

Introduction_Options

September 29, 2021

1 Introduction to Options

1.1 Put-Call Parity

2 Call Options

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

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

```
[9]: dfo.options
```

```
[9]: ('2022-01-20',
      '2020-04-16',
      '2020-03-19',
      '2021-06-17',
      '2020-04-30',
      '2020-10-15',
      '2020-09-17',
      '2020-05-14',
      '2021-09-16',
      '2020-04-23',
      '2020-04-08',
      '2020-04-02',
      '2020-06-18',
      '2020-12-17',
      '2020-03-26',
      '2020-07-16',
      '2021-01-14',
      '2022-06-16')
```

```
[12]: dfo_exp = dfo.option_chain('2020-04-16')
```

```
[13]: dfo_exp.calls
```

```

[13]:      contractSymbol      lastTradeDate  strike  lastPrice      bid  \
0  AAPL200417C00105000  2020-03-12 15:39:28   105.0    149.15  154.75
1  AAPL200417C00110000  2020-03-11 19:41:34   110.0    142.00  161.75
2  AAPL200417C00115000  2020-02-06 20:20:21   115.0    209.52  170.85
3  AAPL200417C00120000  2020-03-02 05:08:26   120.0    150.70  150.25
4  AAPL200417C00125000  2020-01-13 20:05:28   125.0    190.48  200.50
5  AAPL200417C00130000  2020-03-06 17:21:43   130.0    155.45  140.45
6  AAPL200417C00135000  2020-03-02 05:08:27   135.0    126.40  122.55
7  AAPL200417C00140000  2020-03-12 19:40:16   140.0    115.58  131.05
8  AAPL200417C00145000  2020-02-06 20:20:21   145.0    179.50  141.55
9  AAPL200417C00150000  2020-02-14 15:16:17   150.0    114.15  120.75
10 AAPL200417C00155000  2020-02-18 16:24:14   155.0    162.60  105.15
11 AAPL200417C00160000  2020-03-03 18:51:13   160.0    130.30   99.50
12 AAPL200417C00165000  2020-02-26 16:44:12   165.0    132.55   96.20
13 AAPL200417C00170000  2020-03-11 17:20:50   170.0    108.49   91.40
14 AAPL200417C00175000  2020-03-03 15:16:41   175.0    121.20   96.85
15 AAPL200417C00180000  2020-03-13 13:39:55   180.0     83.53   95.10
16 AAPL200417C00185000  2020-03-12 13:30:00   185.0     71.70   76.80
17 AAPL200417C00190000  2020-03-09 19:13:56   190.0     74.75   82.80
18 AAPL200417C00195000  2020-03-12 15:27:51   195.0     66.40   69.70
19 AAPL200417C00200000  2020-03-13 19:57:28   200.0     77.00   76.50
20 AAPL200417C00205000  2020-03-10 19:25:13   205.0     61.00   69.80
21 AAPL200417C00210000  2020-03-11 19:22:52   210.0     60.60   65.50
22 AAPL200417C00215000  2020-03-12 16:01:49   215.0     47.36   51.20
23 AAPL200417C00220000  2020-03-12 19:47:48   220.0     59.00   48.50
24 AAPL200417C00225000  2020-03-12 16:12:00   225.0     45.05   53.00
25 AAPL200417C00230000  2020-03-13 19:47:49   230.0     45.85   41.05
26 AAPL200417C00235000  2020-03-13 19:11:56   235.0     46.16   37.30
27 AAPL200417C00240000  2020-03-13 19:51:28   240.0     42.22   41.30
28 AAPL200417C00245000  2020-03-13 19:55:30   245.0     38.10   37.40
29 AAPL200417C00250000  2020-03-13 19:59:54   250.0     37.20   35.00
..      ...
43 AAPL200417C00320000  2020-03-13 19:59:59   320.0      2.37   1.83
44 AAPL200417C00325000  2020-03-13 19:59:29   325.0      1.59   1.37
45 AAPL200417C00330000  2020-03-13 19:59:22   330.0      1.02   0.83
46 AAPL200417C00335000  2020-03-13 19:57:49   335.0      0.66   0.54
47 AAPL200417C00340000  2020-03-13 19:58:38   340.0      0.41   0.23
48 AAPL200417C00345000  2020-03-13 19:58:38   345.0      0.21   0.13
49 AAPL200417C00350000  2020-03-13 19:55:38   350.0      0.20   0.10
50 AAPL200417C00355000  2020-03-13 19:45:44   355.0      0.09   0.05
51 AAPL200417C00360000  2020-03-13 19:32:51   360.0      0.16   0.01
52 AAPL200417C00365000  2020-03-13 19:38:58   365.0      0.15   0.07
53 AAPL200417C00370000  2020-03-13 19:48:57   370.0      0.07   0.03
54 AAPL200417C00375000  2020-03-13 15:47:39   375.0      0.17   0.00
55 AAPL200417C00380000  2020-03-13 19:32:49   380.0      0.08   0.02
56 AAPL200417C00385000  2020-03-13 18:17:03   385.0      0.05   0.10
57 AAPL200417C00390000  2020-03-13 14:25:54   390.0      0.13   0.01

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58	AAPL200417C00395000	2020-03-13 14:43:31	395.0	0.06	0.01
59	AAPL200417C00400000	2020-03-13 19:30:04	400.0	0.02	0.03
60	AAPL200417C00405000	2020-03-13 14:33:51	405.0	0.10	0.00
61	AAPL200417C00410000	2020-03-06 18:37:02	410.0	0.04	0.00
62	AAPL200417C00415000	2020-03-09 17:59:53	415.0	0.14	0.01
63	AAPL200417C00420000	2020-03-09 13:31:48	420.0	0.02	0.03
64	AAPL200417C00425000	2020-03-12 15:25:16	425.0	0.05	0.00
65	AAPL200417C00430000	2020-03-13 14:09:45	430.0	0.09	0.00
66	AAPL200417C00440000	2020-03-06 19:27:55	440.0	0.03	0.03
67	AAPL200417C00450000	2020-03-13 17:55:24	450.0	0.05	0.03
68	AAPL200417C00460000	2020-03-09 19:11:15	460.0	0.04	0.01
69	AAPL200417C00470000	2020-03-12 14:58:15	470.0	0.02	0.00
70	AAPL200417C00480000	2020-03-11 17:48:29	480.0	0.02	0.02
71	AAPL200417C00490000	2020-03-13 19:10:24	490.0	0.01	0.01
72	AAPL200417C00500000	2020-03-13 18:26:36	500.0	0.01	0.02

	ask	change	percentChange	volume	openInterest	impliedVolatility \
0	155.90	0.000000	0.000000	6.0	3	0.000010
1	162.90	0.000000	0.000000	5.0	5	0.000010
2	173.10	0.000000	0.000000	12.0	0	2.598148
3	154.40	0.000000	0.000000	NaN	2	0.000010
4	201.40	0.000000	0.000000	1.0	0	5.081669
5	144.40	0.000000	0.000000	8.0	0	0.000010
6	127.30	0.000000	0.000000	NaN	1	0.000010
7	134.65	0.000000	0.000000	2.0	2	0.000010
8	143.40	0.000000	0.000000	6.0	0	2.058354
9	124.90	9.150002	8.714287	2.0	26	0.000010
10	108.50	0.000000	0.000000	4.0	2	0.000010
11	103.35	0.000000	0.000000	8.0	32	0.000010
12	99.55	0.000000	0.000000	4.0	4	0.000010
13	94.70	0.000000	0.000000	4.0	287	0.000010
14	100.80	0.000000	0.000000	20.0	499	0.000010
15	98.55	6.680000	8.692258	4.0	70	0.752932
16	79.90	0.000000	0.000000	1.0	2324	0.000010
17	86.60	0.000000	0.000000	15.0	155	0.000010
18	72.30	0.580002	0.881194	1.0	124	0.000010
19	79.65	16.500000	27.272728	141.0	761	0.736819
20	72.05	0.000000	0.000000	6.0	221	0.000010
21	67.35	2.049999	3.501280	2.0	553	0.000010
22	53.40	0.000000	0.000000	20.0	583	0.000010
23	51.15	14.549999	32.733406	12.0	918	0.000010
24	56.00	6.270001	16.168129	24.0	622	0.507329
25	43.50	7.329998	19.029070	164.0	927	0.000010
26	40.20	13.840000	42.821780	371.0	566	0.000010
27	34.40	12.270000	40.968280	714.0	1225	0.000010
28	39.45	9.729998	34.296783	454.0	545	0.539067
29	36.40	15.200001	69.090910	674.0	2735	0.574833

..
43	1.88	0.870000	57.999992	2314.0	24678	0.379767	
44	1.48	0.390000	32.500000	1504.0	16233	0.383307	
45	0.92	0.120000	13.333334	1529.0	18066	0.366706	
46	0.58	-0.100000	-13.157890	315.0	6153	0.355963	
47	0.33	-0.120000	-22.641506	588.0	13535	0.342292	
48	0.19	-0.240000	-53.333336	335.0	6545	0.333014	
49	0.26	-0.110000	-35.483870	448.0	6486	0.368170	
50	0.29	-0.210000	-70.000000	51.0	1252	0.393561	
51	0.26	-0.060000	-27.272728	72.0	2251	0.405279	
52	0.30	-0.020000	-11.764703	57.0	1325	0.432623	
53	0.13	-0.060000	-46.153843	28.0	2232	0.401373	
54	0.33	0.070000	70.000000	16.0	978	0.474615	
55	0.11	-0.020000	-20.000004	3.0	1577	0.424810	
56	0.45	-0.050000	-50.000000	13.0	370	0.533208	
57	0.15	0.050000	62.500000	14.0	604	0.472662	
58	0.28	-0.090000	-60.000004	1.0	910	0.529302	
59	0.02	-0.020000	-50.000000	74.0	13161	0.406256	
60	0.30	0.070000	233.333340	4.0	314	0.516606	
61	0.19	0.000000	0.000000	100.0	4777	0.503911	
62	0.76	0.000000	0.000000	3.0	88	0.617680	
63	0.25	0.000000	0.000000	1.0	1552	0.554692	
64	0.05	0.000000	0.000000	1.0	72	0.507817	
65	0.14	0.020000	28.571432	10.0	4979	0.539067	
66	0.05	0.000000	0.000000	1.0	912	0.533208	
67	0.04	0.010000	25.000006	51.0	9361	0.548833	
68	0.14	0.000000	0.000000	2.0	1269	0.615238	
69	0.76	0.000000	0.000000	1.0	1290	0.771487	
70	0.07	0.000000	0.000000	16.0	2387	0.628910	
71	0.02	-0.020000	-66.666670	1.0	871	0.589848	
72	0.01	0.000000	0.000000	2.0	6303	0.609379	

	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	True	REGULAR	USD
15	True	REGULAR	USD
16	True	REGULAR	USD
17	True	REGULAR	USD
18	True	REGULAR	USD
19	True	REGULAR	USD
20	True	REGULAR	USD
21	True	REGULAR	USD
22	True	REGULAR	USD
23	True	REGULAR	USD
24	True	REGULAR	USD
25	True	REGULAR	USD
26	True	REGULAR	USD
27	True	REGULAR	USD
28	True	REGULAR	USD
29	True	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
49	False	REGULAR	USD
50	False	REGULAR	USD
51	False	REGULAR	USD
52	False	REGULAR	USD
53	False	REGULAR	USD
54	False	REGULAR	USD
55	False	REGULAR	USD
56	False	REGULAR	USD
57	False	REGULAR	USD
58	False	REGULAR	USD
59	False	REGULAR	USD
60	False	REGULAR	USD
61	False	REGULAR	USD
62	False	REGULAR	USD
63	False	REGULAR	USD
64	False	REGULAR	USD
65	False	REGULAR	USD
66	False	REGULAR	USD
67	False	REGULAR	USD
68	False	REGULAR	USD
69	False	REGULAR	USD
70	False	REGULAR	USD
71	False	REGULAR	USD
72	False	REGULAR	USD

[73 rows x 14 columns]

```
[14]: dfo_exp.puts
```

```
[14]:
```

	contractSymbol	lastTradeDate	strike	lastPrice	bid	\
0	AAPL200417P00105000	2020-03-13 19:31:34	105.0	0.48	0.38	
1	AAPL200417P00110000	2020-03-13 19:53:45	110.0	0.50	0.56	
2	AAPL200417P00115000	2020-03-13 19:34:07	115.0	0.56	0.34	
3	AAPL200417P00120000	2020-03-13 19:52:07	120.0	0.51	0.72	
4	AAPL200417P00125000	2020-03-13 19:52:28	125.0	0.71	0.51	
5	AAPL200417P00130000	2020-03-13 19:58:44	130.0	0.80	0.80	
6	AAPL200417P00135000	2020-03-13 19:56:23	135.0	0.88	0.80	
7	AAPL200417P00140000	2020-03-13 19:57:14	140.0	1.00	0.92	
8	AAPL200417P00145000	2020-03-13 19:49:23	145.0	1.27	1.04	
9	AAPL200417P00150000	2020-03-13 19:57:03	150.0	1.35	1.25	
10	AAPL200417P00155000	2020-03-13 19:51:45	155.0	1.39	1.34	
11	AAPL200417P00160000	2020-03-13 19:52:59	160.0	1.57	1.85	
12	AAPL200417P00165000	2020-03-13 19:52:20	165.0	1.76	2.05	
13	AAPL200417P00170000	2020-03-13 19:57:37	170.0	1.75	1.87	
14	AAPL200417P00175000	2020-03-13 19:58:02	175.0	1.93	3.00	
15	AAPL200417P00180000	2020-03-13 19:57:17	180.0	2.37	2.32	
16	AAPL200417P00185000	2020-03-13 19:59:44	185.0	2.20	2.57	
17	AAPL200417P00190000	2020-03-13 19:57:16	190.0	2.50	2.87	
18	AAPL200417P00195000	2020-03-13 19:58:41	195.0	3.49	3.15	
19	AAPL200417P00200000	2020-03-13 19:59:01	200.0	3.00	3.30	
20	AAPL200417P00205000	2020-03-13 19:58:16	205.0	3.16	3.85	
21	AAPL200417P00210000	2020-03-13 19:57:28	210.0	3.65	4.50	
22	AAPL200417P00215000	2020-03-13 19:59:21	215.0	4.81	4.65	
23	AAPL200417P00220000	2020-03-13 19:59:21	220.0	5.12	8.40	
24	AAPL200417P00225000	2020-03-13 19:59:54	225.0	5.50	6.30	
25	AAPL200417P00230000	2020-03-13 19:59:27	230.0	6.46	7.30	
26	AAPL200417P00235000	2020-03-13 19:57:51	235.0	7.50	8.35	
27	AAPL200417P00240000	2020-03-13 19:59:39	240.0	8.20	9.55	
28	AAPL200417P00245000	2020-03-13 19:59:44	245.0	9.13	10.70	
29	AAPL200417P00250000	2020-03-13 19:58:51	250.0	10.31	12.10	
..	
35	AAPL200417P00280000	2020-03-13 19:52:43	280.0	23.80	22.10	
36	AAPL200417P00285000	2020-03-13 19:54:13	285.0	26.70	32.10	
37	AAPL200417P00290000	2020-03-13 19:59:36	290.0	25.00	28.35	
38	AAPL200417P00295000	2020-03-13 19:59:25	295.0	28.00	31.00	
39	AAPL200417P00300000	2020-03-13 19:58:25	300.0	32.50	33.80	
40	AAPL200417P00305000	2020-03-13 19:48:02	305.0	41.24	37.30	
41	AAPL200417P00310000	2020-03-13 19:57:29	310.0	41.45	39.15	
42	AAPL200417P00315000	2020-03-13 19:56:34	315.0	46.00	42.30	
43	AAPL200417P00320000	2020-03-13 19:58:56	320.0	47.75	47.35	
44	AAPL200417P00325000	2020-03-13 18:25:58	325.0	66.80	53.05	

45	AAPL200417P00330000	2020-03-13 19:28:04	330.0	69.60	55.40
46	AAPL200417P00335000	2020-03-13 17:37:13	335.0	75.18	73.85
47	AAPL200417P00340000	2020-03-09 14:03:21	340.0	78.05	64.60
48	AAPL200417P00345000	2020-03-12 16:13:13	345.0	95.17	83.75
49	AAPL200417P00350000	2020-03-13 19:33:35	350.0	74.92	74.85
50	AAPL200417P00355000	2020-03-09 19:43:46	355.0	82.51	93.55
51	AAPL200417P00360000	2020-02-28 16:45:09	360.0	67.40	83.35
52	AAPL200417P00365000	2020-03-09 15:56:53	365.0	88.45	90.75
53	AAPL200417P00370000	2020-03-10 19:59:10	370.0	114.23	108.60
54	AAPL200417P00375000	2020-02-04 18:41:38	375.0	57.62	78.50
55	AAPL200417P00380000	2020-02-26 20:47:14	380.0	87.30	118.60
56	AAPL200417P00385000	2020-03-10 19:16:50	385.0	105.40	108.60
57	AAPL200417P00390000	2020-02-20 20:33:27	390.0	69.30	116.00
58	AAPL200417P00395000	2020-02-12 17:01:32	395.0	70.48	137.20
59	AAPL200417P00400000	2020-03-06 20:19:48	400.0	115.72	126.10
60	AAPL200417P00405000	2020-01-29 15:04:19	405.0	82.90	139.30
61	AAPL200417P00410000	2020-03-05 16:08:26	410.0	111.94	135.55
62	AAPL200417P00415000	2020-03-09 15:56:53	415.0	138.40	140.60
63	AAPL200417P00420000	2020-03-02 15:08:12	420.0	140.00	158.20
64	AAPL200417P00425000	2020-03-09 16:07:22	425.0	147.80	150.30

	ask	change	percentChange	volume	openInterest	impliedVolatility \
0	0.50	-0.070000	-12.727277	3444.0	3692	1.490237
1	0.62	-0.100000	-16.666670	1144.0	1175	1.487307
2	0.73	-0.040000	-6.666670	363.0	321	1.400394
3	0.76	-0.340000	-40.000004	347.0	225	1.408694
4	0.89	-0.150000	-17.441864	54.0	46	1.333988
5	0.90	-0.210000	-20.792078	82.0	307	1.316410
6	0.91	-0.340000	-27.868855	118.0	81	1.258793
7	1.04	-0.640000	-39.024387	65.0	768	1.231449
8	1.16	-0.430000	-25.294123	111.0	1077	1.200199
9	1.29	-0.650000	-32.500000	1364.0	566	1.176762
10	1.47	-0.710000	-33.809520	40.0	226	1.145024
11	2.69	-1.230000	-43.928570	78.0	455	1.209232
12	2.25	-0.720000	-29.032260	125.0	894	1.138188
13	2.01	-1.750000	-50.000000	504.0	835	1.058598
14	3.70	-2.220000	-53.493984	263.0	4503	1.149662
15	2.47	-2.140000	-47.450115	282.0	2427	1.004155
16	2.80	-3.350000	-60.360360	266.0	703	0.979981
17	3.05	-3.750000	-60.000004	201.0	2876	0.952271
18	3.35	-3.410000	-49.420290	165.0	1470	0.924073
19	3.60	-5.000000	-62.500000	1170.0	2187	0.887452
20	4.15	-5.390000	-63.040936	443.0	2138	0.874147
21	4.75	-6.200000	-62.944160	519.0	1908	0.861207
22	4.95	-5.560000	-53.616203	453.0	1334	0.818727
23	9.60	-7.380000	-59.039997	1125.0	2735	0.974671
24	6.60	-8.390000	-60.403168	810.0	6922	0.797793

25	7.55	-9.190000	-58.722042	561.0	2955	0.787417
26	8.60	-9.700001	-56.395350	499.0	3739	0.775637
27	9.80	-10.750001	-56.728237	1384.0	10444	0.765444
28	11.05	-11.169999	-55.024630	1137.0	3123	0.750735
29	12.40	-13.140000	-56.034110	3270.0	13720	0.738040
..
35	22.55	-16.200000	-40.500004	1038.0	17607	0.627872
36	35.00	-15.299999	-36.428570	229.0	6235	0.875184
37	28.65	-20.000000	-44.444447	252.0	12378	0.636295
38	42.85	-21.900002	-43.887775	161.0	6875	0.792788
39	45.20	-22.500000	-40.909092	286.0	14644	0.771548
40	39.30	-15.919998	-27.851640	46.0	7696	0.627506
41	42.65	-17.800000	-30.042192	224.0	9795	0.591923
42	45.35	-19.870003	-30.165482	18.0	8426	0.558720
43	50.20	-22.660004	-32.182930	35.0	8207	0.593754
44	56.30	-2.189995	-3.174366	5.0	3938	0.662906
45	59.30	-7.380005	-9.586911	4.0	2237	0.605595
46	75.95	-8.139999	-9.769563	1.0	513	1.082585
47	68.50	13.800003	21.478603	2.0	584	0.631962
48	87.95	0.000000	0.000000	4.0	370	1.185490
49	78.60	-25.180000	-25.154846	1.0	725	0.697391
50	97.40	0.000000	0.000000	1.0	202	1.241459
51	87.55	0.000000	0.000000	12.0	531	0.684818
52	94.55	0.000000	0.000000	5.0	56	0.822512
53	112.20	0.000000	0.000000	50.0	32	1.334354
54	79.75	0.000000	0.000000	1.0	0	0.000010
55	121.60	0.000000	0.000000	1100.0	0	1.383731
56	112.55	0.000000	0.000000	NaN	0	0.811281
57	120.45	0.000000	0.000000	35.0	0	0.975464
58	139.00	0.000000	0.000000	100.0	7	1.569582
59	129.85	0.000000	0.000000	1.0	2	1.009893
60	140.60	0.000000	0.000000	NaN	0	1.333011
61	139.35	0.000000	0.000000	1.0	0	1.027104
62	144.50	0.000000	0.000000	NaN	0	1.053838
63	161.45	0.000000	0.000000	1.0	0	1.586489
64	155.50	0.000000	0.000000	NaN	0	1.114262

	inTheMoney	contractSize	currency
0	False	REGULAR	USD
1	False	REGULAR	USD
2	False	REGULAR	USD
3	False	REGULAR	USD
4	False	REGULAR	USD
5	False	REGULAR	USD
6	False	REGULAR	USD
7	False	REGULAR	USD
8	False	REGULAR	USD

9	False	REGULAR	USD
10	False	REGULAR	USD
11	False	REGULAR	USD
12	False	REGULAR	USD
13	False	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
..
35	True	REGULAR	USD
36	True	REGULAR	USD
37	True	REGULAR	USD
38	True	REGULAR	USD
39	True	REGULAR	USD
40	True	REGULAR	USD
41	True	REGULAR	USD
42	True	REGULAR	USD
43	True	REGULAR	USD
44	True	REGULAR	USD
45	True	REGULAR	USD
46	True	REGULAR	USD
47	True	REGULAR	USD
48	True	REGULAR	USD
49	True	REGULAR	USD
50	True	REGULAR	USD
51	True	REGULAR	USD
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56	True	REGULAR	USD
57	True	REGULAR	USD
58	True	REGULAR	USD
59	True	REGULAR	USD

60	True	REGULAR	USD
61	True	REGULAR	USD
62	True	REGULAR	USD
63	True	REGULAR	USD
64	True	REGULAR	USD

[65 rows x 14 columns]

```
[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	0.406782	0.513393	0.515625	0.513393	0.513393	117258400
1980-12-15	0.385558	0.486607	0.488839	0.486607	0.488839	43971200
1980-12-16	0.357260	0.450893	0.453125	0.450893	0.453125	26432000
1980-12-17	0.366103	0.462054	0.464286	0.462054	0.462054	21610400
1980-12-18	0.376715	0.475446	0.477679	0.475446	0.475446	18362400

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

```
[8]:
```

	Adj Close	Close	High	Low	Open	\
Date						
2020-03-09	266.170013	266.170013	278.089996	263.000000	263.750000	
2020-03-10	285.339996	285.339996	286.440002	269.369995	277.140015	
2020-03-11	275.429993	275.429993	281.220001	271.859985	277.390015	
2020-03-12	248.229996	248.229996	270.000000	248.000000	255.940002	
2020-03-13	277.970001	277.970001	279.920013	252.949997	264.890015	

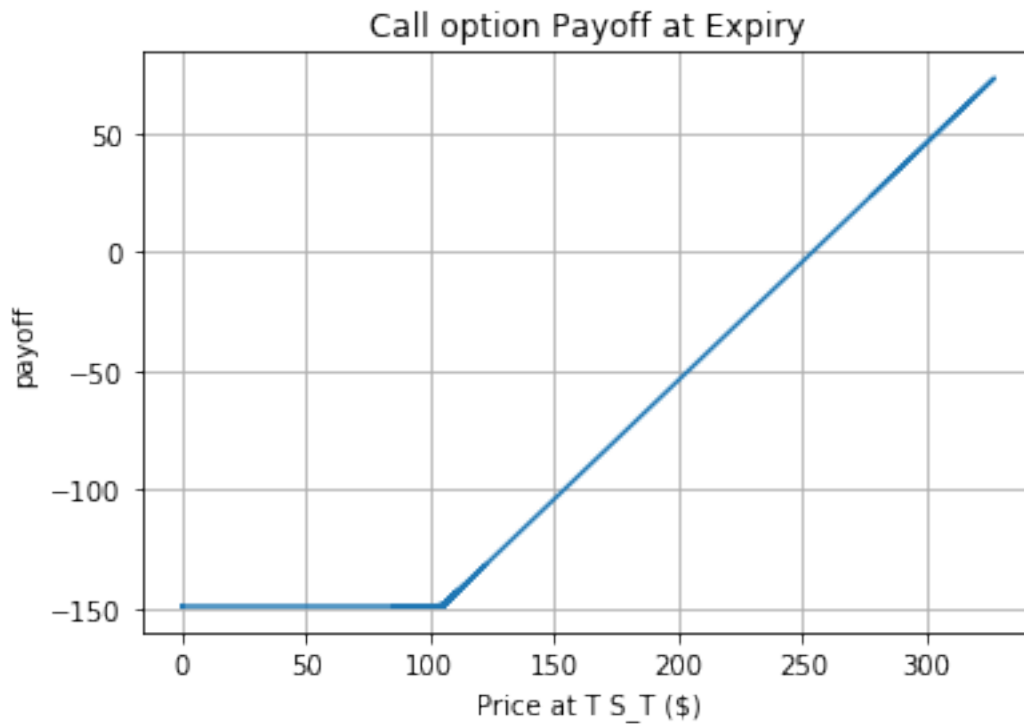
	Volume
Date	
2020-03-09	71686200
2020-03-10	71322500
2020-03-11	63899700
2020-03-12	104618500
2020-03-13	92481100

```
[22]: price = df['Adj Close']
strike = dfo_exp.calls['strike'][0]
premium = dfo_exp.calls['lastPrice'][0]
```

```
[23]: payoff = [max(-premium, i - strike-premium) for i in price]
```

```
[24]: payoff = [max(-premium, i - strike-premium) for i in price]
```

```
[25]: plt.plot(price, payoff)
plt.xlabel('Price at T S_T ($)')
plt.ylabel('payoff')
plt.title('Call option Payoff at Expiry')
plt.grid(True)
```



3 Put Option

```
[27]: price = df['Adj Close']
strike = dfo_exp.puts['strike'][0]
premium = dfo_exp.puts['lastPrice'][0]
```

```
[28]: payoff = [max(-premium, strike - i - premium) for i in price]
```

```
[29]: plt.plot(price, payoff)
plt.xlabel('Price at T S_T ($)')
plt.ylabel('payoff')
plt.title('Put option Payoff at Expiry')
plt.grid(True)
```

