

Lab - 02

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210123083

Ques – 1

The initial option prices for the European Call Option and European Put Option are:

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Set = 1
Call Option = 15.68176045159868
Put Option = 7.993395090262697

Set = 2
Call Option = 15.736778626185817
Put Option = 8.048413264849804

```

Binomial Pricing Algorithm:

- At time $t = t_i$ ($= i \cdot \delta t$), there are $i + 1$ possible asset prices, i.e,

$$S_n^i = d^{i-n} u^n S_0, 0 \leq n \leq i$$

- Since continuous compounding convention is used, gross return is $R = e^{r \cdot \delta t}$.

- The probability (p) of an upward return in price is: -

$$\frac{R-d}{u-d}$$

- At expiry, i.e, $t = T$, we calculate the price of the option using the respective payoff function for both the call and put option, i.e,

$$\begin{aligned}
 C_n^M &= \max(S_n^M - K, 0), & 0 \leq n \leq M \\
 P_n^M &= \max(K - S_n^M, 0), & 0 \leq n \leq M
 \end{aligned}$$

where, C_n^M is the nth possible price of the call option for the Mth interval, and

P_n^M is the nth possible price of the put option for the Mth interval

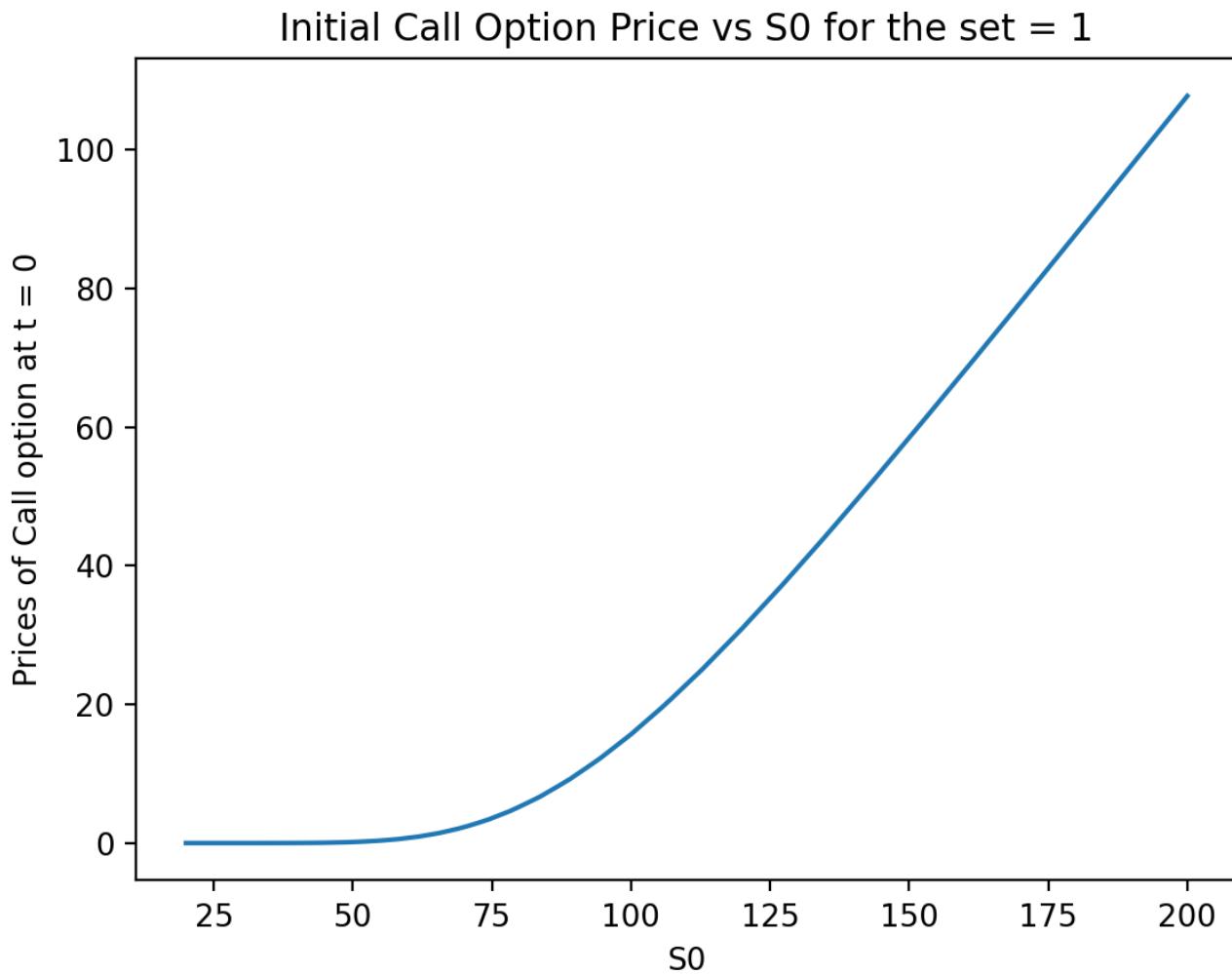
5. Now, we continuously apply **Backward Induction** to find out the option price at $t = 0$ by using following relation:

$$C_n^i = (1 - p) \cdot C_{n+1}^{i+1} + p \cdot C_n^{i+1} \quad , 0 \leq n \leq i \quad \& \quad 0 \leq i \leq M - 1$$

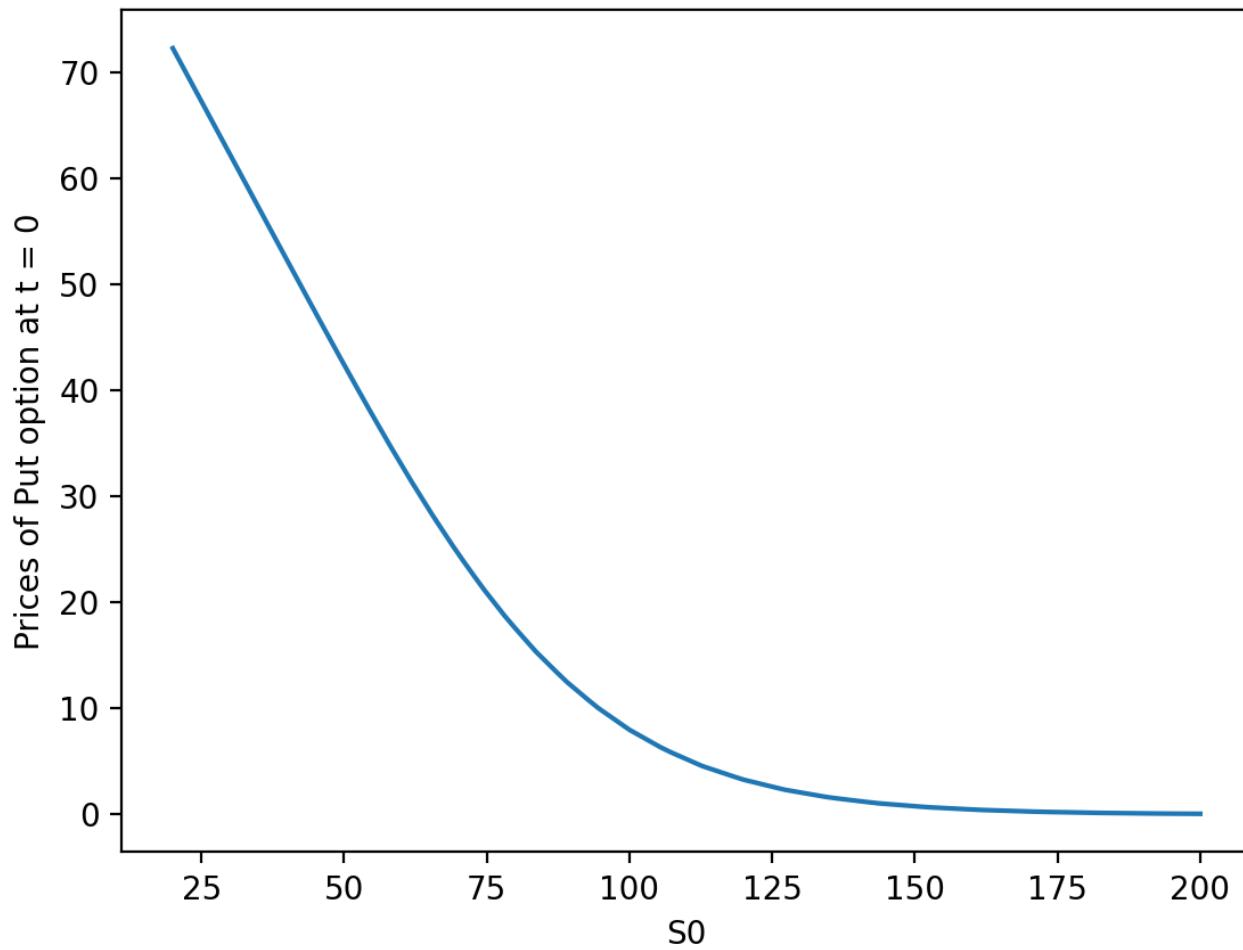
$$P_n^i = (1 - p) \cdot P_{n+1}^{i+1} + p \cdot P_n^{i+1} \quad , 0 \leq n \leq i \quad \& \quad 0 \leq i \leq M - 1$$

6. C_0^0 and P_0^0 are the required values, i.e, initial option prices.

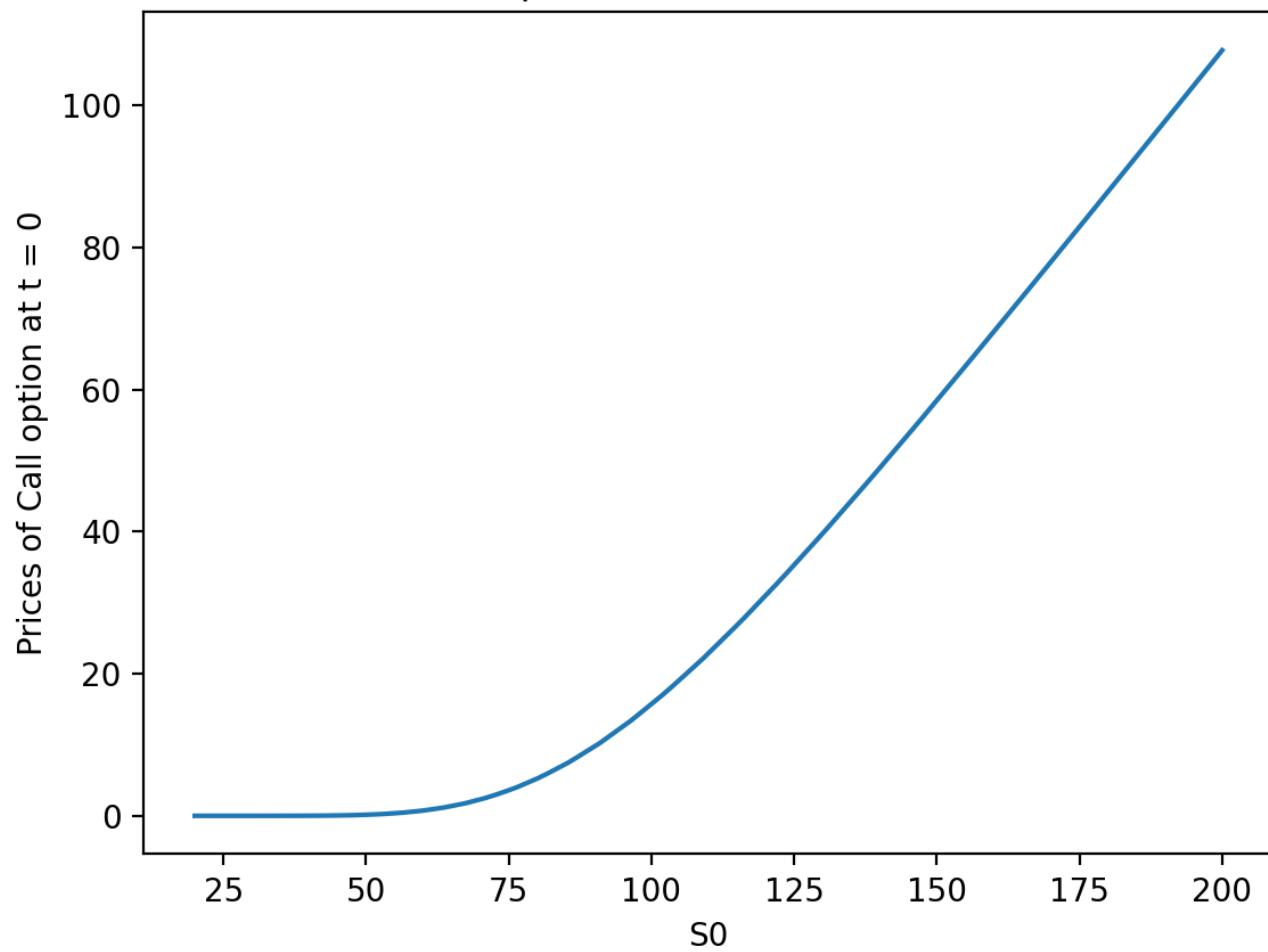
Sensitivity Analysis



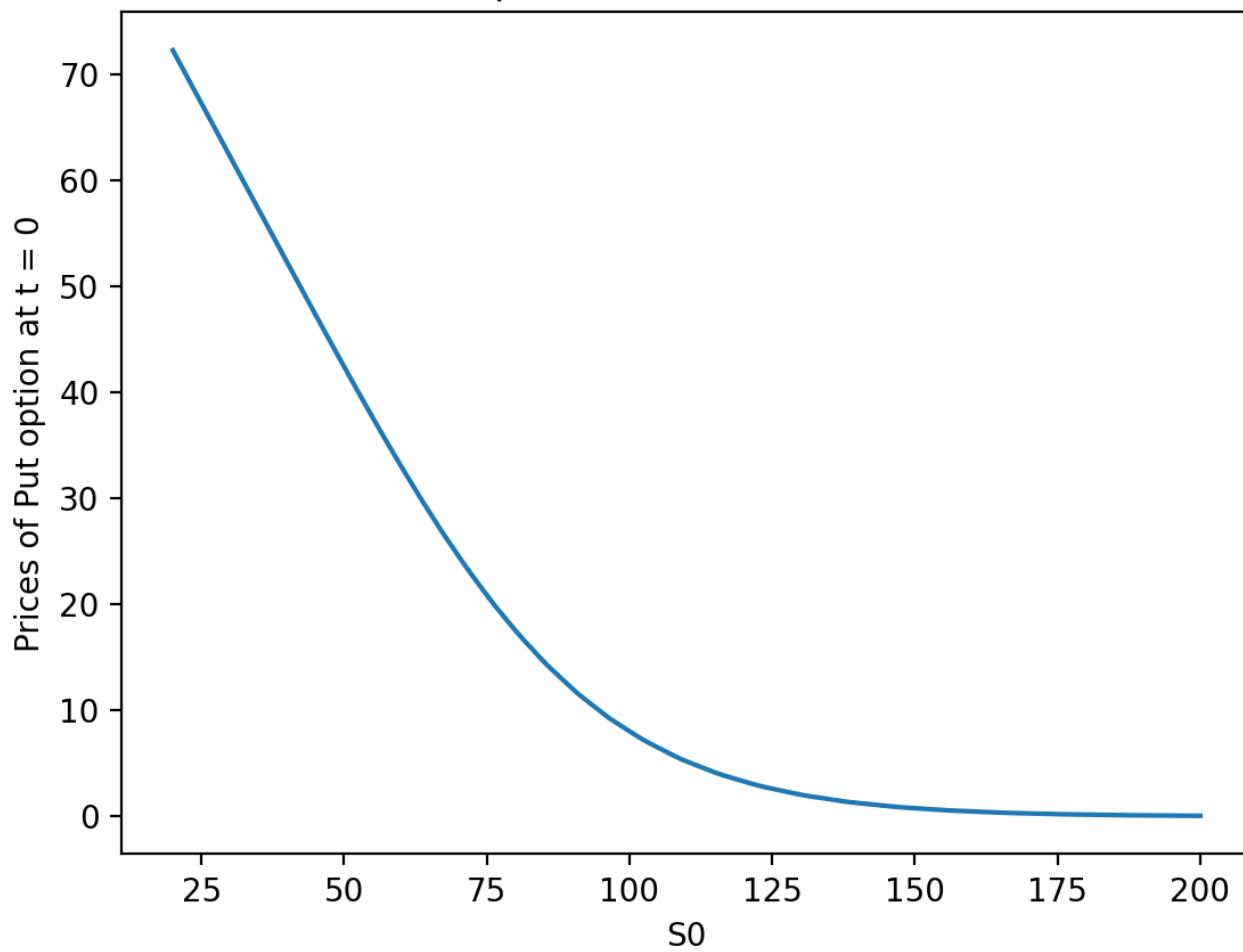
Initial Put Option Price vs S_0 for the set = 1



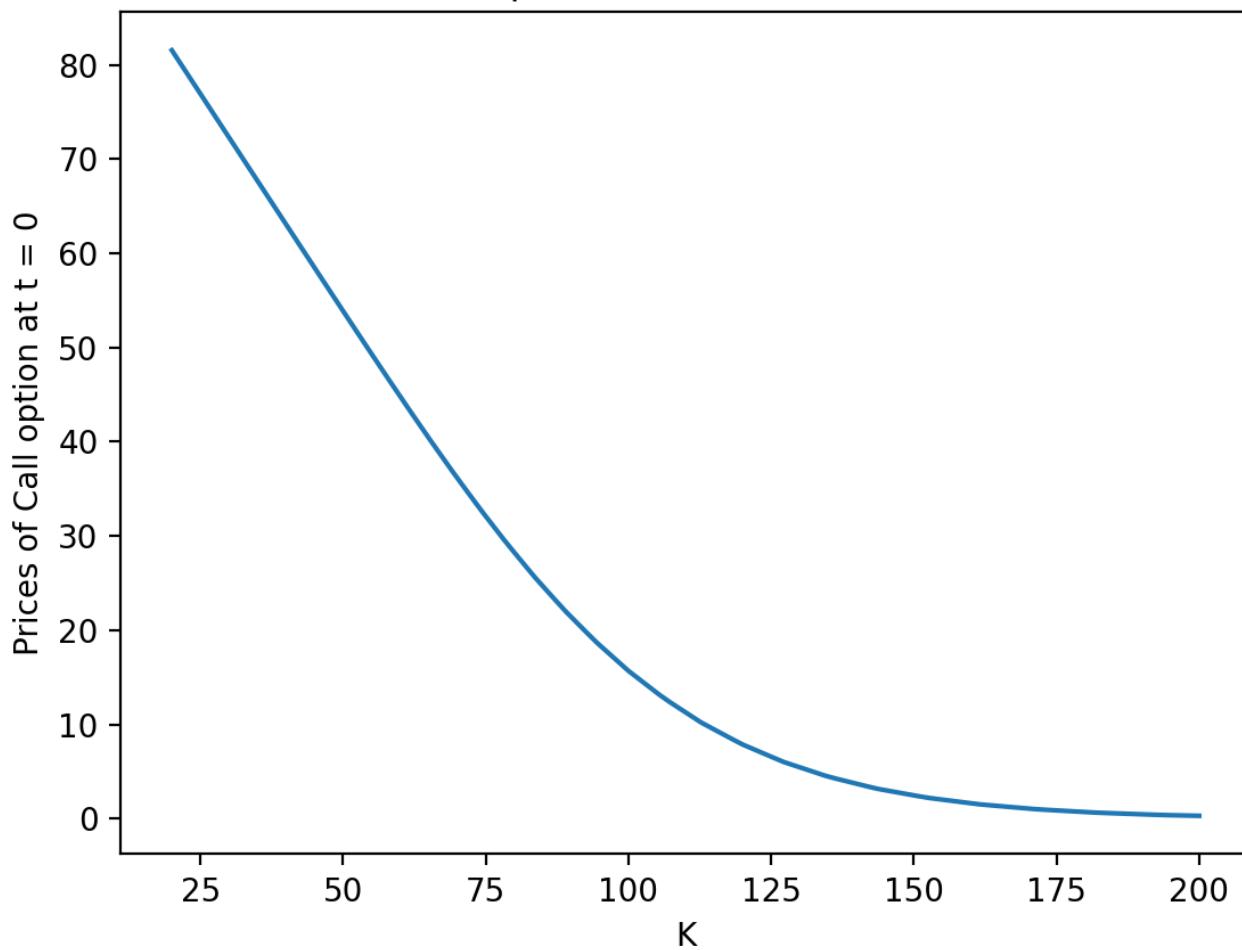
Initial Call Option Price vs S_0 for the set = 2



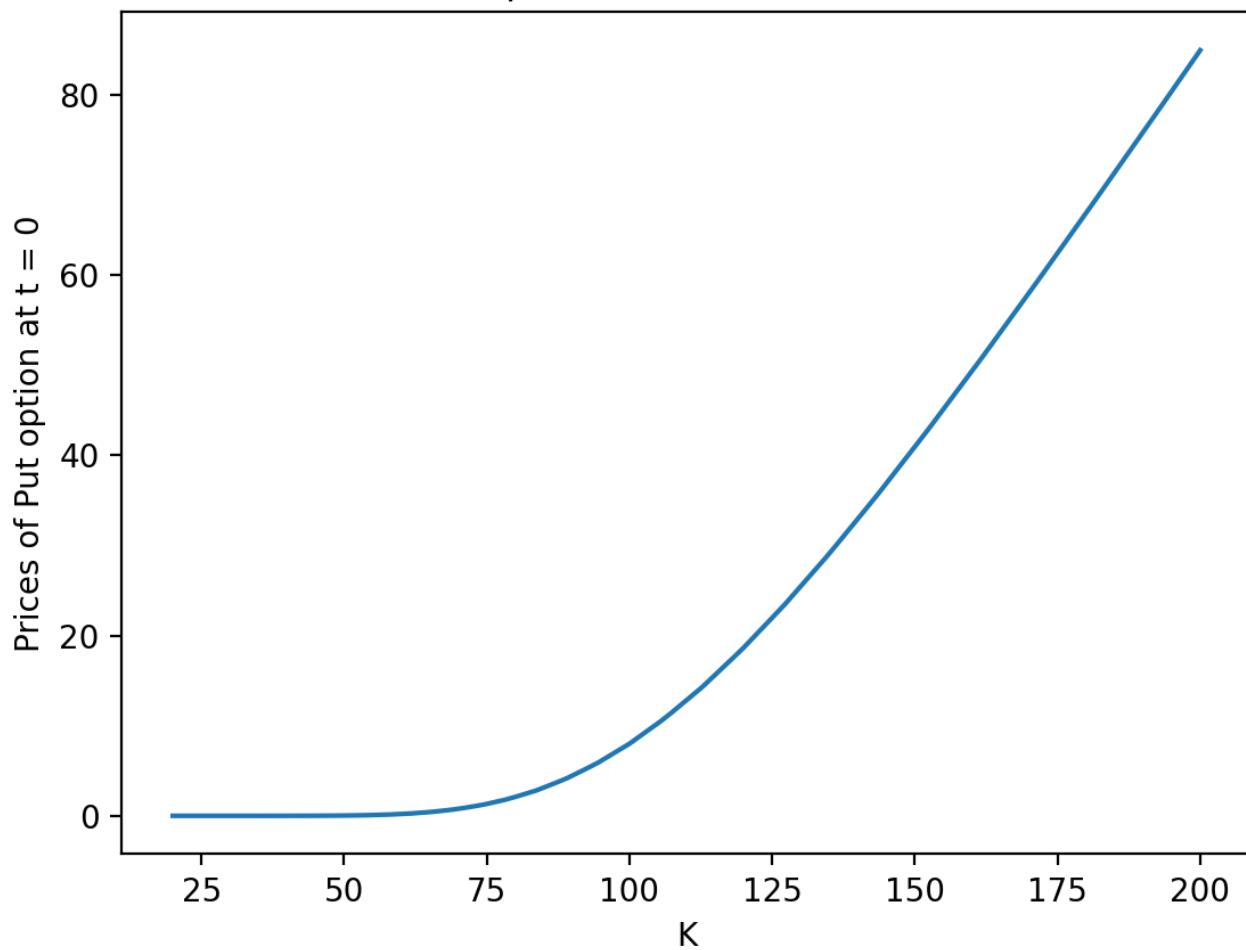
Initial Put Option Price vs S_0 for the set = 2



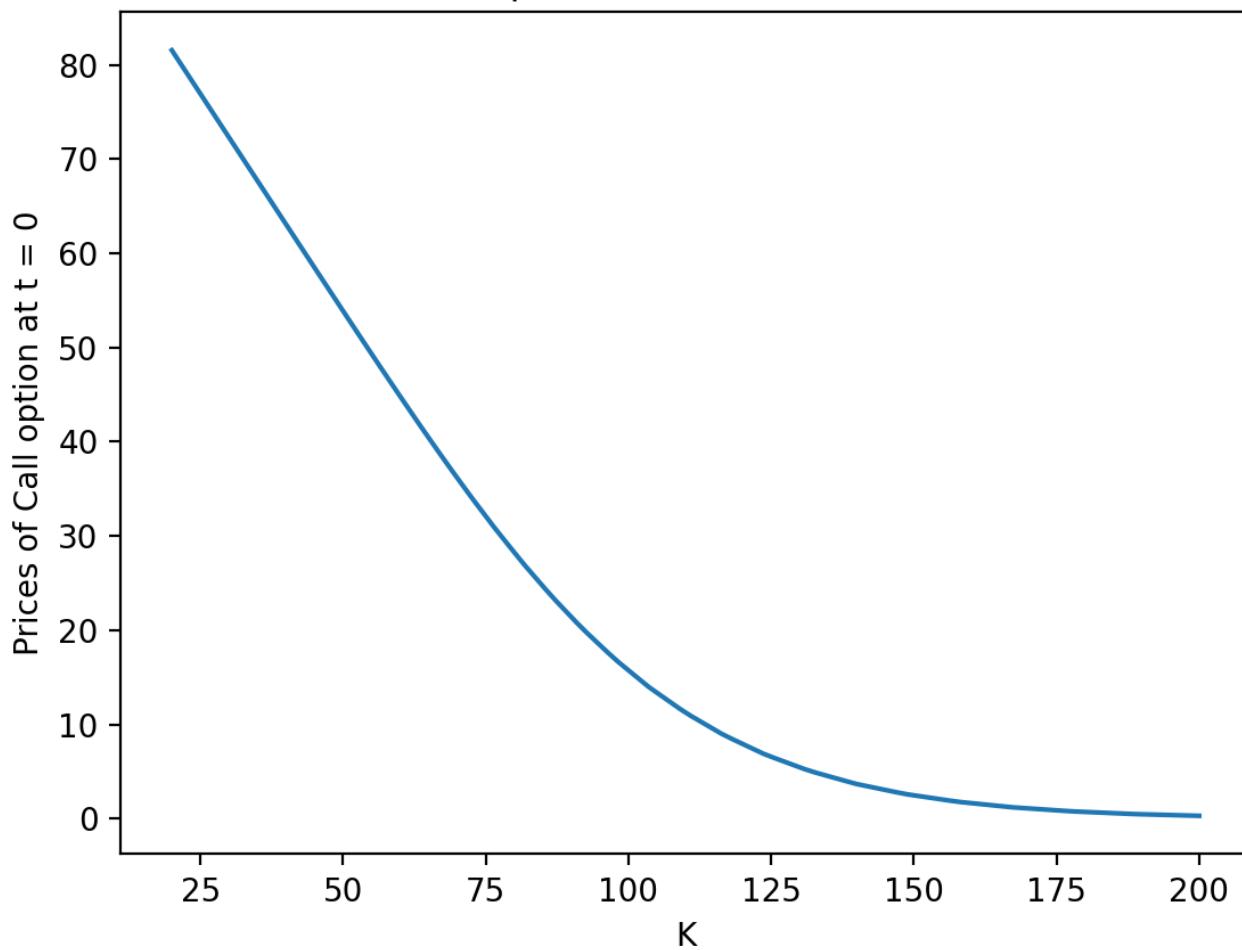
Initial Call Option Price vs K for the set = 1



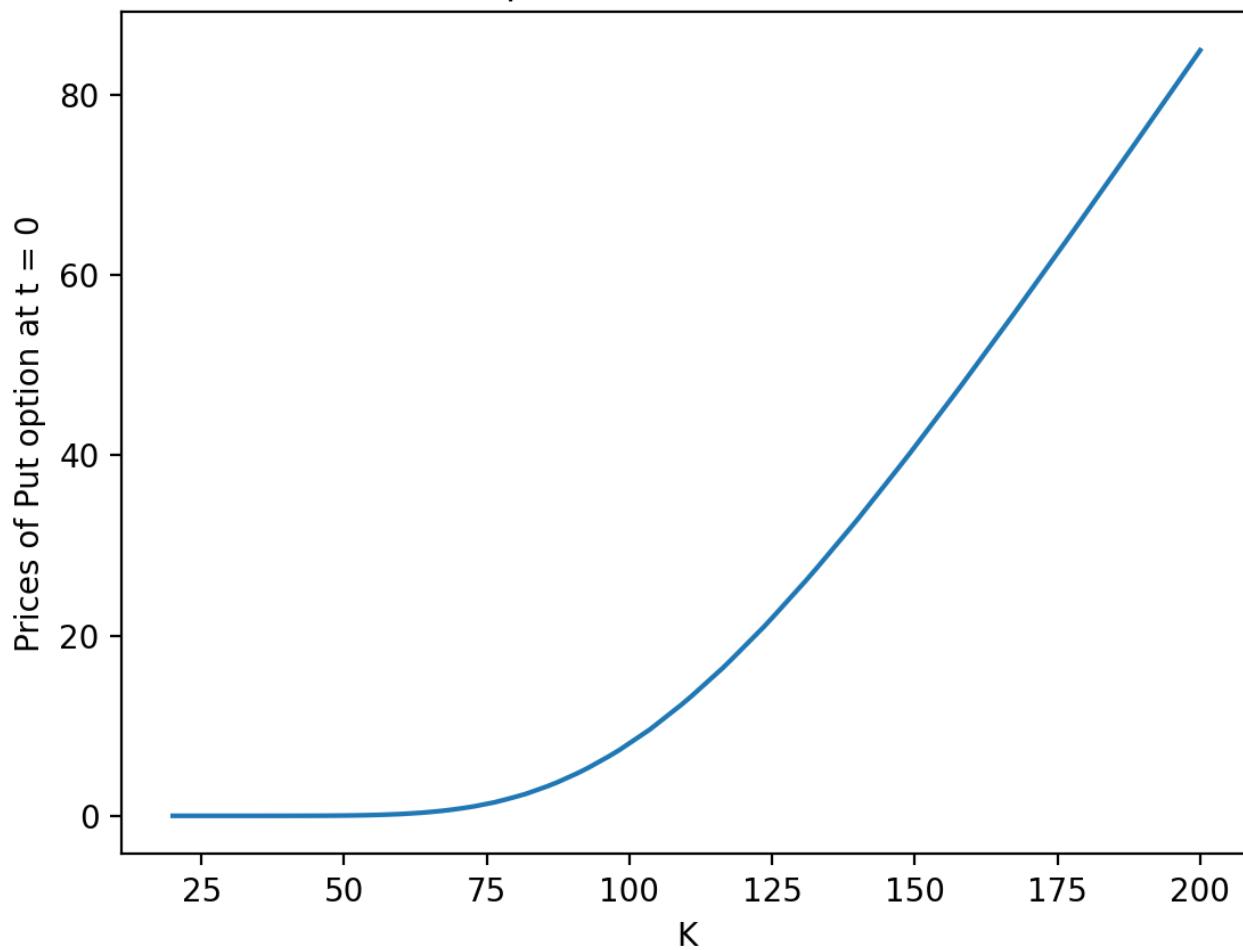
Initial Put Option Price vs K for the set = 1



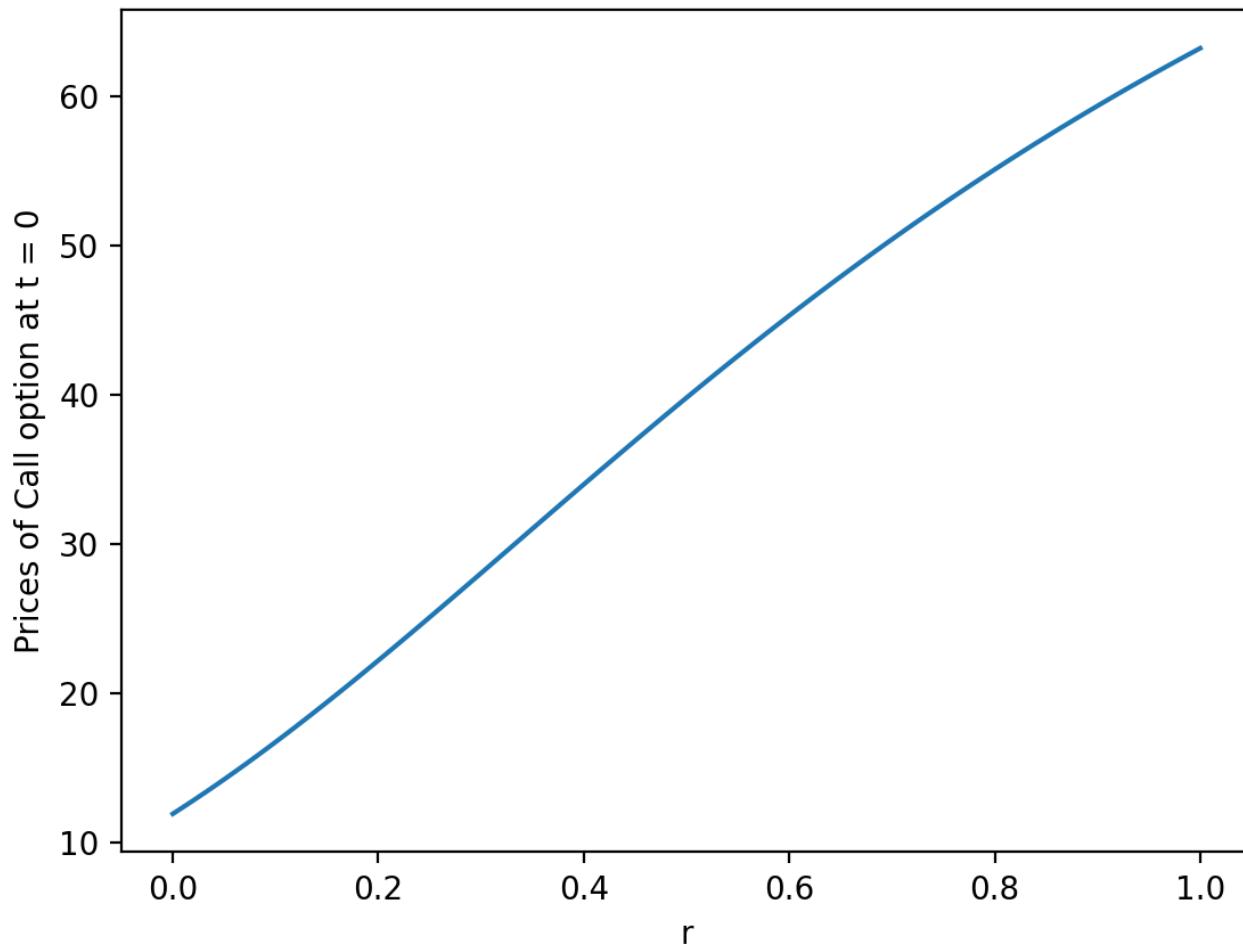
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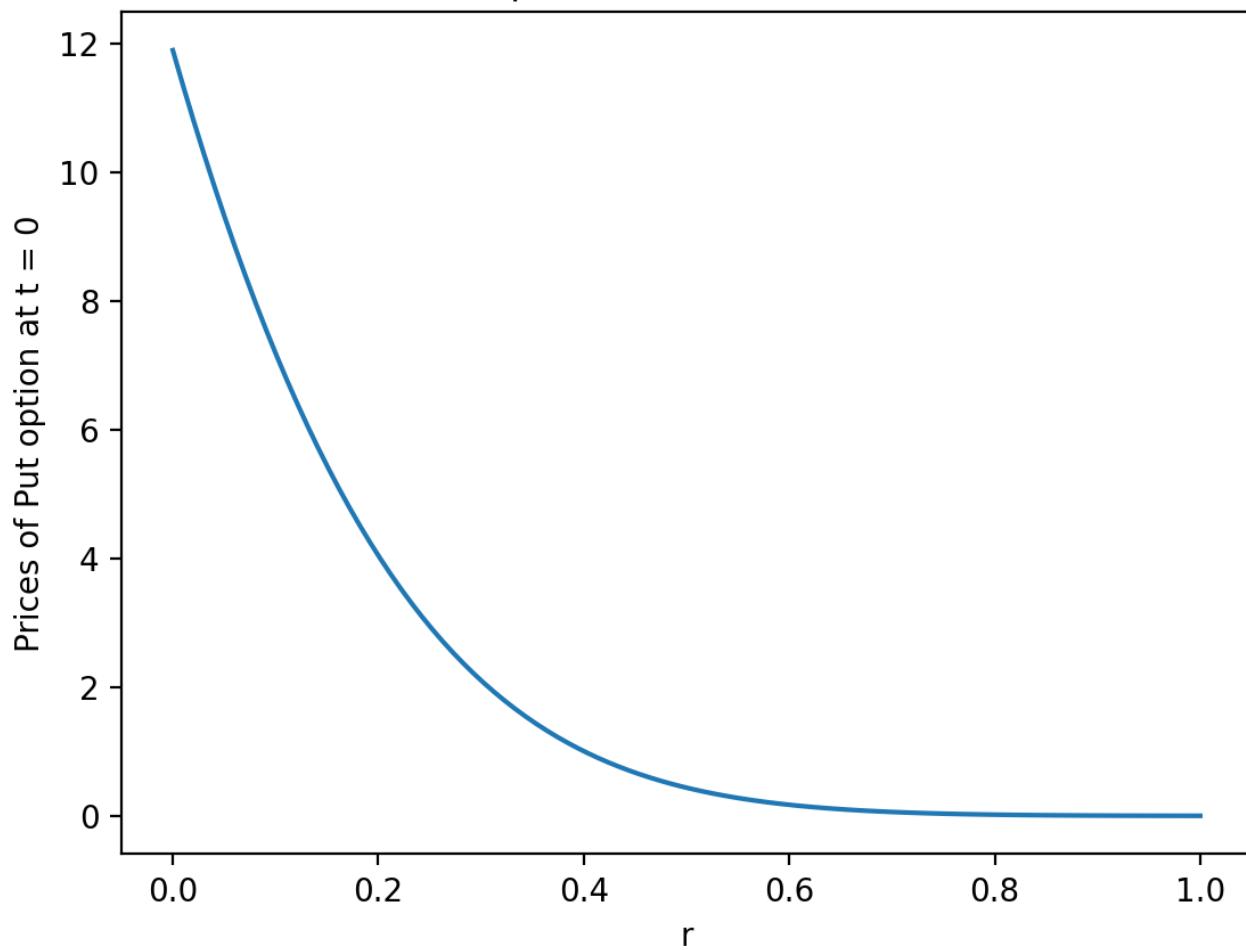
Initial Put Option Price vs K for the set = 2



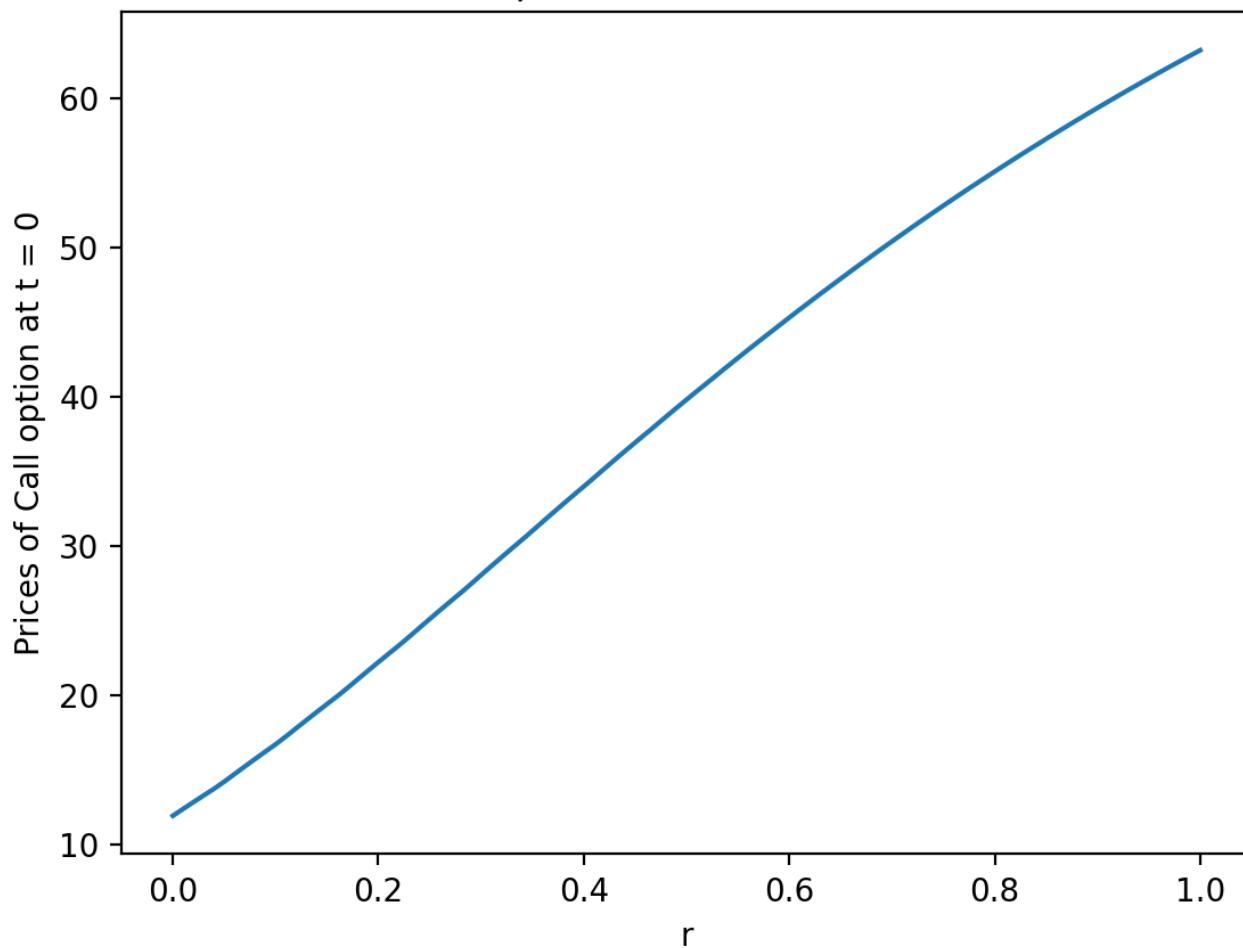
Initial Call Option Price vs r for the set = 1



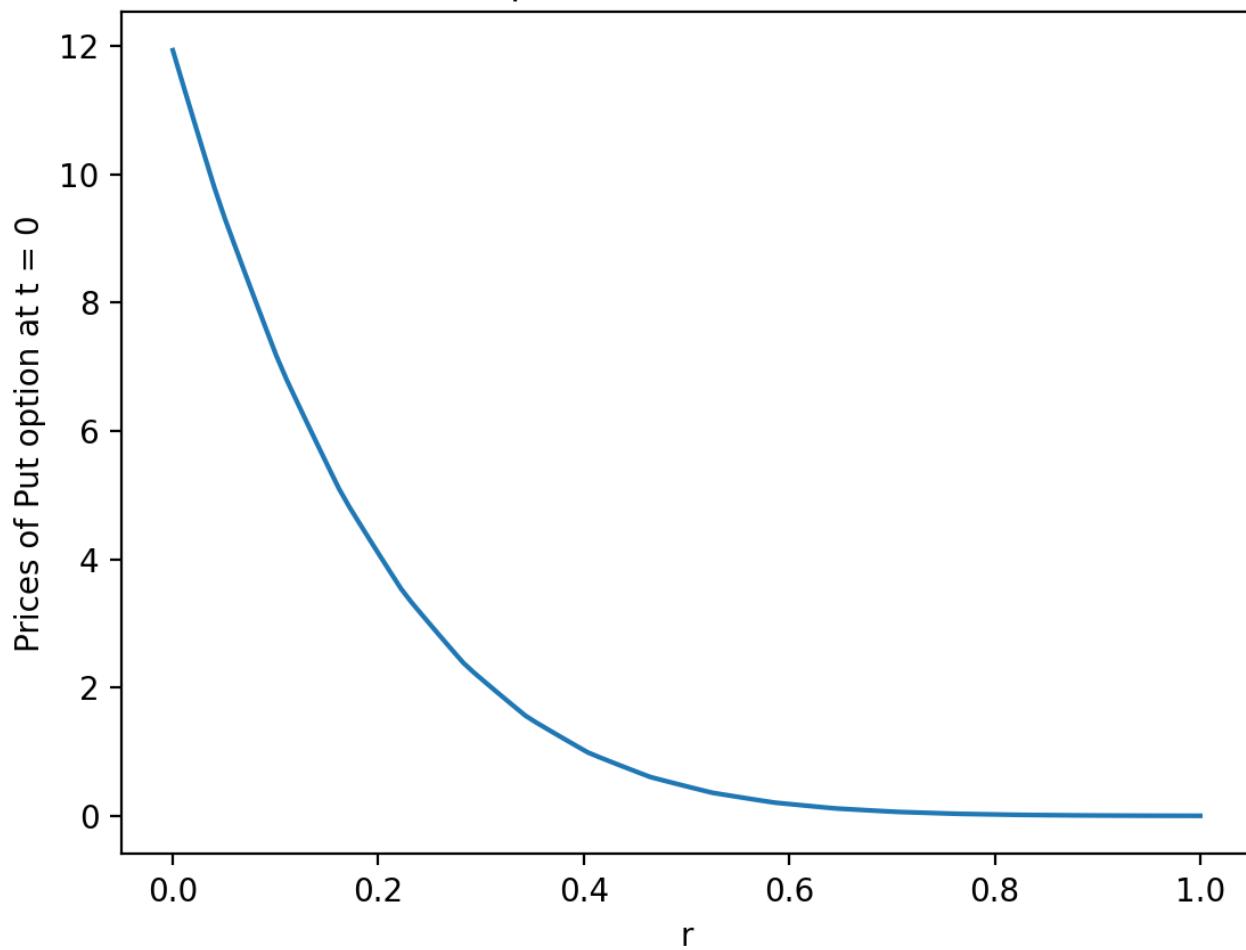
Initial Put Option Price vs r for the set = 1



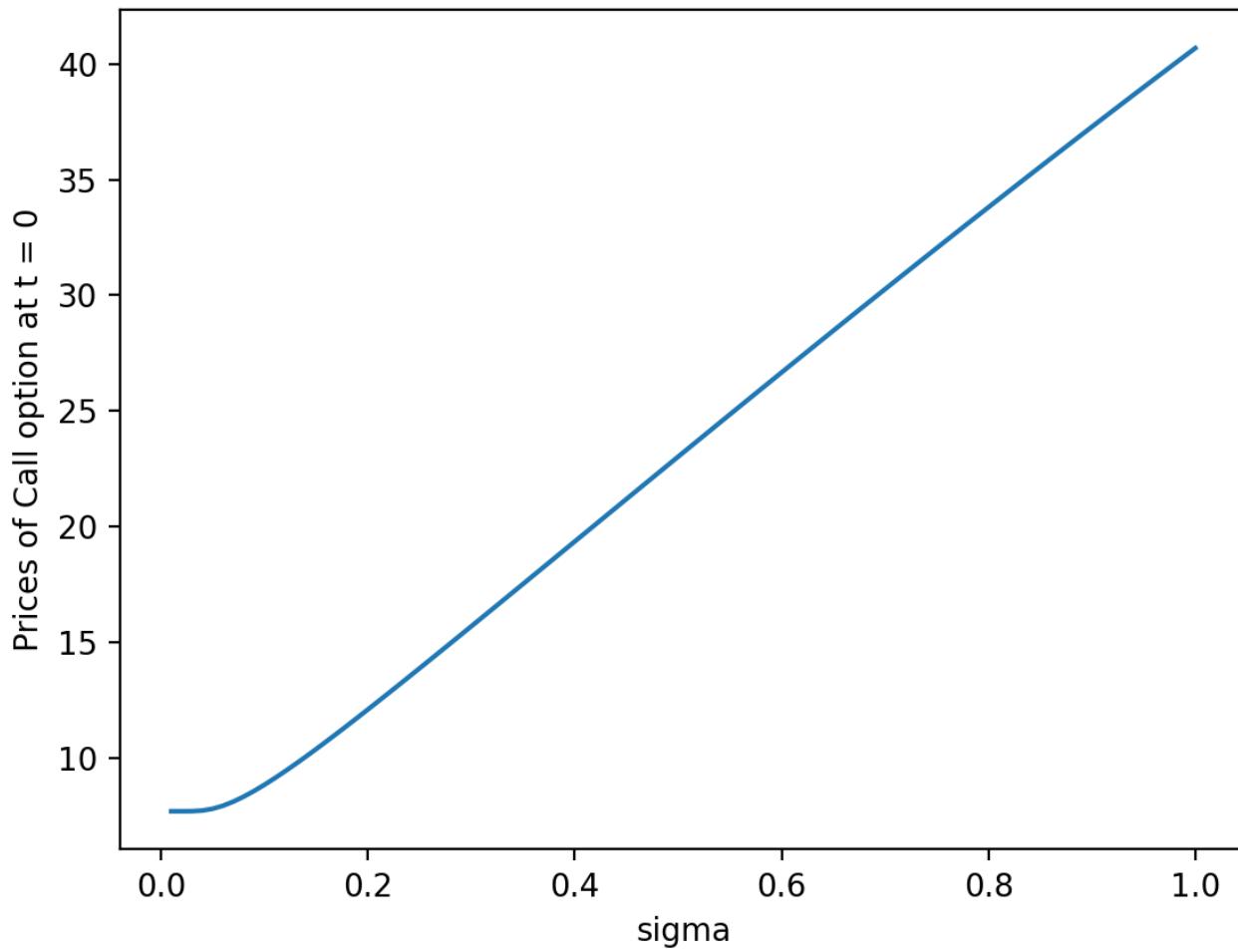
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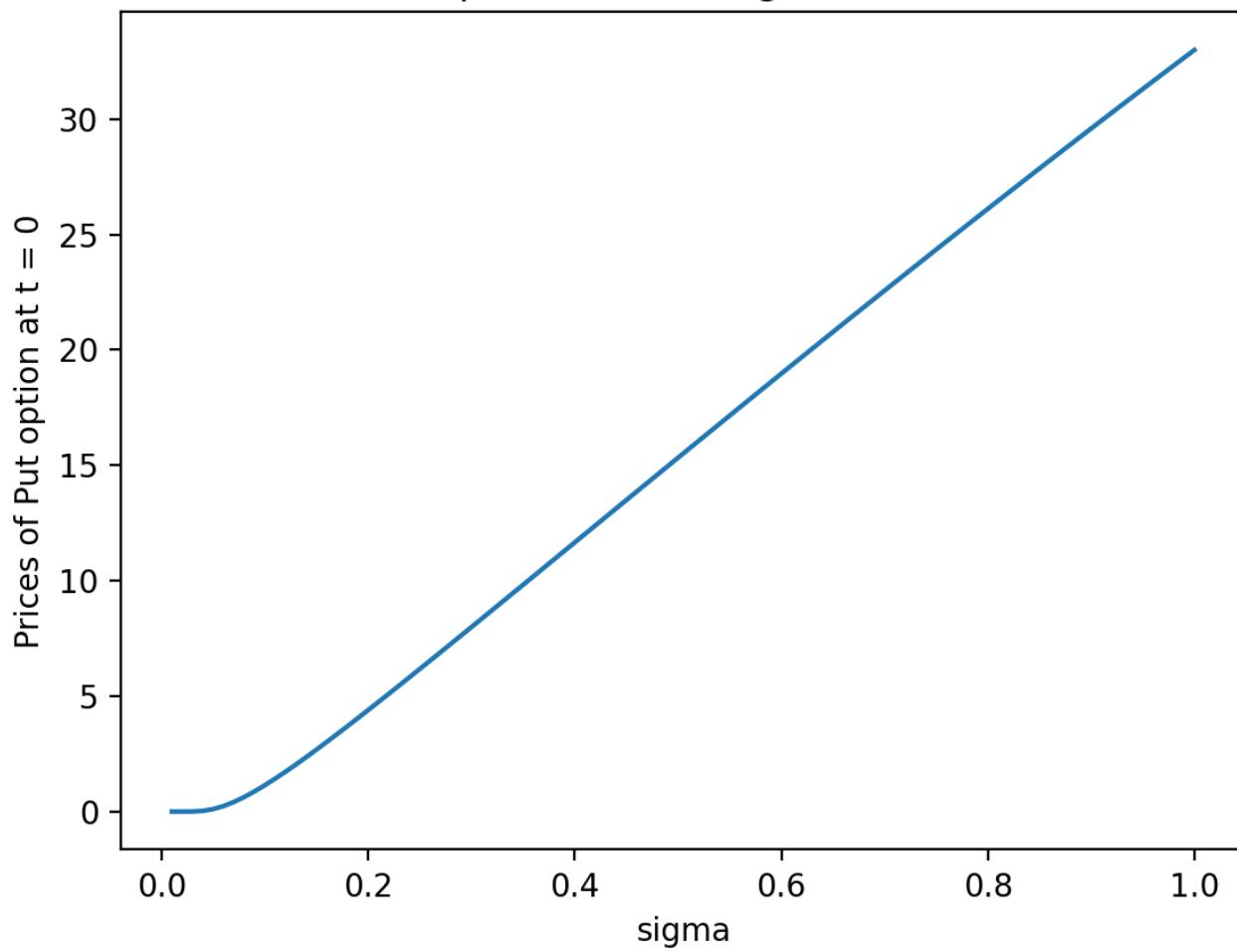
Initial Put Option Price vs r for the set = 2



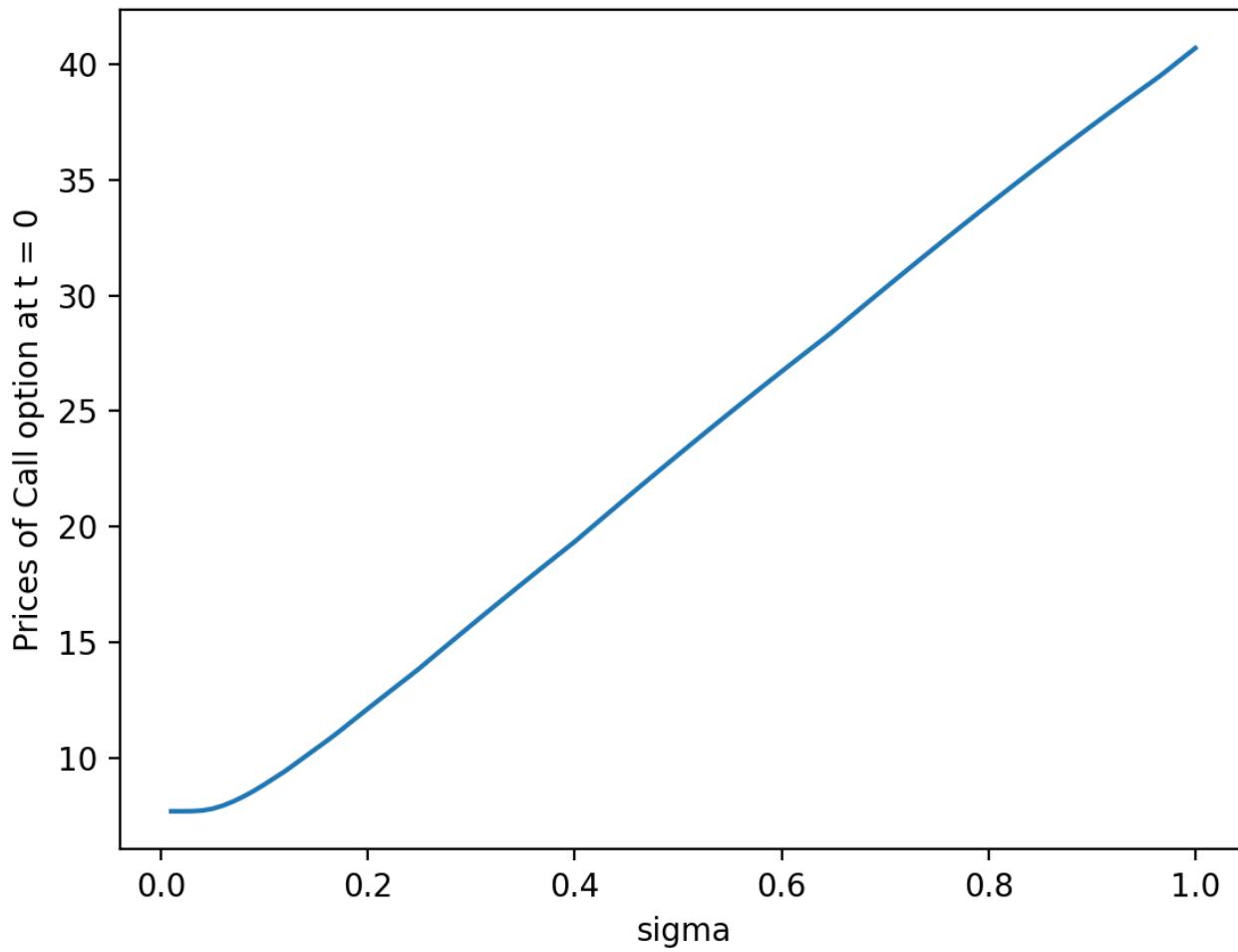
Initial Call Option Price vs sigma for the set = 1



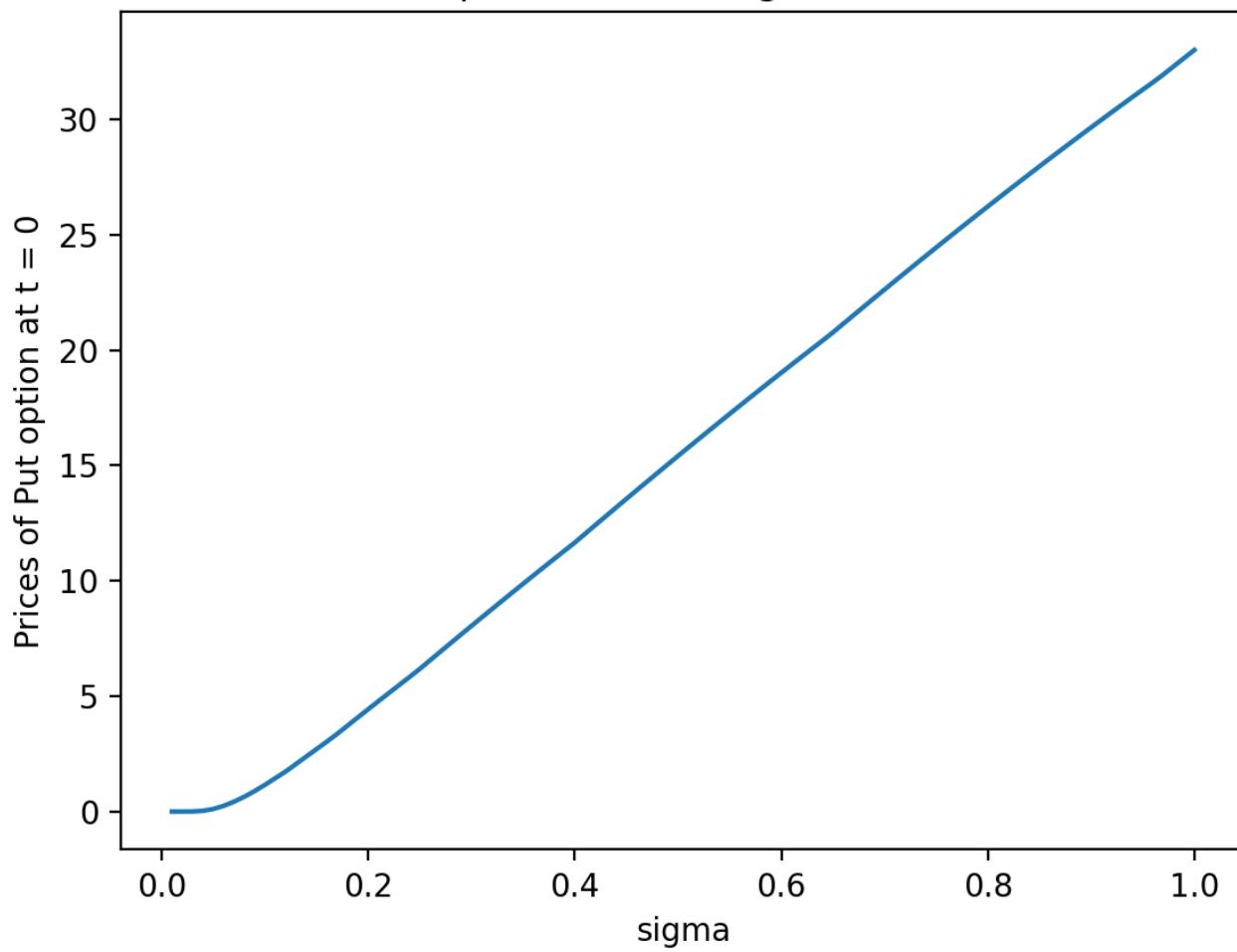
Initial Put Option Price vs sigma for the set = 1



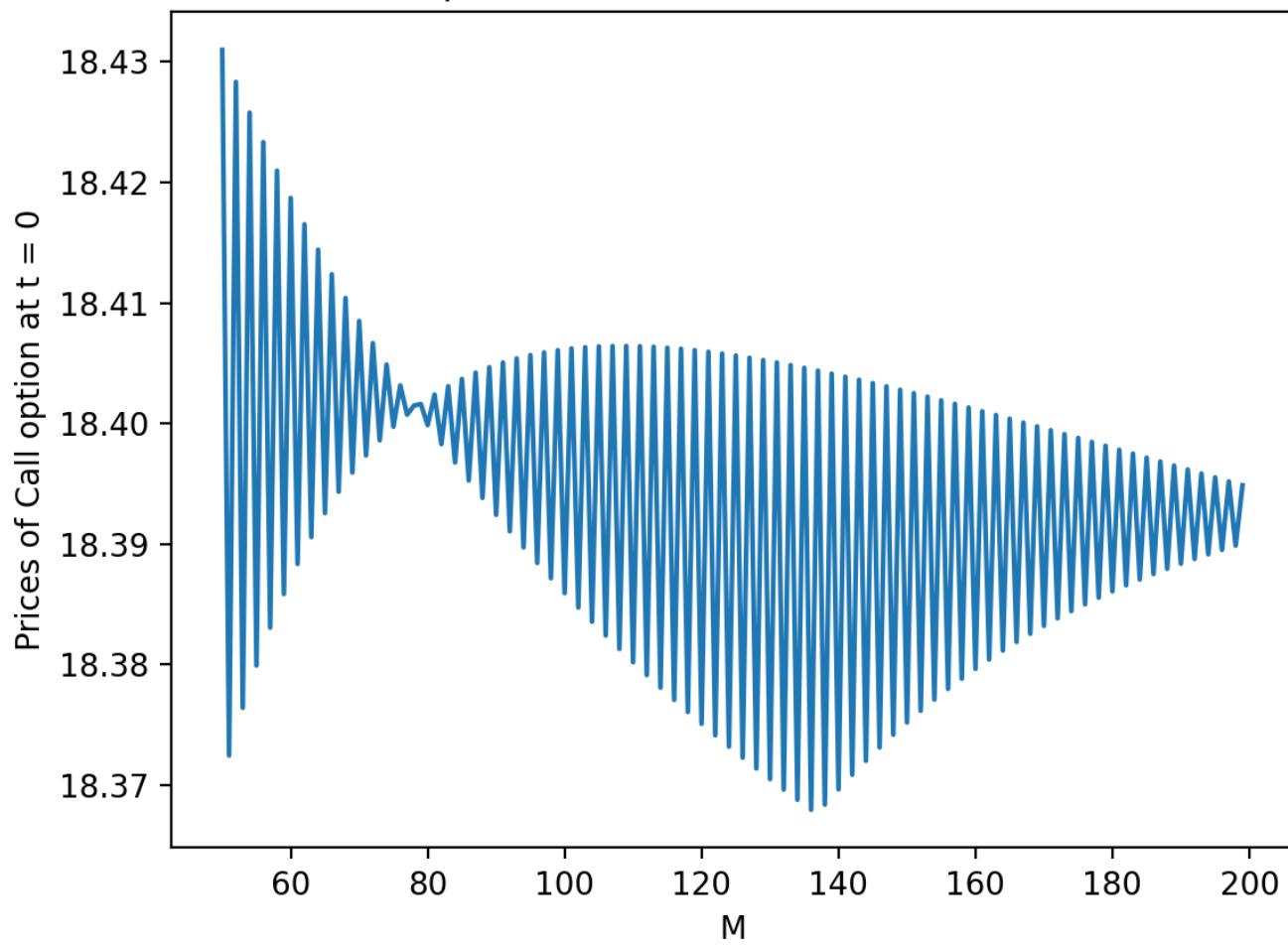
Initial Call Option Price vs sigma for the set = 2

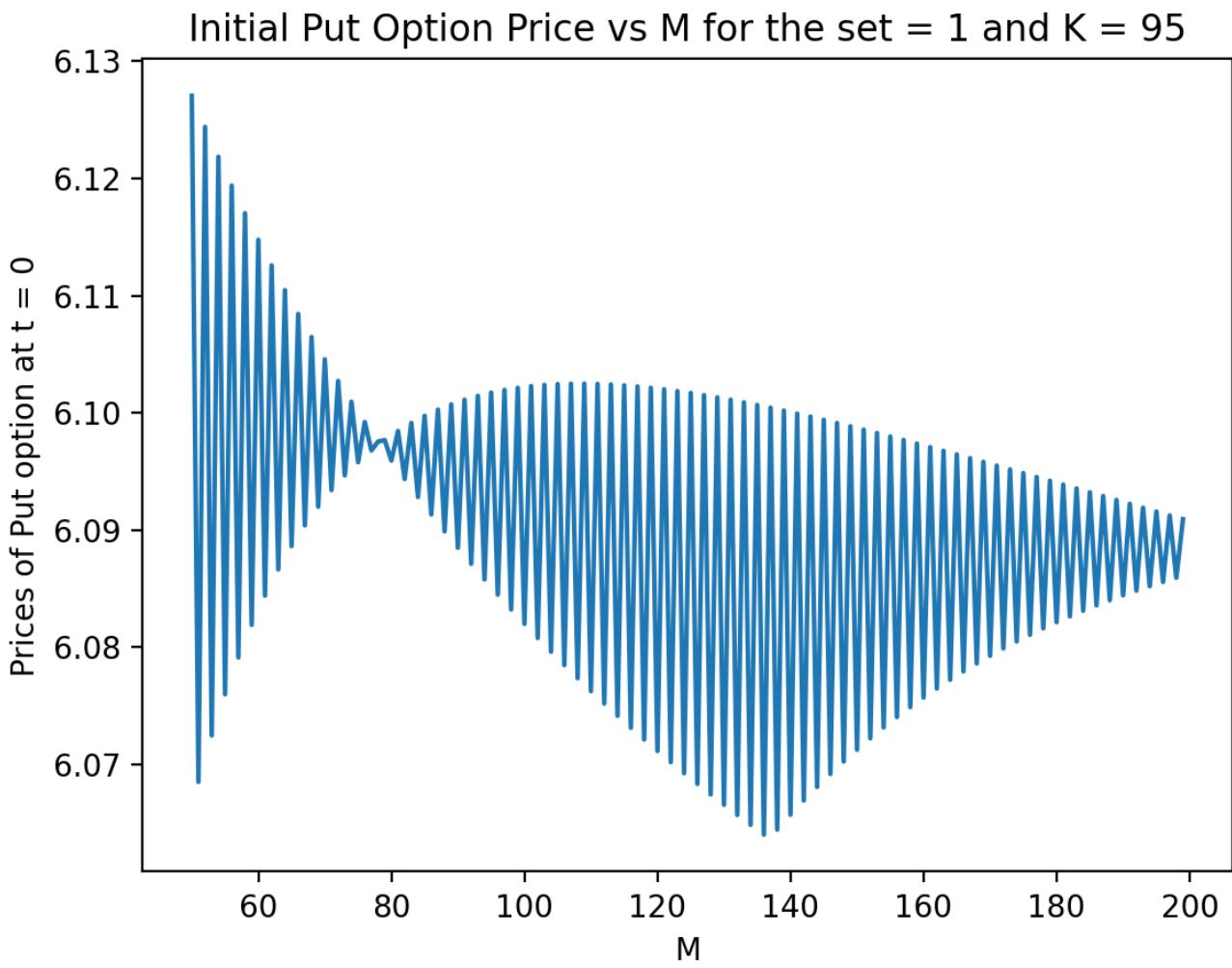


Initial Put Option Price vs sigma for the set = 2

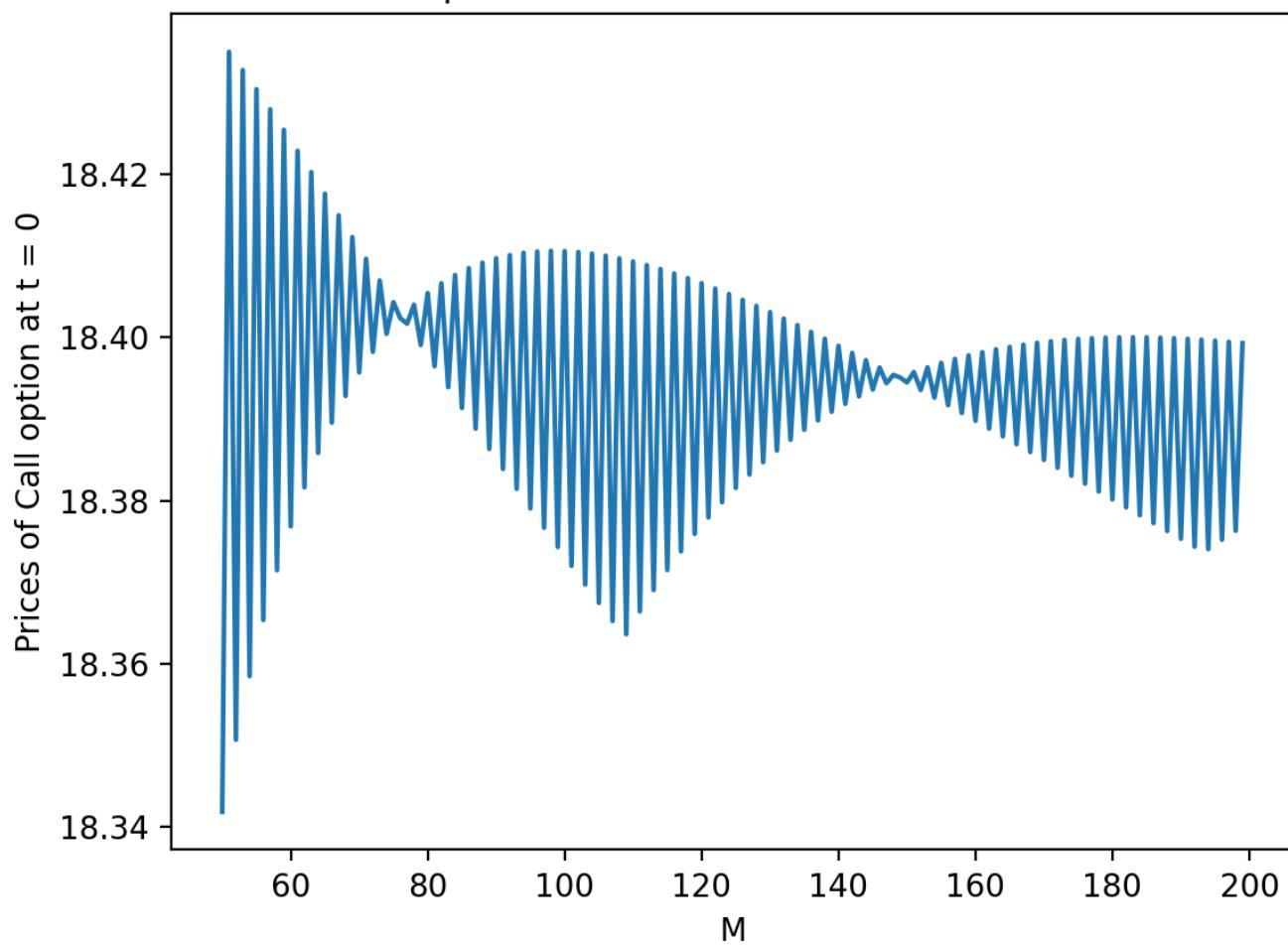


Initial Call Option Price vs M for the set = 1 and K = 95

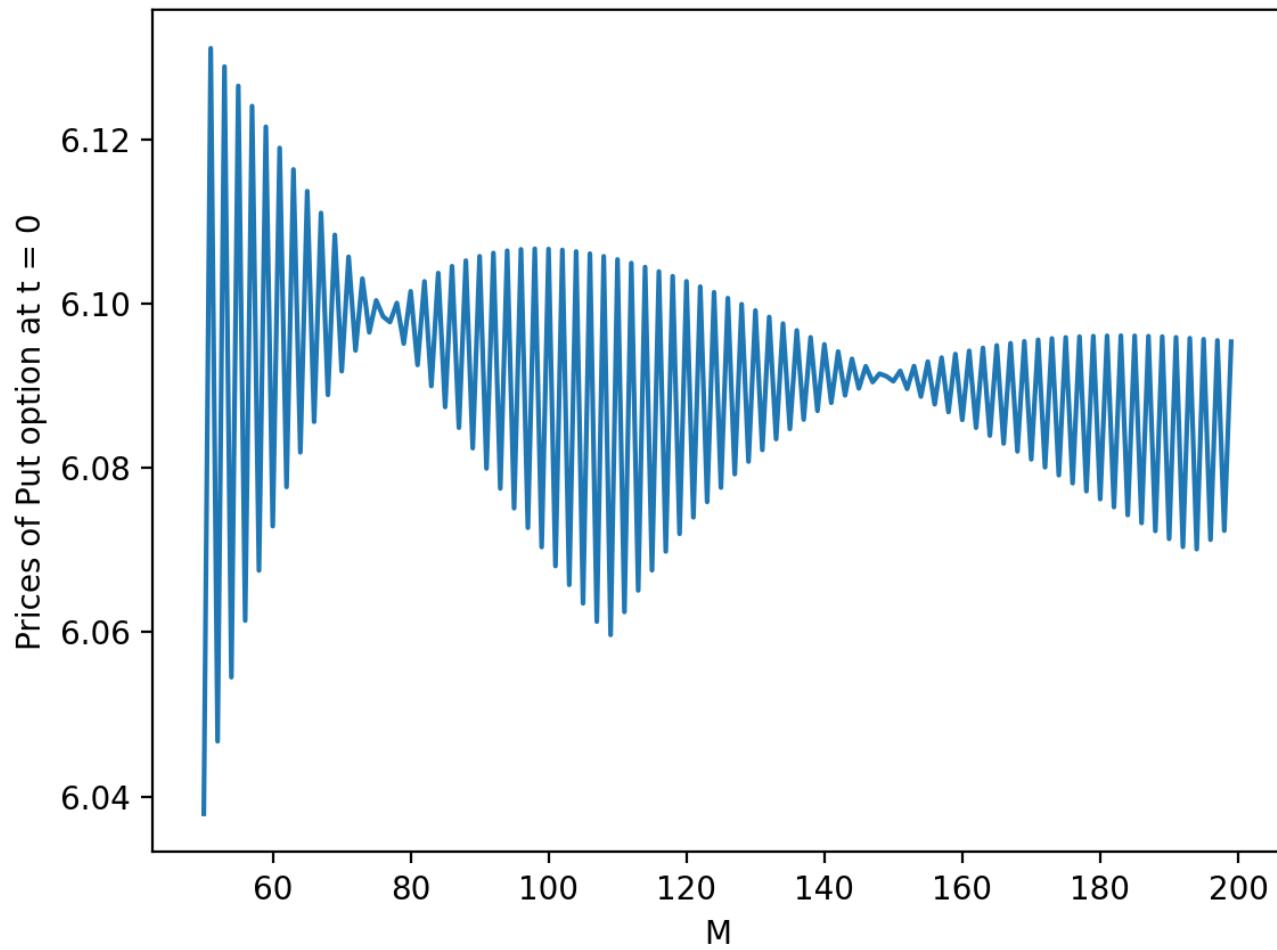




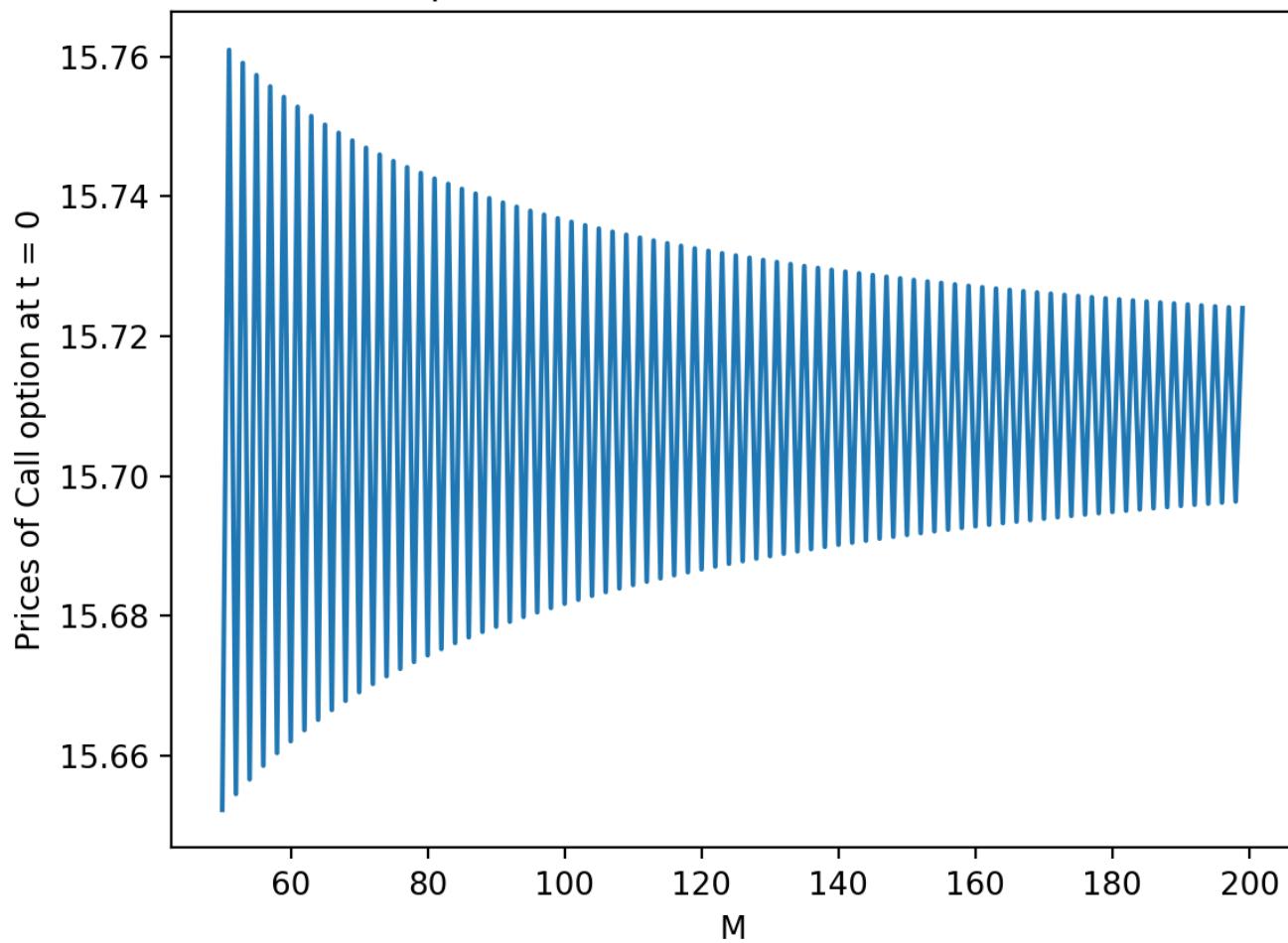
Initial Call Option Price vs M for the set = 2 and K = 95



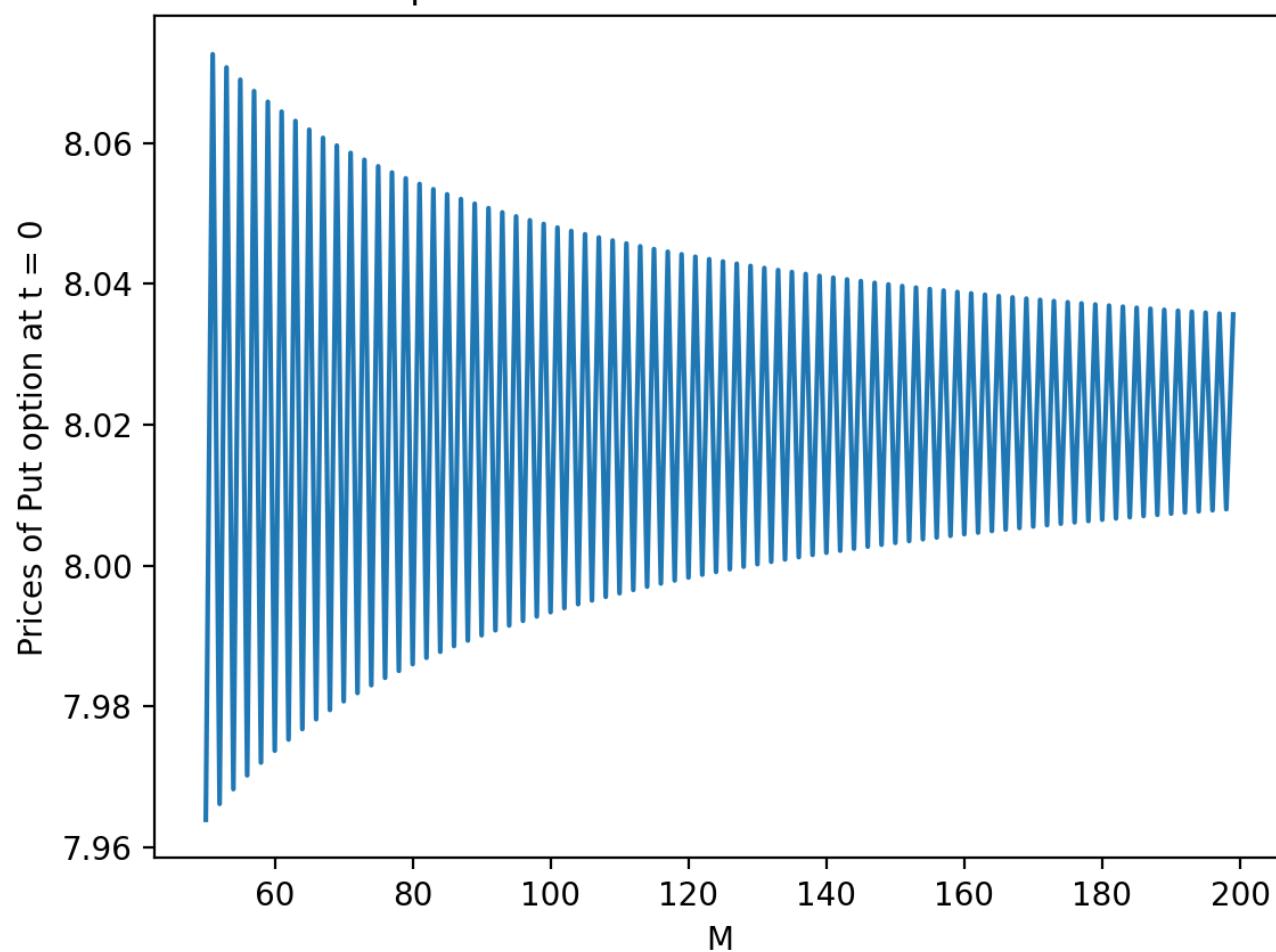
Initial Put Option Price vs M for the set = 2 and K = 95



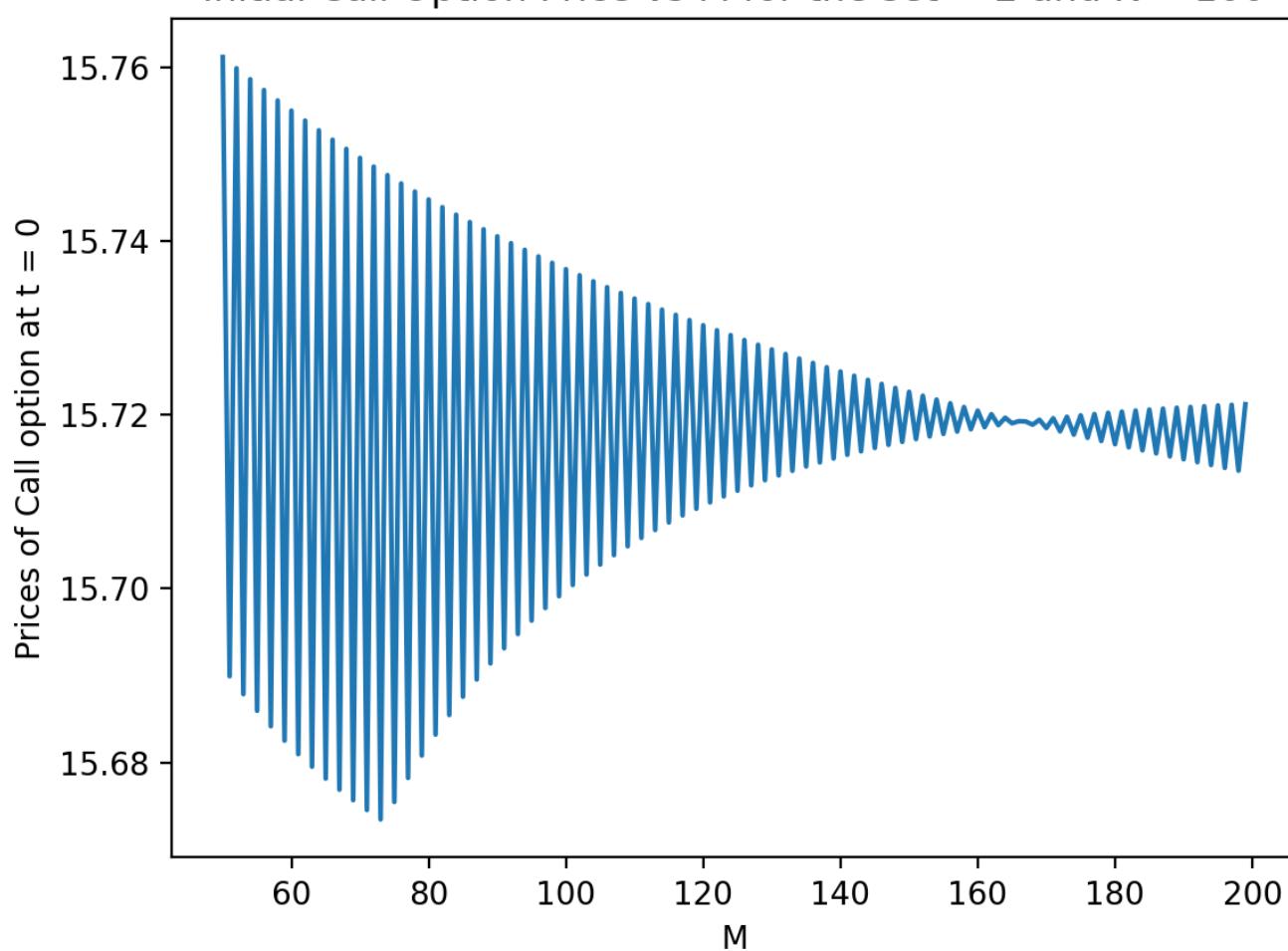
Initial Call Option Price vs M for the set = 1 and K = 100



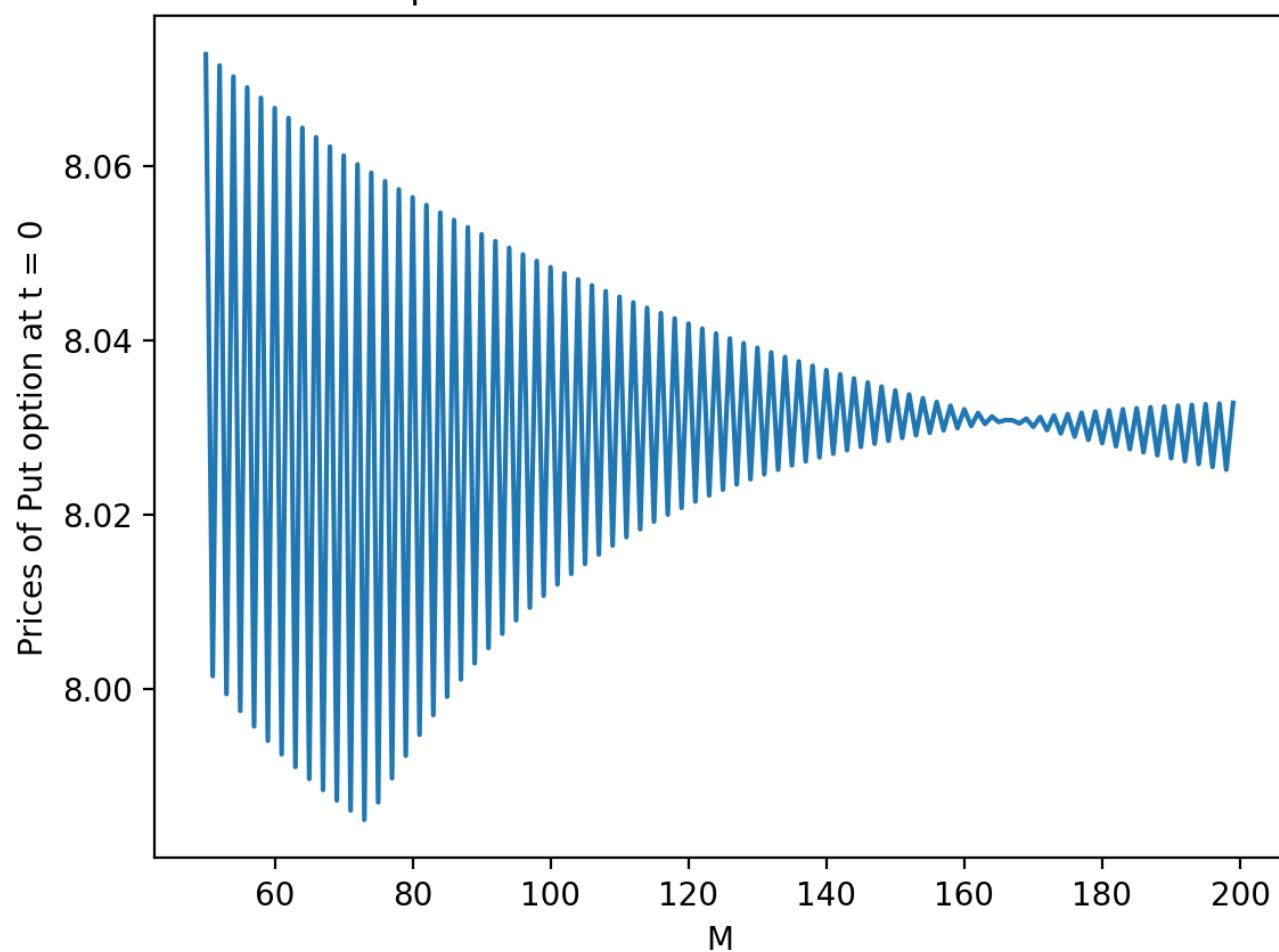
Initial Put Option Price vs M for the set = 1 and K = 100

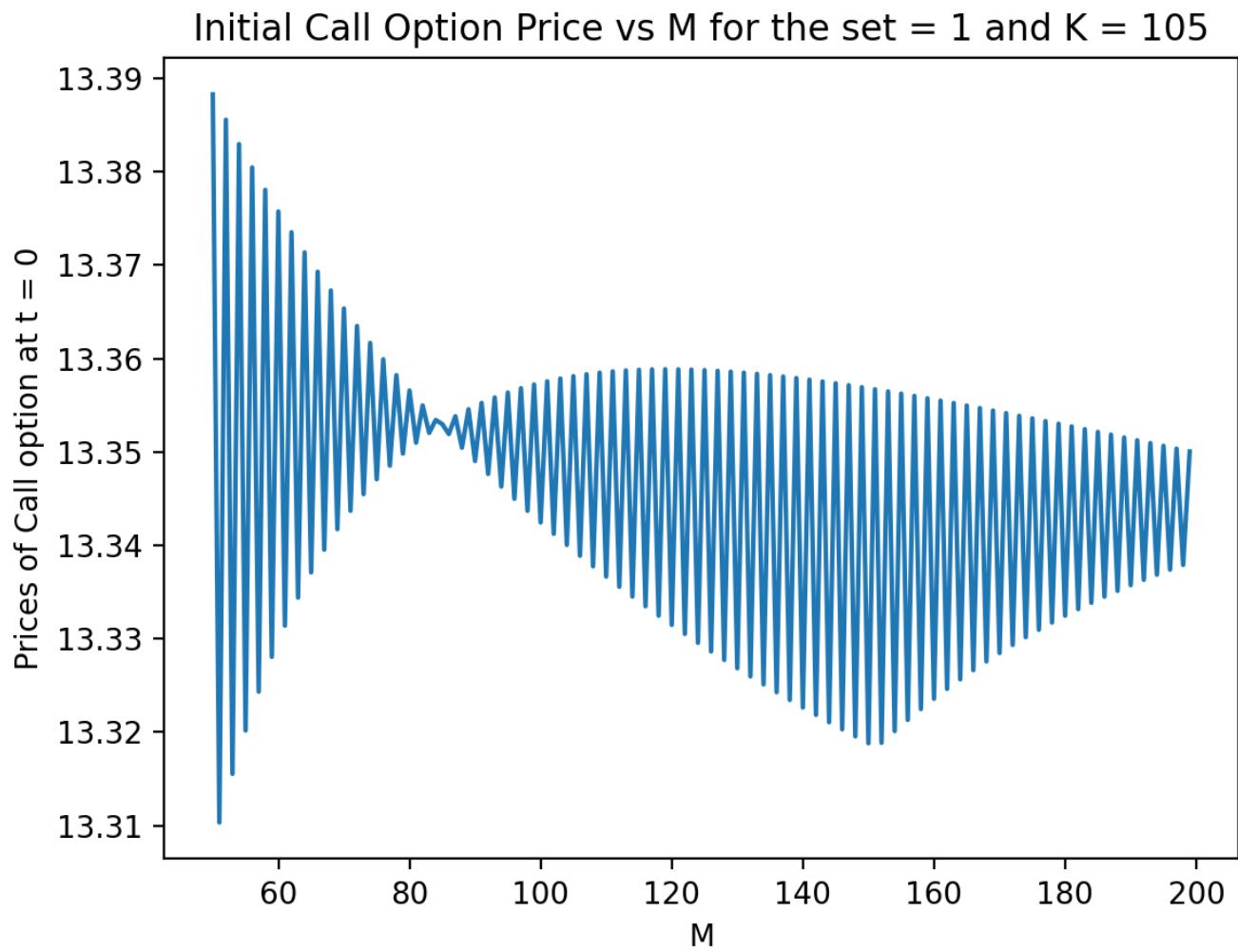


Initial Call Option Price vs M for the set = 2 and K = 100

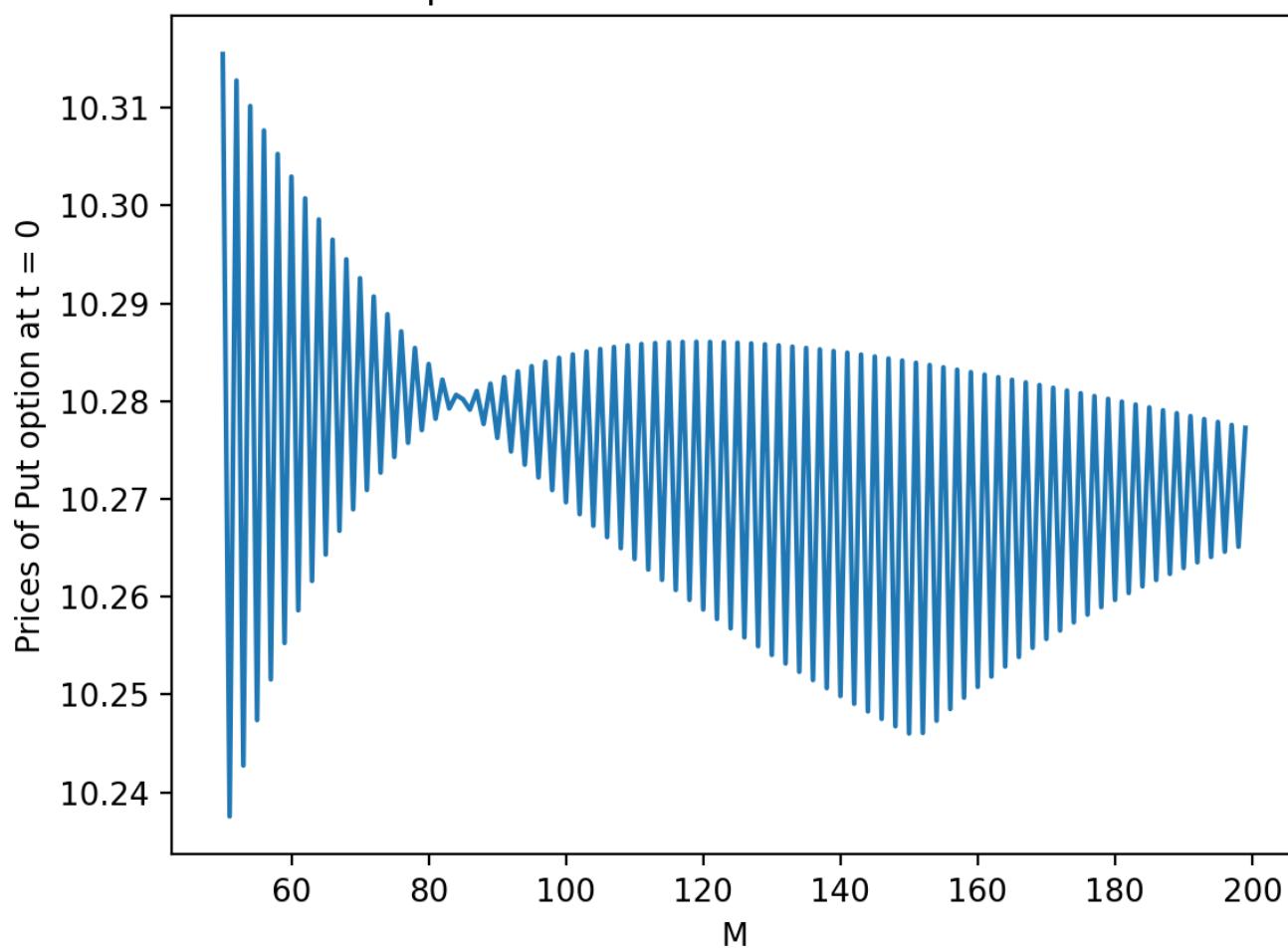


Initial Put Option Price vs M for the set = 2 and K = 100

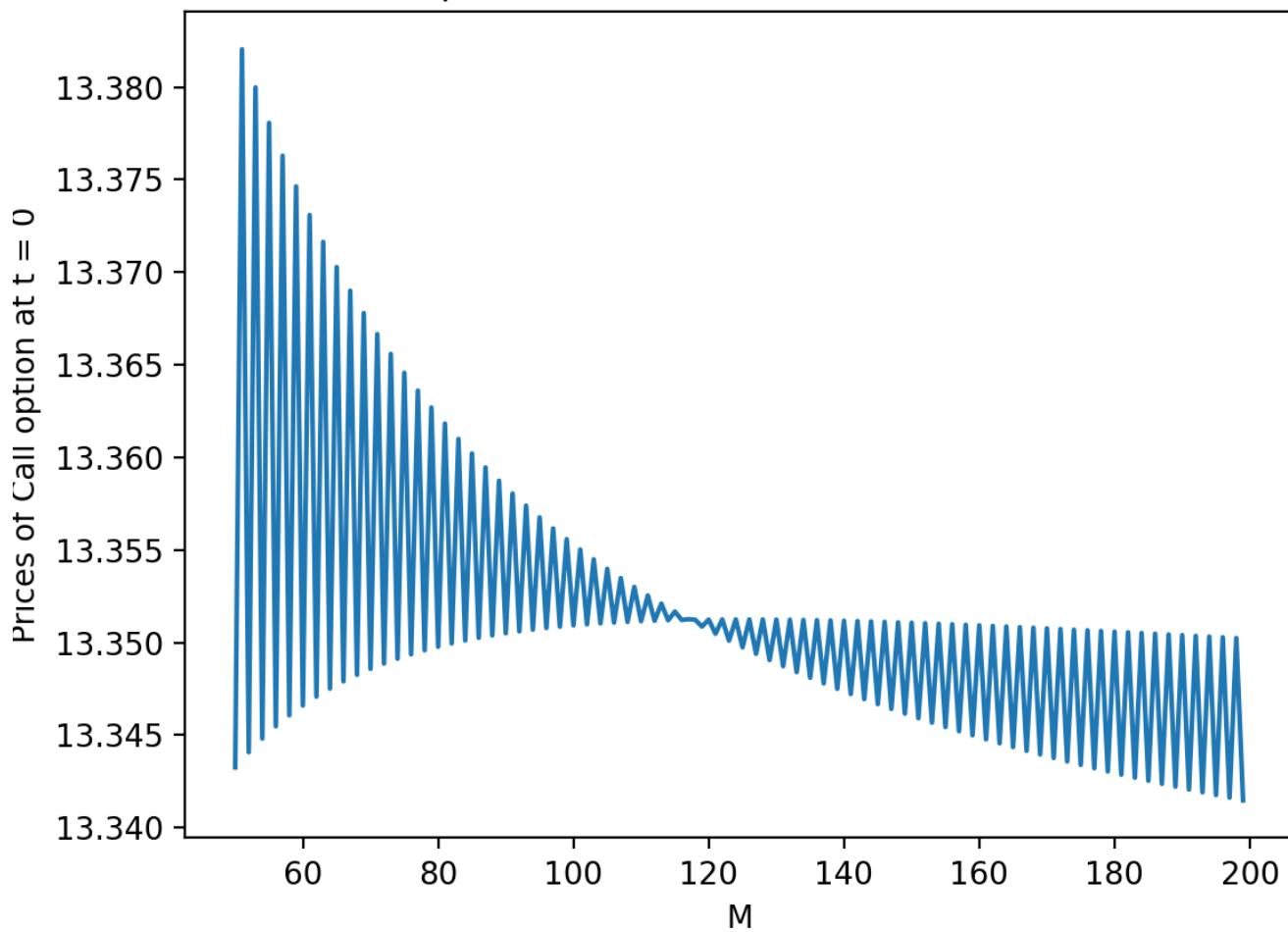




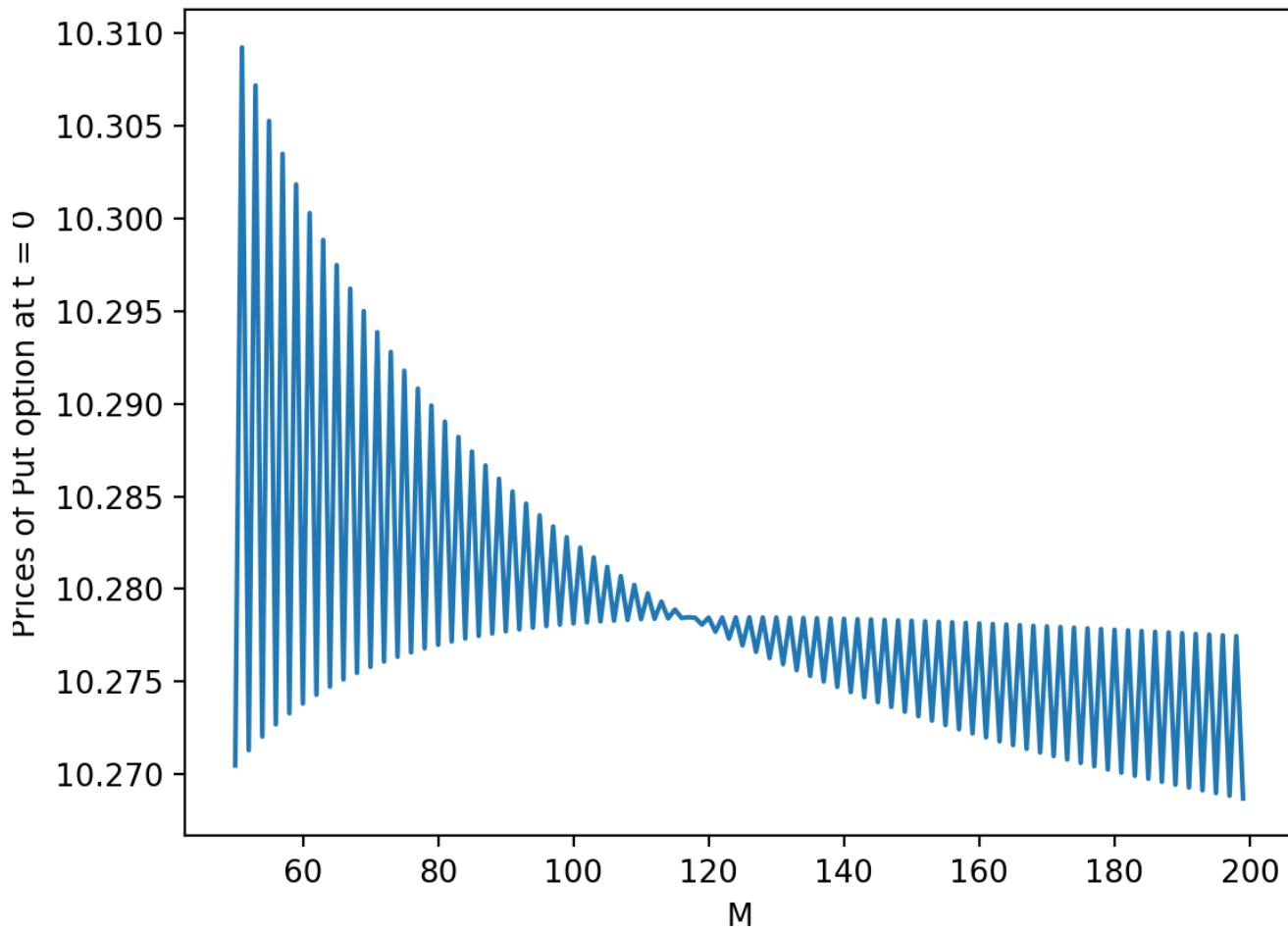
Initial Put Option Price vs M for the set = 1 and K = 105



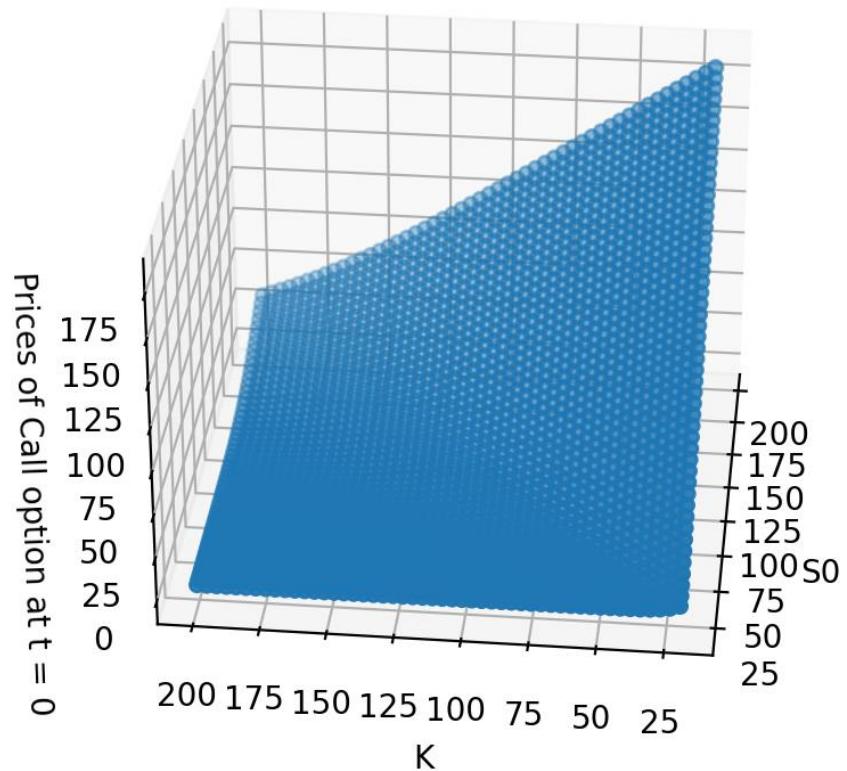
Initial Call Option Price vs M for the set = 2 and K = 105



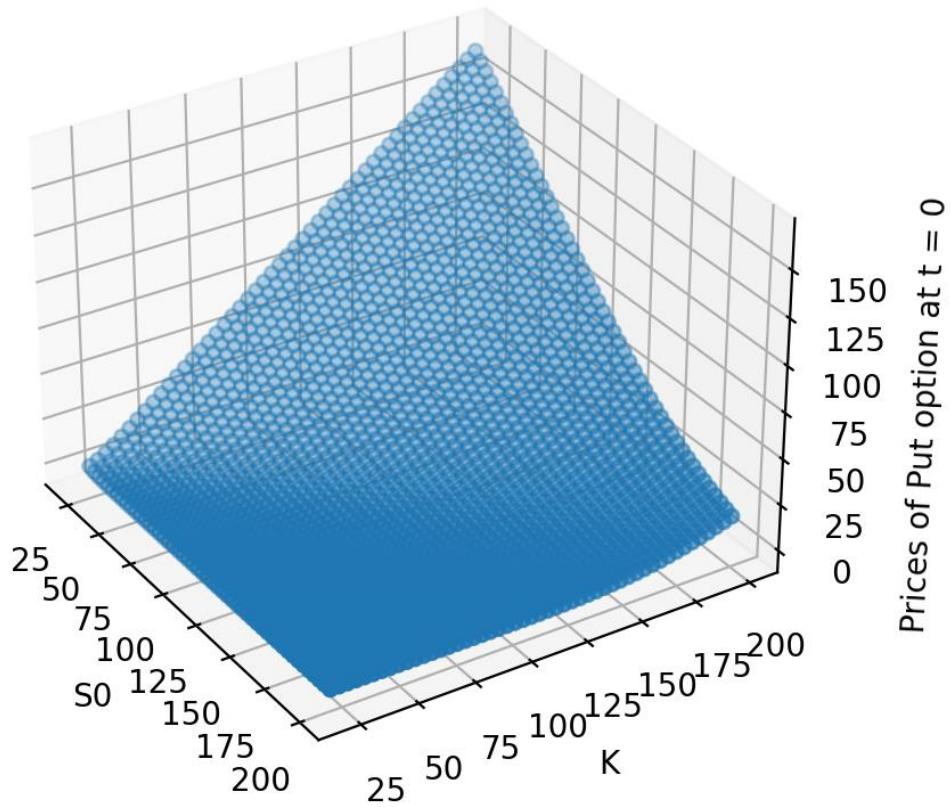
Initial Put Option Price vs M for the set = 2 and K = 105



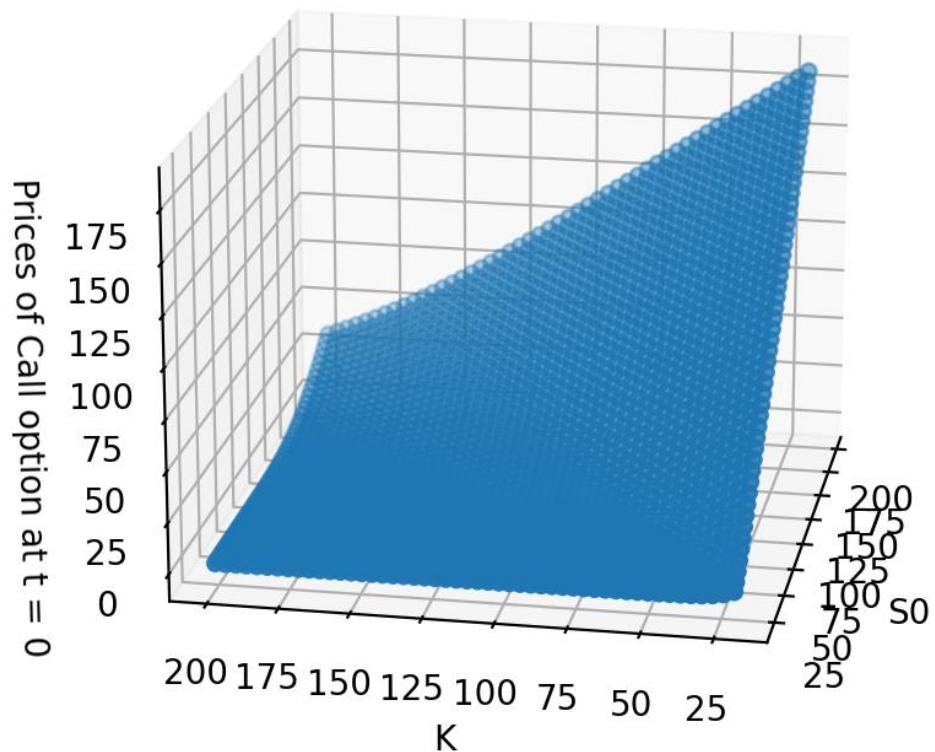
Initial Call Option Price vs S_0 and K for the set = 1



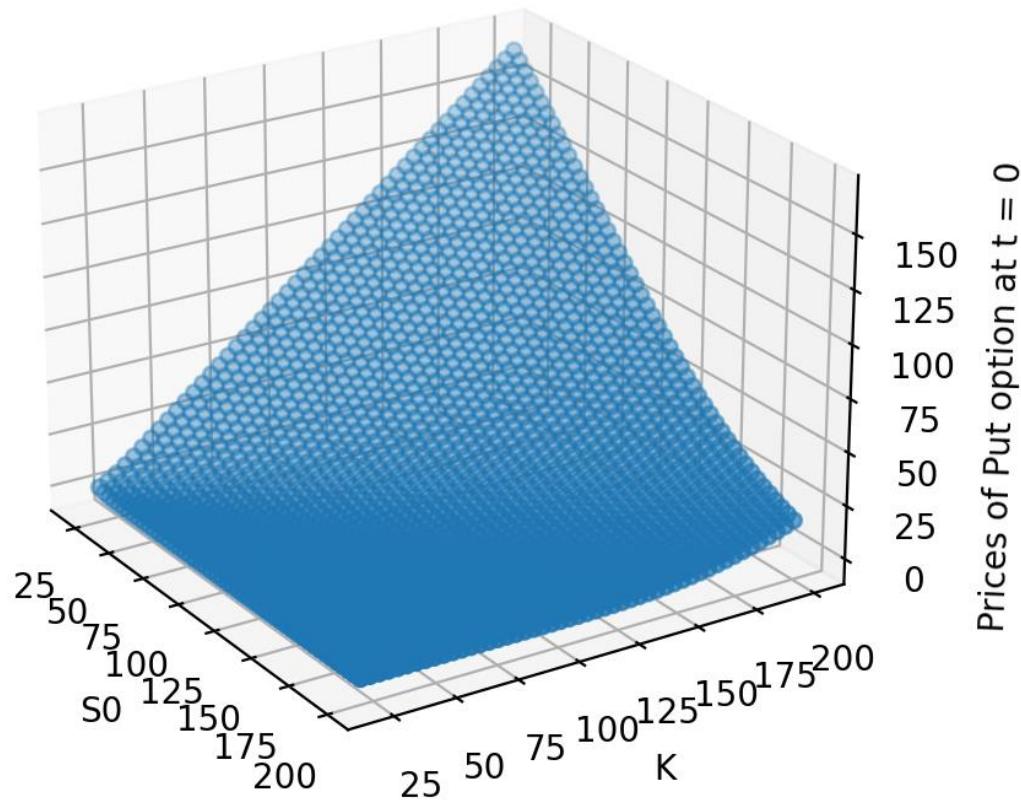
Initial Put Option Price vs S_0 and K for the set = 1



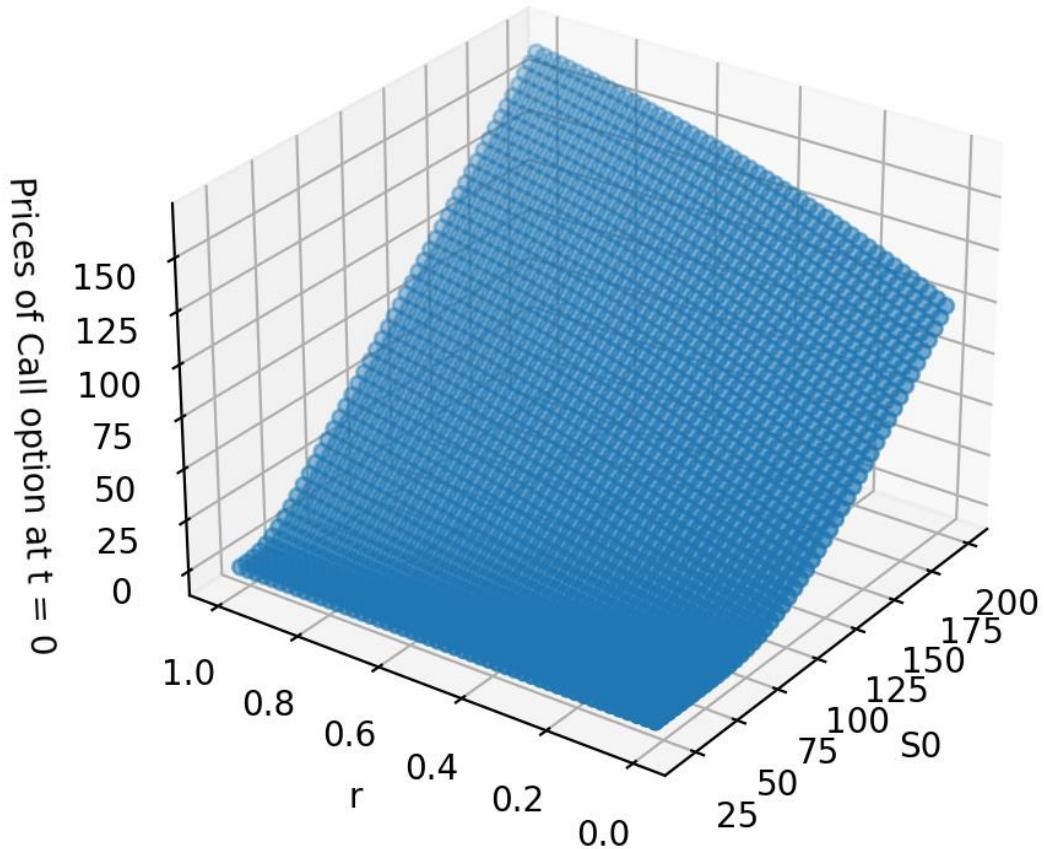
Initial Call Option Price vs S_0 and K for the set = 2



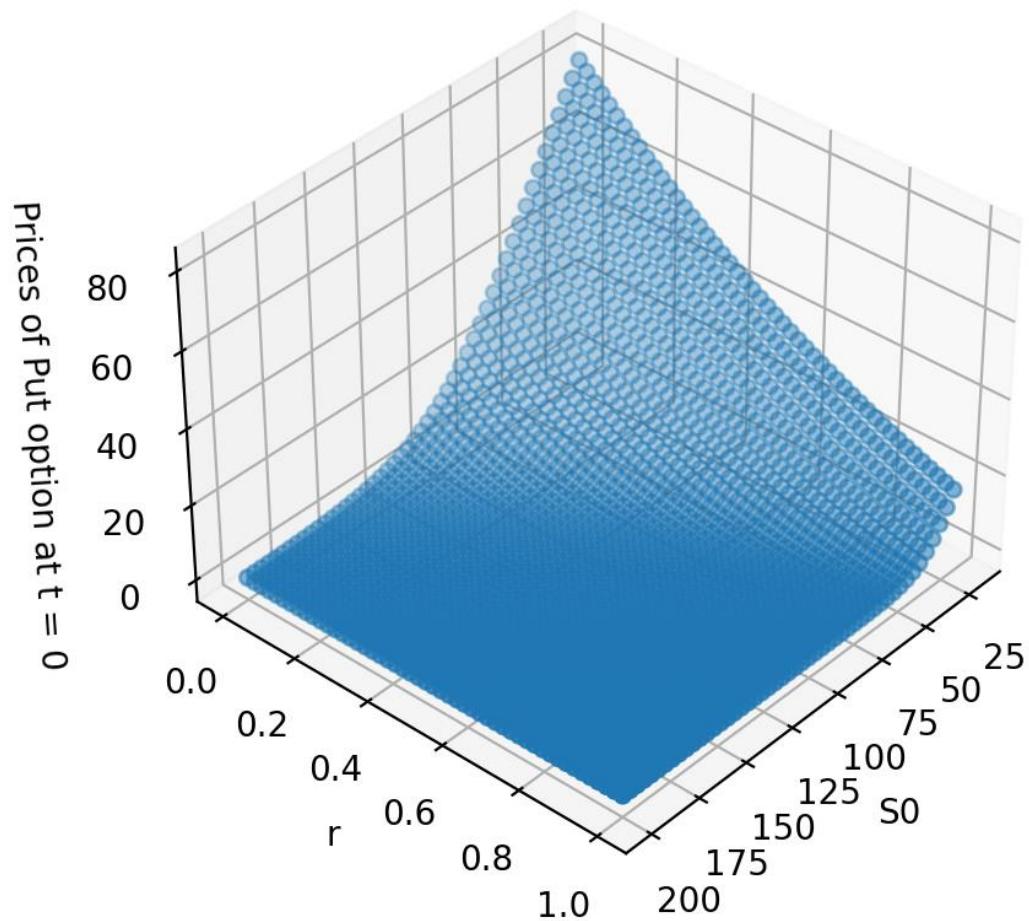
Initial Put Option Price vs S_0 and K for the set = 2



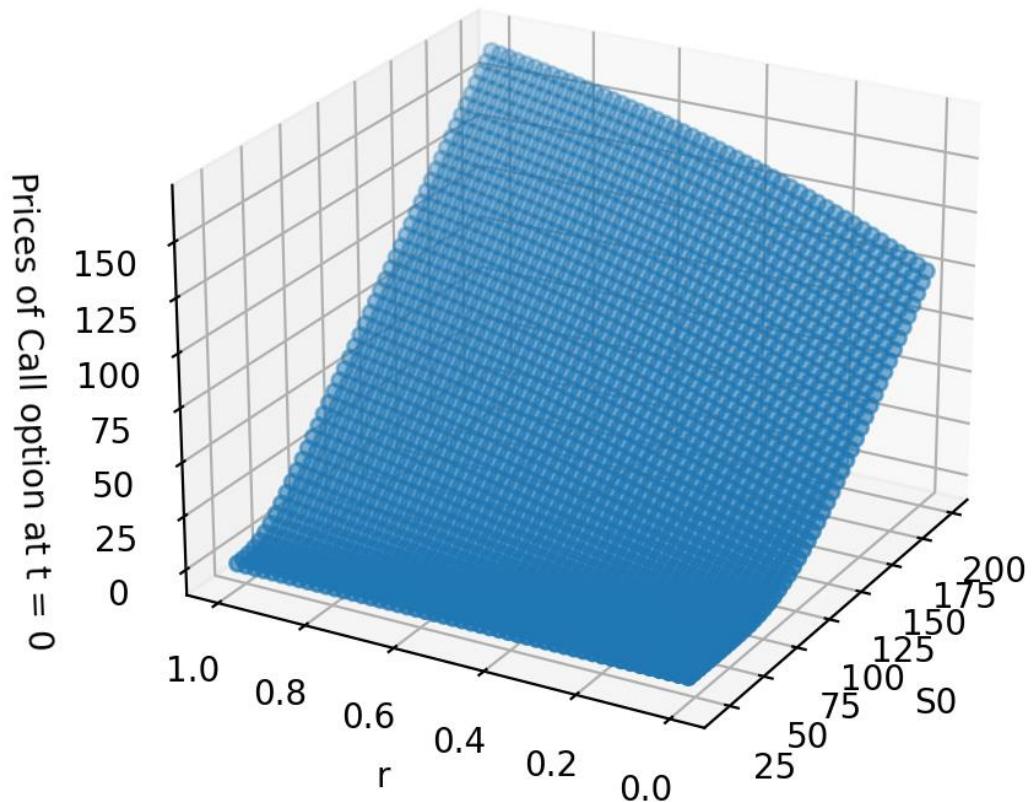
Initial Call Option Price vs S_0 and r for the set = 1



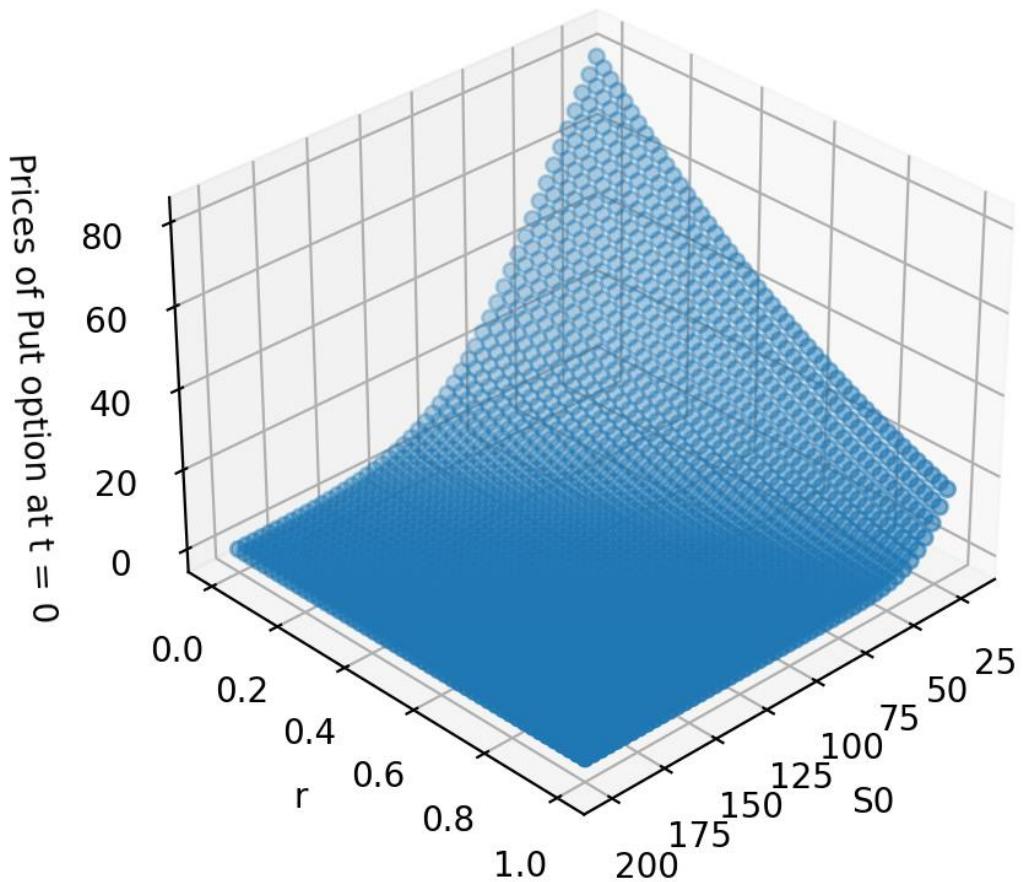
Initial Put Option Price vs S_0 and r for the set = 1



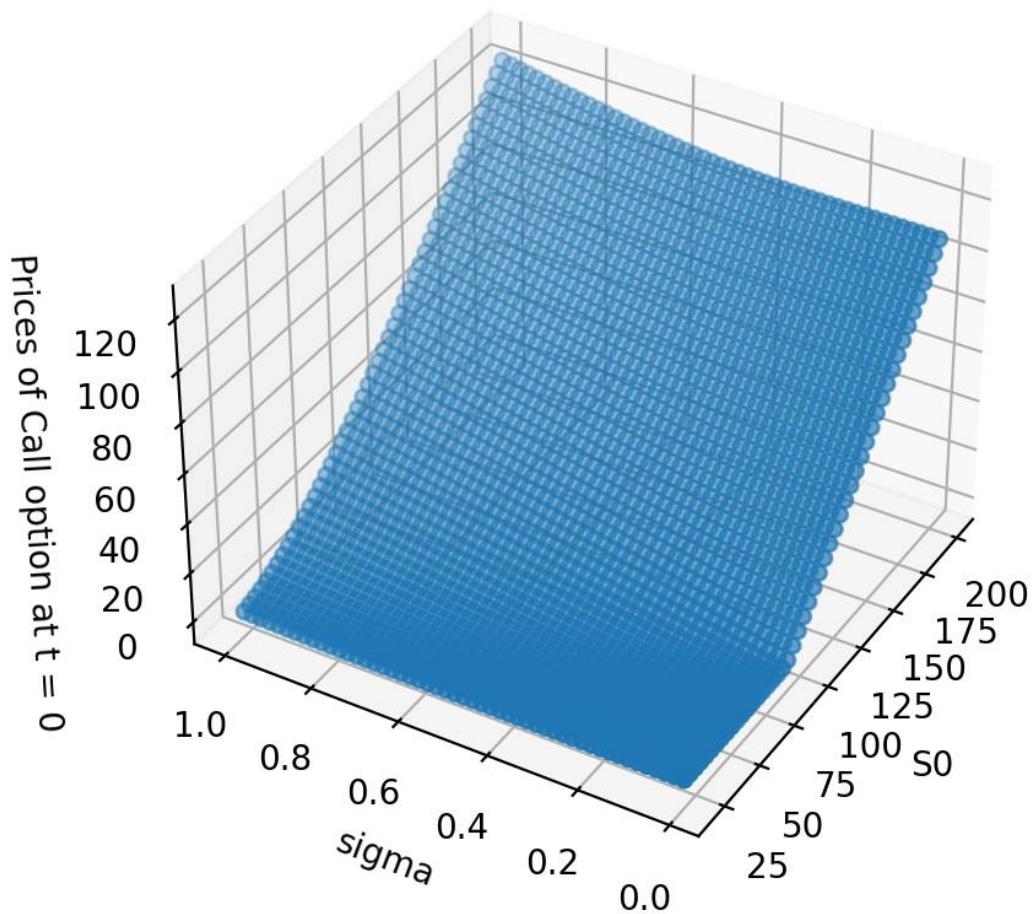
Initial Call Option Price vs S_0 and r for the set = 2



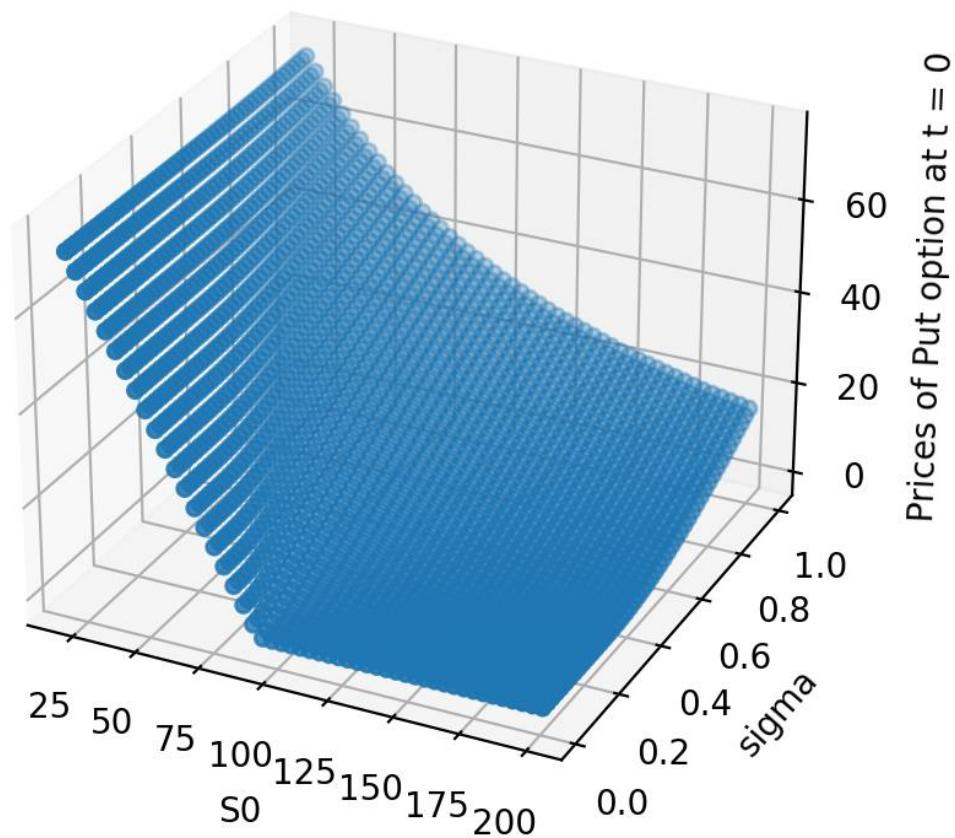
Initial Put Option Price vs S_0 and r for the set = 2



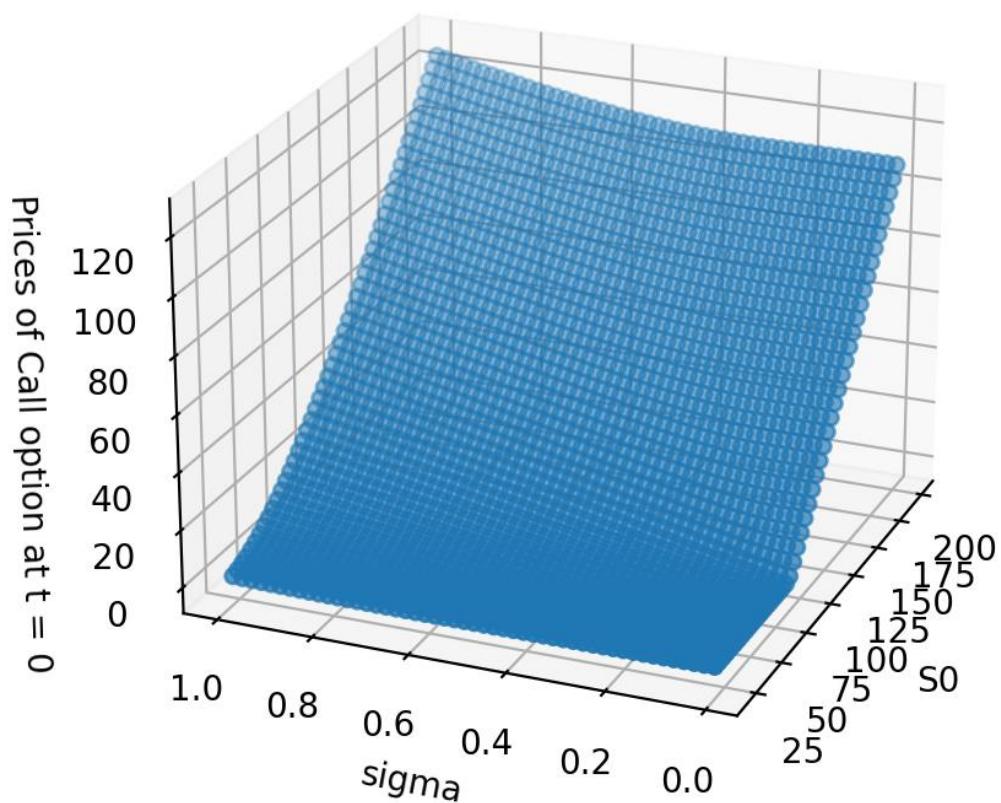
Initial Call Option Price vs S_0 and σ for the set = 1



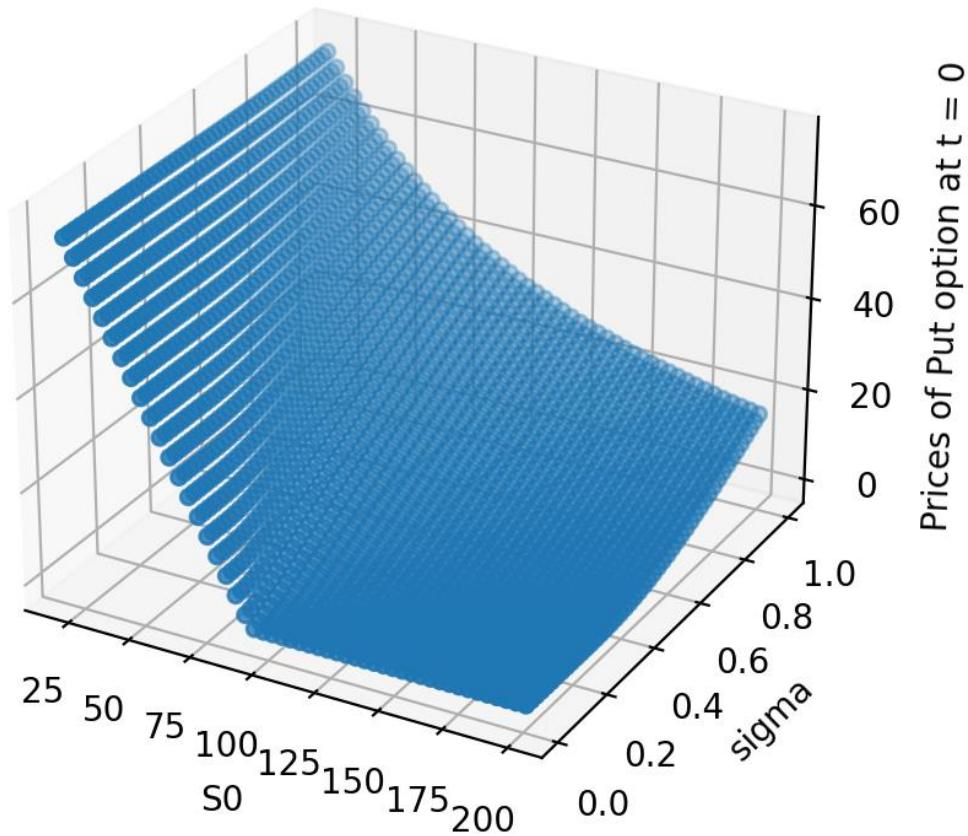
Initial Put Option Price vs S_0 and sigma for the set = 1



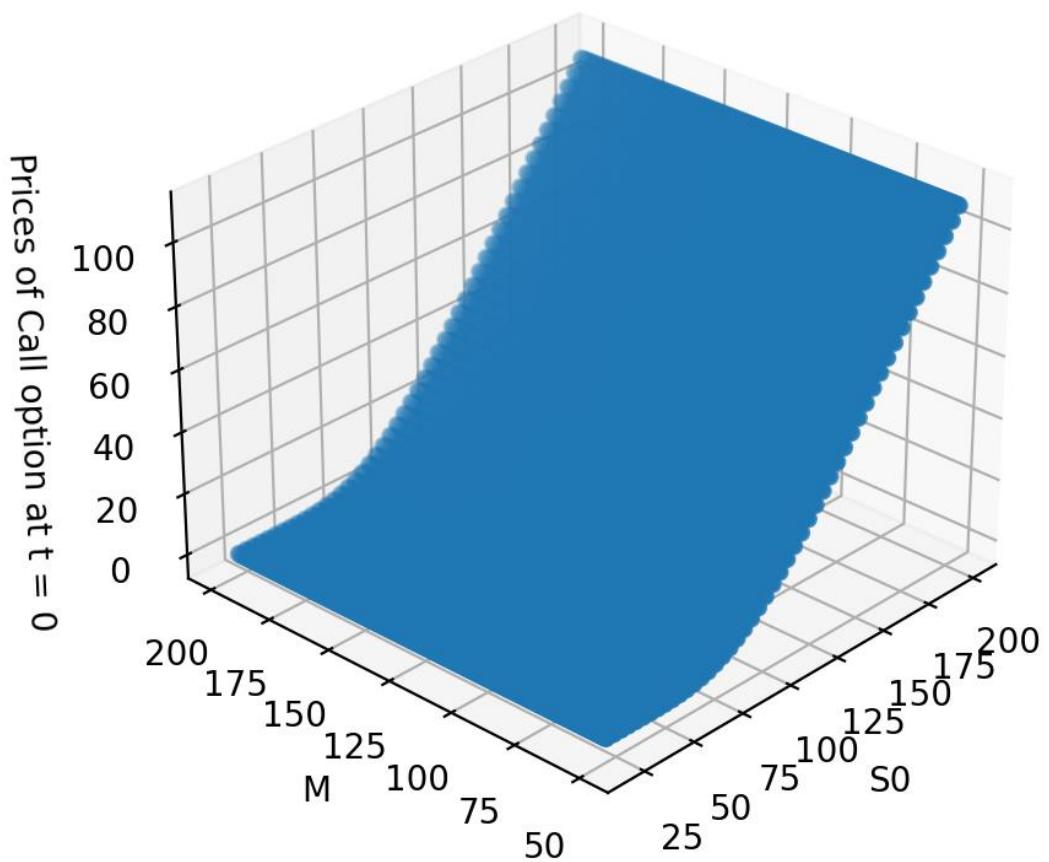
Initial Call Option Price vs S_0 and σ for the set = 2



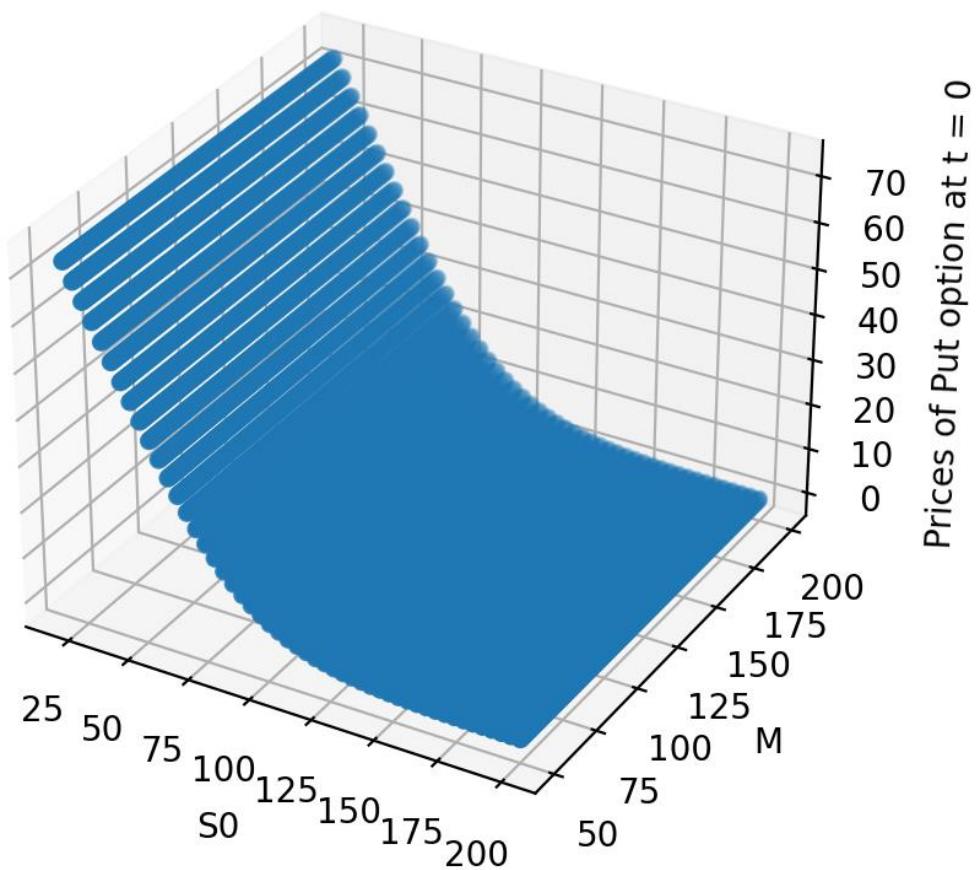
Initial Put Option Price vs S_0 and sigma for the set = 2



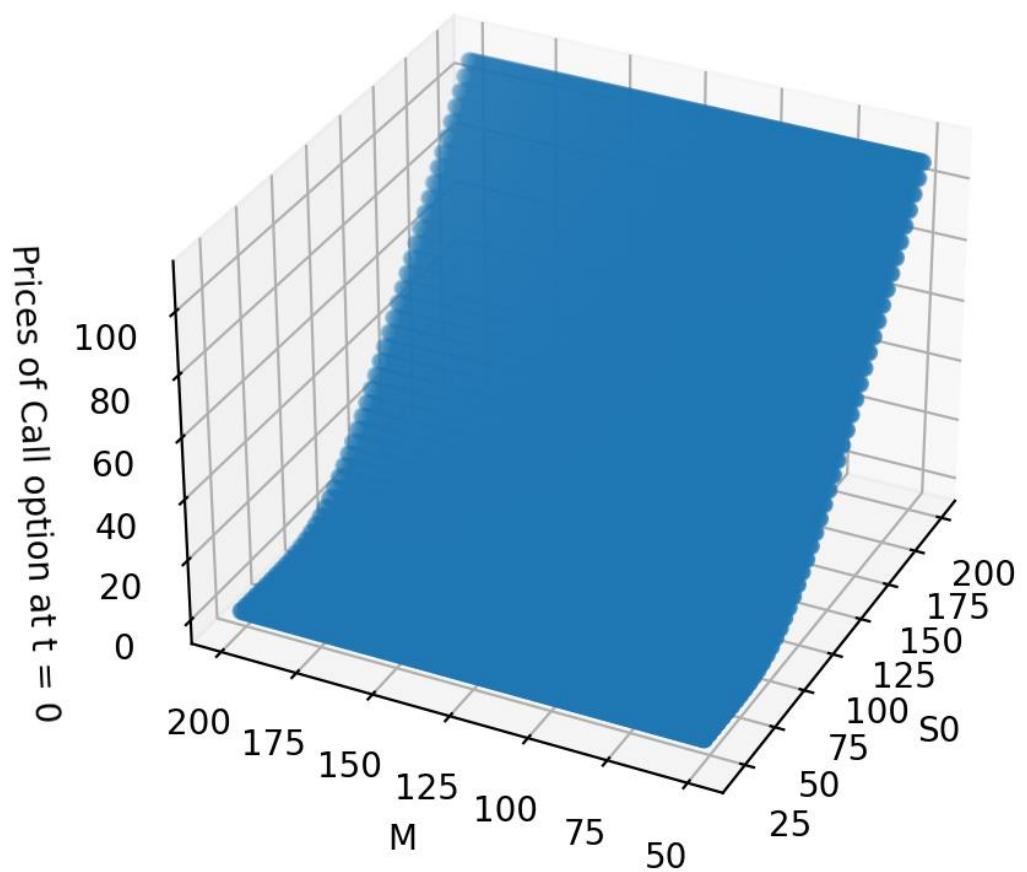
Initial Call Option Price vs S_0 and M for the set = 1



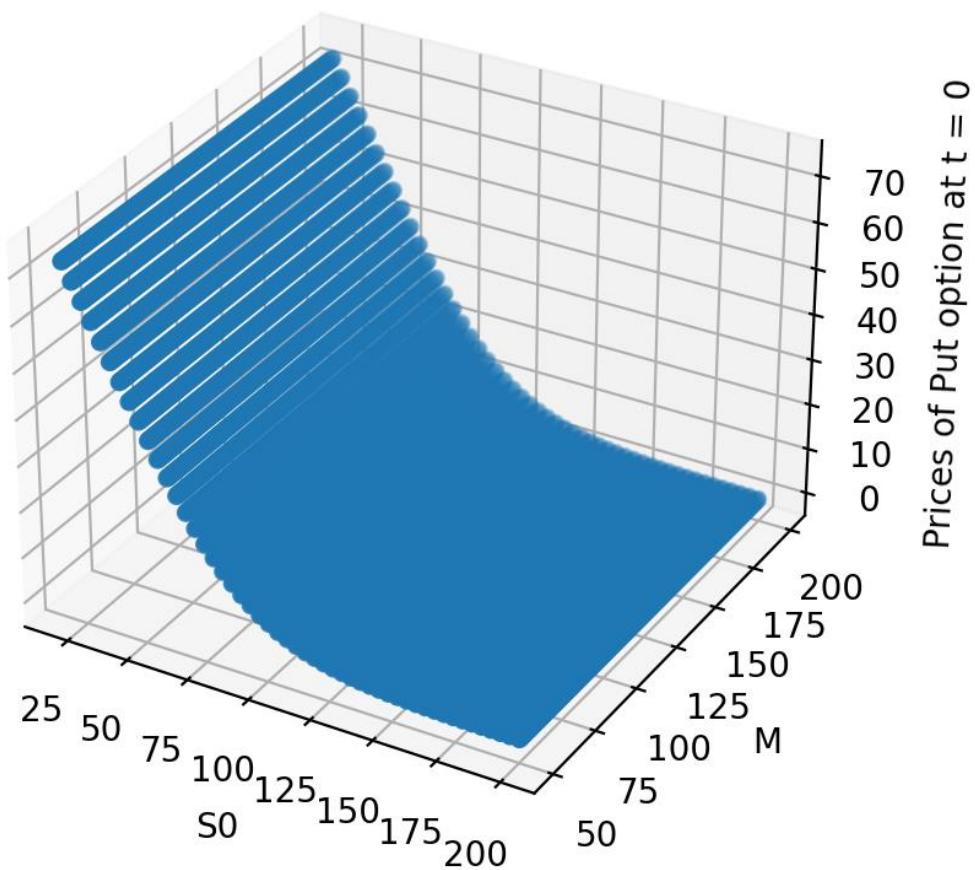
Initial Put Option Price vs S_0 and M for the set = 1



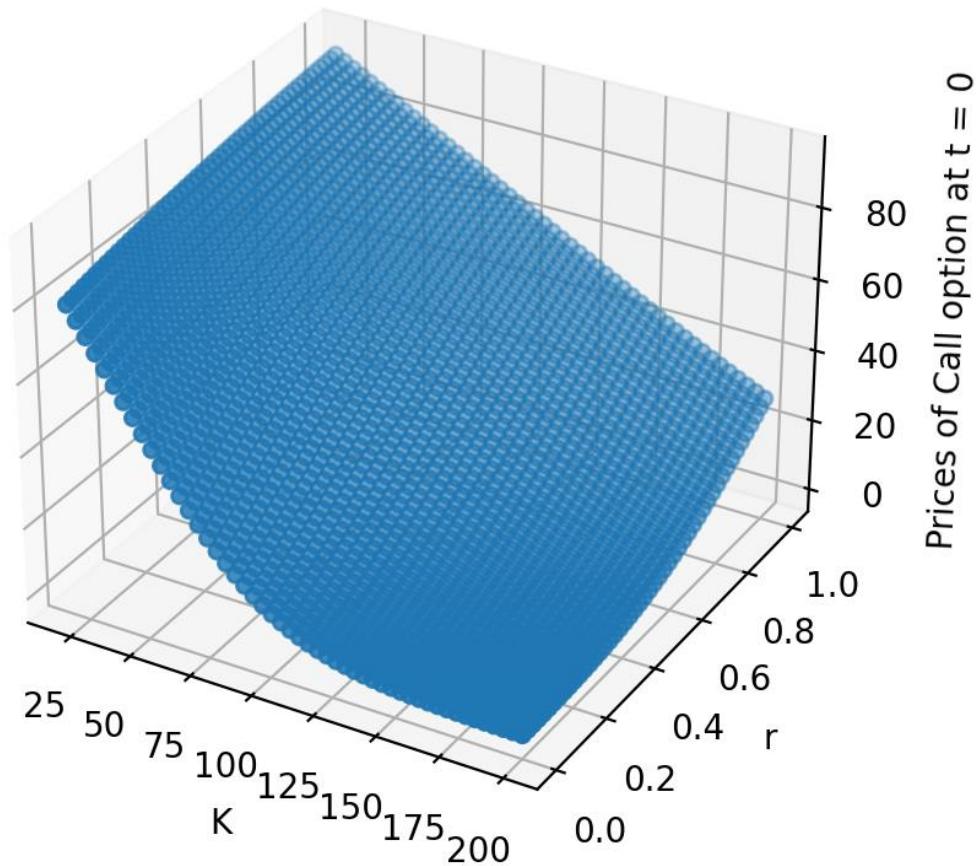
Initial Call Option Price vs S_0 and M for the set = 2



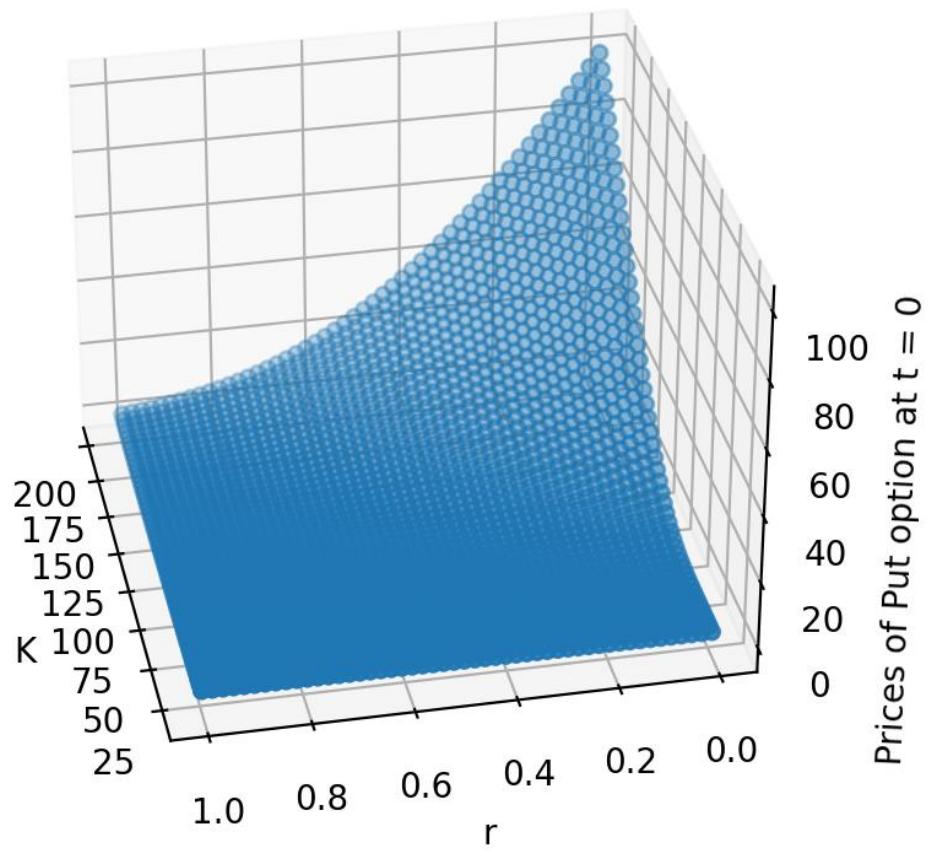
Initial Put Option Price vs S_0 and M for the set = 2



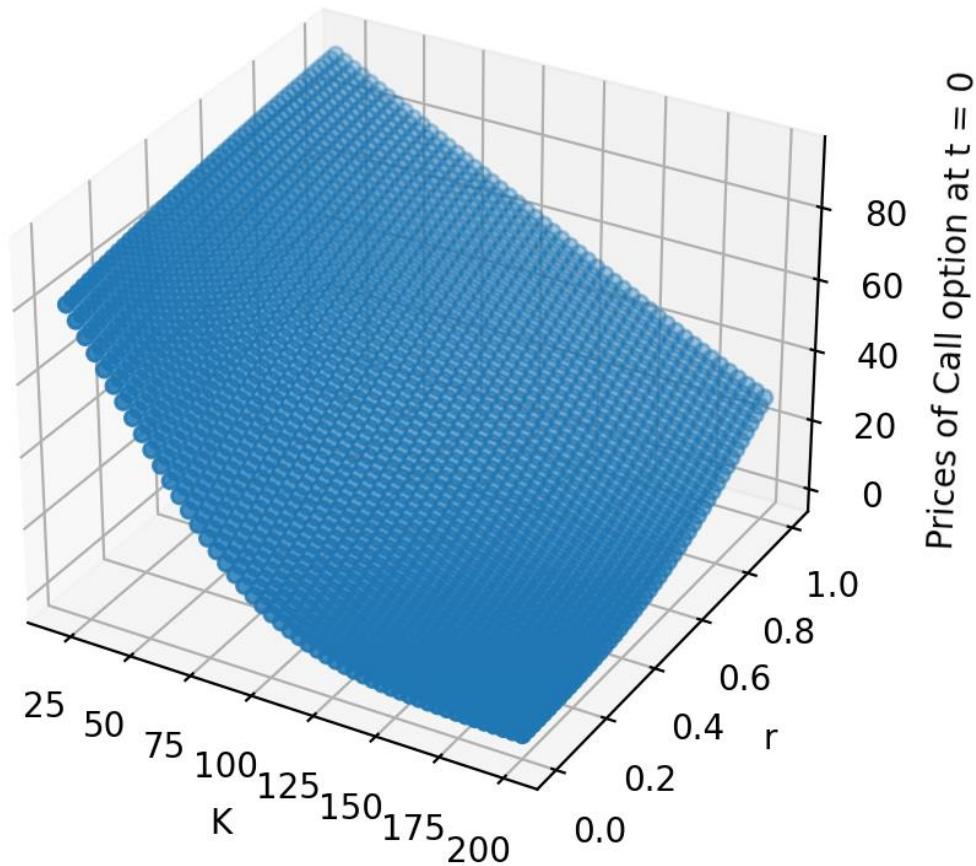
Initial Call Option Price vs K and r for the set = 1



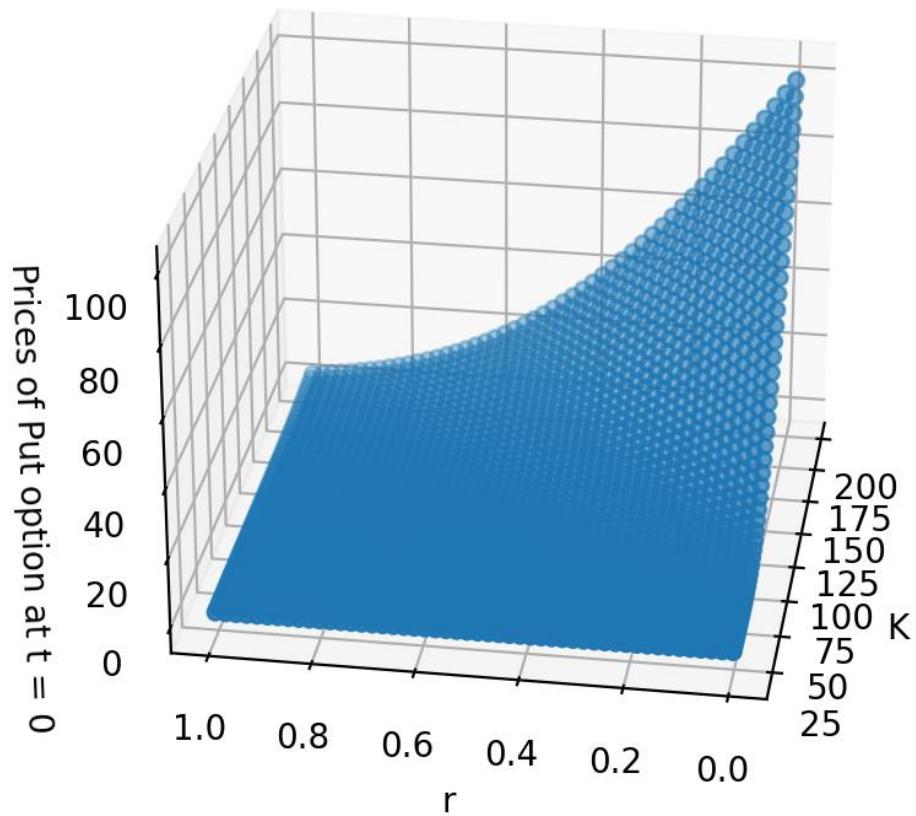
Initial Put Option Price vs K and r for the set = 1



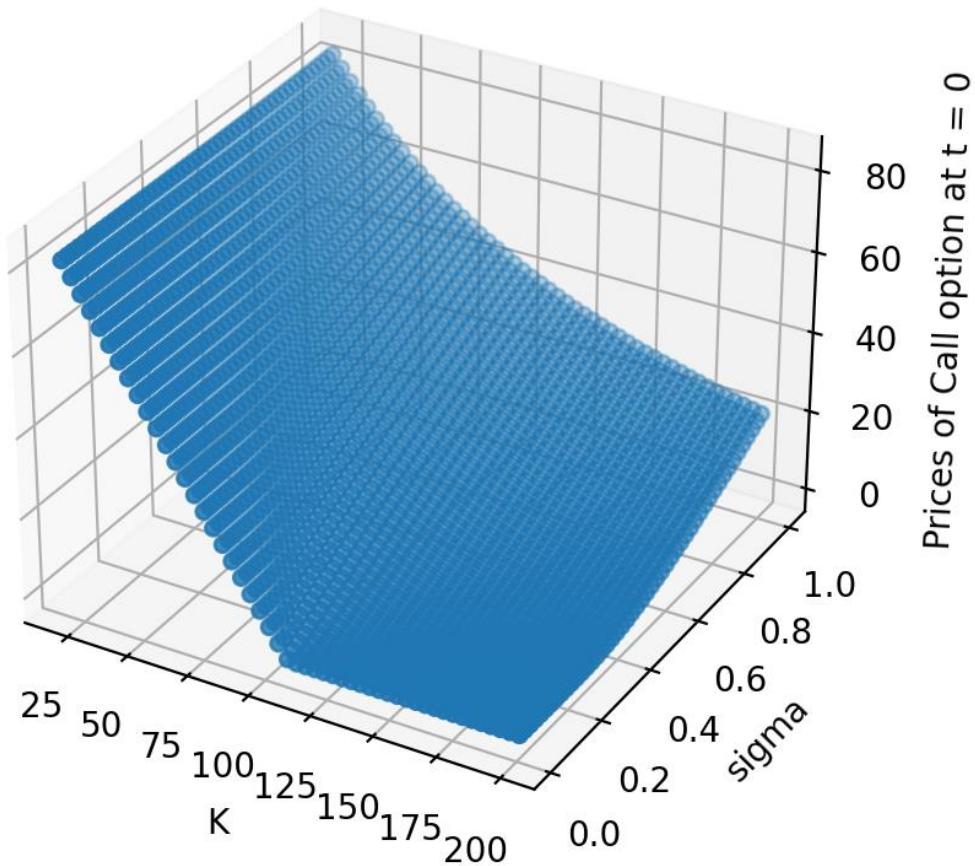
Initial Call Option Price vs K and r for the set = 2



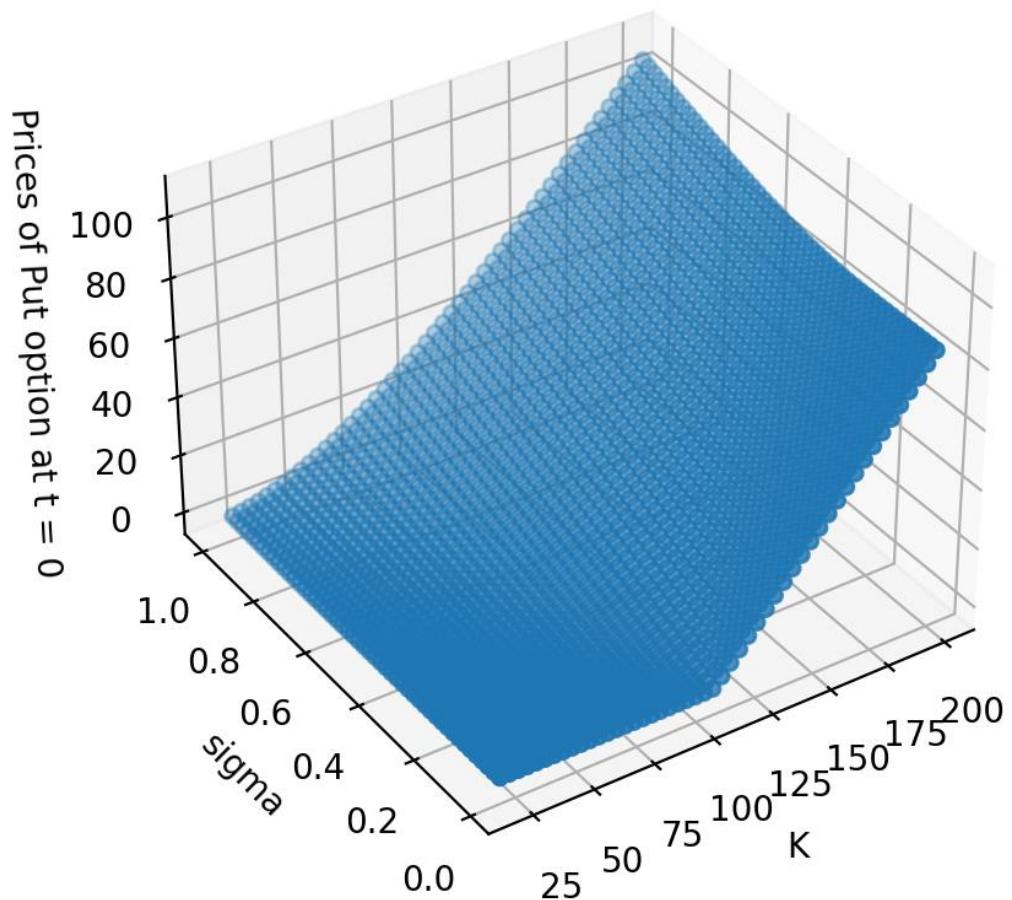
Initial Put Option Price vs K and r for the set = 2



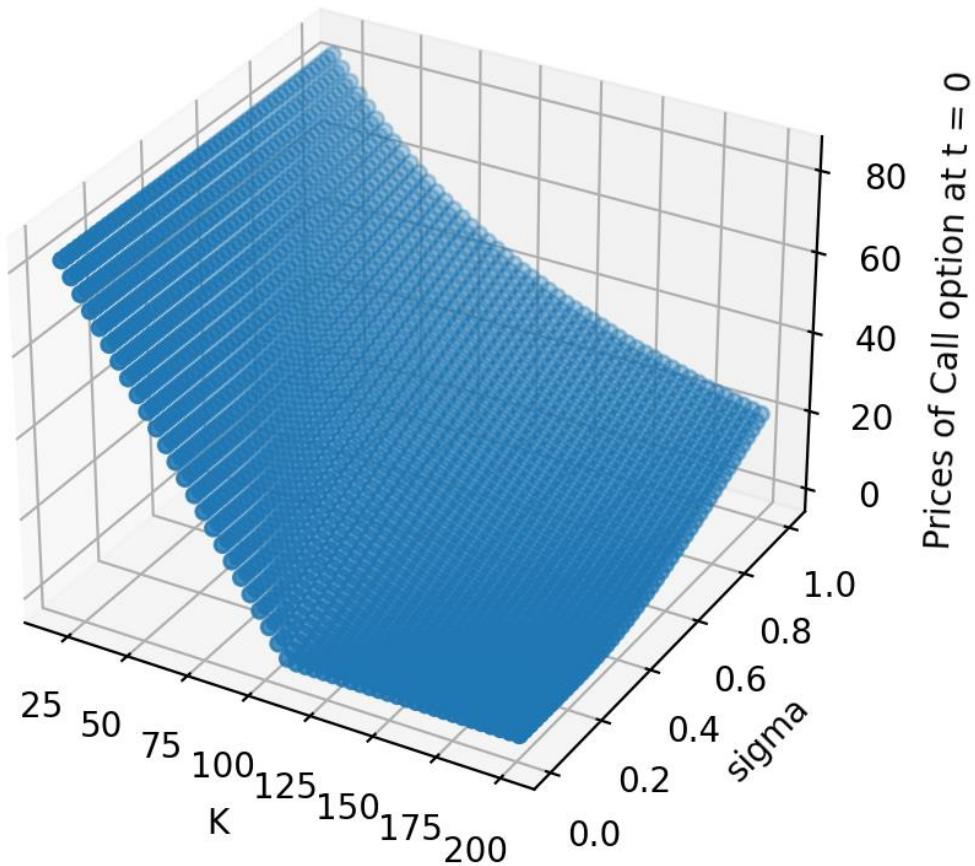
Initial Call Option Price vs K and sigma for the set = 1



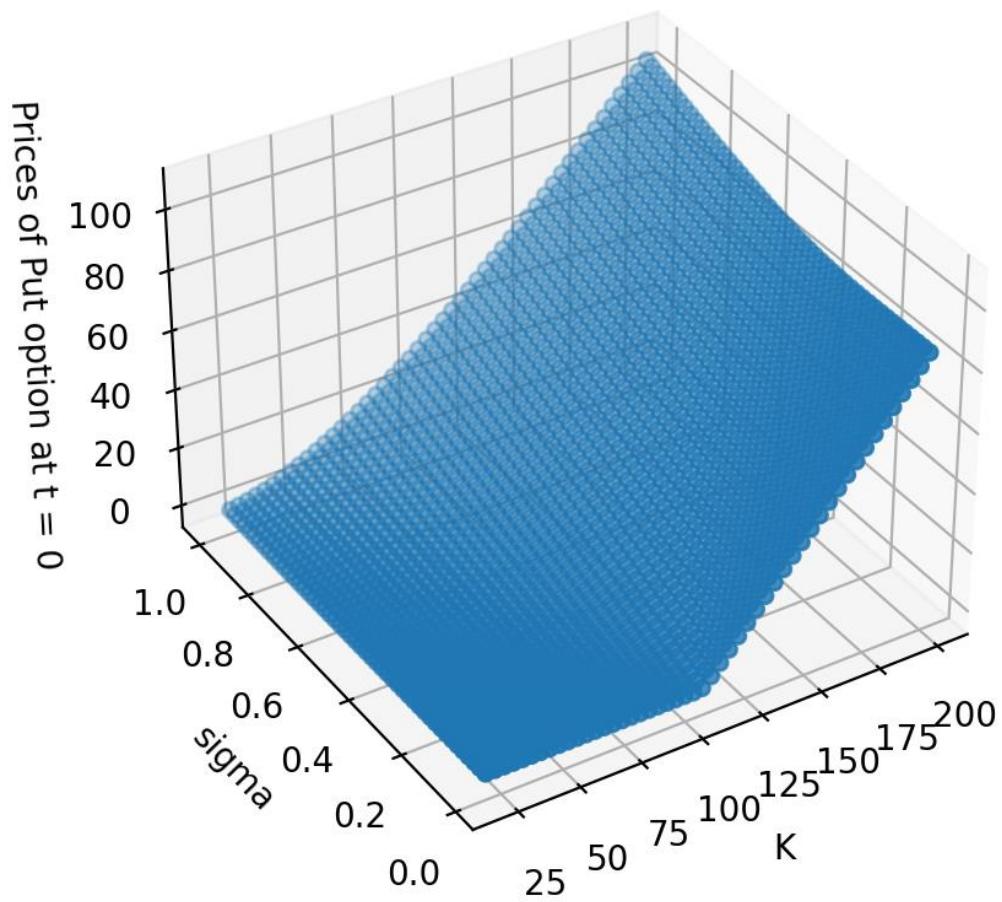
Initial Put Option Price vs K and sigma for the set = 1



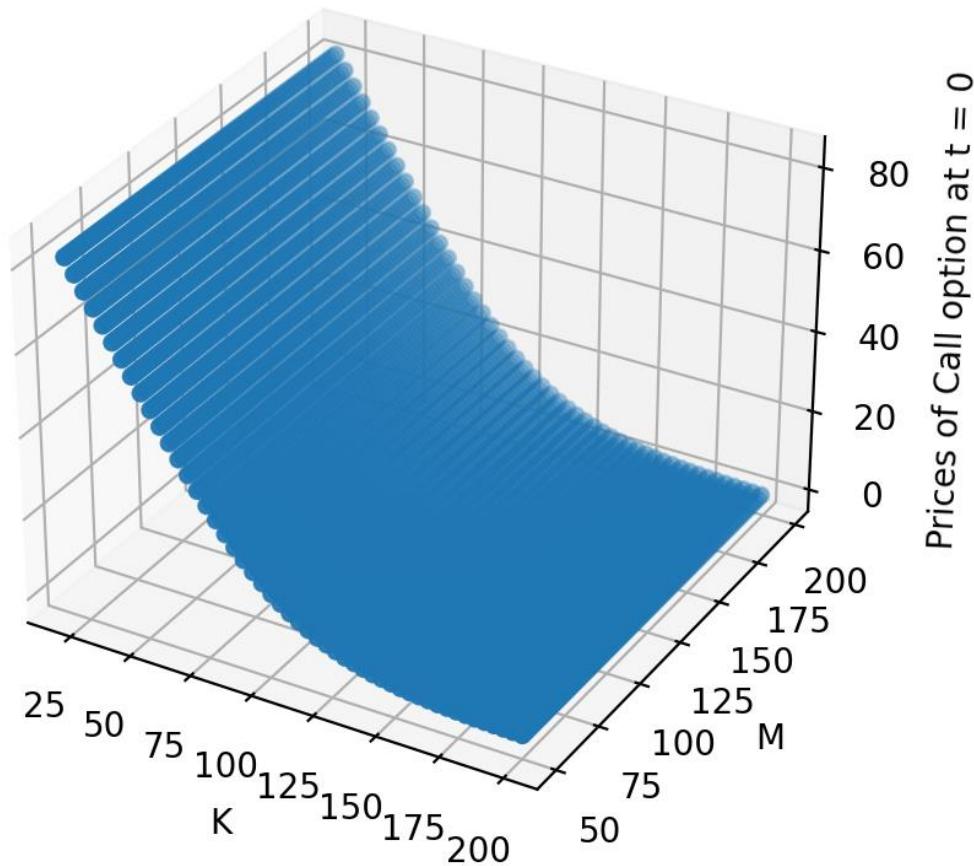
Initial Call Option Price vs K and sigma for the set = 2



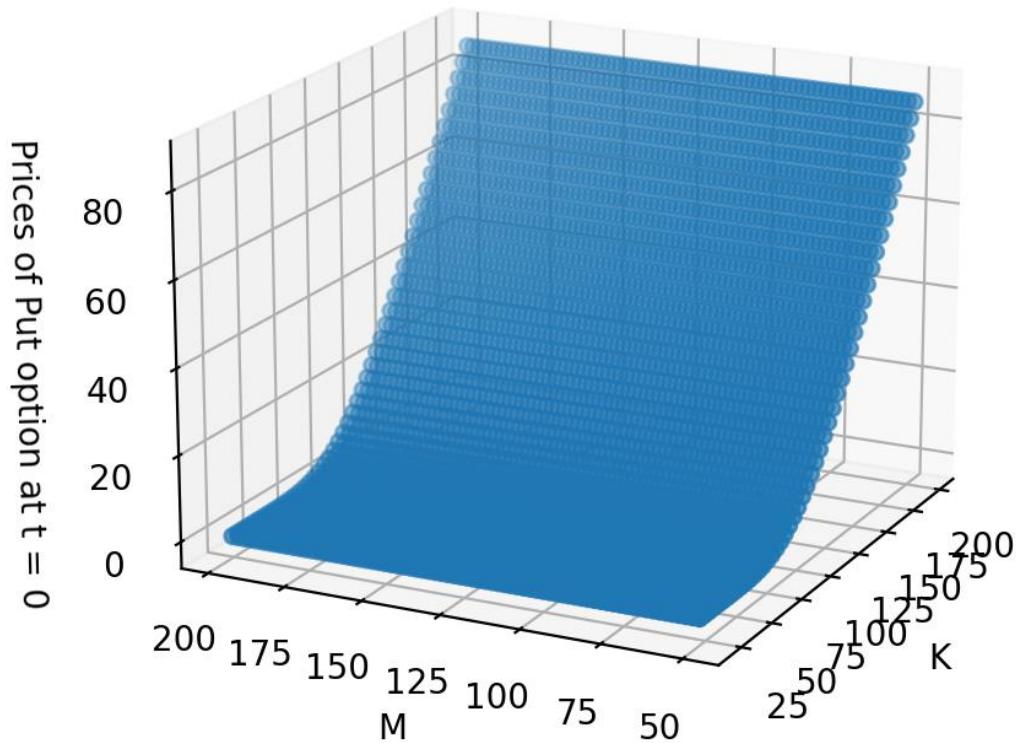
Initial Put Option Price vs K and sigma for the set = 2



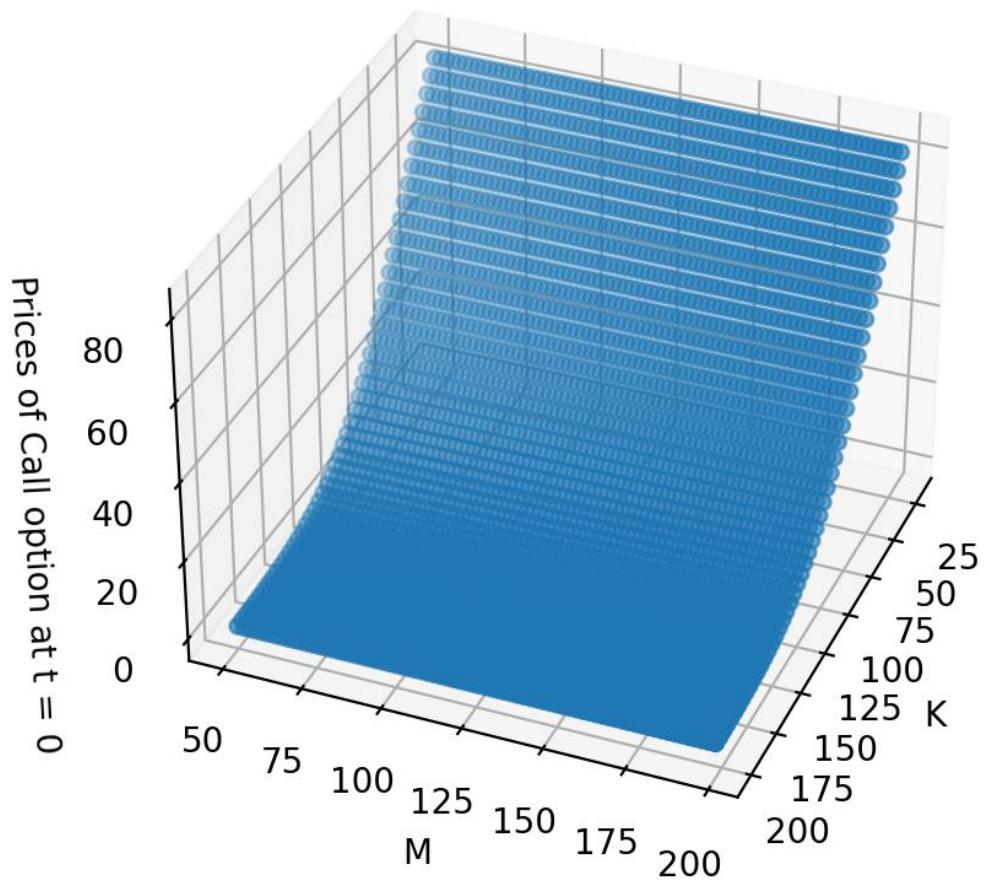
Initial Call Option Price vs K and M for the set = 1



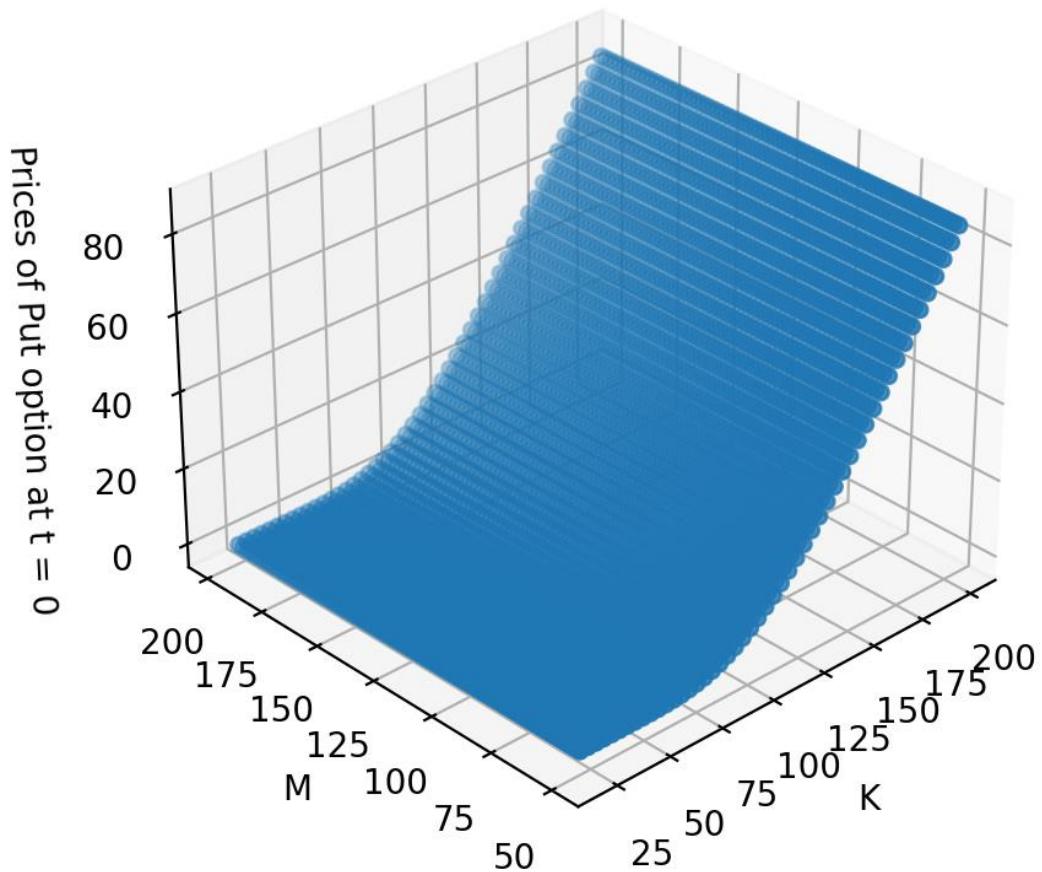
Initial Put Option Price vs K and M for the set = 1



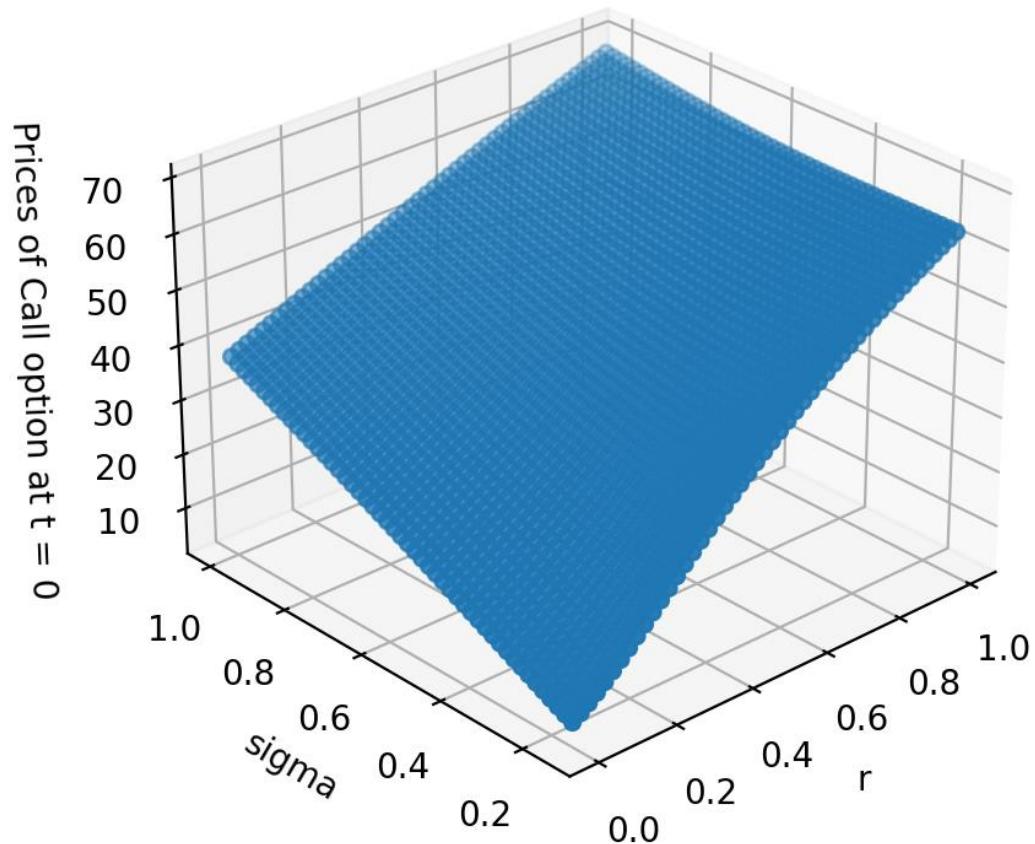
Initial Call Option Price vs K and M for the set = 2



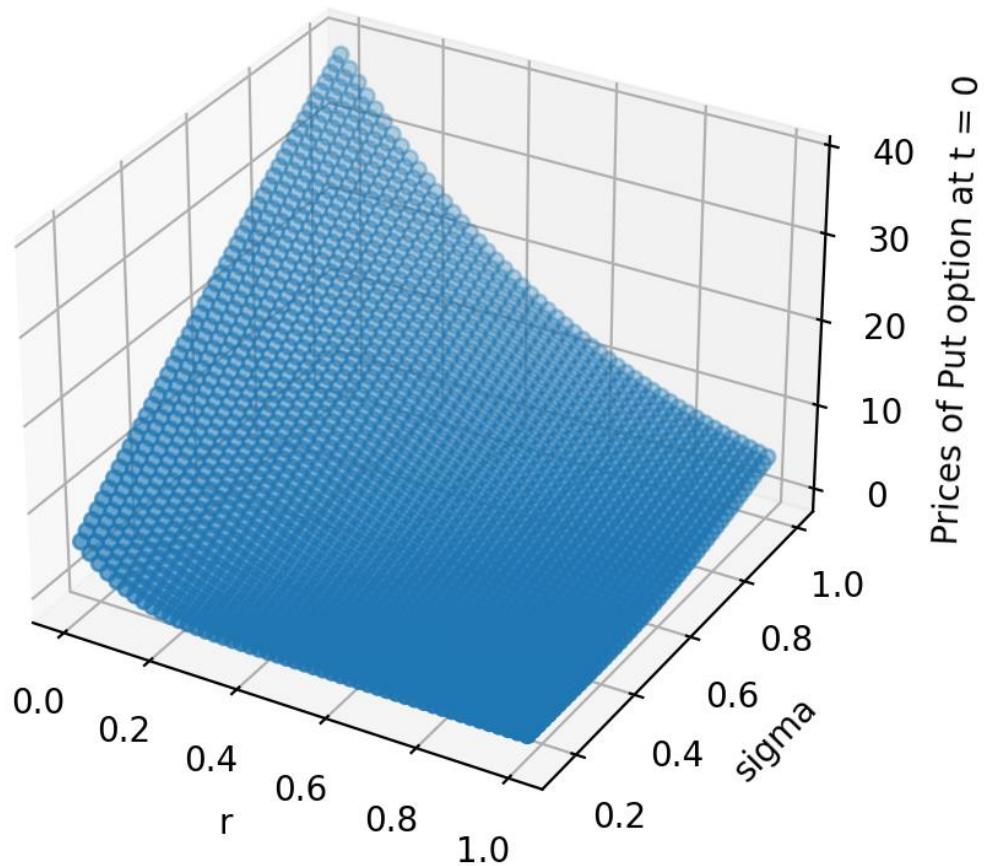
Initial Put Option Price vs K and M for the set = 2



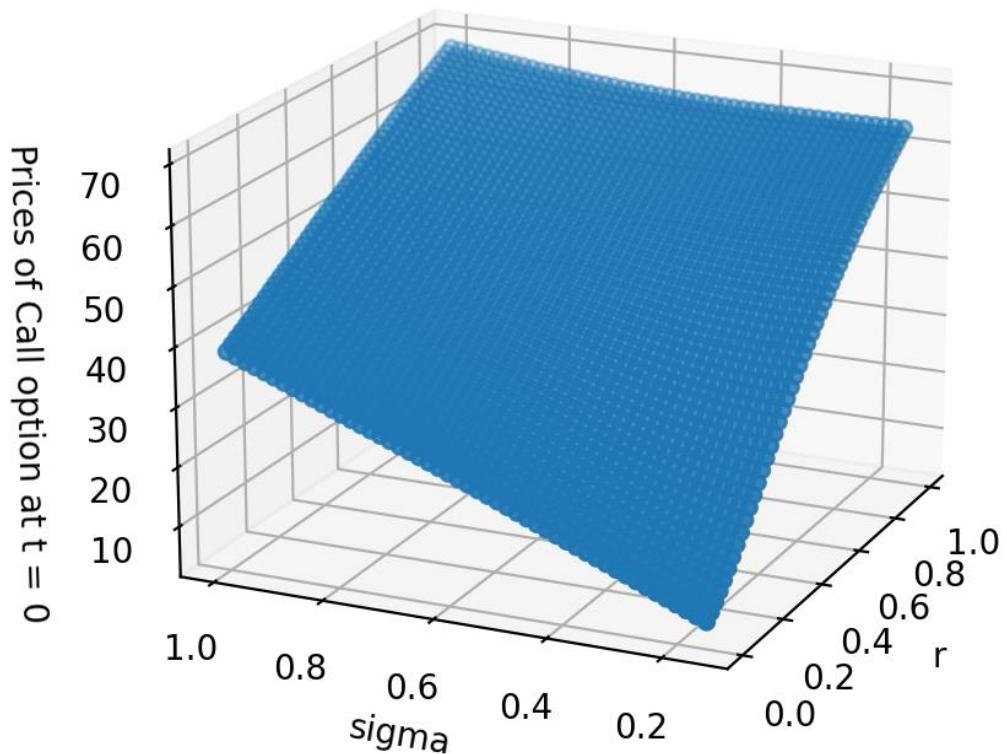
Initial Call Option Price vs r and σ for the set = 1



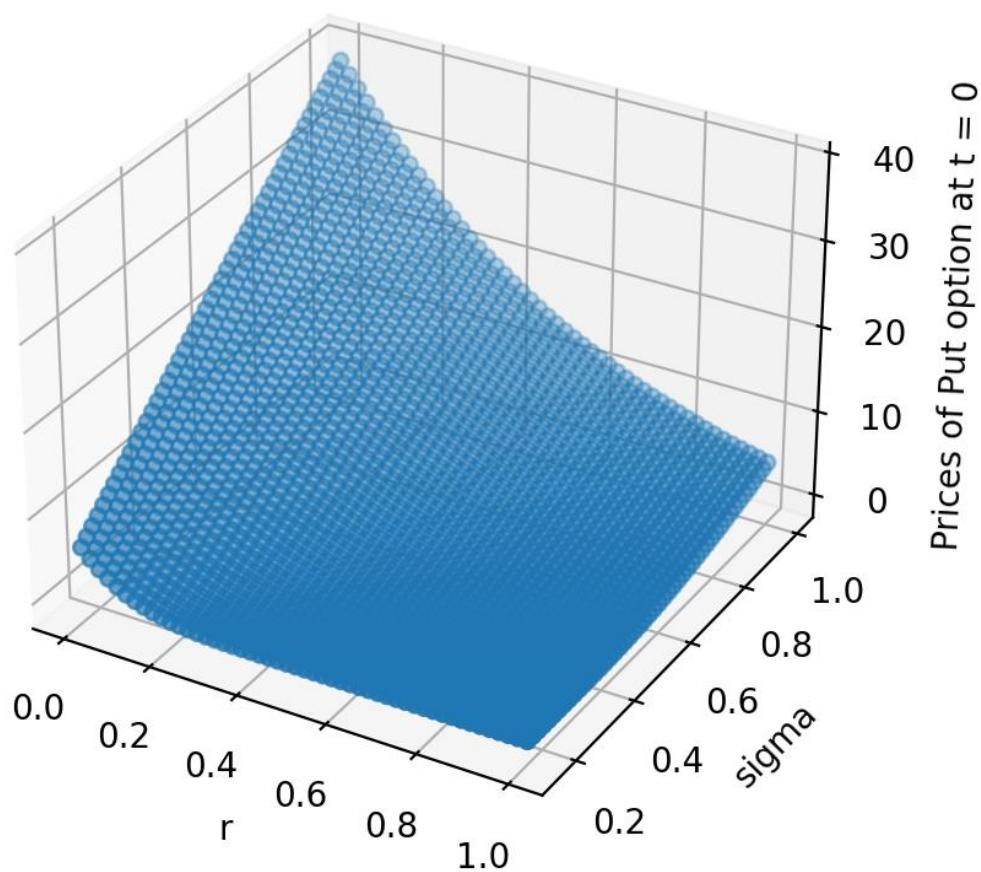
Initial Put Option Price vs r and σ for the set = 1



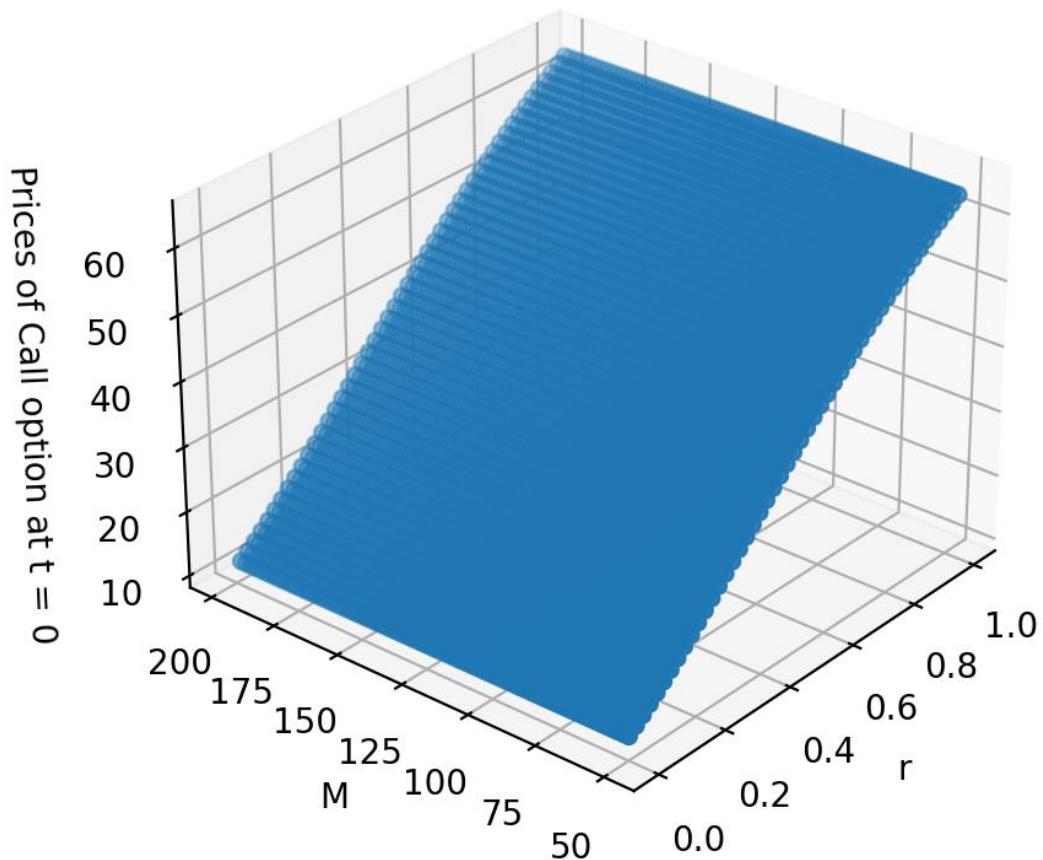
Initial Call Option Price vs r and sigma for the set = 2



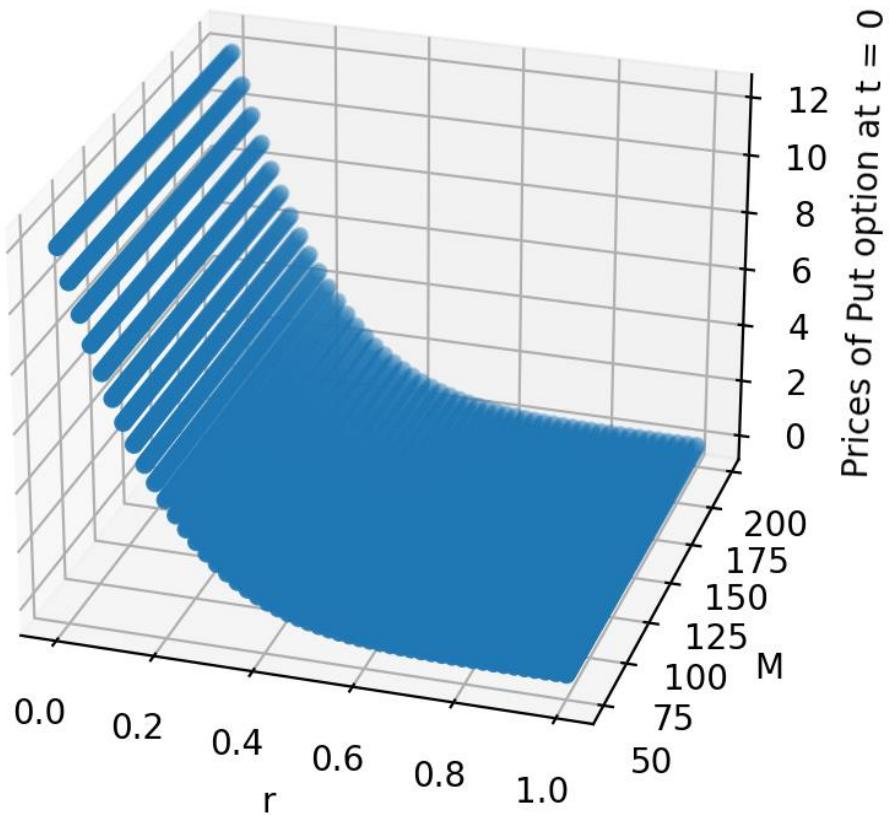
Initial Put Option Price vs r and σ for the set = 2



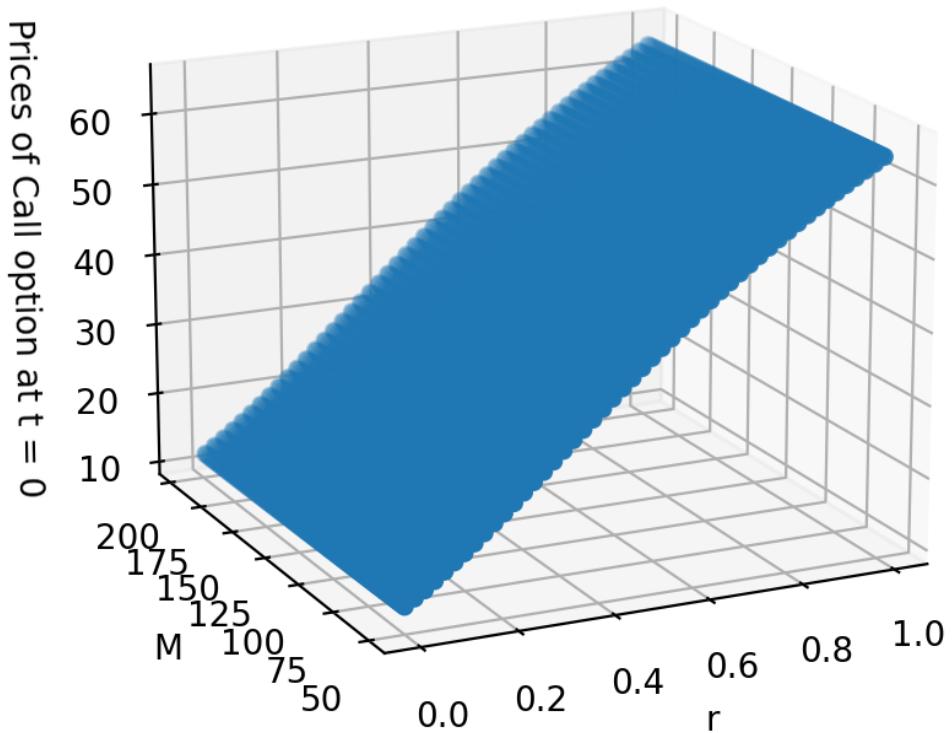
Initial Call Option Price vs r and M for the set = 1



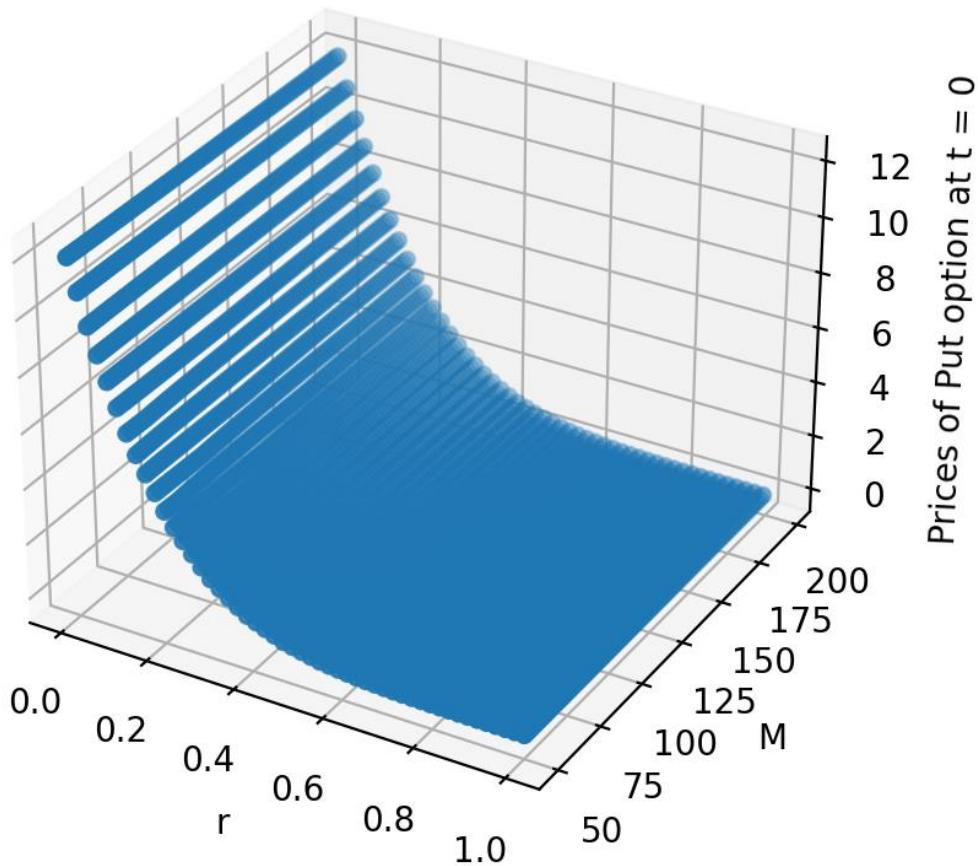
Initial Put Option Price vs r and M for the set = 1



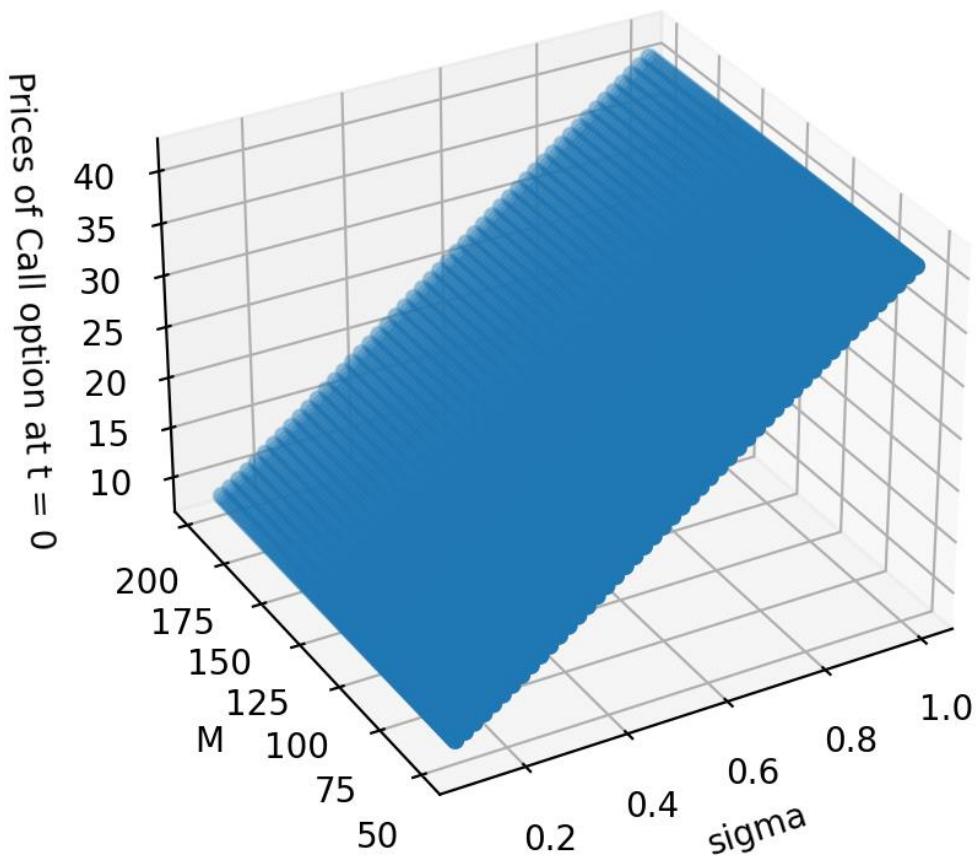
Initial Call Option Price vs r and M for the set = 2



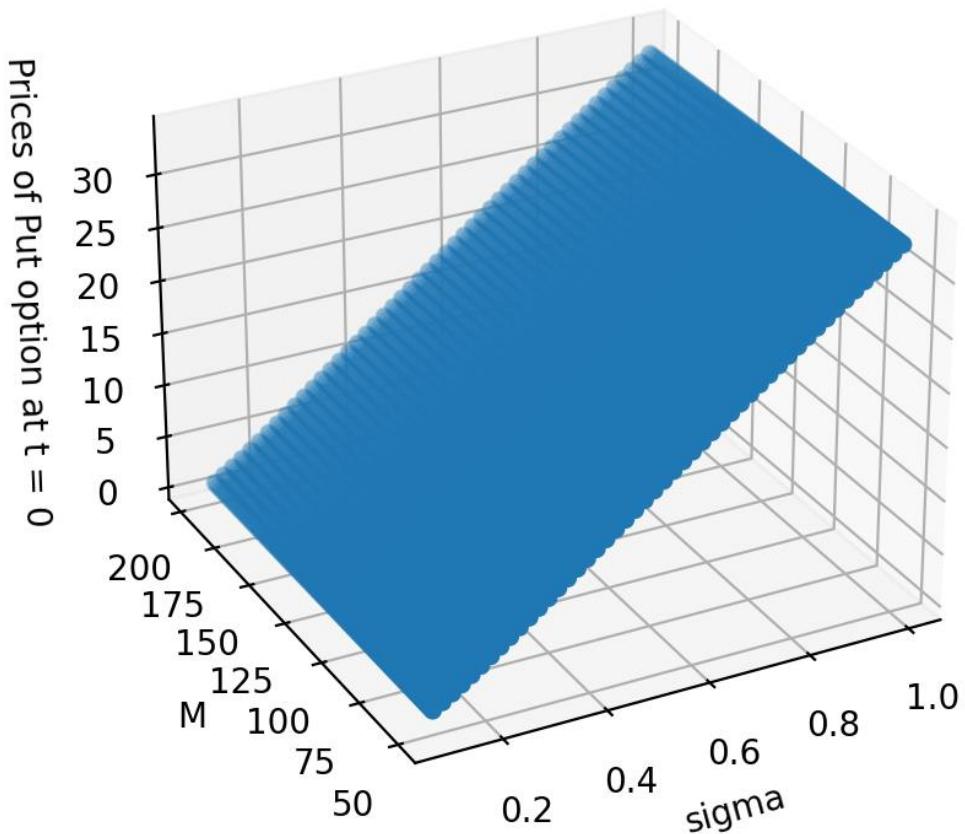
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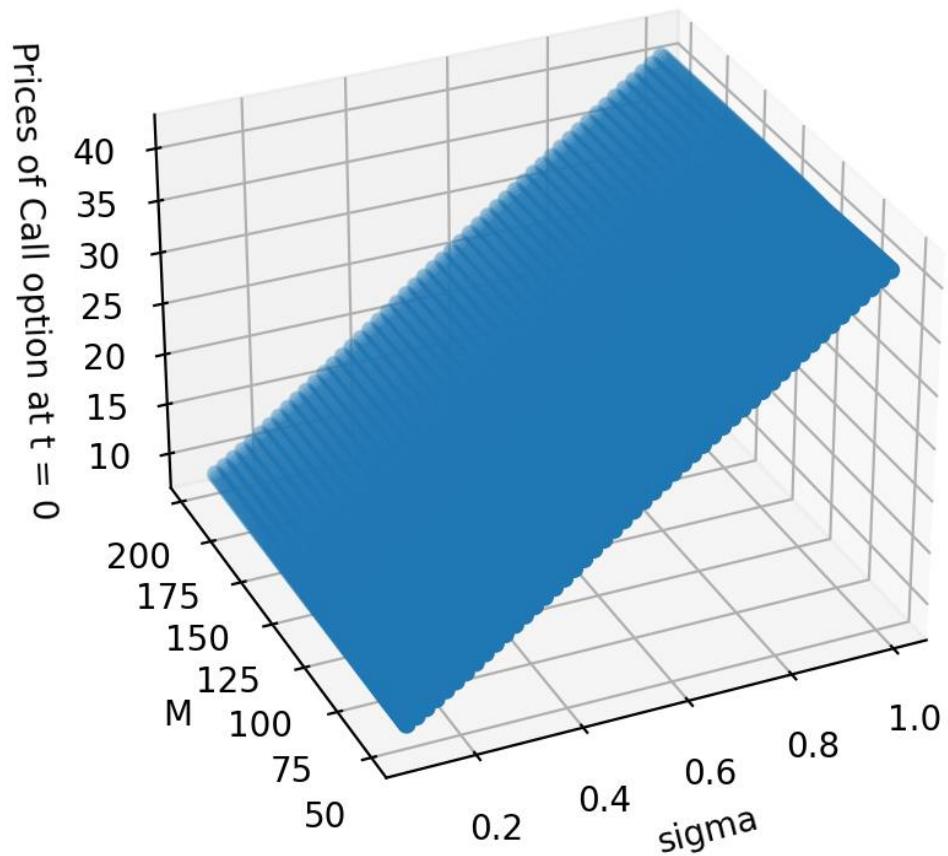
Initial Call Option Price vs sigma and M for the set = 1



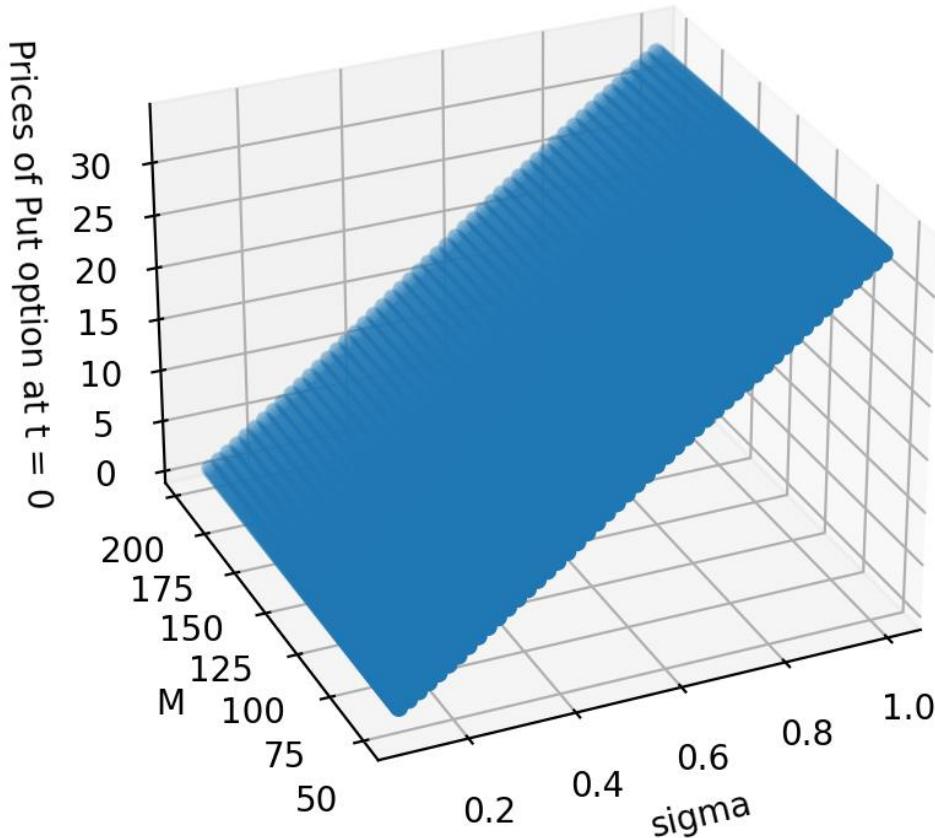
Initial Put Option Price vs sigma and M for the set = 1



Initial Call Option Price vs sigma and M for the set = 2



Initial Put Option Price vs sigma and M for the set = 2



Ques – 2

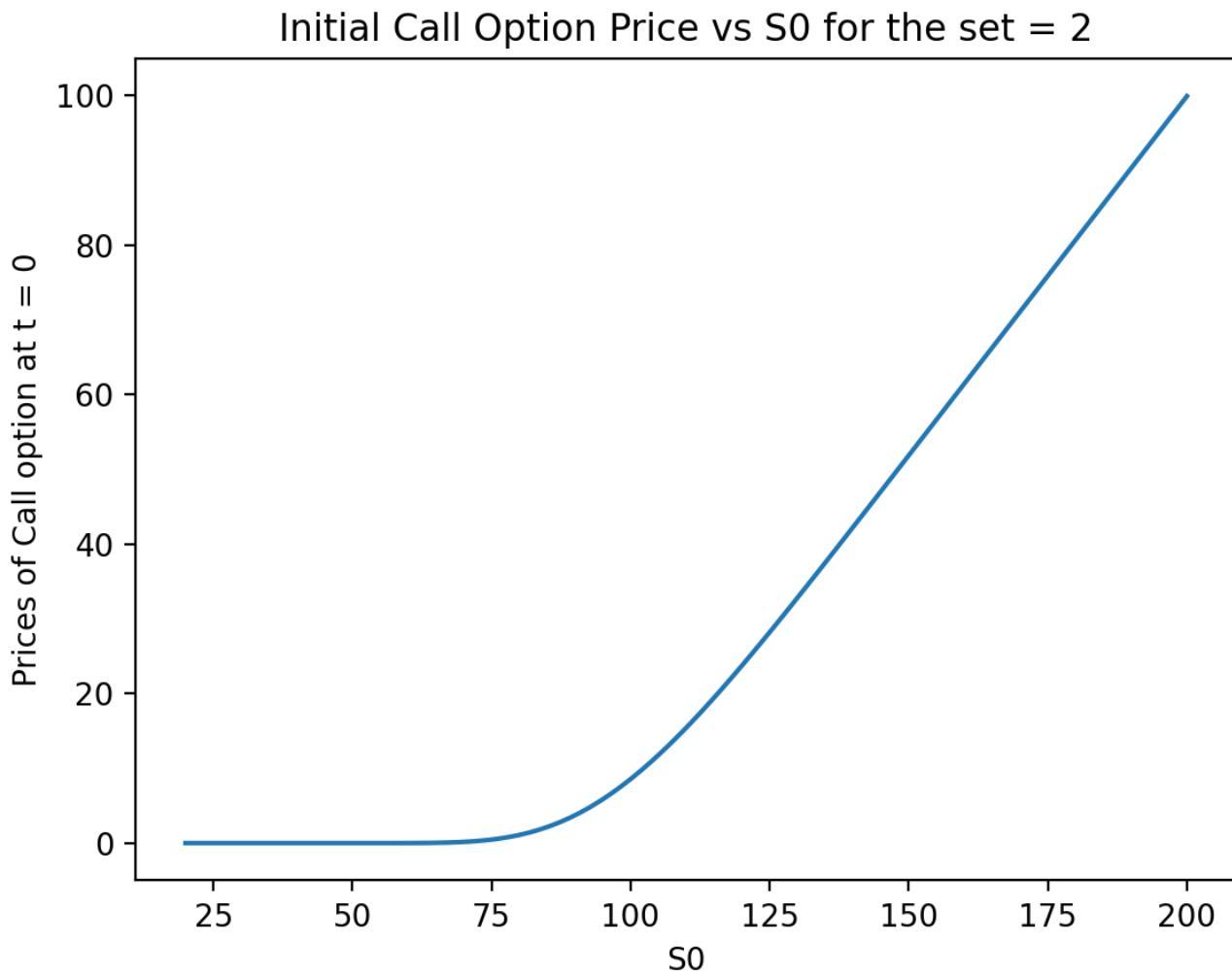
The path dependent derivative option chosen is **Asian Option**.

The initial option prices for the Asian Call Option and Asian Put Option for $M = 10$ and using set 2: -

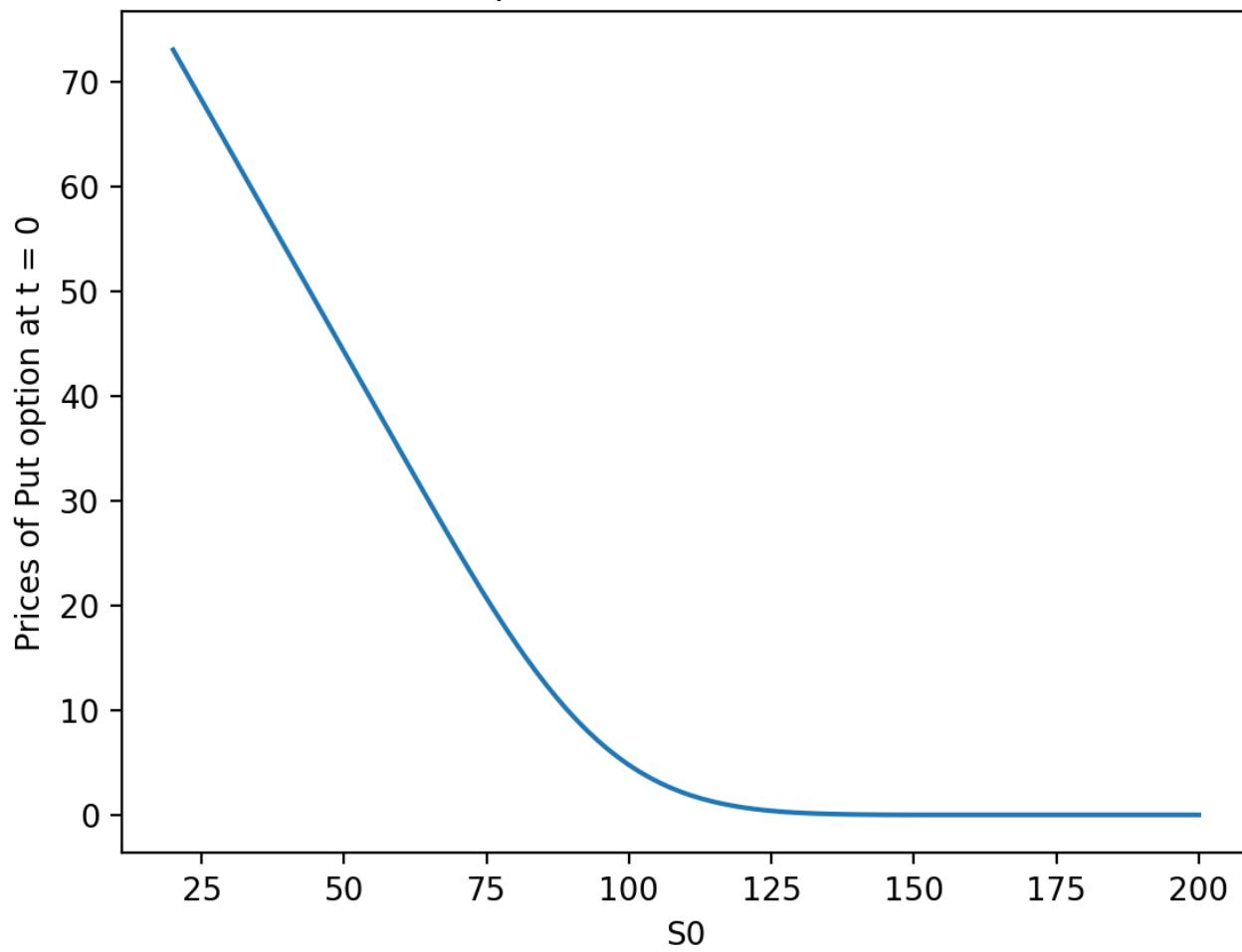
Call Option = 8.55955470713114
Put Option = 4.761497263210775

The **payoff for Asian Call Option** at expiry T is $\max(1/N \sum_{i=1}^N S(t_i) - K, 0)$, while the same **payoff for Asian Put Option** is $\max(K - 1/N \sum_{i=1}^N S(t_i), 0)$.

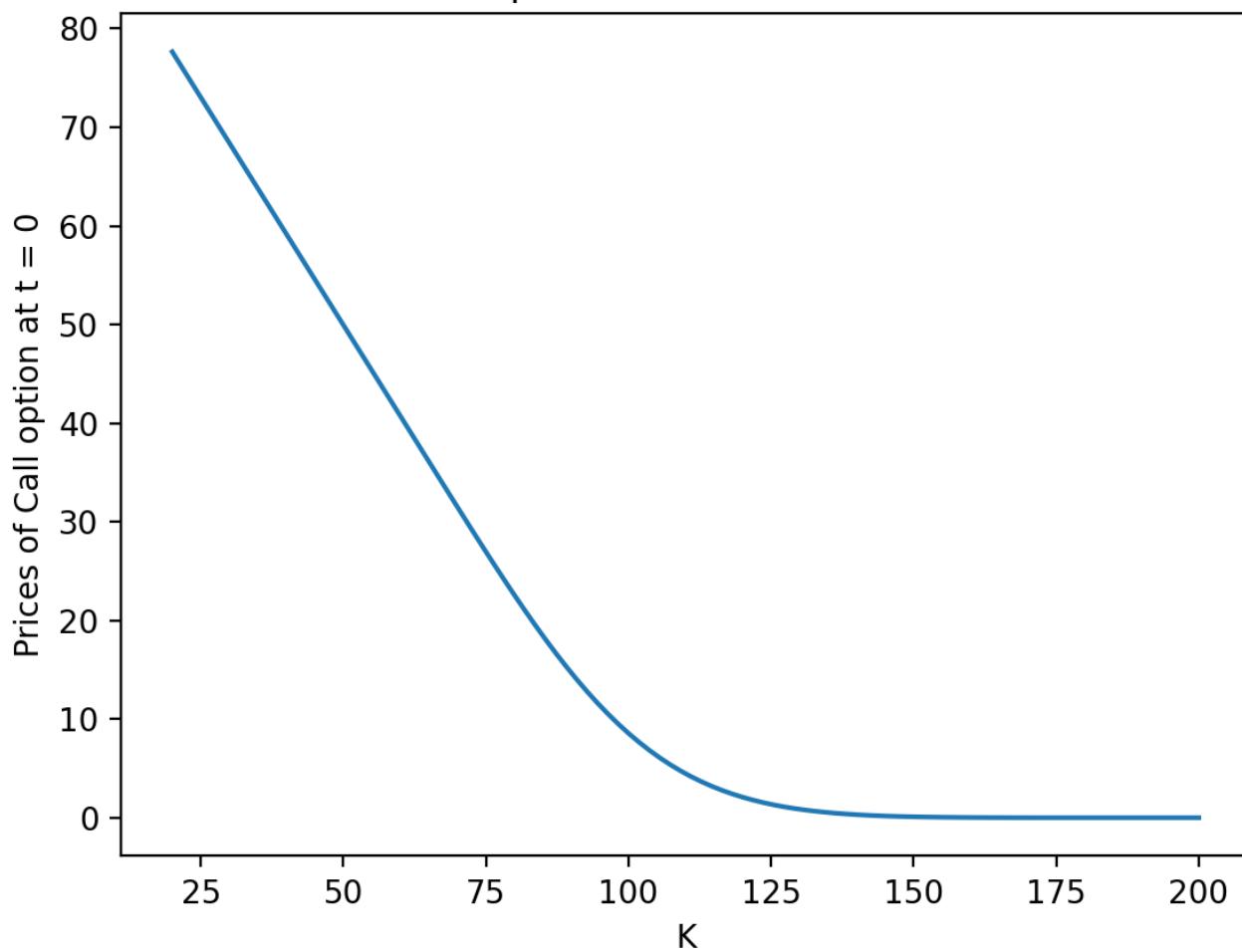
Sensitivity Analysis



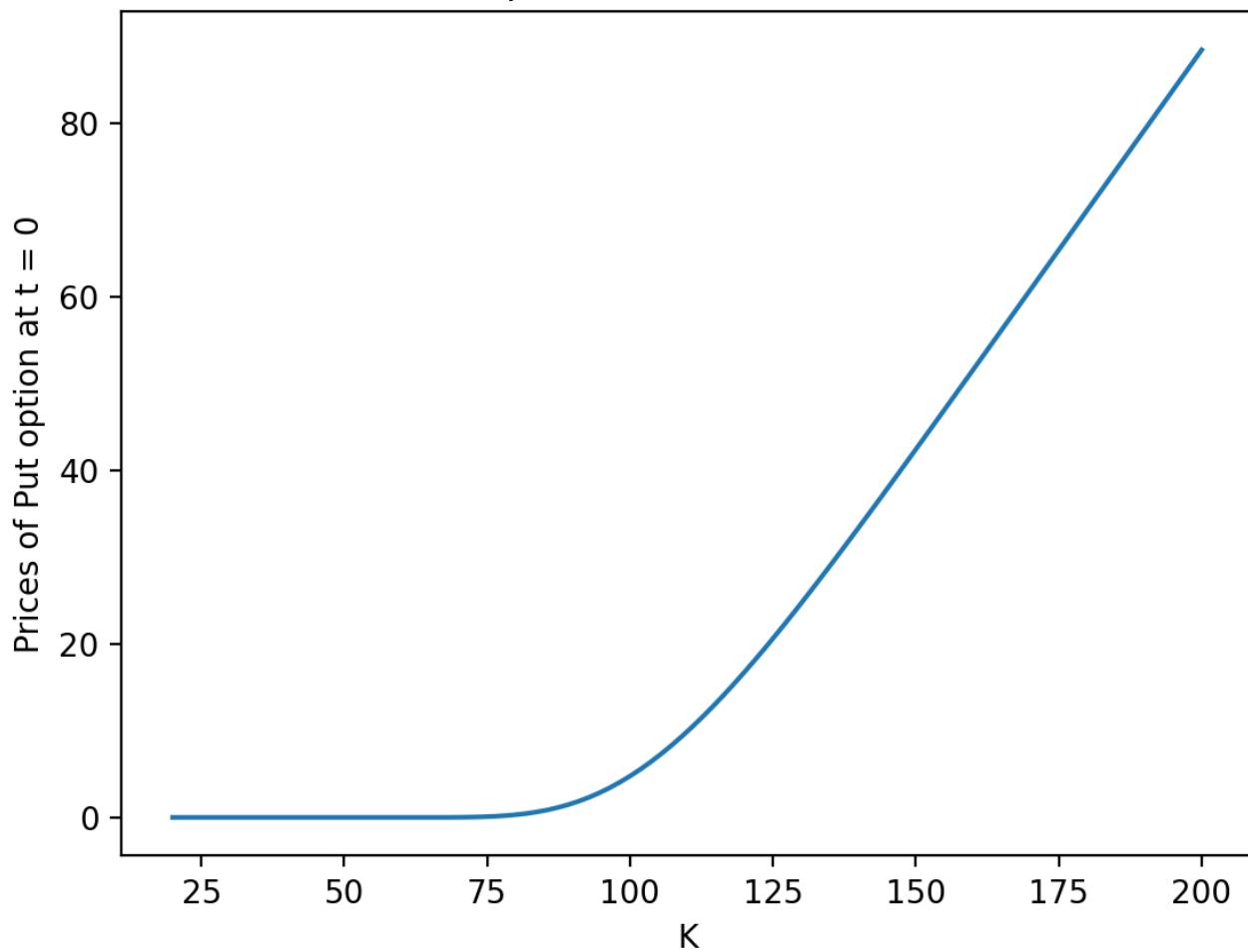
Initial Put Option Price vs S_0 for the set = 2



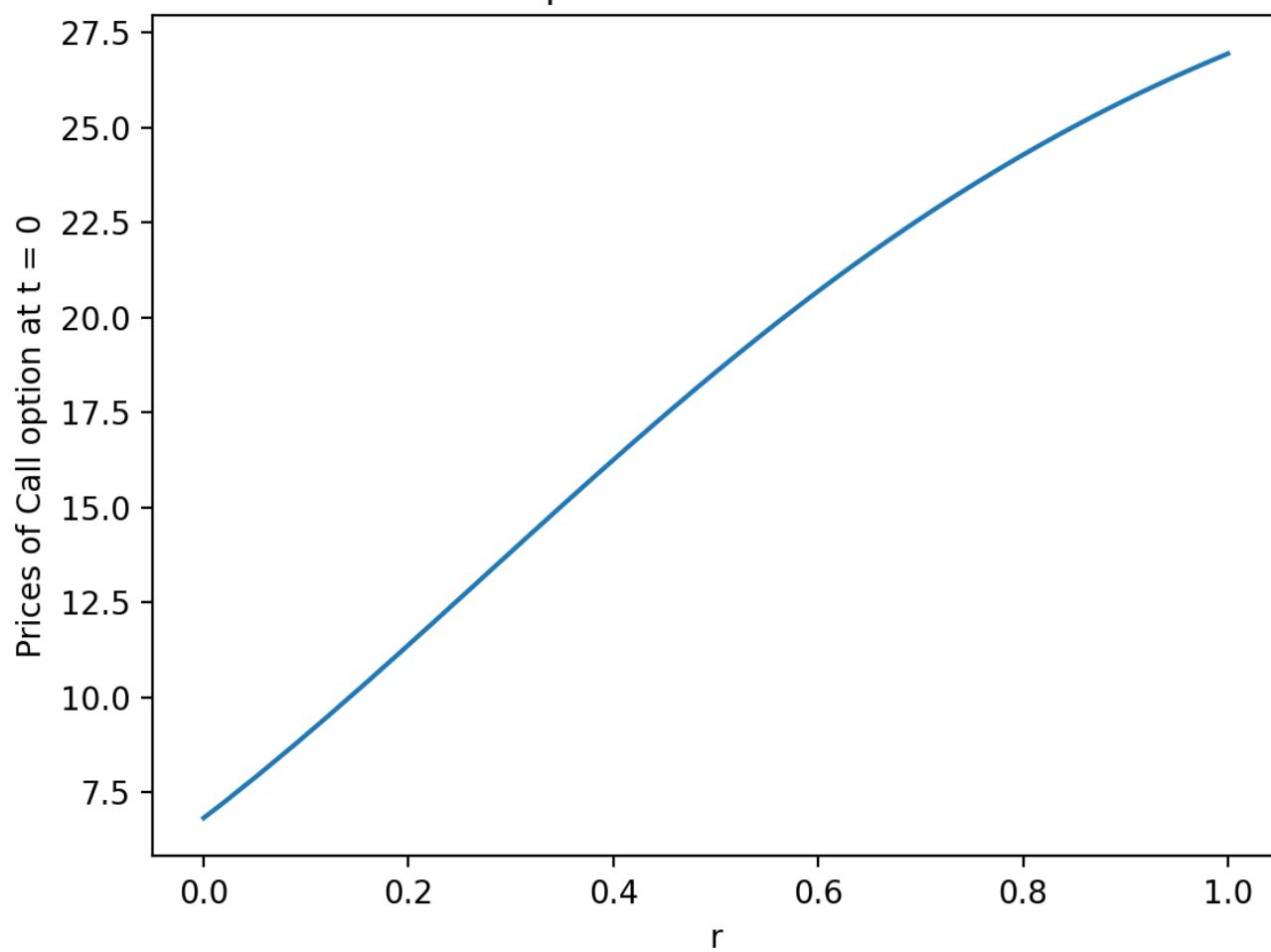
Initial Call Option Price vs K for the set = 2



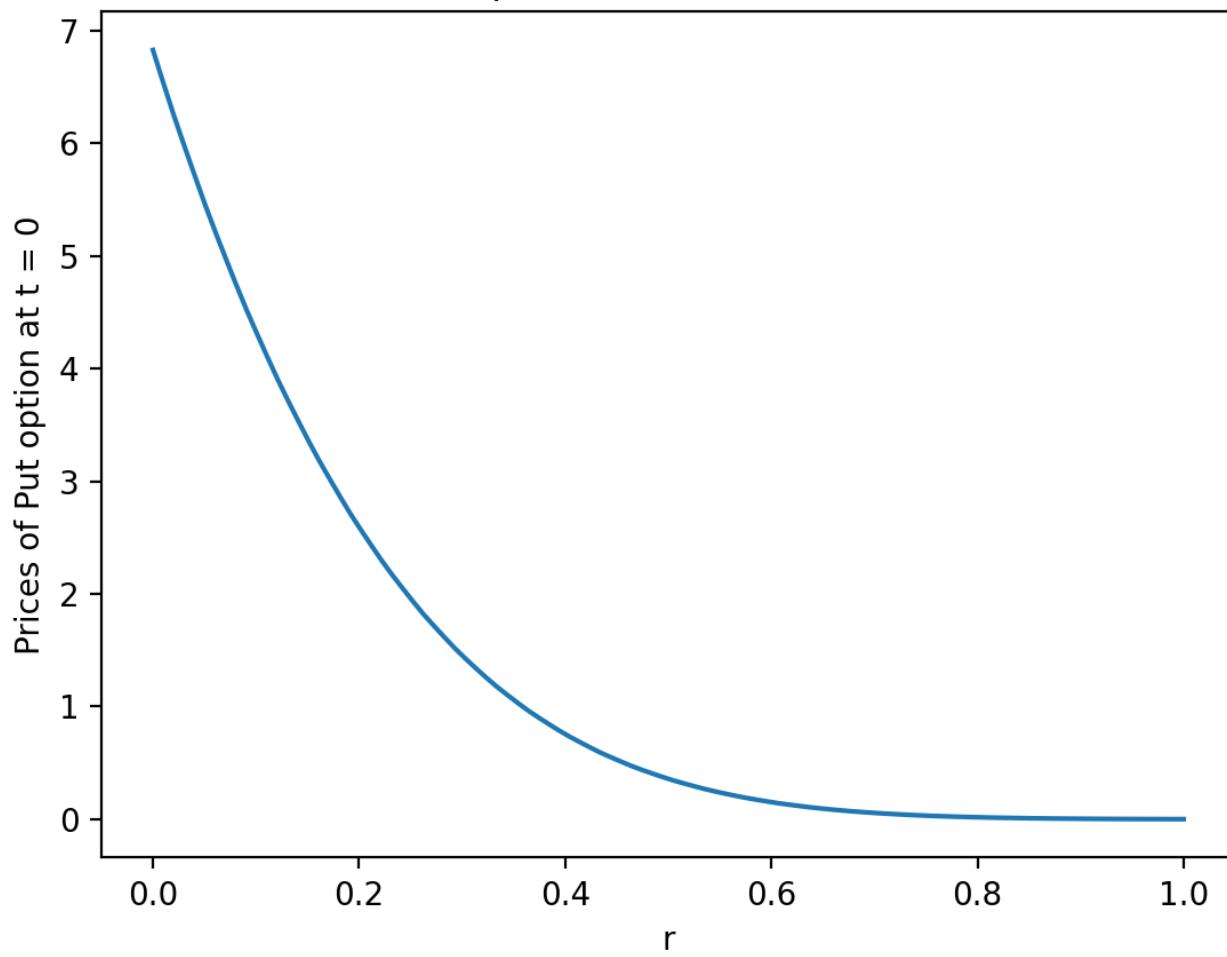
Initial Put Option Price vs K for the set = 2



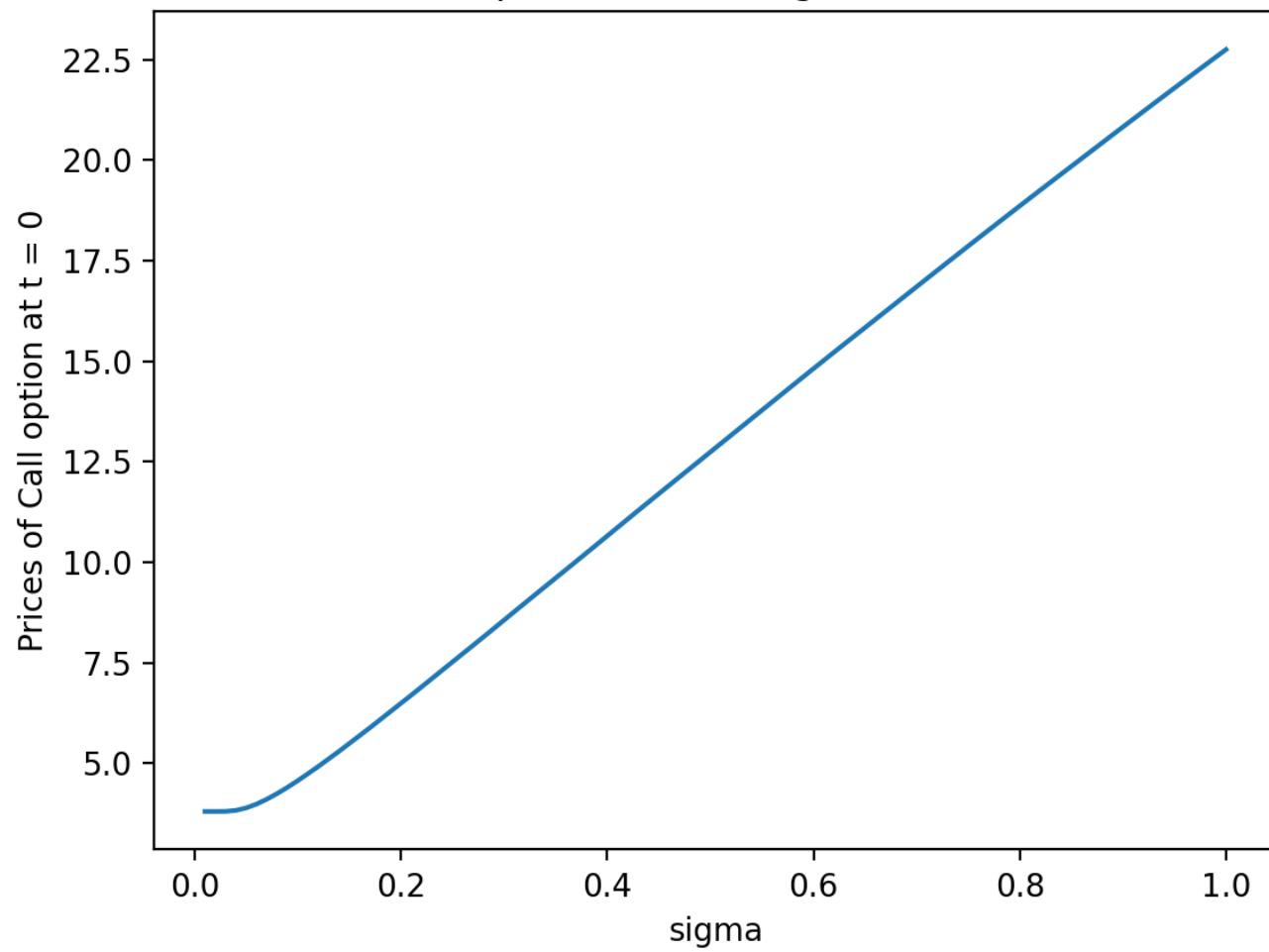
Initial Call Option Price vs r for the set = 2



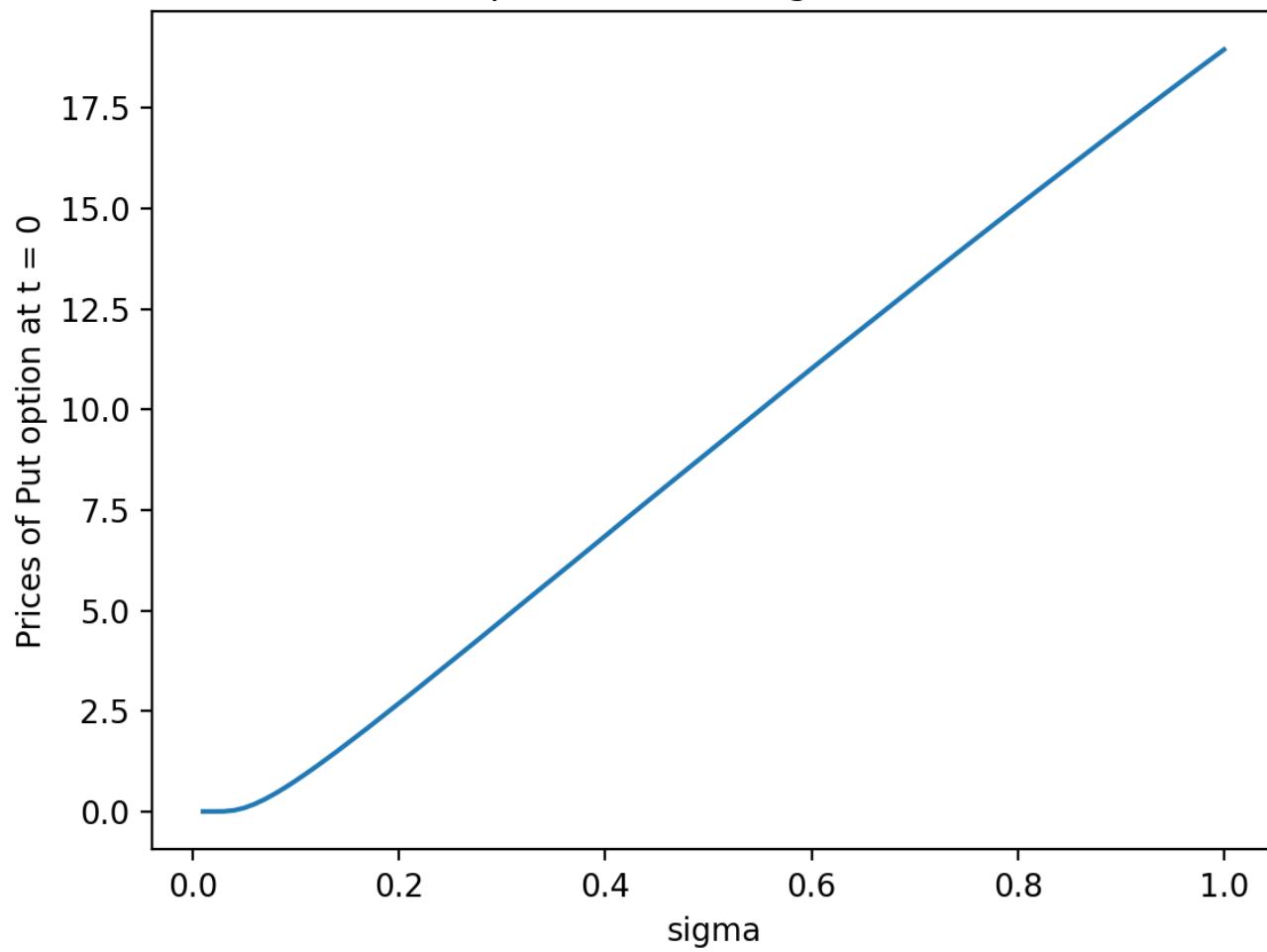
Initial Put Option Price vs r for the set = 2



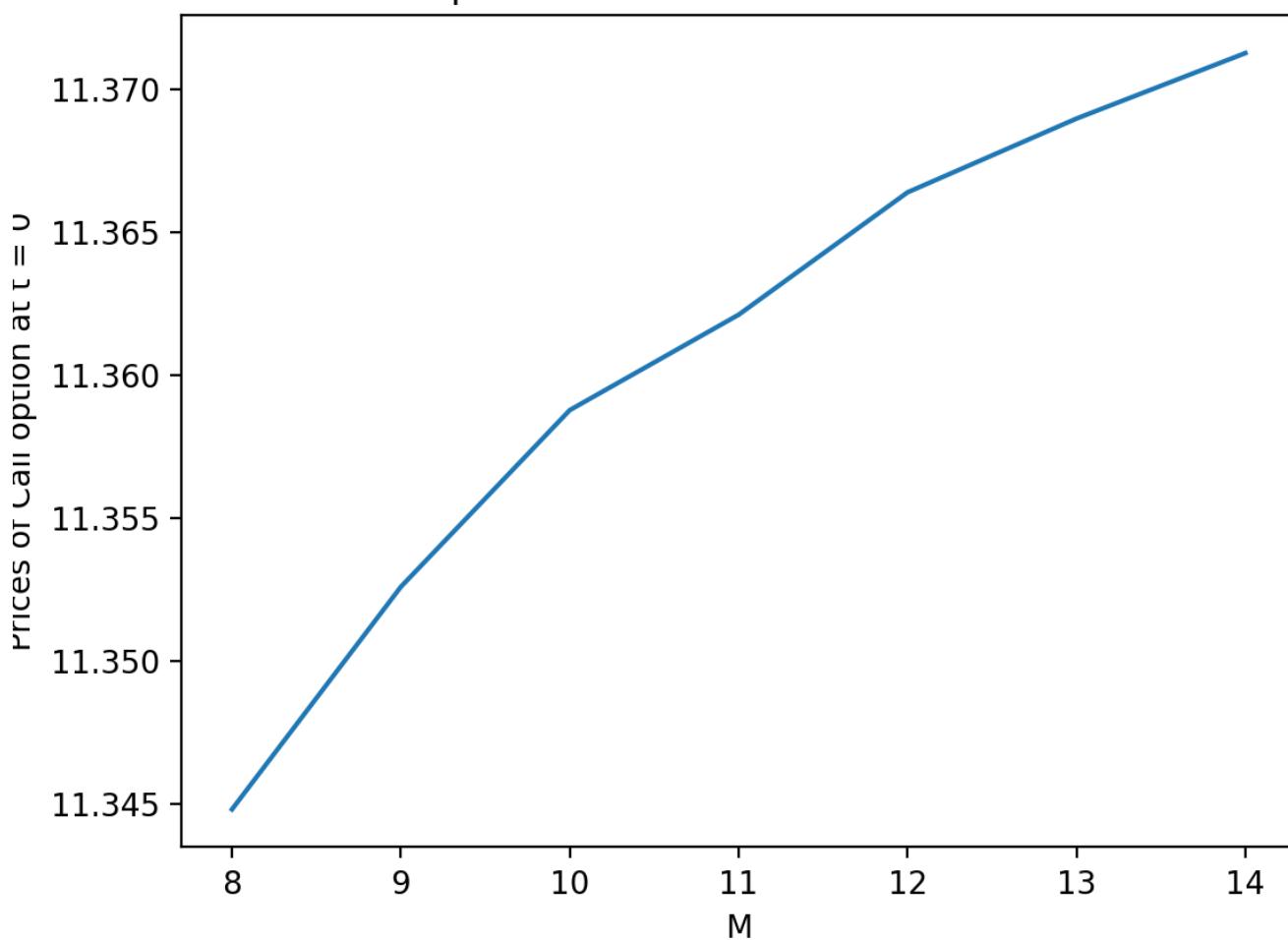
Initial Call Option Price vs sigma for the set = 2



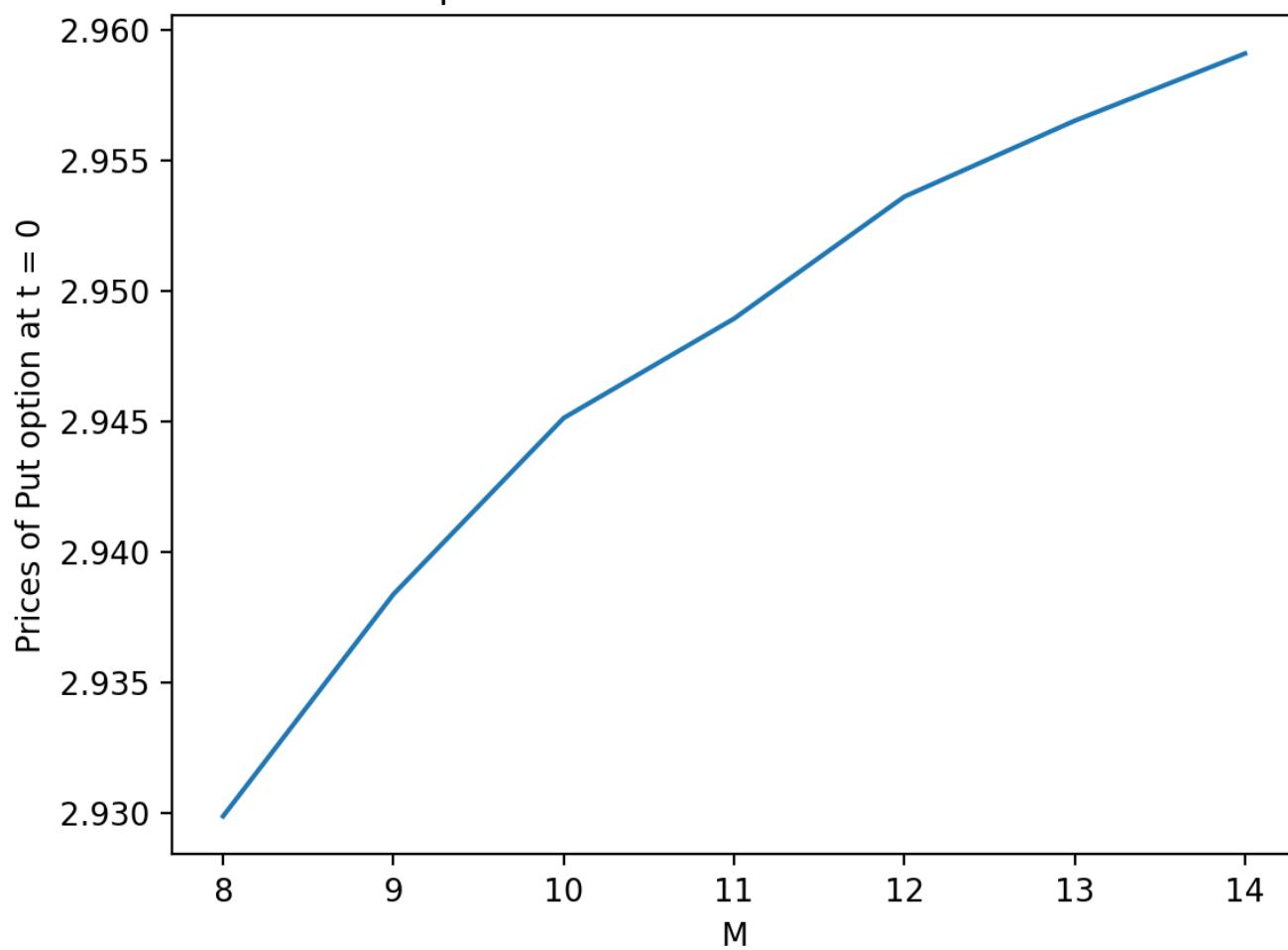
Initial Put Option Price vs sigma for the set = 2



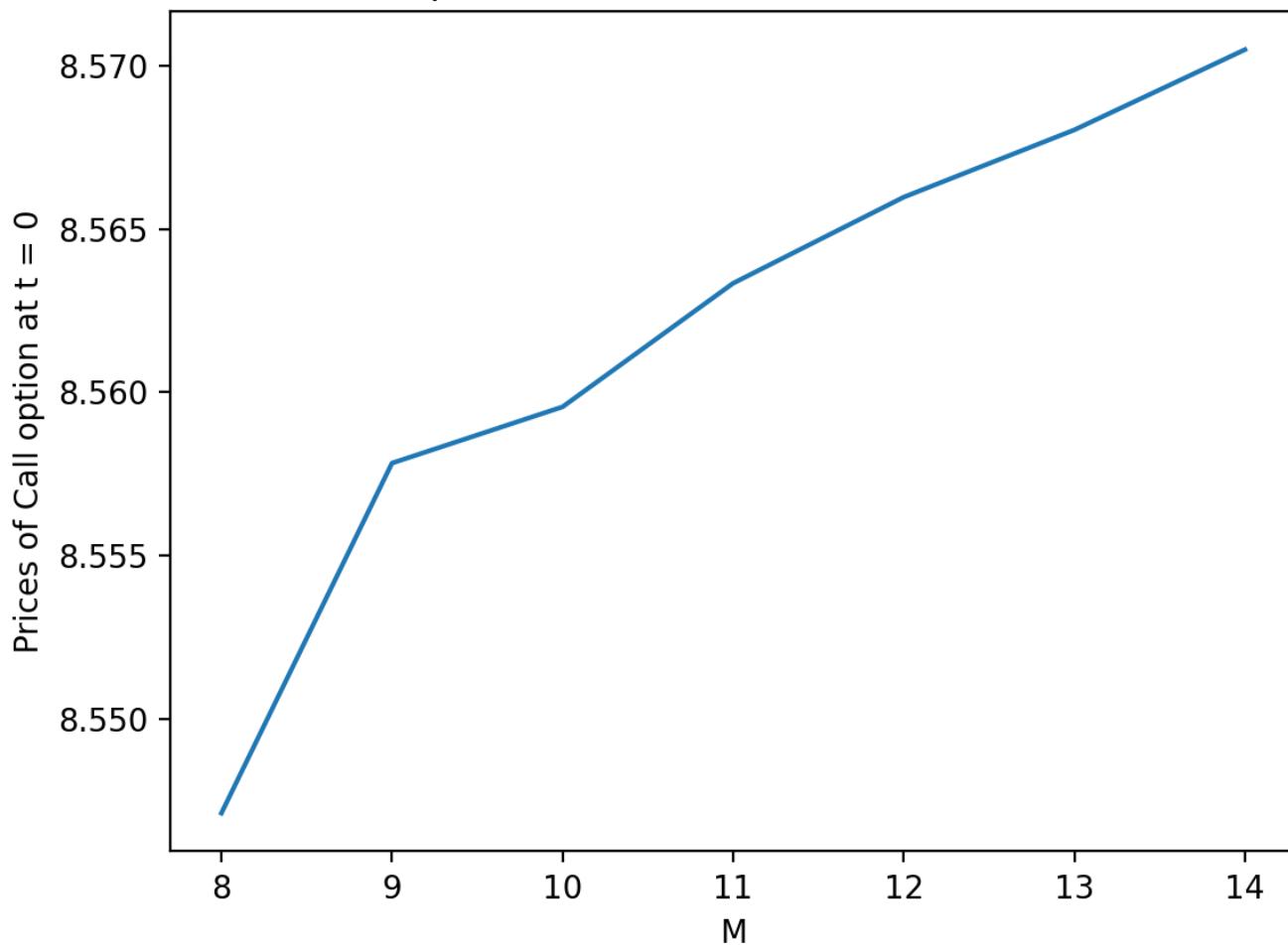
Initial Call Option Price vs M for the set = 2 and K = 95



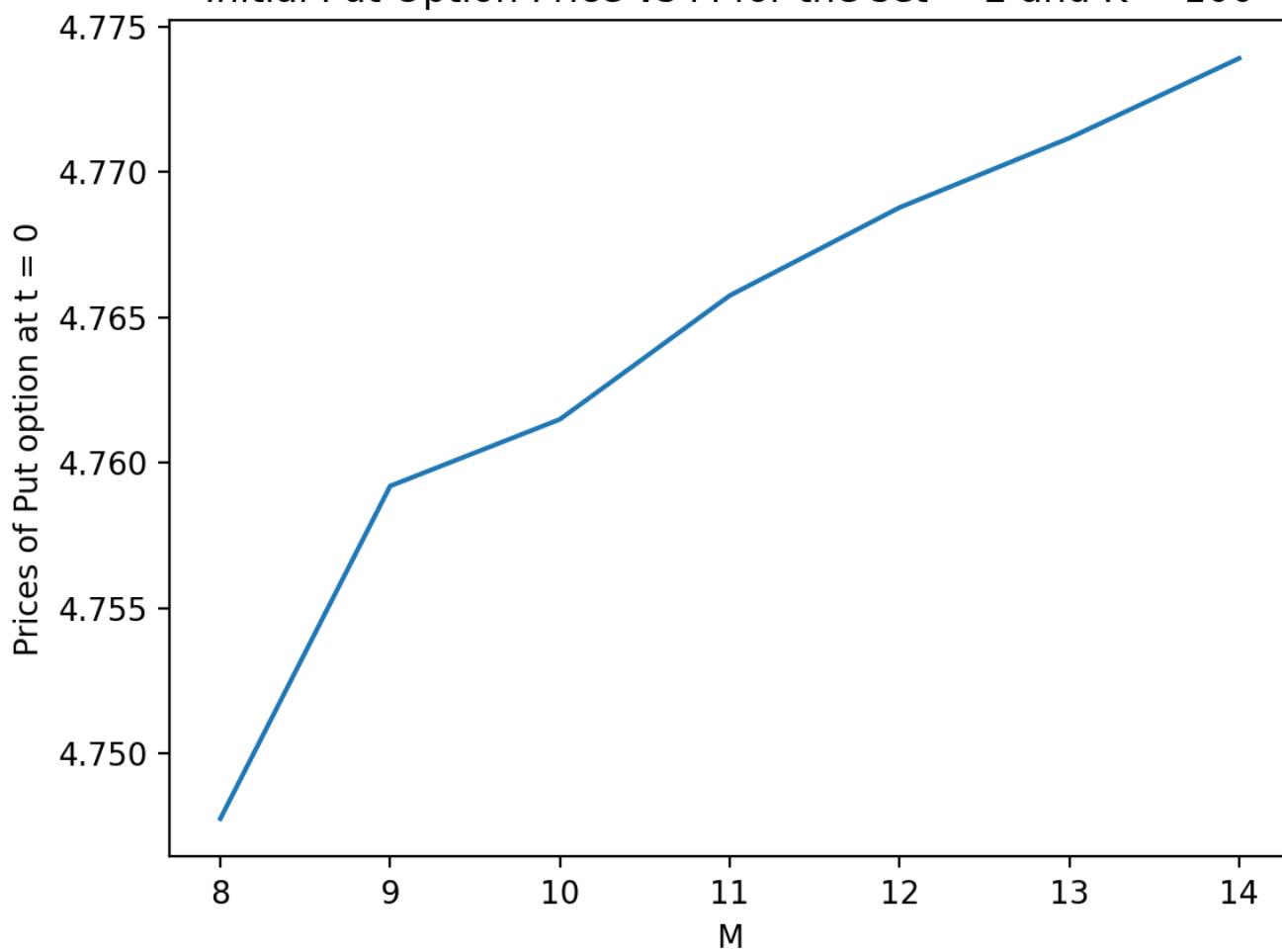
Initial Put Option Price vs M for the set = 2 and K = 95



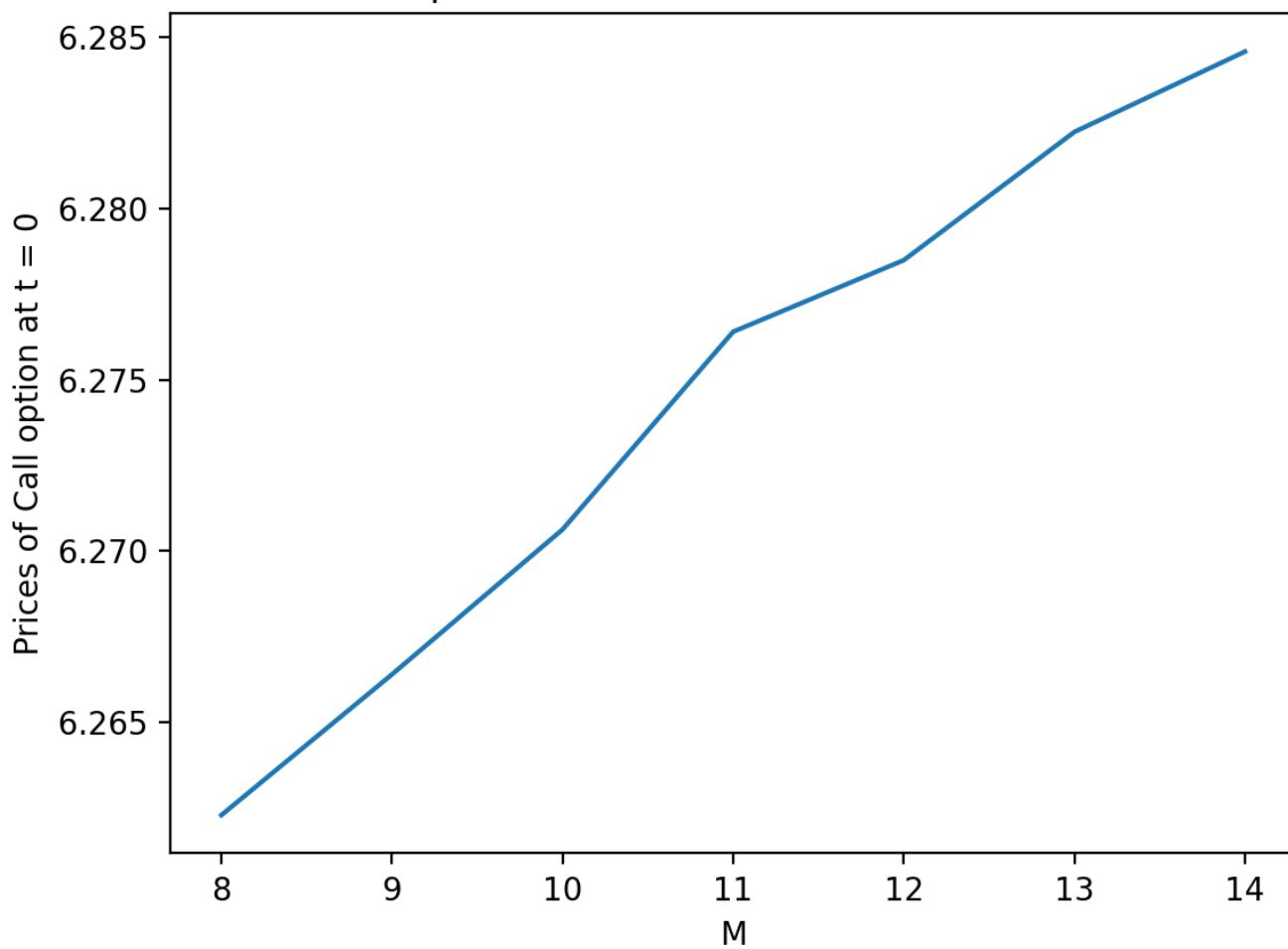
Initial Call Option Price vs M for the set = 2 and K = 100



Initial Put Option Price vs M for the set = 2 and K = 100



Initial Call Option Price vs M for the set = 2 and K = 105



Initial Put Option Price vs M for the set = 2 and K = 105

