



Seminar #2

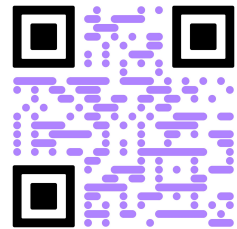
Trading 101 - Options Market

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

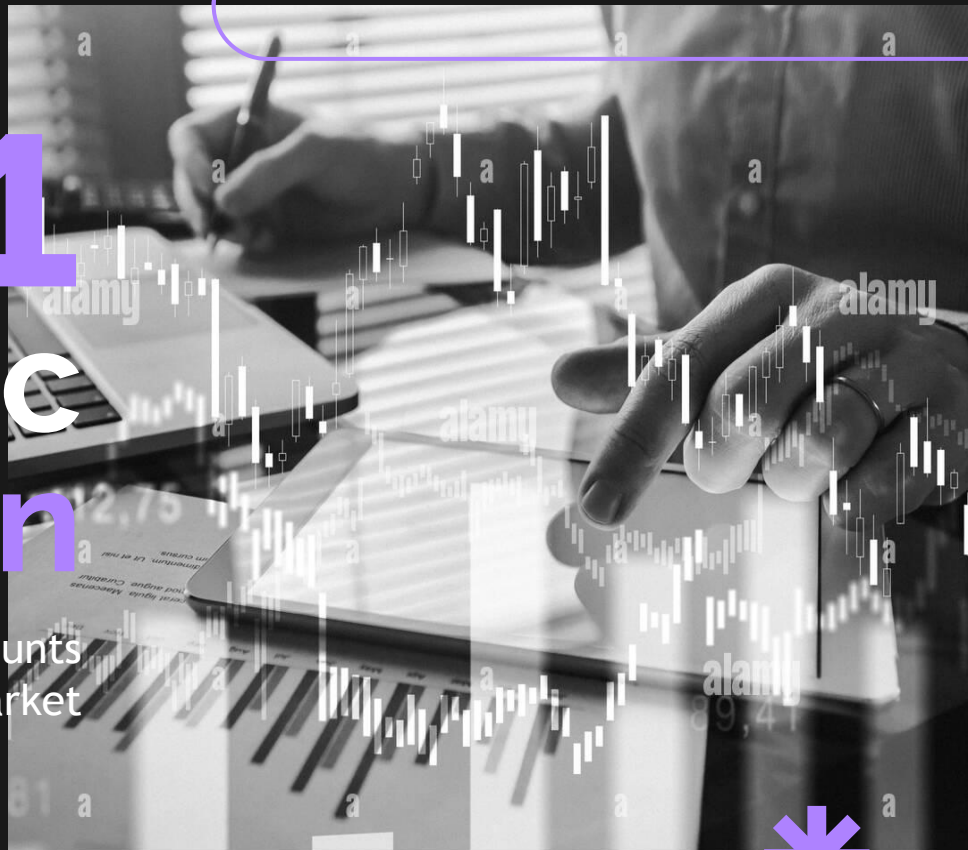
04

**Code algo.
implementation**

Backtesting,
options analysis,
and automating
strategies

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:** $SMA_{short}(t) > SMA_{long}(t)$ (crossover)
 - **Bear Market:** $SMA_{short}(t) < SMA_{long}(t)$

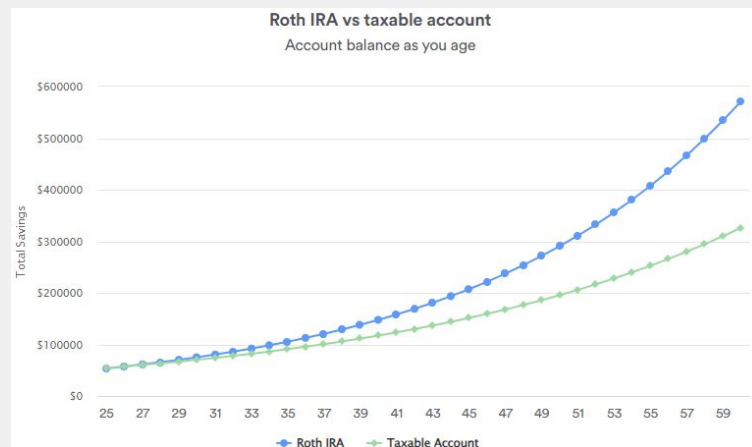


$$SMA_n(t) = \frac{1}{n} \sum_{i=0}^{n-1} P(t - i)$$

- $P(t)$ represents the price at time t
- n is the period (e.g., 50 days or 200 days).
- $SMA_n(t)$ 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)**

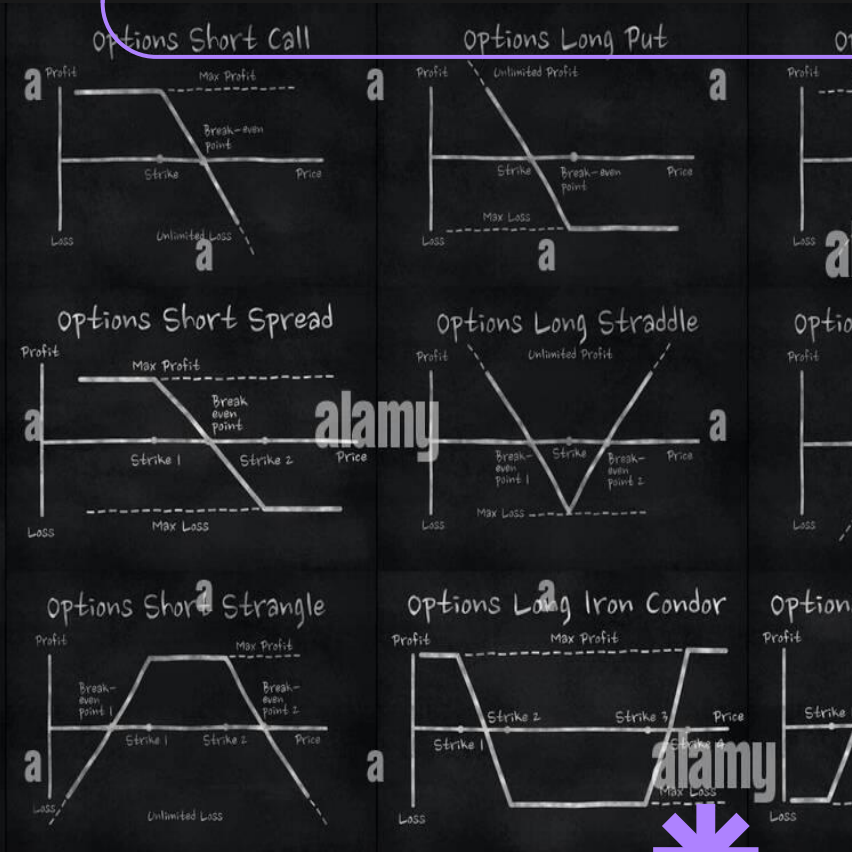
EXAMPLE: Assume SPY moves +10% on Day 1 and -10% on Day 2. If you start with \$100:

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.

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 (v):** 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?: Black-Scholes Model

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)

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):**

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

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)**.

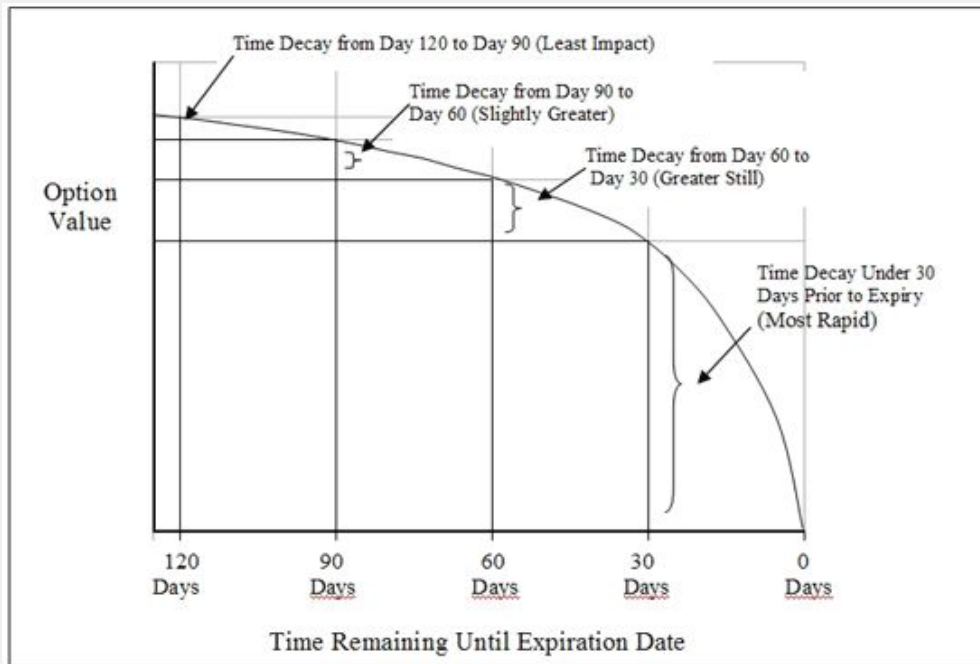
Theta (Θ) - Time Decay?:

- 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

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



04 Algorithm Implement

Automating and Backtesting Options
Strategies via QuantConnect

```
Iron Portfolio: Weights: [0.000000  
0.999999998e-01 2.77555756e-17  
09], Performance: (0.013529775  
41517)  
Portfolio: Weights: [6.6096600  
2.61287e-17 0.000000000e+00  
-17], Performance: (0.003136050  
0329968)  
Equal Weight Portfolio: Weights: [5  
e+00 4.10602771e-01 0.000000000e-  
-17], Performance: (0.007606469  
0686851)
```





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



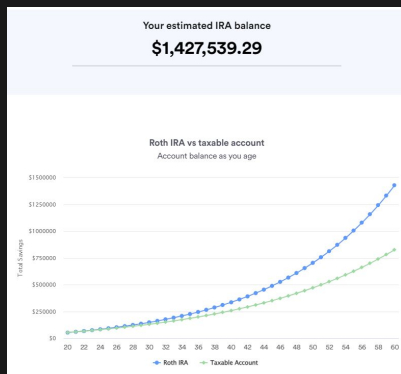
\$571,726

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



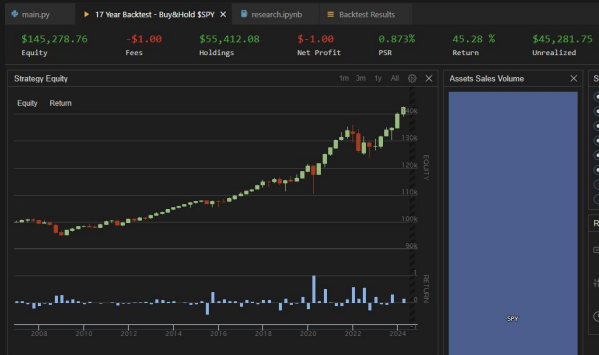
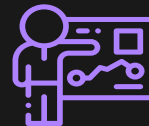
ONE LAST TIME:

Can We Do Better?!

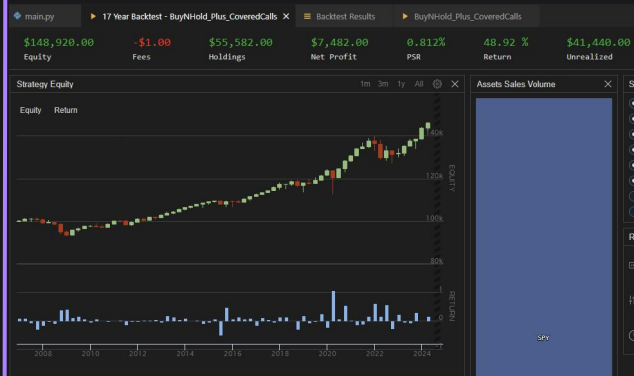
930000	34.599998	32.945000	33.639999	20819200	0.0	0.0	0.0 -0.
570000	35.125000	33.540001	34.639999	20186000	0.0	0.0	0.0 3.
634998	34.740002	33.430000	33.560001	19032500	0.0	0.0	0.0 -3.
720001	34.119999	32.290001	32.500000	29136100	0.0	0.0	0.0 -3.
360001	34.136002	32.849998	34.029999	22686500	0.0	0.0	0.0 2.
470001	33.794998	33.099998	33.619999	13480200	0.0	0.0	0.0 0.
520000	34.770000	33.349998	33.919998	21676600	0.0	0.0	0.0 -1.
880001	35.145000	33.529999	35.130001	22993900	0.0	0.0	0.0 3.
660000	34.735001	34.240002	34.349998	15825100	0.0	0.0	0.0 -0.
805000	36.439999	34.639999	36.279999	51673300	0.0	0.0	0.0 4.
40000	36.415001	35.900000	36.890000	19479700	0.0	0.0	0.0 -0.
560001	35.587002	34.900000	35.000001	19488600	0.0	0.0	0.0 -0.
090000	35.200001	32.900000	33.500000	36000000	0.0	0.0	0.0 -1.
200000	34.500001	33.500000	33.600000	12500000	0.0	0.0	0.0 -1.
002000	34.000000	32.800000	33.300000	13230000	0.0	0.0	0.0 -1.
000000	33.800002	32.700001	32.900000	7297000	0.0	0.0	0.0 -1.
000000	33.799999	31.900000	32.000001	10000000	0.0	0.0	0.0 2.
230000	31.999998	31.700000	32.1850000	20000000	0.0	0.0	0.0 -1.
285000	32.380001	30.240000	30.410000	40486800	0.0	0.0	0.0 -5.
520000	32.580002	31.174000	32.509998	24533700	0.0	0.0	0.0 3.
410000	33.060001	32.150002	33.000000	10648700	0.0	0.0	0.0 1.
330000	33.014999	31.580000	32.790000	20000000	0.0	0.0	0.0 1.

	Open	High	Low	Close	Volume	Dividends	Stock Splits
190000	4531.0000	5007.552051	5000.898438	59354.515625	37078637820	0.0	0.0 1.
560000	3031.0000	372.390000	5005.253906	59609.566406	30327698167	0.0	0.0 2.
110000	6100.0000	6112.0000	5002.875000	8737.269500	29961696180	0.0	0.0 -3.
33.261719	59838.648438	56161.593750	57560.097656	35682112440	0.0	0.0 -1.	
60.273438	59847.359375	57110.019531	58894.105469	29350938673	0.0	0.0 2.	
26.968750	59403.070312	57136.027344	59112.480469	27036454524	0.0	0.0 3.	
86.191406	59815.058594	57425.167969	57431.023438	26666961053	0.0	0.0 -2.	
30.347656	58511.570312	55673.164062	57971.539062	35627680312	0.0	0.0 0.	
71.703125	58300.582031	55712.453125	56160.488281	31030200656	0.0	0.0 -3.	
60.191406	56976.109375	52598.699219	53948.753906	49361693566	0.0	0.0 -3.	
49.085938	54838.144531	53740.070312	54139.687500	19061486526	0.0	0.0 0.	
47.933594	55300.859375	53653.757812	54841.566406	18268287531	0.0	0.0 1.	
51.886719	58041.125000	54598.433594	57019.535156	34618096173	0.0	0.0 3.	
20.097656	58029.976562	56419.414062	57648.710938	28857630507	0.0	0.0 1.	
50.289062	57991.320312	55567.339844	57343.171875	37049062672	0.0	0.0 -0.	
44.031250	58423.277344	57344.031250	57679.785156	35171495936	0.0	0.0 0.	

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 00:00:00-04:00
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