Options Implied Volatility: Smile, Surface & Covered-Call Overlay

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1. Objective

Compute implied volatilities from an options chain, visualize the volatility smile and surface, and compare a covered-call overlay to buy-and-hold.

2. Data

Synthetic options chain with strikes 320–480 and maturities 30–180 days; underlying price 400; risk-free rate 2%.

3. Method

Derived implied vols via bisection on Black–Scholes prices. Visualized smile (nearest maturity) and full surface (strike × maturity). Toy backtest compares monthly covered-call returns to buy-and-hold to illustrate income vs upside tradeoff.

4. Results

Figures show put skew (higher IV for lower strikes) and term structure effects. The covered-call overlay produced a smoother equity path but capped upside.

Implied Vol Smile (tau≈0.08y)

Implied Volatility Surface

Covered Call vs Buy & Hold (Toy Example)
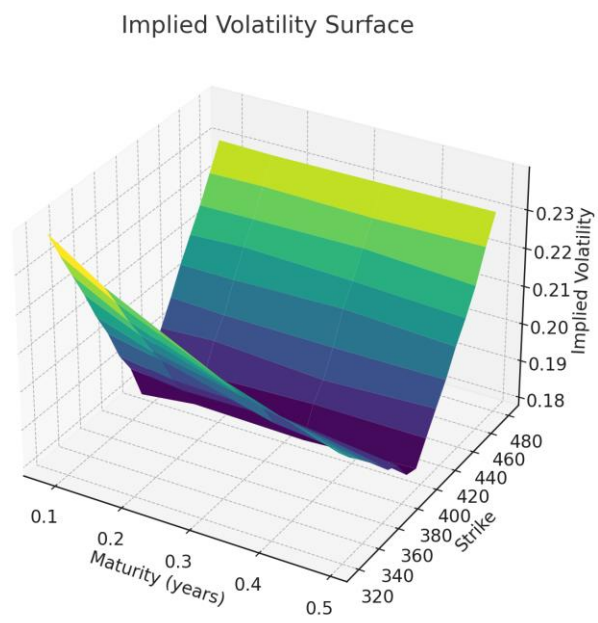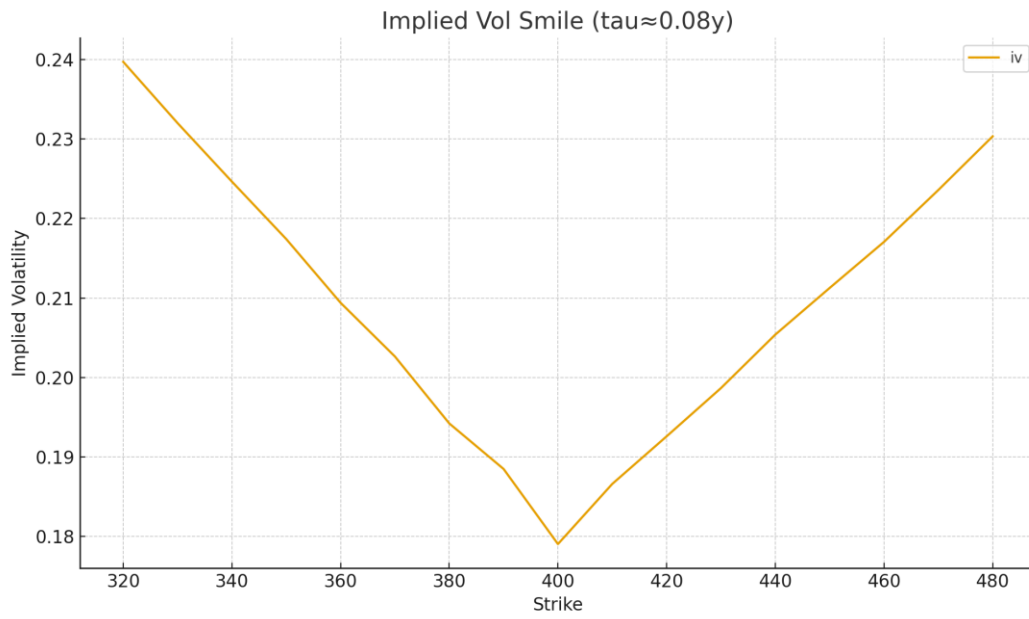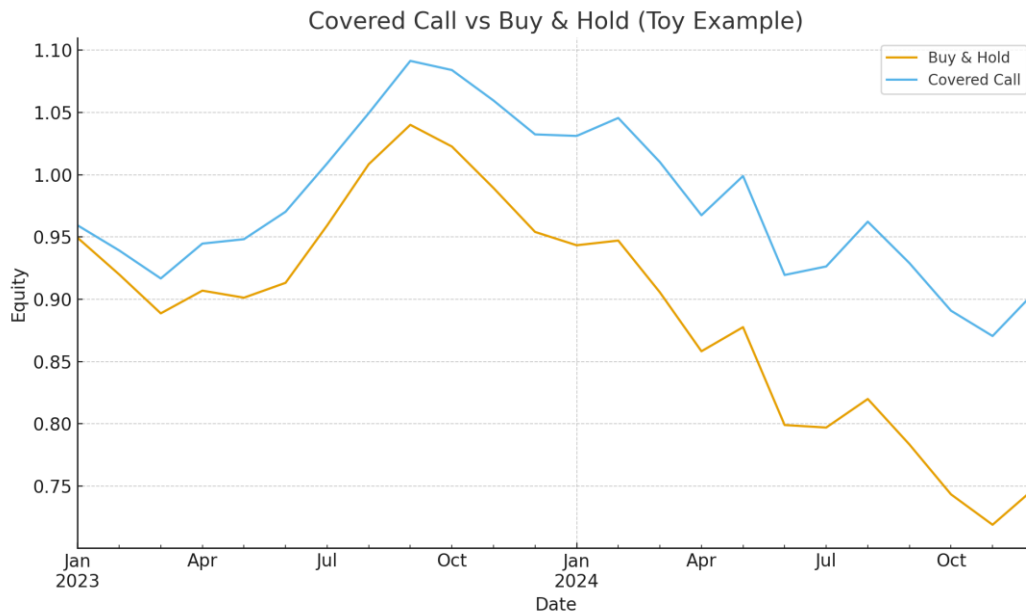
5. Interpretation

Implied volatility skew reflects asymmetric crash risk pricing. Covered calls trade upside for premium income; performance depends on realized volatility vs implied.

6. Limitations

Synthetic data; no transaction costs or assignment risk; dividends ignored. Real backtests need daily options data and execution assumptions.

7. Next Steps

Use real SPY option chains, construct delta-based strikes, and test rules across multiple regimes.