Trading the Volatility Surface Report – Assignment 4

Introduction

The purpose of this study is to develop a trading strategy based on the implied volatility surface of options. Implied volatility (IV) is a critical component in options pricing and can provide insights into market expectations. By analyzing the implied volatility surface and constructing a trading program based on deviations from fitted curves, we aim to exploit potential mispricing in options markets.

Data

- Data Sources: Standard options quotes for the S&P 500 (SPX) obtained from yahoo finance.
- Maturity Date: 03/21/2024 (Tried a month out and results were not of use)
- Assets Collected: Options data including strike prices, expiration dates, bid/ask prices, and IVs.

Methodology

In the first step, we gather options data and calculate implied volatilities using standard pricing models. This involves finding the volatility value that matches theoretical option prices with market prices. Then, we organize this data into a grid/matrix, showing strike prices and implied volatilities for different expiration dates.

Next, we fit smooth curves, called splines, to the implied volatility data for each expiration date. We adjust these curves to closely match the volatility patterns seen.

Finally, we use these fitted curves to create probability distributions of future asset prices, which help us identify potential trading opportunities.

Empirical Results

In the empirical analysis, significant patterns appear within the implied volatility. These patterns, such as the volatility smile (figure 2 and 3), offer crucial insights for trading decisions. Our fitted spline model effectively shows these patterns, which allows us to identify overvalued and undervalued options. Additionally, risk-neutral density plots offer valuable insights into other potential areas of mispricing. Overall, our findings show the viability of our trading strategy.

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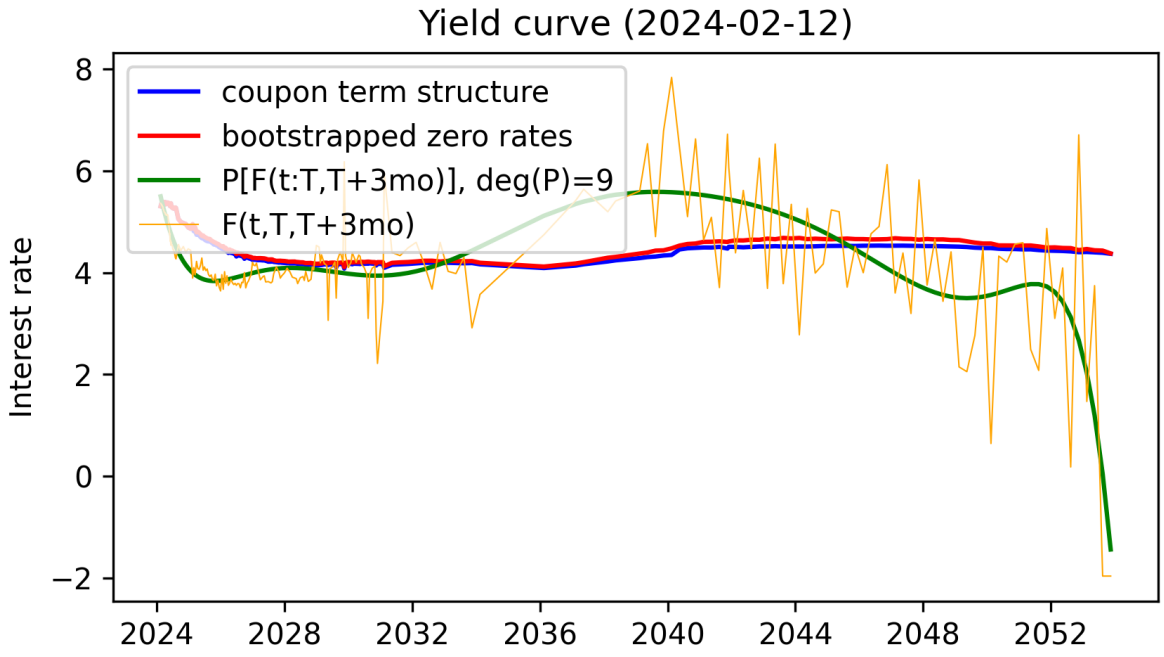
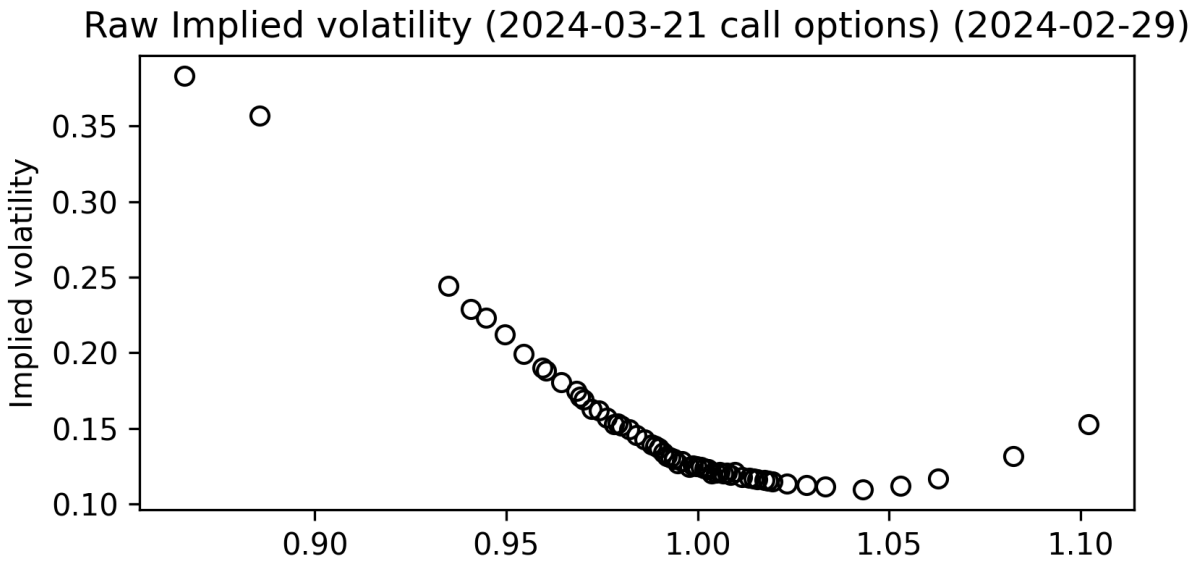
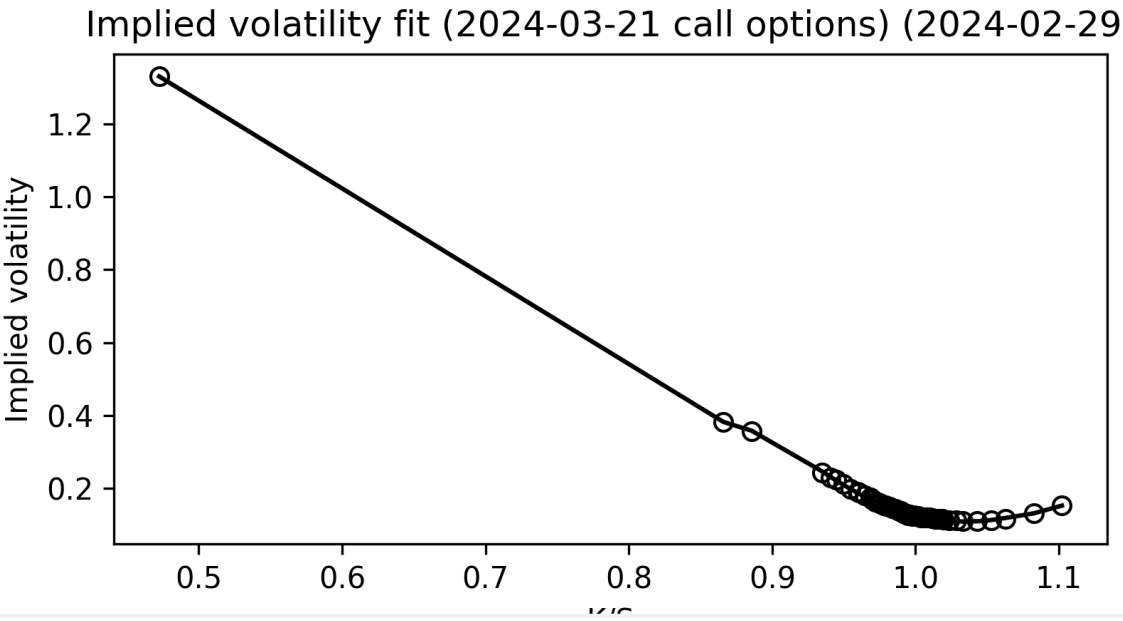
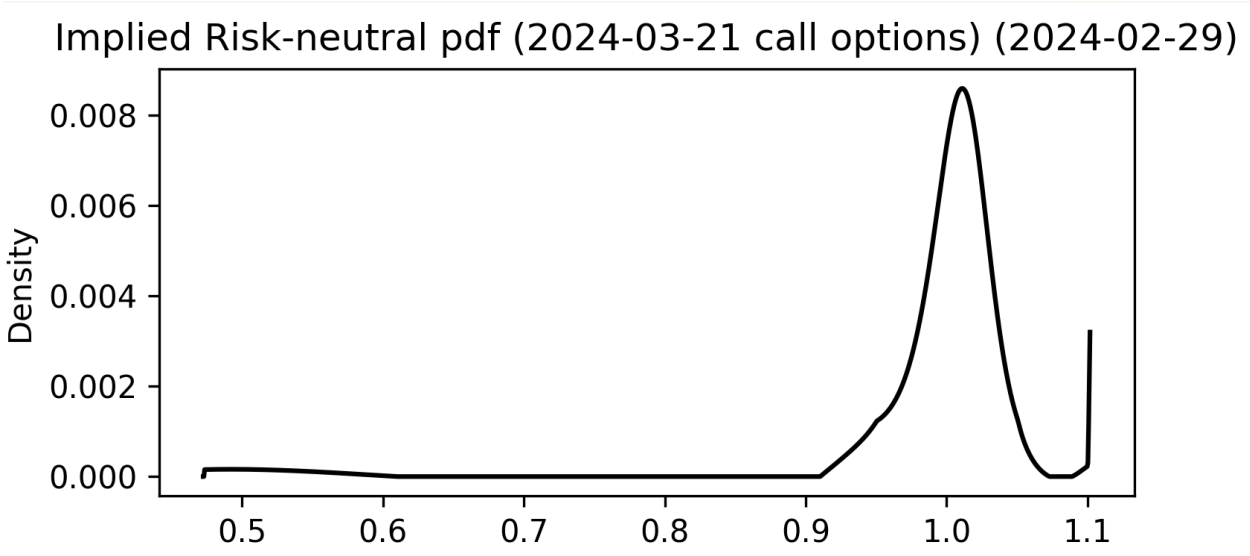
Conclusion

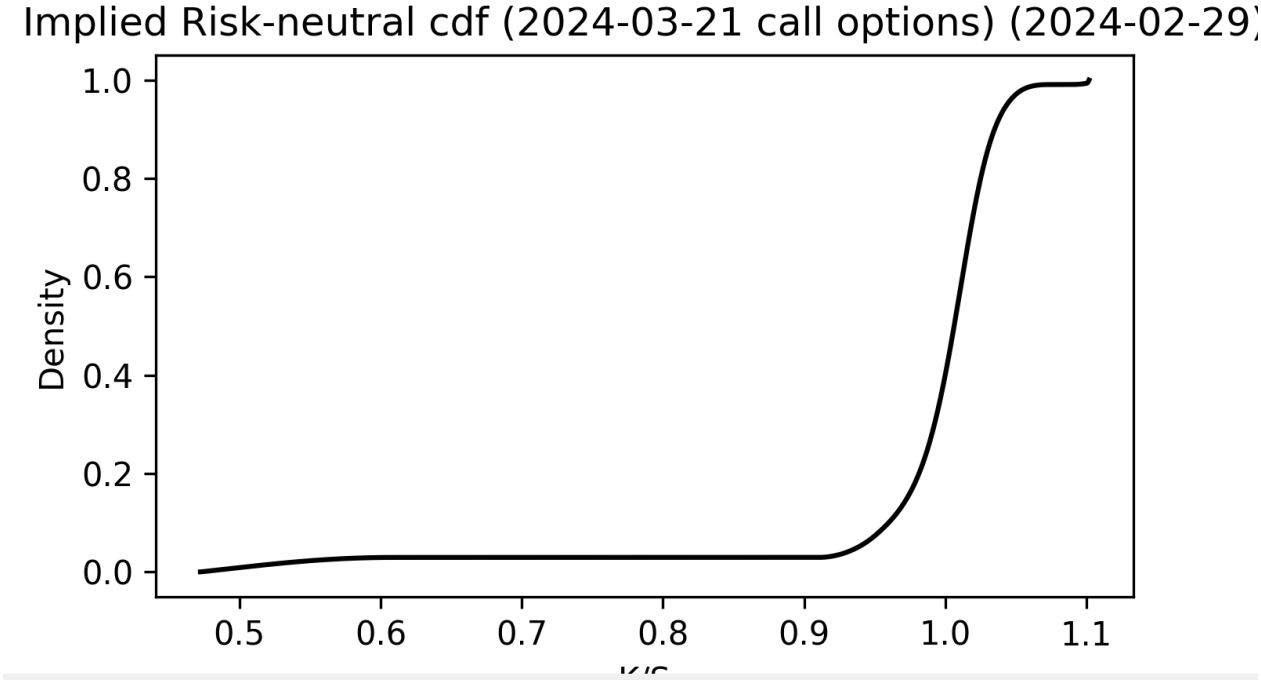
In conclusion, our trading strategy shows promise in capitalizing on deviations between observed implied volatilities and fitted curves. By strategically selling overvalued options and acquiring undervalued ones, we can potentially profit from mispricing in the options market. However, successful execution requires good risk management and a deep understanding of options pricing dynamics. To further enhance the model's performance, other variables can be added to more closely follow the actual IV and therefore improve trading outcomes.

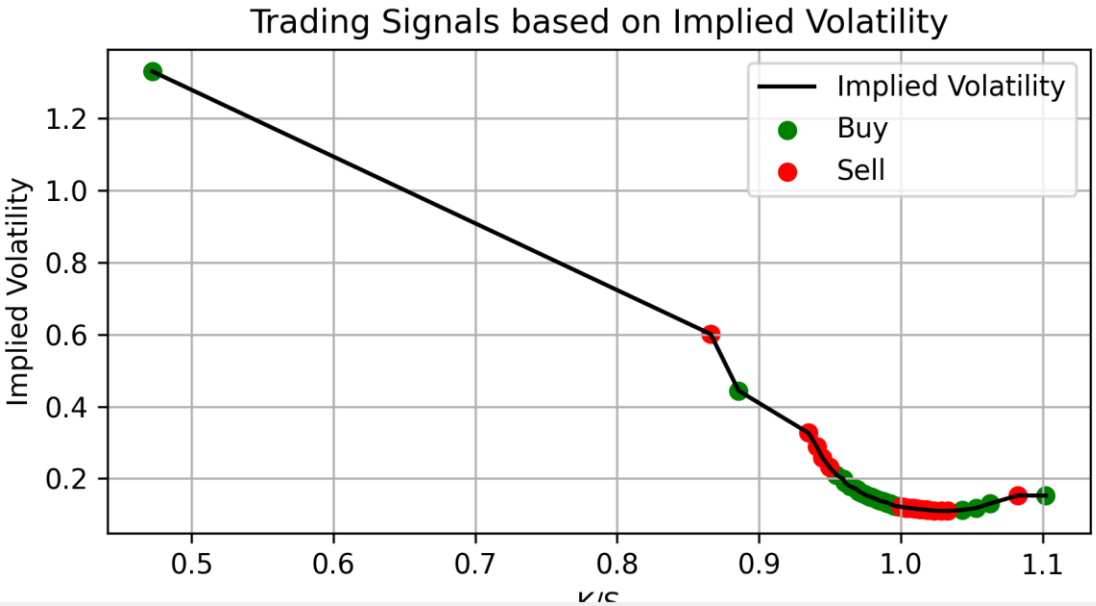

Yield curve (2024-02-12)
coupon term structure
bootstrapped zero rates
P[F(t:T,T+3mo)], deg(P)=9
F(t,T,T+3mo)
Interest rate
8
6
4
2
0
−2
2024
2028
2032
2036
2040
2044
2048
2052


Raw Implied volatility (2024-03-21 call options) (2024-02-29)
Implied volatility
0.35
0.30
0.25
0.20
0.15
0.10
0.90
0.95
1.00
1.05
1.10


Implied volatility fit (2024-03-21 call options) (2024-02-29)
Implied volatility
1.2
1.0
0.8
0.6
0.4
0.2
0.5
0.6
0.7
0.8
0.9
1.0
1.1


Implied Risk-neutral pdf (2024-03-21 call options) (2024-02-29)
Density
0.008
0.006
0.004
0.002
0.000
0.5
0.6
0.7
0.8
0.9
1.0
1.1


Implied Risk-neutral cdf (2024-03-21 call options) (2024-02-29)
Density
1.0
0.8
0.6
0.4
0.2
0.0
0.5
0.6
0.7
0.8
0.9
1.0
1.1


Trading Signals based on Implied Volatility
Implied Volatility
Buy
Sell
Implied Volatility
1.2
1.0
0.8
0.6
0.4
0.2
0.5
0.6
0.7
0.8
0.9
1.0
1.1