GARCH GJR and VaR

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The Problem:

Incorporate 2 stocks into our portfolio:

- Apple (AAPL)
- S & P 500 index (SPY)

US$	CASH	AAPL	SPY
holdings	$10,000	100	-100
price	1	186.79	281.12

What are associated risks?

What are associated returns?

How do these stocks interact in our portfolio?

GARCH GJR

- Forecast future volatility from simulating volatility
- Penalizes risks when forecasting volatility

$$\sigma^2_t = \omega + (\alpha + \gamma I_{t-1})\varepsilon^2_{t-1} + \beta\sigma^2_{t-1}$$

VaR

- Probabilities created from the variance of historic volatility
- Probabilities created from the variance of GARCH GJR volatility

Data Source

Source: Yahoo Finance API for: “AAPL” and “SPY”

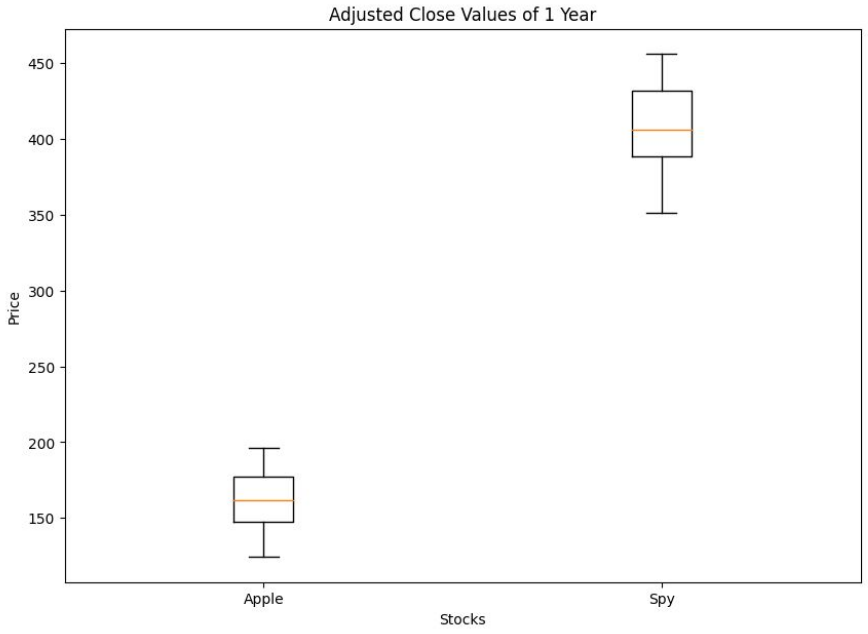
Date: 2022-09-01 to 2023-11-01

Total Observations per stock: 292

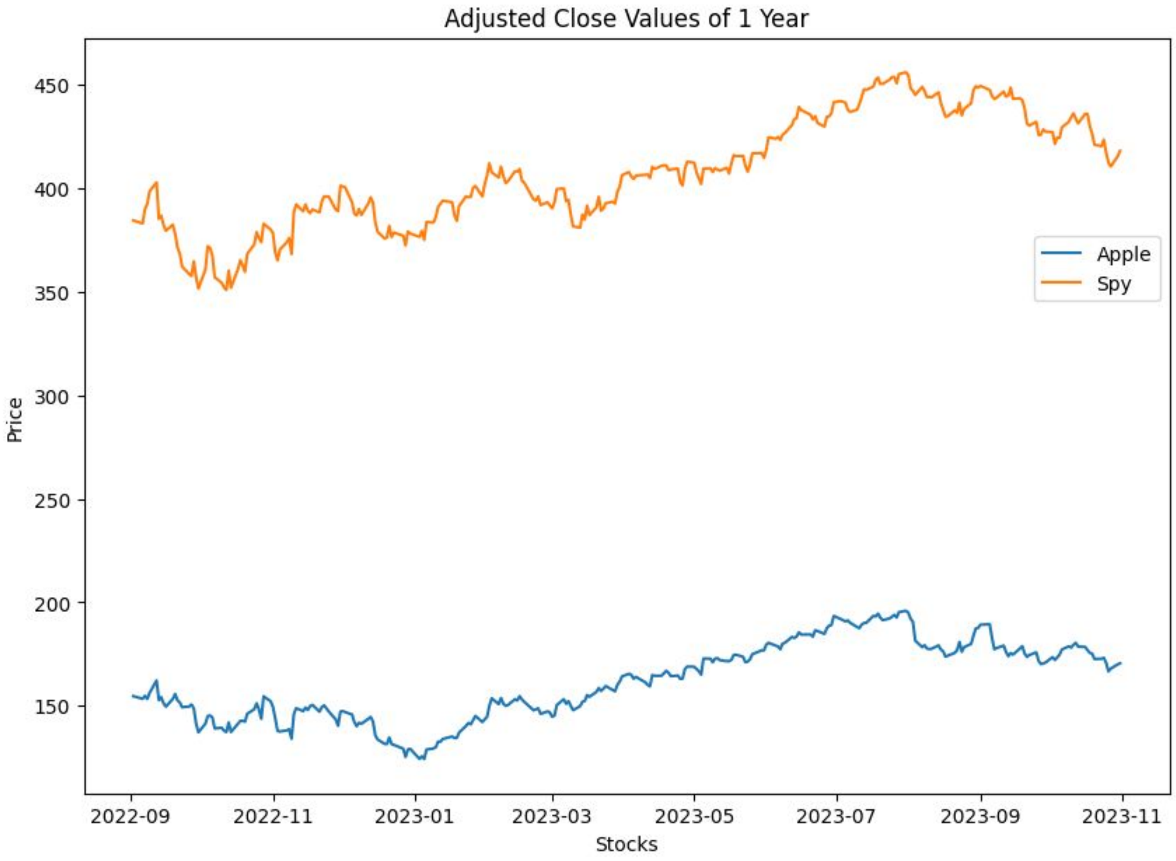
Key value: Adjusted Closing price

Descriptive Statistics

	Apple Adj Close	Apple returns	Spy Adj Close	Spy returns
count	292	292	292	292
mean	161.723	0.000	407.636	0.000
std	18.438	0.017	26.688	0.011
min	124.325	-0.059	351.034	-0.043
25%	147.202	-0.009	388.388	-0.007
50%	161.978	0.001	406.366	-0.000
75%	177.052	0.009	432.245	0.007
max	195.927	0.089	456.181	0.055



Spy and Apple's 1 Year Historical Adjusted Close



Volatility

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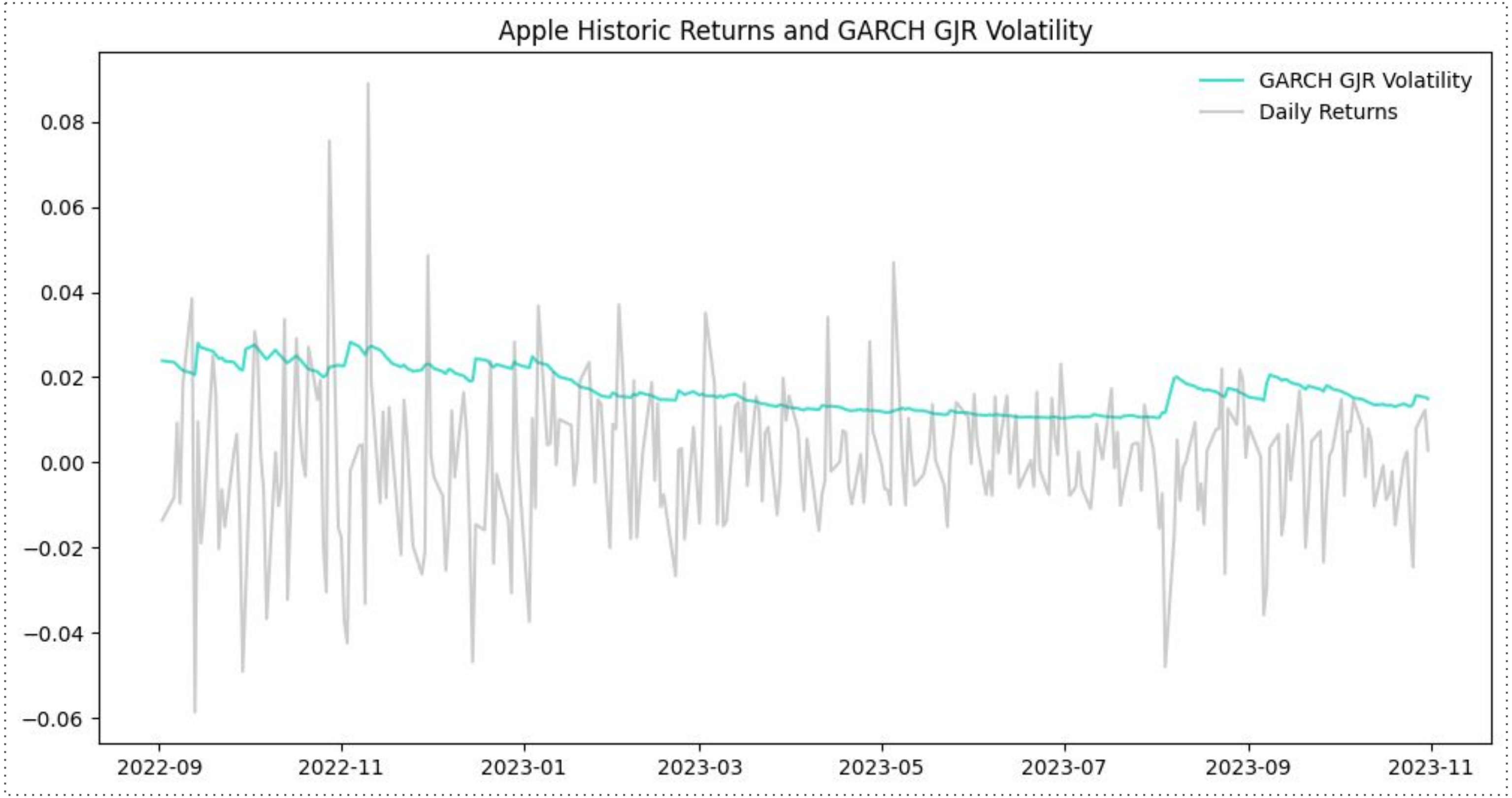
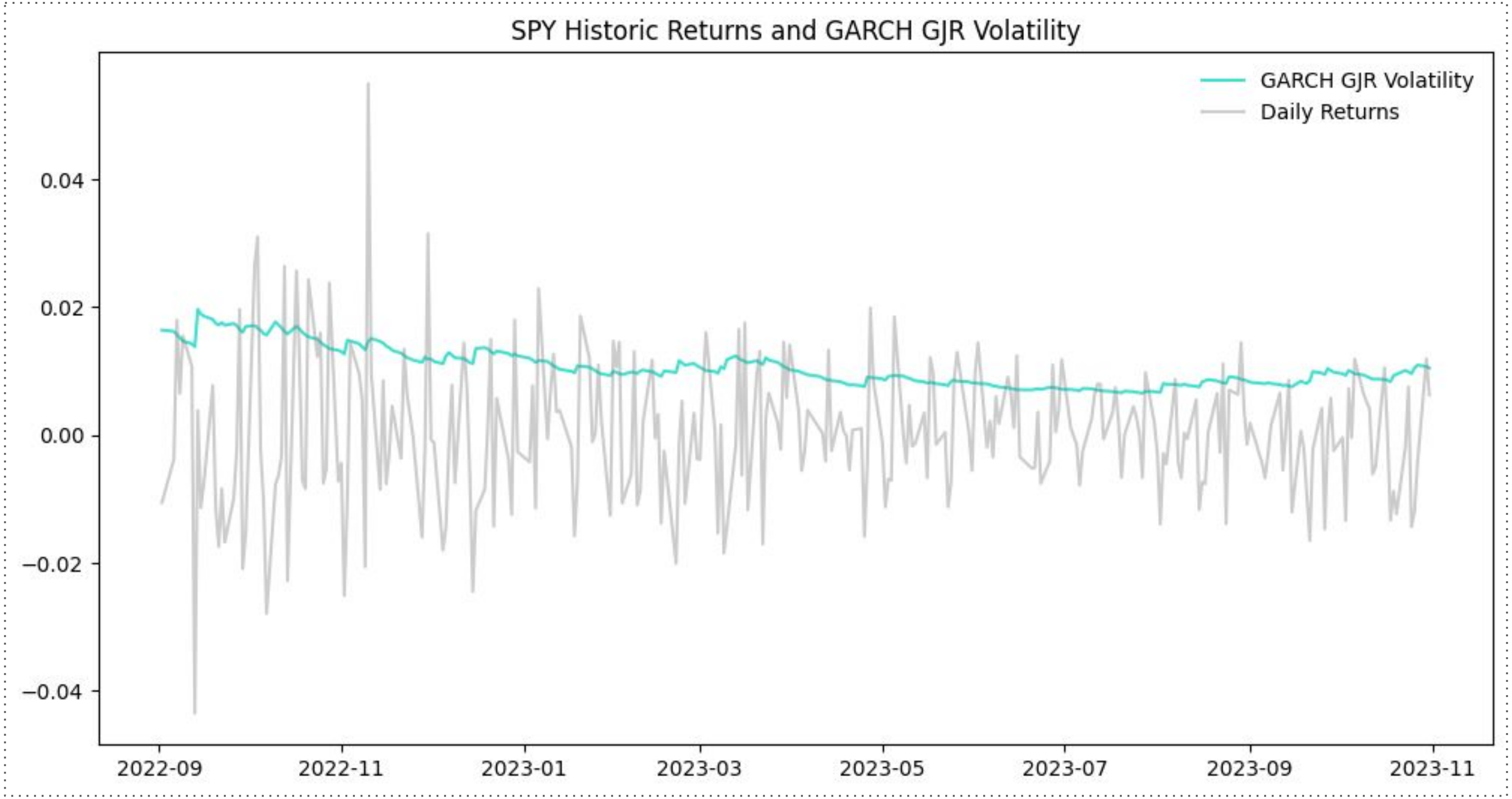
Duration	APPLE	SPY
Daily Volatility	1.75%	1.10%
Monthly Volatility	8.01%	5.06%
Yearly Volatility	27.76%	17.53%

Apple’s 1-year Risk (GARCH GJR)



SPY (S & P 500) Historical Prices



Portfolio VaR

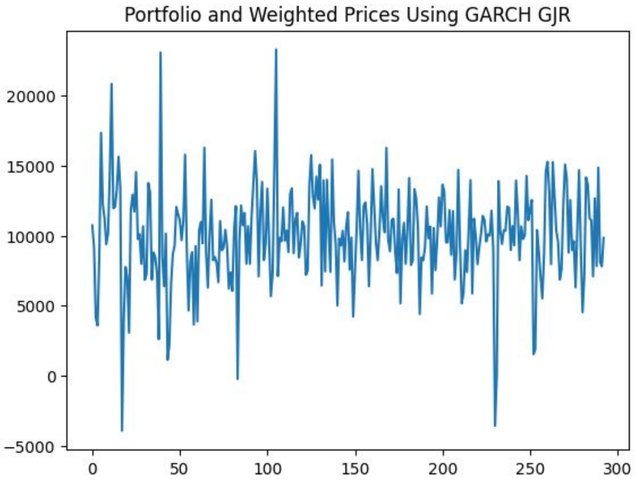
US$	CASH	AAPL	SPY
holdings	$10,000	100	-100
price	1	186.79	281.12

Portfolio = (0.015072 Apple vol) * $186.79 * 100 + (0.010319 Spy vol) * $281.12 * -100 + $10,000 * $1

$9,991.44 Total portfolio amount

Weights = [100,-100, $10,000] * [$186.79, $281.12, $1] / ∑([100,-100, $10,000] * [$186.79, $281.12, $1])

Portfolio VaR



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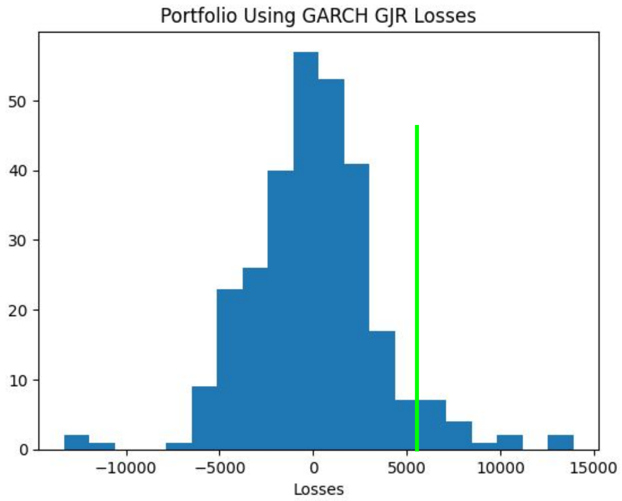

Expected loss at the 5% risk at the next 10 days is $5787.33 or greater

Backtesting and Limitations

Though VaR is a workhorse for risk management , it fails to account for the volatility clustering.

We are limited by 1 year of data.

Backtesting for the APPLE and SPY

Forecasting variability

Actual volatility.

Index	MAE	MSE	MAPE
Apple	0.0145	0.00021	4.23e+03
SPY	0.012	0.000104	1.54e+04

Thank You