{T}} - rKe^{-rT}N(d_2)$$



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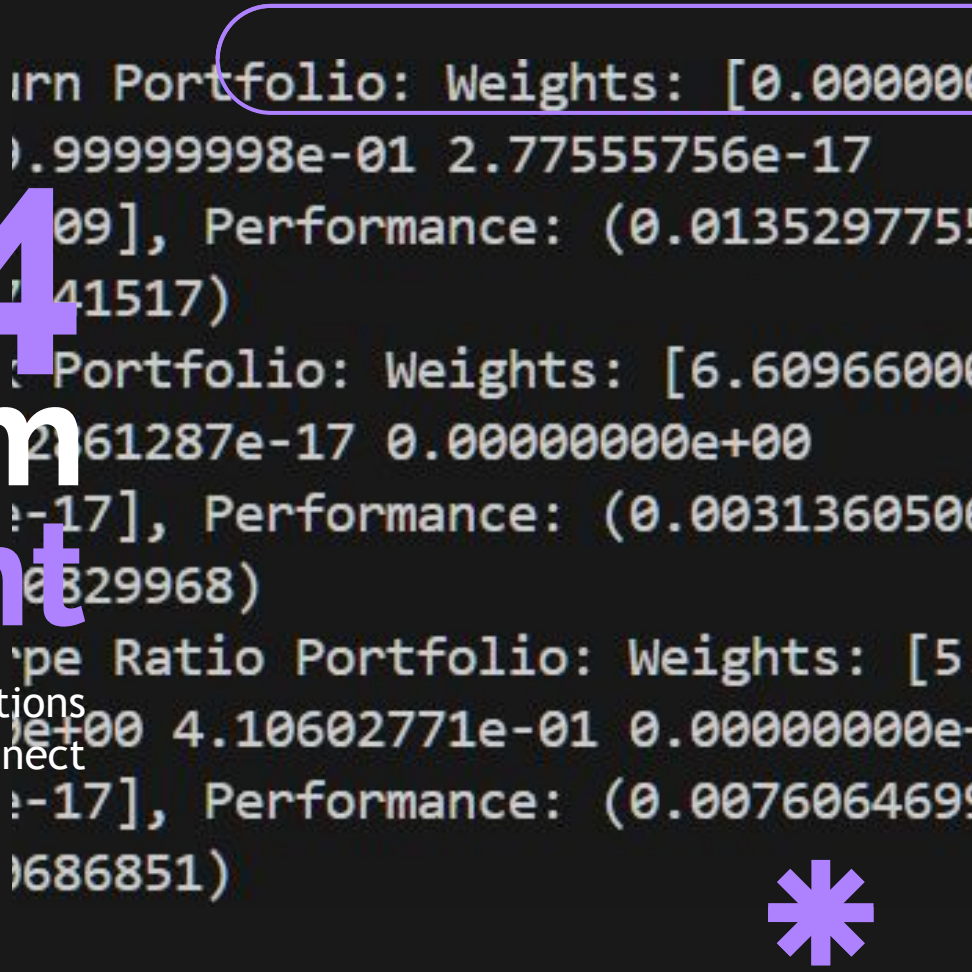
04 Algorithm Implement

Automating and Backtesting Options Strategies via QuantConnect



Let's Automate:

VIA QUANTCONNECT (Python):

Backtesting: Running a historical simulation of a strategy to evaluate its performance. This step helps ensure the strategy would have been profitable in the past before committing real capital.

Options Analysis: Tools like QuantConnect can be used to analyze option trades, helping you compute Greeks, assess volatility, and test different strategies.

The Strategy:

- **Automate** a covered call strategy by dynamically selling call options on a stock like SPY whenever certain conditions are met (e.g., delta close to 0.3 for lower risk).
- **Risk Management**: Include stop-loss rules in your algorithm to minimize potential downside risk.
- **QuantConnect Integration**: Showcase how to use QuantConnect to create backtests and implement live trading strategies, leveraging their algorithmic infrastructure.
- **Why Python?**: QuantConnect allows both C# and Python Implementations, C# being noticeably faster. Yet since we are only selling call options monthly we do not need the speed/precision of C# and stick with a more beginner friendly python implementation

Initial:
Setting up a $SPY Buy-and-Hold Portfolio: We can first simulate a buy-and-hold strategy by simply buying $SPY shares and holding them over the simulation period.

Compare Performance

Improved:
$SPY Buy-and-Hold + Covered Calls: Sell covered calls by using QuantConnect built-in options trading functionalities, data-driven approach to low-risk options strategies

*

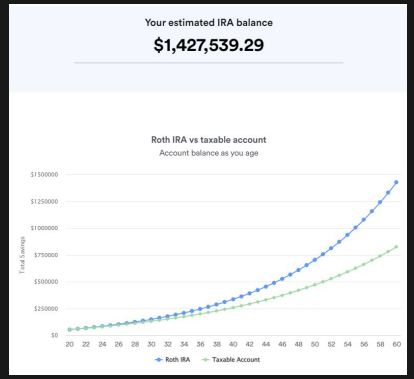
$571,726

Original: Roth IRA Buy and Hold

+$245,370 (+54.65%) than **Traditional Account**

*

$1,427,539



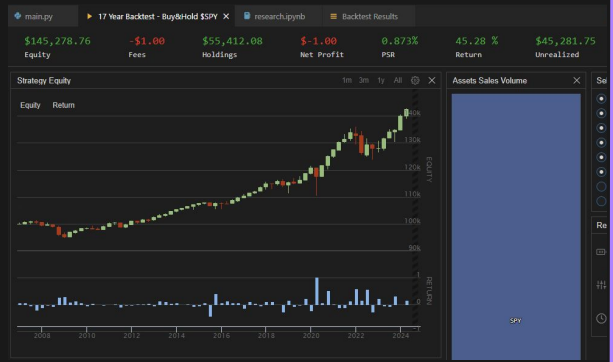
Improved: Covered Calls Reinvesting

+$1,101,183 (+77.14%) than **Traditional Account**
+$855,813 (59.95%) than RothIRA

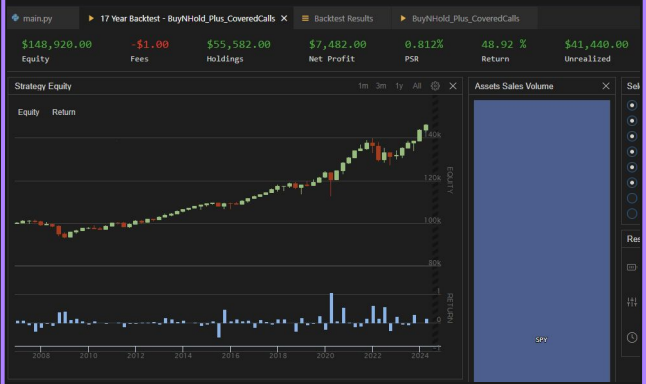
ONE LAST TIME:

Can We Do Better?!

Backtest Results - Over 17 Year Period*



Buy_N_Hold $SPY



Buy_N_Hold $SPY + Monthly Covered Calls Delta <= .25 Reinvesting

```
Sold covered call: SPY241008C00605000 on 2023-07-03 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2023-08-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2023-09-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2023-10-02 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2023-11-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2023-12-01 00:00:00-05:00
Sold covered call: SPY241008C00605000 on 2024-01-02 00:00:00-05:00
Sold covered call: SPY241008C00605000 on 2024-02-01 00:00:00-05:00
Sold covered call: SPY241008C00605000 on 2024-03-01 00:00:00-05:00
Sold covered call: SPY241008C00605000 on 2024-04-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2024-05-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2024-06-03 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2024-07-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2024-08-01 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2024-09-03 00:00:00-04:00
Sold covered call: SPY241008C00605000 on 2024-10-01 00:00:00-04:00
Starting portfolio value: $111876.61
Final portfolio value: $203119.59

# Profit Difference: $91,242.98
# Percentage Difference: 81.56%
# So, over the 5-year period, your portfolio increased by approximately 81.56%.
```

Leveraged - Buy_N_Hold LEAPs $SPY + Monthly Covered Calls Delta <= .25

*

$3.64M

Leveraged: Covered Calls w/ LEAPs as Collateral

Sources

Very good sources I used to learn real-world application of options trading:

Credits:

- **INVESTOPEDIA (holy grail of trading advice):**
- Covered Calls: How They Work and How to Use Them in Investing
- The Basics of Covered Calls

- **Pandrea @Youtube (grew portfolio to 1M+ trading the same options strategy)**
- How To Sell Covered Calls (Easy Monthly Income)
- Selling Options 101: Learn The SECRET Strategy
- Options Trading For Beginners | Step By Step

Thank You!

Platforms I use for technical analysis:

- https://optionstrat.com/
- https://www.tradingview.com/
- https://finviz.com/screener.ashx?v=111&o=-change

Comments Questions?:

- LinkedIn: Rudy_Osuna