Week 7 Proejct

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Q1:

Here's the result of greeks calculated by BSM:

Put

```
{'value': {'option value': 13.751949648187235,
  'intrinsic value': 13.969999999999999,
  'time value': -0.21805035181276367},
 'greeks': {'delta': -0.9169889291037313,
  'gamma': 0.016830979206204362,
  'theta': -0.005520019492833374,
  'vega': 0.06942036604441162,
  'rho': -0.1376459723603804},
 'Carry Rho': 13.679464983478951}
```

Call

```
{'value': {'option value': 0.3359599437090406,
  'intrinsic value': 0,
  'time value': 0.3359599437090406},
 'greeks': {'delta': 0.08301107089626869,
  'gamma': 0.016830979206204362,
  'theta': -0.02227999433394731,
  'vega': 0.06942036604441162,
  'rho': 0.011031223810791666},
 'Carry Rho': 1.2383432356991317}
```

Here's the result of greeks calculated by infinite diff method:

```
Call  delta : 0.08297134424122277 Gamma : 0.016822917423553463 Theta : -0.09724280164056233
Put  delta : -0.9165495924605693 Gamma : 0.016822917814351968 Theta : 0.3323717247206667
```

These two sets of Greeks are very similar.

The graph below includes values of American Option value with or without dividends:

```
value of American call Option w/ div is : 0.29181370999094486
value of American put Option w/ div is : 14.627752573353897
value of American call Option w/o div is : 0.3359668460797688
value of American call Option w/o div is : 14.038608480309883
```

Q2:

The first step is using an American option value function and applying a solver to find the implied volatility.

```
[0.2649281037758111,
 0.26186227132436496,
 0.2649281037758111,
 0.26186227132436496,
 0.2649281037758111,
 0.2336101965351821,
 0.26186227132436496,
 0.28238433791042467,
 0,
 0.2649281037758111,
 0.26186227132436496,
 0,
 0.2447132724090443,
 0,
 0.26921400715881616]
```

We simulated APPL's return, and generate thousand value for APPL's price after 10 days.
Then based on the IV, we calculate option value after ten days(T0 to T1, T0 move 10 days forward).
Store those values in a Dictionary, key is strategy, value is option value we calculated.
Use this dictionary to calculate each portfolio's value under different prices.

Finally, calculate VaR and ES, and make a comparison between week 6' s result.
I met a problem when I was trying to calculate each option's value under thousand simulated prices. The nested for loop below is incorrect.

```
for i in range(len(K)):
    for j in range(len(sim_prices)):
        if ivol[i] == 0:
            tem_price = sim_prices
        else:
            tem_price = bt_american(O_type[i], j, K[i], ttm, r, rate,ivol[i], nperiods, dividends=
        result=[(i,j,tem_price)]
```

Week 6:

Portfolio	mean	VaR	ES
Call	0.114595	4.358820	4.435184
CallSpread	-0.241876	3.639153	3.715283
CoveredCall	-0.150163	9.128753	12.182153
ProtectedPut	0.239424	4.143372	4.201838
Put	0.274991	4.254978	4.334247
PutSpread	0.396478	2.674248	2.742863
Stock	-0.035568	13.487573	16.617337
Straddle	0.389586	2.443232	2.452474
SynLong	-0.160396	13.703021	16.850682

Q3:

Based on a multi factor model and daily returns, we can calculate betas. Then calculate the daily return for the past 10 years. To calculate Sharpe Ratio, we need to create a Cov matrix. Then use this matrix to find an efficient portfolio curve. Finally, find the highest sharpe ratio on that curve. The Portfolio's Sharpe Ratio is: 1.7494940726026273

	weight %
0	4.307682e-14
1	0.000000e+00
2	2.439030e+01
3	1.623790e-15
4	3.752205e-14
5	0.000000e+00
6	0.000000e+00
7	8.156784e-15
8	2.182235e-14
9	0.000000e+00
10	3.365858e-14
11	6.598014e+01
12	0.000000e+00
13	0.000000e+00
14	3.821399e+00
15	5.412733e-14
16	0.000000e+00
17	5.808159e+00
18	0.000000e+00
19	2.815394e-14