Queries in the model

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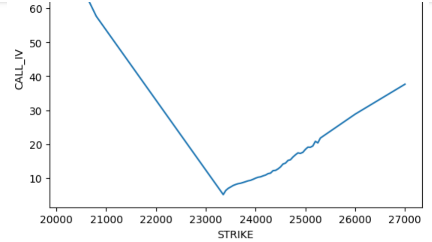
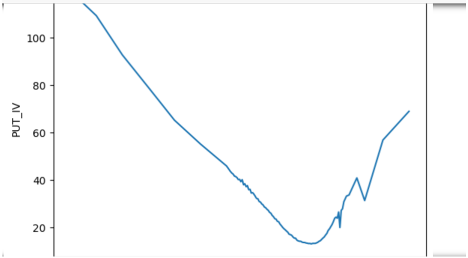
What I have implemented so far

- Wrote code to generate the smile nature of implied volatility of calls and puts of 5 weeks of NIFTY 50 index options.
- Generated the implied volatility surface using linear interpolation.
- Wrote code to calculate the call price function using the Black-Scholes formula.
- From this I generate the volatility surface using Dupire's formula.
- Then I usee the model to estimate the stock at given timesteps.

What I have implemented so far





What I have implemented so far

In [238]:
```
S_0 = 23501
r = 0.05
```

In [239]:
```
def LSV(sigma):
    global S_0
    stocks = []
    dt = 0.01
    n = 1000
    for i in range(n):
        ds = r/365*S_0*dt + sigma(i*dt,S_0)*S_0*np.random.normal(loc=0, scale=np.sqrt(dt),size=None)
        S_0 = S_0 + ds
        if i%100 == 0:
            stocks.append(S_0) # Stock value every day
    return stocks
def der_t(price,T,K):
  dt = 0.01
  return (price(T+dt,K)-price(T-dt,K))/(2*dt)
def der_x(price,T,K):
  ds = 1
  return (price(T,K+ds)-price(T,K-ds))/(2*ds)
def der2_x(price,T,K):
  ds = 1
  return (price(T,K+ds)-2*price(T,K)+price(T,K-ds))/(ds*ds)
def generate_volatility(price,T,K):
   return np.sqrt((2*der_t(price,T,K)+2*r/365*K*der_x(price,T,K))/(der2_x(price,T,K)))
```

In [240]:
```
def bsmcall(vol,T,K):
    T = T/365
    dp = (1/vol*T**0.5)*(np.log(S_0/K)+(r+0.5*vol**2)*T)
    dm = (1/vol*T**0.5)*(np.log(S_0/K)+(r-0.5*vol**2)*T)
    pk = S_0*norm.cdf(dp)-K*np.exp(-r*T)*norm.cdf(dm)
    return pk
def price(ivs):
  return lambda T,K: bsmcall(ivs(T,K),T,K)
iv = CALL_DATA["IV"]
strike = CALL_DATA["STRIKE"]
expiry = CALL_DATA["EXPIRY"]
ivs= lambda T,K: LinearNDInterpolator(list(zip(expiry,strike)), list(iv))(T,K)/100
#print(ivs(5,25000))
sigma = lambda T,K:generate_volatility(price(ivs),T,K)
print(price(ivs)(20,22000))
```

What is working and what is not

- Successfully generated the smile for 5 weeks of call and put options.
- Successfully generated the implied volatility surface using linear interpolation.
- Price obtained from the Black-Scholes formula is not matching with the actual price and is even giving negative prices for high strikes of call options.