QUANTITATIVE
FINANCE
SOCIETY

# Options 201

# BRAINTEASER!

I'm driving out to a resort, which is pretty far away. Luckily, the first three quarters of the distance is all highway driving, but I have to drive the rest on slower local roads. I drive at 60 mph on the highway, but only 20 mph on local roads. What's my average speed for this trip?

# ANSWER:

You might think you can just take a weighted average of the two speeds, and conclude the answer is just $\frac{3}{4}\times 60 + \frac{1}{4}\times 20 = 50$ mph, but that's not correct! This is because average speed is calculated by averaging speed over time, not over distance.

Solution:

Let x be the total distance to the resort. The time you spend on the highway is $\frac{\frac{3}{4}x}{60} = \frac{x}{80}$ hours, and the time you spend on the local roads is $\frac{\frac{1}{4}x}{20} = \frac{x}{80}$ hours. Then your average speed is $\frac{x}{\frac{x}{80}+\frac{x}{80}} = 40$ mph.

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# Key Definitions

**Call Option**

- An agreement that gives the buyer the right, but not the obligation, to buy an underlying asset at a specified price within a specific time period

**Put Option**

- An agreement that gives the buyer the right, but not the obligation, to sell an underlying asset at a specified price within a specific time period

# Other Key Terms To Know

- **S - Price of Underlying Asset**
- **F - Forward (Futures) Price of Underlying Asset**
- **K - Strike (Exercise) Price**
- **t - Time to Expiration**
- **r - Rate of Interest**
- **σ - Volatility**
- **C - Call Price**
- **P - Put Price**
- **q - Dividend Yield**

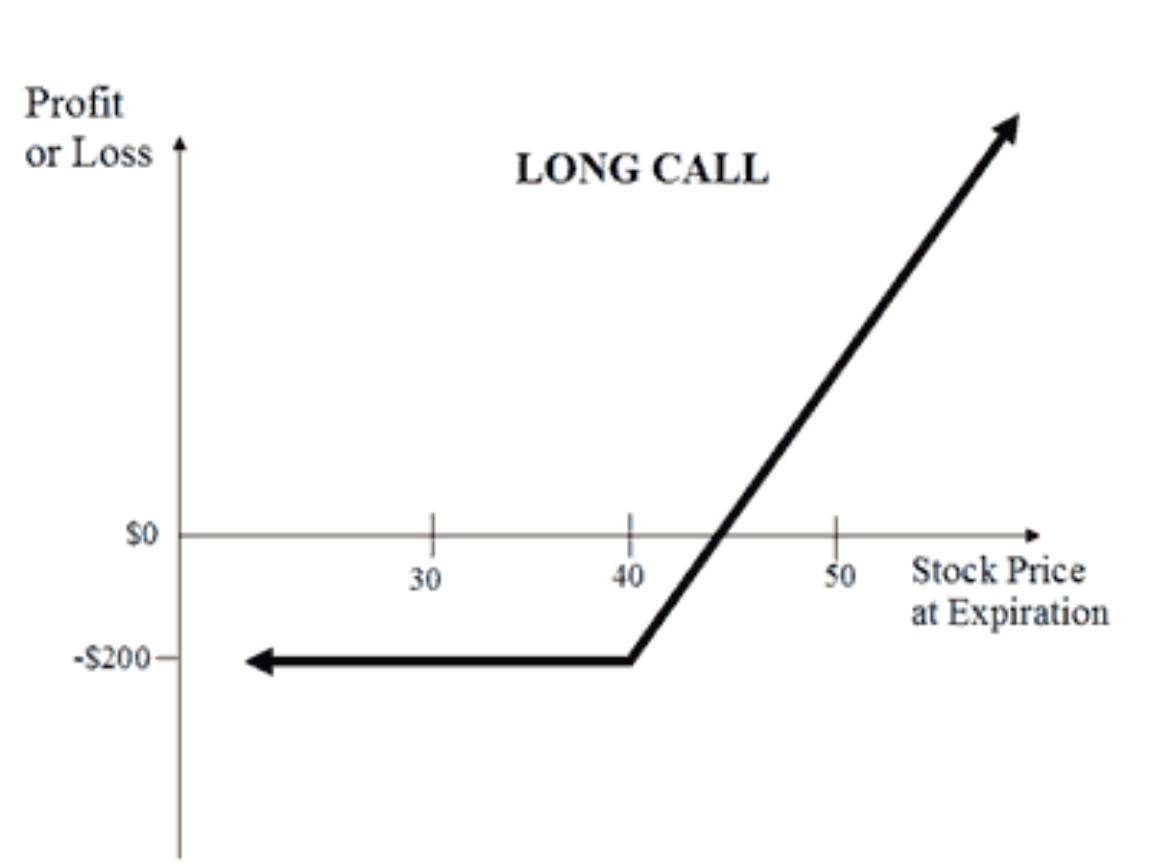
**The forward (F) is more "important" than spot (S). Why?**

# 2 Types of Options

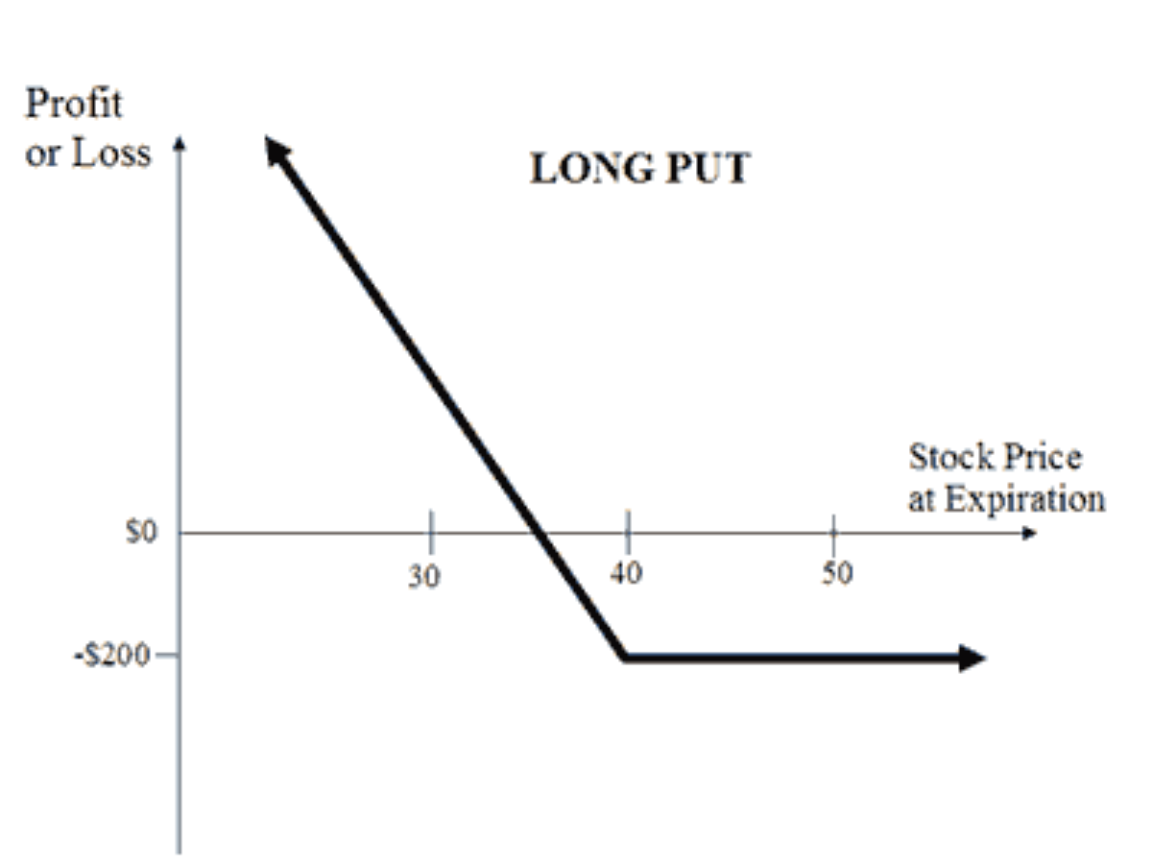
**American Options –** buyer can exercise option early

**European Options –** buyer cannot exercise option early and has to wait until expiration

# Payoff Diagram For Buying A Call



# Payoff Diagram For Buying A Put



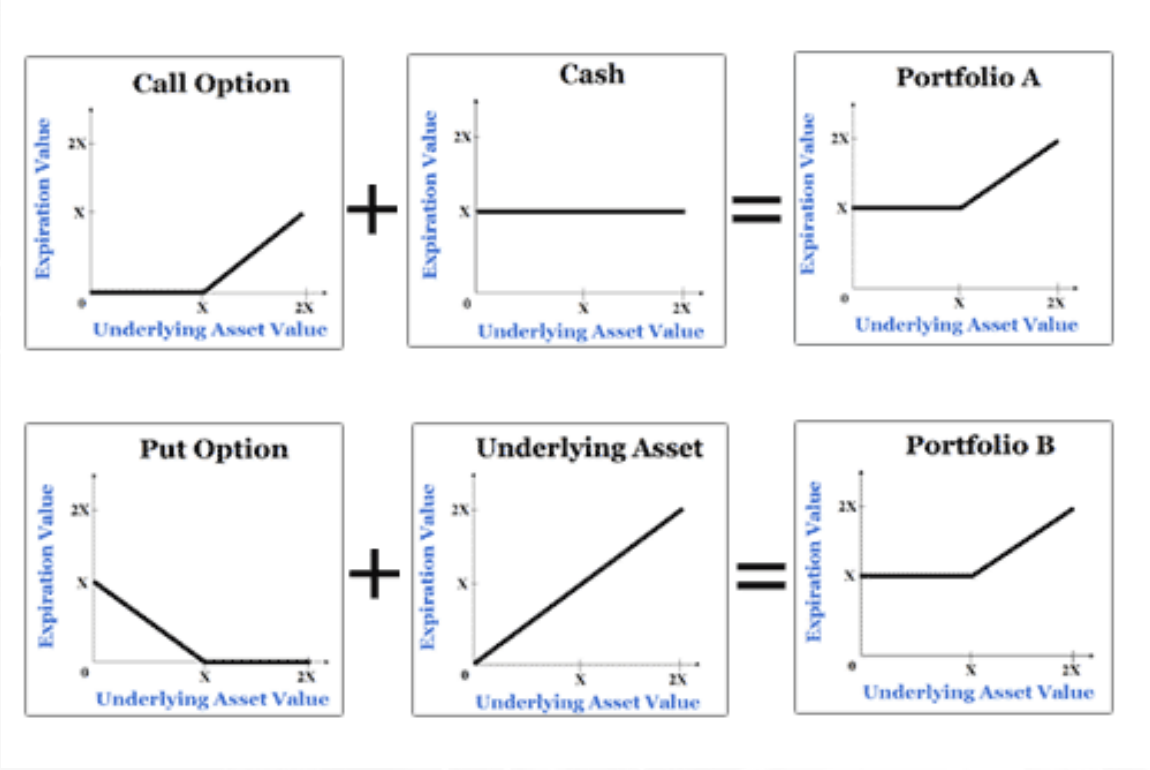
# Early Exercise of American puts

**American Options –** buyer can exercise option early

Why would someone ever exercise their option early?

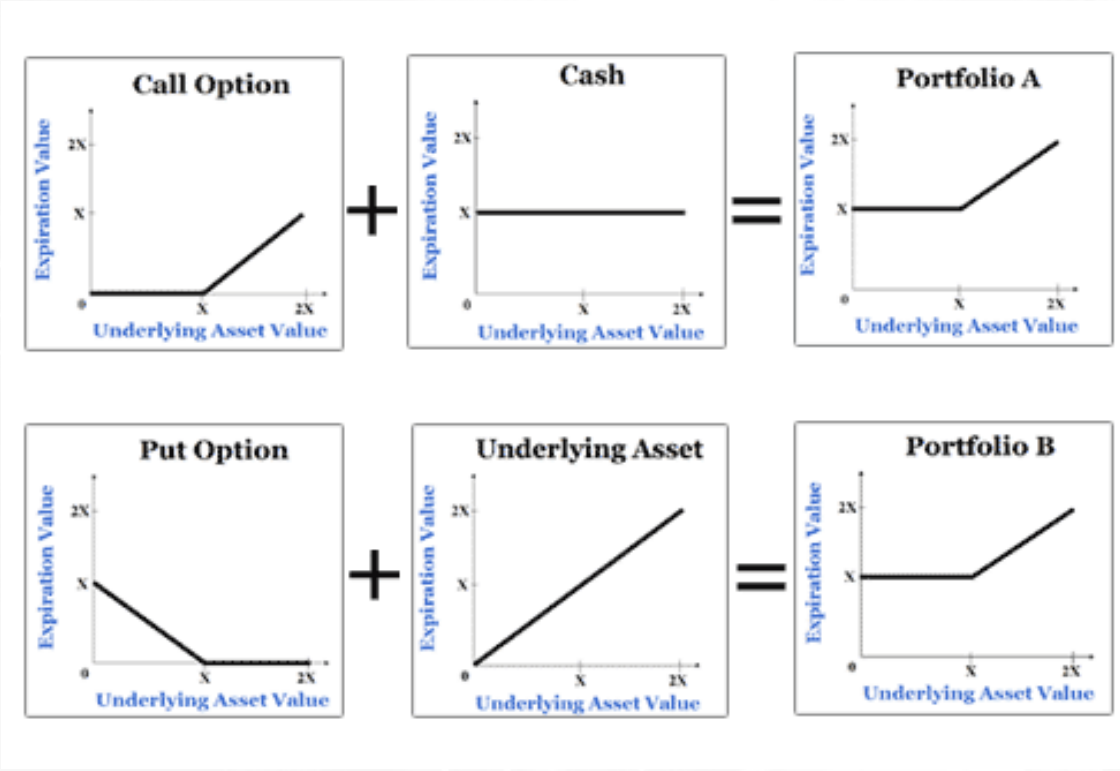
# Put-Call Parity

- Defines the relationship between the price of a European put and European call of the same class (same strike/underlying asset/expiration date)



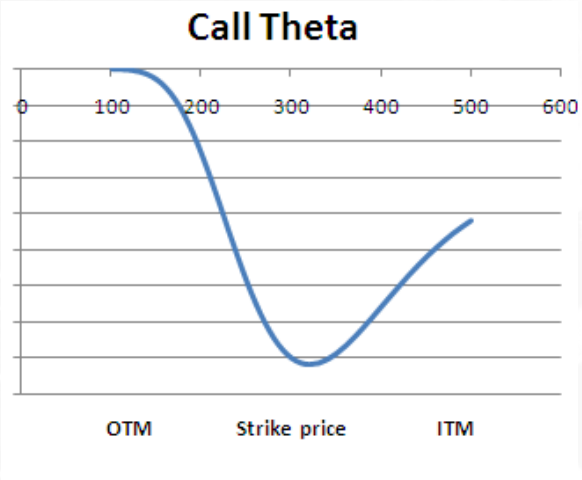
# Put-Call Parity

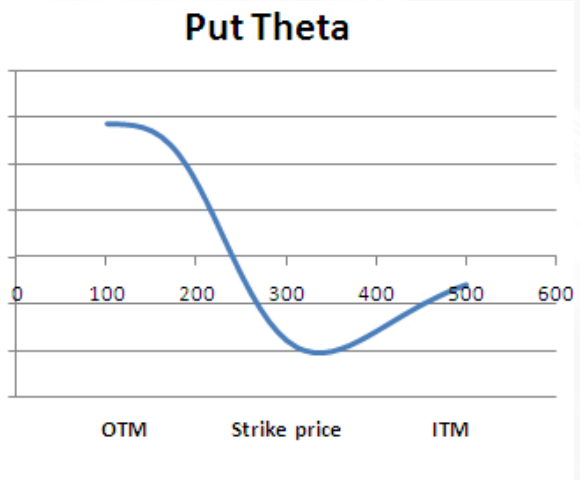
- $P + S = C + PV(K)$
- $C = P + S - PV(K)$



# THETA

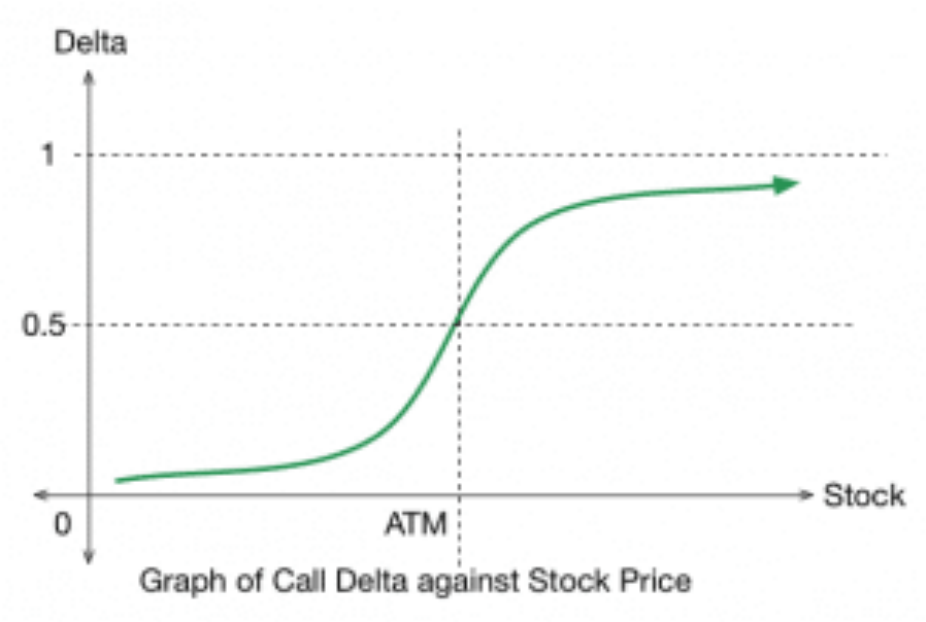
- Change in value of option as you move closer to expiry (time decay)



# Delta

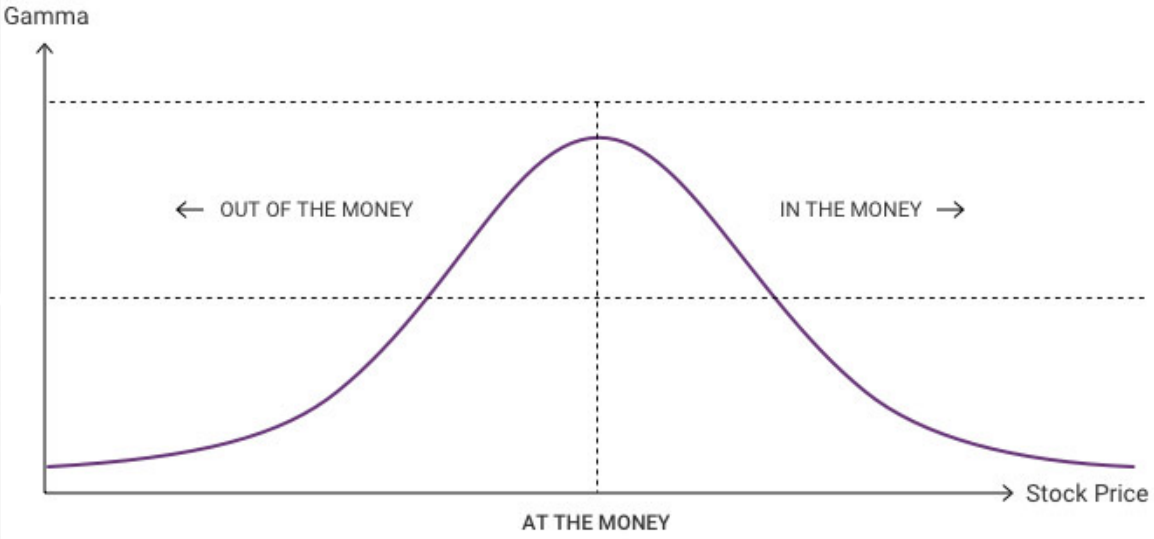
- Change in price of option for every dollar movement in underlying



Graph of Call Delta against Stock Price

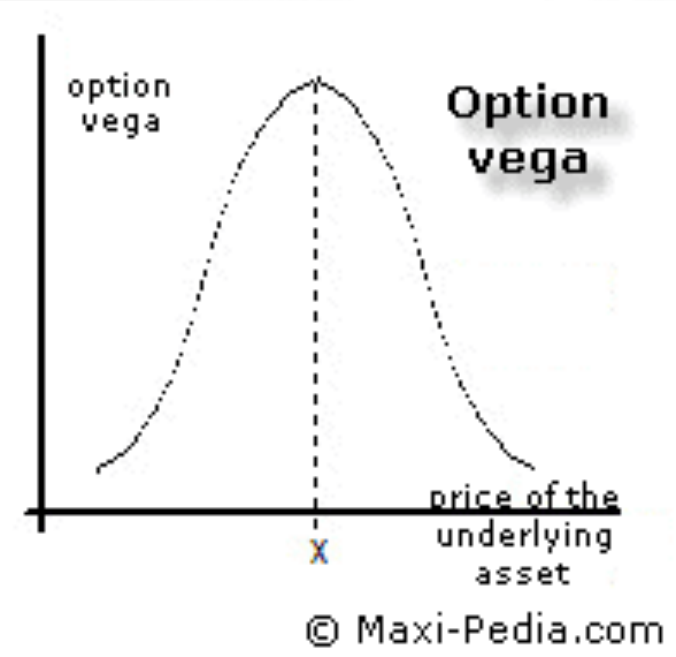
# GAMMA

- Second derivative of delta – measures rate of change in delta



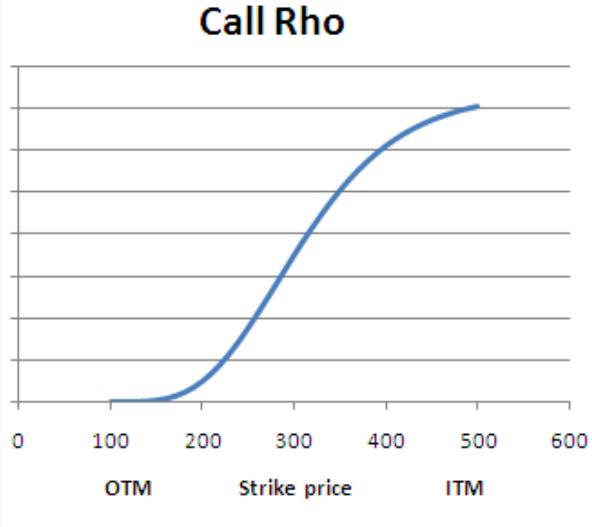
# VEGA

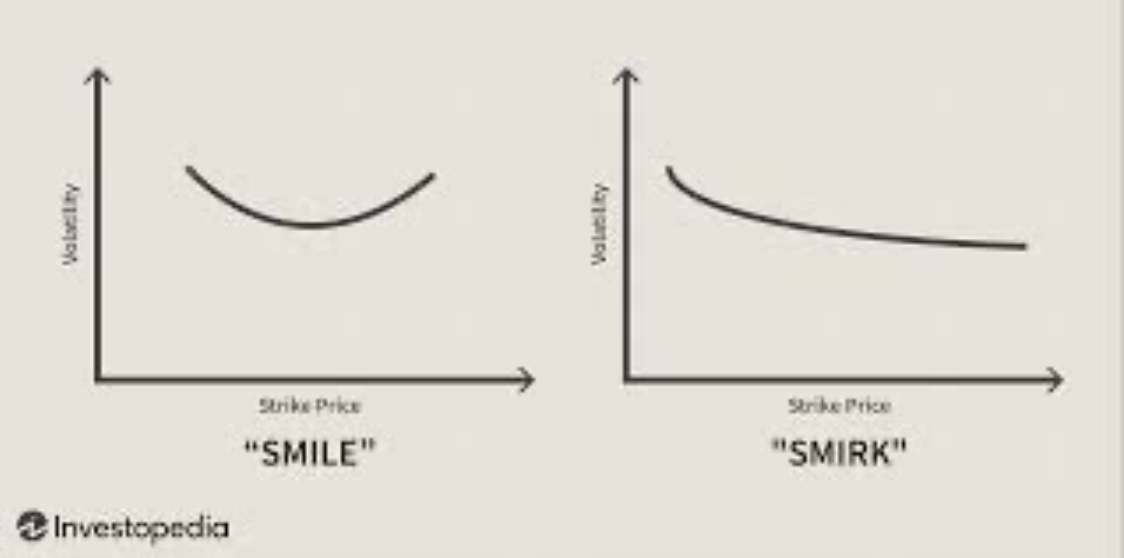
- Price sensitivity to 1% change in volatility of underlying



# Rho

- How sensitive options pricing is to interest rates



# VOLATILITY SKEW

- Measures implied vol (demand) of options
- Skew: spot-vol relationship
- Smile: positive vol convexity