

Options_Butterfly_Spread

September 29, 2021

1 Butterfly Spread

```
[1]: import numpy as np
import matplotlib.pyplot as plt
import yfinance as yf
```

```
[2]: dfo = yf.Ticker("AAPL")
```

```
[3]: dfo.options
```

```
[3]: ('2021-06-17',
      '2020-11-19',
      '2021-09-16',
      '2022-06-16',
      '2021-04-15',
      '2022-01-20',
      '2020-12-17',
      '2020-11-12',
      '2023-01-19',
      '2020-11-05',
      '2020-12-03',
      '2022-09-15',
      '2021-03-18',
      '2020-11-26',
      '2021-01-14')
```

```
[4]: dfo_exp = dfo.option_chain('2020-11-26')
```

```
[5]: dfo_exp.calls
```

```
[5]:
```

| | contractSymbol | lastTradeDate | strike | lastPrice | bid | ask | \ |
|---|---------------------|---------------------|--------|-----------|-------|-------|---|
| 0 | AAPL201127C00070000 | 2020-10-29 14:54:49 | 70.0 | 44.75 | 38.75 | 39.60 | |
| 1 | AAPL201127C00080000 | 2020-10-29 14:44:08 | 80.0 | 29.00 | 28.85 | 29.90 | |
| 2 | AAPL201127C00085000 | 2020-10-30 17:59:57 | 85.0 | 23.75 | 23.95 | 24.85 | |
| 3 | AAPL201127C00090000 | 2020-10-30 18:58:52 | 90.0 | 18.91 | 19.15 | 20.05 | |
| 4 | AAPL201127C00095000 | 2020-10-30 19:30:01 | 95.0 | 14.50 | 14.10 | 15.75 | |
| 5 | AAPL201127C00100000 | 2020-10-30 19:46:45 | 100.0 | 10.30 | 10.45 | 11.30 | |

| | | | | | | | |
|----|---------------------|------------|----------|-------|------|------|-------|
| 6 | AAPL201127C00101000 | 2020-10-30 | 19:45:01 | 101.0 | 9.75 | 9.25 | 10.35 |
| 7 | AAPL201127C00102000 | 2020-10-30 | 19:26:52 | 102.0 | 8.75 | 8.45 | 9.90 |
| 8 | AAPL201127C00103000 | 2020-10-30 | 19:33:34 | 103.0 | 8.06 | 7.55 | 8.90 |
| 9 | AAPL201127C00104000 | 2020-10-30 | 19:28:03 | 104.0 | 7.41 | 6.90 | 8.90 |
| 10 | AAPL201127C00105000 | 2020-10-30 | 19:56:03 | 105.0 | 6.95 | 7.20 | 7.70 |
| 11 | AAPL201127C00106000 | 2020-10-30 | 19:59:34 | 106.0 | 6.75 | 6.40 | 6.95 |
| 12 | AAPL201127C00107000 | 2020-10-30 | 19:40:03 | 107.0 | 5.79 | 5.80 | 6.35 |
| 13 | AAPL201127C00108000 | 2020-10-30 | 19:57:07 | 108.0 | 5.55 | 5.35 | 6.05 |
| 14 | AAPL201127C00109000 | 2020-10-30 | 19:58:28 | 109.0 | 5.20 | 4.85 | 5.20 |
| 15 | AAPL201127C00110000 | 2020-10-30 | 19:59:05 | 110.0 | 4.65 | 4.35 | 4.80 |
| 16 | AAPL201127C00111000 | 2020-10-30 | 19:56:33 | 111.0 | 4.10 | 4.05 | 4.30 |
| 17 | AAPL201127C00112000 | 2020-10-30 | 19:51:22 | 112.0 | 3.52 | 3.30 | 4.00 |
| 18 | AAPL201127C00113000 | 2020-10-30 | 19:52:24 | 113.0 | 3.09 | 2.95 | 4.15 |
| 19 | AAPL201127C00114000 | 2020-10-30 | 19:52:24 | 114.0 | 3.01 | 2.79 | 3.40 |
| 20 | AAPL201127C00115000 | 2020-10-30 | 19:58:42 | 115.0 | 2.69 | 2.46 | 2.73 |
| 21 | AAPL201127C00116000 | 2020-10-30 | 19:57:16 | 116.0 | 2.37 | 2.05 | 2.60 |
| 22 | AAPL201127C00117000 | 2020-10-30 | 19:48:27 | 117.0 | 2.04 | 1.67 | 2.57 |
| 23 | AAPL201127C00118000 | 2020-10-30 | 19:53:09 | 118.0 | 1.67 | 1.50 | 2.09 |
| 24 | AAPL201127C00119000 | 2020-10-30 | 19:53:09 | 119.0 | 1.48 | 1.36 | 1.85 |
| 25 | AAPL201127C00120000 | 2020-10-30 | 19:59:17 | 120.0 | 1.42 | 1.25 | 1.50 |
| 26 | AAPL201127C00121000 | 2020-10-30 | 19:53:11 | 121.0 | 1.23 | 1.06 | 1.48 |
| 27 | AAPL201127C00122000 | 2020-10-30 | 19:53:41 | 122.0 | 1.02 | 0.95 | 1.17 |
| 28 | AAPL201127C00123000 | 2020-10-30 | 19:59:36 | 123.0 | 0.99 | 0.80 | 1.05 |
| 29 | AAPL201127C00124000 | 2020-10-30 | 19:15:47 | 124.0 | 0.80 | 0.76 | 1.05 |
| 30 | AAPL201127C00125000 | 2020-10-30 | 19:51:04 | 125.0 | 0.73 | 0.71 | 0.94 |
| 31 | AAPL201127C00126000 | 2020-10-30 | 19:57:32 | 126.0 | 0.63 | 0.62 | 0.90 |
| 32 | AAPL201127C00127000 | 2020-10-30 | 19:57:29 | 127.0 | 0.55 | 0.55 | 0.97 |
| 33 | AAPL201127C00128000 | 2020-10-30 | 19:52:03 | 128.0 | 0.50 | 0.49 | 0.68 |
| 34 | AAPL201127C00129000 | 2020-10-30 | 19:36:00 | 129.0 | 0.44 | 0.43 | 0.55 |
| 35 | AAPL201127C00130000 | 2020-10-30 | 19:57:31 | 130.0 | 0.40 | 0.38 | 0.65 |
| 36 | AAPL201127C00131000 | 2020-10-30 | 19:49:49 | 131.0 | 0.35 | 0.34 | 0.55 |
| 37 | AAPL201127C00132000 | 2020-10-30 | 19:58:19 | 132.0 | 0.34 | 0.31 | 0.66 |
| 38 | AAPL201127C00133000 | 2020-10-30 | 19:03:54 | 133.0 | 0.29 | 0.27 | 0.48 |
| 39 | AAPL201127C00134000 | 2020-10-30 | 19:09:34 | 134.0 | 0.25 | 0.24 | 0.57 |
| 40 | AAPL201127C00135000 | 2020-10-30 | 19:57:31 | 135.0 | 0.24 | 0.21 | 0.25 |
| 41 | AAPL201127C00140000 | 2020-10-30 | 19:51:31 | 140.0 | 0.16 | 0.15 | 0.43 |
| 42 | AAPL201127C00145000 | 2020-10-30 | 19:31:09 | 145.0 | 0.12 | 0.10 | 0.14 |
| 43 | AAPL201127C00150000 | 2020-10-30 | 19:59:19 | 150.0 | 0.10 | 0.08 | 0.13 |
| 44 | AAPL201127C00155000 | 2020-10-30 | 19:56:17 | 155.0 | 0.07 | 0.05 | 0.08 |
| 45 | AAPL201127C00160000 | 2020-10-30 | 19:55:29 | 160.0 | 0.06 | 0.02 | 0.10 |
| 46 | AAPL201127C00165000 | 2020-10-30 | 15:07:38 | 165.0 | 0.05 | 0.05 | 0.09 |
| 47 | AAPL201127C00170000 | 2020-10-30 | 17:38:28 | 170.0 | 0.06 | 0.04 | 0.08 |
| 48 | AAPL201127C00175000 | 2020-10-30 | 16:03:54 | 175.0 | 0.03 | 0.01 | 0.08 |

| | change | percentChange | volume | openInterest | impliedVolatility \ |
|---|-----------|---------------|--------|--------------|---------------------|
| 0 | 0.000000 | 0.000000 | 202 | 252 | 0.907227 |
| 1 | -5.479999 | -15.893270 | 1 | 29 | 0.741214 |

| | | | | | |
|----|-----------|------------|------|-------|----------|
| 2 | -7.549999 | -24.121403 | 13 | 466 | 0.627933 |
| 3 | -5.190001 | -21.535270 | 3 | 46 | 0.555180 |
| 4 | -6.690001 | -31.571499 | 65 | 56 | 0.602055 |
| 5 | -6.380000 | -38.249400 | 194 | 561 | 0.515142 |
| 6 | -3.950000 | -28.832117 | 24 | 7 | 0.488775 |
| 7 | -7.090000 | -44.760100 | 34 | 46 | 0.510991 |
| 8 | -4.200000 | -34.257744 | 34 | 30 | 0.477056 |
| 9 | -4.290000 | -36.666668 | 63 | 26 | 0.534673 |
| 10 | -5.790000 | -45.447410 | 194 | 178 | 0.479375 |
| 11 | -5.400000 | -44.444443 | 201 | 69 | 0.463628 |
| 12 | -5.430000 | -48.395720 | 194 | 73 | 0.458746 |
| 13 | -4.809999 | -46.428566 | 598 | 368 | 0.477056 |
| 14 | -4.800000 | -48.000000 | 979 | 110 | 0.446050 |
| 15 | -3.850000 | -45.294117 | 7691 | 23795 | 0.450933 |
| 16 | -4.350000 | -51.479294 | 1213 | 279 | 0.444708 |
| 17 | -4.830000 | -57.844310 | 325 | 523 | 0.453130 |
| 18 | -4.060000 | -56.783222 | 369 | 432 | 0.498418 |
| 19 | -3.790000 | -55.735294 | 1129 | 380 | 0.463384 |
| 20 | -3.300000 | -55.091816 | 2489 | 2172 | 0.431646 |
| 21 | -3.300000 | -58.201060 | 859 | 1124 | 0.446417 |
| 22 | -2.960000 | -59.200000 | 922 | 1127 | 0.469488 |
| 23 | -3.080000 | -64.842100 | 367 | 861 | 0.446783 |
| 24 | -2.750000 | -65.011820 | 143 | 983 | 0.445074 |
| 25 | -2.180000 | -60.555553 | 7091 | 16609 | 0.428473 |
| 26 | -2.620000 | -68.051950 | 336 | 1237 | 0.447027 |
| 27 | -2.330000 | -69.552240 | 775 | 1221 | 0.428961 |
| 28 | -1.890000 | -65.625000 | 317 | 866 | 0.432135 |
| 29 | -1.790000 | -69.111970 | 548 | 1191 | 0.450445 |
| 30 | -1.550000 | -67.982450 | 1538 | 7692 | 0.452642 |
| 31 | -1.430000 | -69.417480 | 249 | 653 | 0.463873 |
| 32 | -1.410000 | -71.938774 | 105 | 535 | 0.491704 |
| 33 | -1.000000 | -66.666670 | 271 | 401 | 0.459966 |
| 34 | -1.220000 | -73.493980 | 234 | 2518 | 0.450689 |
| 35 | -0.800000 | -66.666670 | 1256 | 9326 | 0.485357 |
| 36 | -0.910000 | -72.222220 | 146 | 244 | 0.480474 |
| 37 | -0.840000 | -71.186430 | 158 | 109 | 0.517583 |
| 38 | -0.740000 | -71.844660 | 107 | 399 | 0.493169 |
| 39 | -0.660000 | -72.527470 | 108 | 292 | 0.527348 |
| 40 | -0.520000 | -68.421050 | 695 | 1283 | 0.455084 |
| 41 | -0.300000 | -65.217390 | 284 | 1288 | 0.529790 |
| 42 | -0.220000 | -64.705880 | 383 | 1430 | 0.507817 |
| 43 | -0.150000 | -60.000004 | 272 | 780 | 0.546880 |
| 44 | -0.110000 | -61.111110 | 611 | 1993 | 0.556645 |
| 45 | -0.080000 | -57.142853 | 636 | 249 | 0.593754 |
| 46 | -0.070000 | -58.333332 | 18 | 125 | 0.644535 |
| 47 | -0.040000 | -40.000004 | 10 | 175 | 0.671878 |
| 48 | -0.040000 | -57.142853 | 24 | 31 | 0.687503 |

| | inTheMoney | contractSize | currency |
|----|------------|--------------|----------|
| 0 | True | REGULAR | USD |
| 1 | True | REGULAR | USD |
| 2 | True | REGULAR | USD |
| 3 | True | REGULAR | USD |
| 4 | True | REGULAR | USD |
| 5 | True | REGULAR | USD |
| 6 | True | REGULAR | USD |
| 7 | True | REGULAR | USD |
| 8 | True | REGULAR | USD |
| 9 | True | REGULAR | USD |
| 10 | True | REGULAR | USD |
| 11 | True | REGULAR | USD |
| 12 | True | REGULAR | USD |
| 13 | True | REGULAR | USD |
| 14 | False | REGULAR | USD |
| 15 | False | REGULAR | USD |
| 16 | False | REGULAR | USD |
| 17 | False | REGULAR | USD |
| 18 | False | REGULAR | USD |
| 19 | False | REGULAR | USD |
| 20 | False | REGULAR | USD |
| 21 | False | REGULAR | USD |
| 22 | False | REGULAR | USD |
| 23 | False | REGULAR | USD |
| 24 | False | REGULAR | USD |
| 25 | False | REGULAR | USD |
| 26 | False | REGULAR | USD |
| 27 | False | REGULAR | USD |
| 28 | False | REGULAR | USD |
| 29 | False | REGULAR | USD |
| 30 | False | REGULAR | USD |
| 31 | False | REGULAR | USD |
| 32 | False | REGULAR | USD |
| 33 | False | REGULAR | USD |
| 34 | False | REGULAR | USD |
| 35 | False | REGULAR | USD |
| 36 | False | REGULAR | USD |
| 37 | False | REGULAR | USD |
| 38 | False | REGULAR | USD |
| 39 | False | REGULAR | USD |
| 40 | False | REGULAR | USD |
| 41 | False | REGULAR | USD |
| 42 | False | REGULAR | USD |
| 43 | False | REGULAR | USD |
| 44 | False | REGULAR | USD |

| | | | |
|----|-------|---------|-----|
| 45 | False | REGULAR | USD |
| 46 | False | REGULAR | USD |
| 47 | False | REGULAR | USD |
| 48 | False | REGULAR | USD |

```
[6]: df = yf.download("AAPL")
```

```
[*****100%*****] 1 of 1 completed
```

```
[7]: df.head()
```

```
[7]:
```

| | Adj Close | Close | High | Low | Open | Volume |
|------------|-----------|----------|----------|----------|----------|-----------|
| Date | | | | | | |
| 1980-12-12 | 0.101261 | 0.128348 | 0.128906 | 0.128348 | 0.128348 | 469033600 |
| 1980-12-15 | 0.095978 | 0.121652 | 0.122210 | 0.121652 | 0.122210 | 175884800 |
| 1980-12-16 | 0.088934 | 0.112723 | 0.113281 | 0.112723 | 0.113281 | 105728000 |
| 1980-12-17 | 0.091135 | 0.115513 | 0.116071 | 0.115513 | 0.115513 | 86441600 |
| 1980-12-18 | 0.093777 | 0.118862 | 0.119420 | 0.118862 | 0.118862 | 73449600 |

```
[8]: df.tail()
```

```
[8]:
```

| | Adj Close | Close | High | Low | Open \ |
|------------|------------|------------|------------|------------|------------|
| Date | | | | | |
| 2020-10-26 | 115.050003 | 115.050003 | 116.550003 | 112.879997 | 114.010002 |
| 2020-10-27 | 116.599998 | 116.599998 | 117.279999 | 114.540001 | 115.489998 |
| 2020-10-28 | 111.199997 | 111.199997 | 115.430000 | 111.099998 | 115.050003 |
| 2020-10-29 | 115.320000 | 115.320000 | 116.930000 | 112.199997 | 112.370003 |
| 2020-10-30 | 108.860001 | 108.860001 | 111.989998 | 107.720001 | 111.059998 |


```
Volume
```

| Date | Volume |
|------------|-----------|
| 2020-10-26 | 111850700 |
| 2020-10-27 | 92276800 |
| 2020-10-28 | 143937800 |
| 2020-10-29 | 146129200 |
| 2020-10-30 | 190272600 |

```
[9]: df['Adj Close'][-1]
```

```
[9]: 108.86000061035156
```

```
[10]: K1 = dfo_exp.calls['strike'][11]
      K2 = dfo_exp.calls['strike'][13]
      K3 = dfo_exp.calls['strike'][15]
```

```
[11]: CurrentStockPrice = df['Adj Close'][-1]
```

```

[12]: i = 0
while i < 10:
    CurrentStockPrice = CurrentStockPrice + 25
    payoff = 0
    if (CurrentStockPrice > K1 and CurrentStockPrice <= K2):
        payoff = CurrentStockPrice - K1
    elif (CurrentStockPrice > K2 and CurrentStockPrice < K3):
        payoff = K3 - CurrentStockPrice
    elif (CurrentStockPrice <= K1):
        payoff = 0
    elif (CurrentStockPrice >= K3):
        payoff = 0
    else:
        payoff = 0
    print("Stock price: %2.2f"%CurrentStockPrice)
    print("Payoff from butterfly spread: %2.2f"%payoff)
    print("-"*35)
    i = i + 1

while i >= 0:
    CurrentStockPrice = CurrentStockPrice - 25
    payoff = 0
    if (CurrentStockPrice > K1 and CurrentStockPrice <= K2):
        payoff = CurrentStockPrice - K1
    elif (CurrentStockPrice > K2 and CurrentStockPrice < K3):
        payoff = K3 - CurrentStockPrice
    elif (CurrentStockPrice <= K1):
        payoff = 0
    elif (CurrentStockPrice >= K3):
        payoff = 0
    else:
        payoff = 0

    print("Stock price: %2.2f"%CurrentStockPrice)
    print("Payoff from butterfly spread: %2.2f"%payoff)
    print("-"*35)
    i = i - 1

```

```

Stock price: 133.86
Payoff from butterfly spread: 0.00
-----
Stock price: 158.86
Payoff from butterfly spread: 0.00
-----
Stock price: 183.86
Payoff from butterfly spread: 0.00
-----

```

| | |
|---------------------|------------------------------------|
| Stock price: 208.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 233.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 258.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 283.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 308.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 333.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 358.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 333.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 308.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 283.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 258.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 233.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 208.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 183.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 158.86 | Payoff from butterfly spread: 0.00 |
| ----- | |
| Stock price: 133.86 | Payoff from butterfly spread: 0.00 |
| ----- | |

Stock price: 108.86
Payoff from butterfly spread: 1.14

Stock price: 83.86
Payoff from butterfly spread: 0.00
