Advanced Options Strategies

Part 2 – Spreads – revised and finalized for April 22, 2019

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A basic program designed to extract a level 1 quote only, then save or log it. Used in part to debug the quote extraction process.

```
import math
import numpy as np
import matplotlib
import dateutil
from datetime import datetime
import ib_insync

from ib_insync import *

util.startLoop()
ib = IB()
ib.connect('127.0.0.1', 7496, clientId=19)

<IB connected to 127.0.0.17496 clientId=19>

symbol = "FB"

stock = Stock(symbol, 'SMART', 'USD')
ib.qualifyContracts(stock)
ll_quote = ib.reqMktData(stock, '', False, False)
ll_quote

Ticket:contract(Stock(coid=107113396, symbol='FB', exchange='SMART', primaryExchange='NASDAQ', currency='USD', localSymbol='FB', tradingClass='NASD')

Grab the quotes (this is where the process sometimes must be repeated):

s_bid = ll_quote.bid
s_ask = ll_quote.ask
s_net = (s_ask + s_bid) / 2.0
s_peg = round(s_peg, 2)
print('Last:', s_last, 'Bid:', s_bid, 'Ask:', s_ask, 'Peg:', s_peg)

ib.disconnect()
```
A spread is typically a two-legged bet consisting of the primary bet, which usually involves writing a naked call or put, and a hedge, which involves buying a call or put of the same underlying at a different strike price (usually the case) or a different expiry.

A naked call or put exposes the writer to a potentially huge liability, even if improbable, for a relatively small gain. By critics this is called “picking up dimes in front of a steamroller.” Placing a hedge on the original bet by making a smaller opposite bet reduces the maximum gain possible from the original bet, but also eliminates the risk of a huge loss.

If you trade two options (whether buying or selling) with the same expiration date, that is called a VERTICAL SPREAD. If the two options have different expiries, that is called a CALENDAR SPREAD.

If you write one option and buy another in a vertical spread, if the option that you write is more expensive than the option you buy, this is called a CREDIT SPREAD. If, on the other hand, the option that you buy is more expensive than the option you write, this is called a DEBIT SPREAD, because your account is debited with the difference.

If you profit if a stock goes up, then you have a BULL SPREAD, otherwise you have a BEAR SPREAD.
Candidates for our example:

May 17 expiry: 32 days on April 15

Might have also considered a closer expiry ...
**Strategy 5 – The Bear Credit Spread – OTM options**

<table>
<thead>
<tr>
<th>The options trader doing a Bear Credit Spread essentially writes a call, typically near the money but out of the money, *to a counter-party who is buying the call.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because she is writing a call, her account is credited for the value of the call <strong>(less fees).</strong></td>
</tr>
<tr>
<td>But, as we will see in our example, the call-writer has a huge potential liability because she has written a naked call.</td>
</tr>
<tr>
<td>Therefore she has to hedge her written call. To do that, she caps her liability by also buying a less expensive call that is further out of the money. On net, the hedge will reduce her credit and her profit, put prevent catastrophic loss in case the underlying stock has a positive 4-sigma surge.</td>
</tr>
<tr>
<td>Often the person writing the bear credit spread will choose deltas that enhance the policy, such as “write a call with an approximate 0.45 delta, buy a hedge call with an approximate 0.25 delta.</td>
</tr>
</tbody>
</table>

*This is not a hard and fast rule. There may be a reason to write an ITM call.  
**Although this cash is credited to the account, it is committed and cannot be used until the trade is offset.*
Some examples - gathering some useful information about the calls ... especially the deltas.

Why? Because many spread traders who trade credit spreads in calls, for example, like to follow rules like (1) write (short) a 0.45 delta call and (2) buy (as a hedge) a 0.30 or 0.25 call. Such a strategy will always produce a credit (as we will see).
Review: In order to understand the logic of the OTM Bear Credit Spread

Here we are looking at the trade from the perspective of the counter-party.

When you do a bear credit spread, the strategy is the opposite of buying a call ... in fact, someone must buy your call for the strategy to work.

Shown here is the payoff for the person on the other side of the trade (for the first leg).

Your counter-party’s trade (your first leg): Buy the 292 Call for 2.72. His option will have intrinsic value if the stock rises above 292, and he will have a profit if the stock goes above 294.72.
The position for the writer of that same call ...

The call-writer’s trade is the mirror-image of the counter-party trade. His loss is her gain, his gain is her loss.

The writer pockets the 2.72 per share (so this is a credit trade), but may have to give it back and more if the stock rises above 294.72.

Note the potential for a huge loss in the event of a sharp rise in the price of the stock. Therefore the smart trader will hedge by buying a low-delta call. But how much of a hedge?

So far, this is just a naked call with unacceptable exposure. When the hedge is added, this is called a bear credit spread.
OTM Bear Credit Spread Payoff (at expiry only)

1. Why “credit?”
   • Because the transaction starts cash positive, given that you are selling an asset more valuable than the hedge.

2. Why “spread?”
   • This is the standard term for two-legged positions where one is long and the other short.

3. Why “bear?”
   • This is a bet that the market will not rise. It doesn’t have to go down, but it can’t rise.

4. When would you do this?
   • When you think call options are over-valued or when you think there is a genuine bear market.

5. Typical delta strategy?
   • Sell at 0.48 – 0.40
   • Buy at 0.20 – 0.25
The OTM Bear Credit Spread trader also must face **assignment risk**! If the original call option that was written goes into the money (if the underlying goes above 292), then the call **at any point** can be assigned, which will require the trader to buy the stock to cover the assignment. This further implies that the amount of cash required to cover a Bear Credit Spread is, with a margin account, 50% of the value of 100 shares at the strike, which in this example is $14,600!
Obviously the maximum gain and loss and general risk exposure depends upon your choice of hedge. Here we are considering a hedge (295) with a higher delta, which, when compared to the previous hedge, offers a smaller maximum gain but also a smaller loss. Hence the selection of legs based upon deltas.
Common features of Bear Credit Spreads (so we can program them):

1. The credit will equal the value of the shorted option minus the value of the hedge option.
   • $1.64 = 2.92 – 1.08

2. The credit will also be the maximum gain!
   • $1.64

3. The maximum loss will always equal the spread between the short strike and the hedge strike minus the credit.
   • -$2.36 = (292 – 296) + 1.64

4. The maximum gain will always apply to all final stock prices below the short strike.

5. The maximum loss will always apply to all final stock prices above the hedge strike.

6. The probability of maximum game is always equal to one minus the delta of the short strike option.

7. The probability of maximum loss is always equal to the delta of the hedge strike option.

8. The probability of an outcome between the maximums is equal to one minus the sum of the maximum’s individual probabilities.
Our Python program -

```
Credit Spread mappings - Master

credit_spread_v1_1_master April 20, 2019. This is the master. Do not alter. Copy to revise!

Designed by Prof Evans for use by students in Econ 136.

In [15]: #matplotlib inline

In [16]: import numpy as np
   ...: import math
   ...: import matplotlib.pyplot as plt
   ...: import seaborn as sns

Later versions of this code allow it to be used with pandas. Call = True is a marker for that only and not used here. The delta for the two strikes is not used in this but is used in the student HW problem, so those markers are set here as well. The short strike refers to the option that we are writing, which will be more expensive than the hedge. The hedge refers to the option that we are buying as a hedge. The short_delta will be higher than the hedge_delta, like 0.45 compared to 0.25.

In [17]:
   ...: call = True
   ...: strike = "put"
   ...: expiry = "20300511"
   ...: dates = int(17)
   ...: stock_price = 290.06
   ...: short_strike = 292.00
   ...: short_price = 2.72
   ...: hedge_strike = 295.0
   ...: hedge_price = 1.40
   ...: short_delta = "NaN"
   ...: hedge_delta = "NaN"

These elementary formulas below work for all credit spreads.

In [18]:
   ...: spread = hedge_strike - short_strike
   ...: max_gain = short_price - hedge_price
   ...: max_loss = max_gain - spread
   ...: print("Spread: {:.2f}, Maximum gain: {:.3f}, and Maximum Loss: {:.3f}".format(spread, max_gain, max_loss))
   ...: Spread: 3.00, Maximum gain: 1.320, and Maximum Loss: -1.480.

For the mapping, we center allow 19 strikes by default, and then center that on either the center of the spread or on the stock price. We then allow an offset for the sake of appearance. The user can experiment with the appearance by over-riding the defaults. Then we set the strikes and print (for debugging).

In [19]:
   ...: num_strikes = 19 #default 19 - must be an odd number
   ...: sides = num_strikes - 1)/2
   ...: # center = int(stock_price)
   ...: center = int(short_strike + spread/2)
   ...: left_offset = 0 # this shifts the center of the mapping left (pos) or right (neg)
   ...: low_str = center - sides - left_offset
   ...: hi_str = center + sides + left_offset
```
An example of a deep bear spread (of the kind used in the CBOE educational examples):

The problem with this?? Assignment and the cash requirements associated with assignment!

Underlying: SPY
Stock price: 290.06.
Expiry: 20190517
Days: 17
Short strike: 285.00.
Short strike price: 7.57.
Hedge strike: 292.00.
Hedge strike price: 2.74.
Spread: 7.00.
Max gain: 4.83.
Max loss: -2.17.
But what about assignment risk???

The amount of cash needed to secure a spread equals 50% of a 100 share long position because of assignment risk. This lowers the projected ROI!
Strategy 6 – The OTM Bull Credit Spread

The options trader doing a Bull Credit Spread essentially writes a put, typically near the money but out of the money,* to a counter-party who is buying the put.

Because he is writing a put, his account is credited for the value of the call** (less fees).

The put-writer has a huge potential liability because she has written a naked put.

Therefore he has to hedge his written put. To do that, he caps his liability by also buying a less expensive put that is further out of the money. On net, the hedge will reduce his credit and his profit, put prevent catastrophic loss in case the underlying stock has a 4-sigma plunge.

Often the person writing the bull credit spread will choose deltas that enhance the policy, such as “write a put with an approximate 0.45 delta, buy a hedge put with an approximate 0.25 delta.

*This is not a hard and fast rule. There may be a reason to write an ITM put.
**Although this cash is credited to the account, it is committed and cannot be used until the trade is offset.
May 17 32 days on April 15, 2019    SPY: 290.06

<table>
<thead>
<tr>
<th>STRIKE</th>
<th>BID</th>
<th>ASK</th>
<th>BID SIZE</th>
<th>ASK SIZE</th>
<th>LAST</th>
<th>LOW</th>
<th>HIGH</th>
<th>OPTN</th>
<th>VOLUME</th>
<th>CHANGE %</th>
</tr>
</thead>
<tbody>
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<td>0.63</td>
<td>15,023</td>
<td>6,838</td>
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<tr>
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<td>0.68</td>
<td>20,427</td>
<td>1,507</td>
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<td>0.67</td>
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<td>0.74</td>
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<td>430</td>
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<td>0.80</td>
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<td>1.37</td>
<td>9,798</td>
<td>33</td>
<td>1.35</td>
<td>1.34</td>
<td>1.64</td>
<td>20.3K</td>
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<td>1.50</td>
<td>1.51</td>
<td>10,152</td>
<td>33</td>
<td>1.49</td>
<td>1.49</td>
<td>1.76</td>
<td>25.4K</td>
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<td>1.67</td>
<td>4,863</td>
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<td>285</td>
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<td>1.85</td>
<td>4,565</td>
<td>82</td>
<td>1.83</td>
<td>1.82</td>
<td>2.23</td>
<td>68.2K</td>
<td>2.91K</td>
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<td>286</td>
<td>2.05</td>
<td>2.06</td>
<td>658</td>
<td>1,958</td>
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<td>2.02</td>
<td>2.45</td>
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<td>2.28</td>
<td>2.30</td>
<td>3,242</td>
<td>4,495</td>
<td>2.26</td>
<td>2.26</td>
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<td>27.7K</td>
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<td>288</td>
<td>2.55</td>
<td>2.57</td>
<td>1,640</td>
<td>4,336</td>
<td>2.55</td>
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<td>2.88</td>
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<td>5,187</td>
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<td>2.83</td>
<td>3.43</td>
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<td>10.4K</td>
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<td>3.21</td>
<td>3.23</td>
<td>437</td>
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<tr>
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<td>3.61</td>
<td>3.63</td>
<td>355</td>
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<td>4.09</td>
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<td>1,862</td>
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<td>1.28K</td>
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<tr>
<td>293</td>
<td>4.58</td>
<td>4.61</td>
<td>306</td>
<td>1,332</td>
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<td>4.55</td>
<td>5.25</td>
<td>3.39K</td>
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<td>1.31%</td>
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<tr>
<td>294</td>
<td>5.17</td>
<td>5.19</td>
<td>68</td>
<td>1,488</td>
<td>5.28</td>
<td>5.06</td>
<td>5.90</td>
<td>1.20K</td>
<td>353</td>
<td>2.52%</td>
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</tbody>
</table>
Review: In order to understand the logic of the Bull Credit Spread

When you do a bull credit spread, the strategy is the opposite of buying a put ... in fact, someone must buy your put for the strategy to work.

As before, we start by reminding ourselves of the payoff for your counterparty?

The counterparty’s gain is our loss and loss is our gain.

Likewise, it is clear that we will have to hedge by buying a cheaper put, like the 285 (not shown).

Your counter-party’s trade (your first leg): Buy the 289 Put for 2.72 for 2.87. Her option will have intrinsic value if the stock falls below 289, and she will have a profit if the stock goes below 286.13.
The reversed (written) hedged position:

1. Why “credit?”
   - Because the transaction starts cash positive, given that you are selling an asset more valuable than the hedge.

2. Why “spread?”
   - This is the standard term for two-legged positions where one is long and the other short.

3. Why “bull?”
   - This is a bet that the market will rise, or at least that it will not go down.

4. When would you do this?
   - When you think options are being priced without drift parameters and/or during a genuine momentum market.

5. Typical delta strategy?
   - Sell at 0.48 – 0.40
   - Buy at 0.20 – 0.25

Here we are still looking at it from the perspective of the counter-party (although it is not the original counter-party who sold you the hedge.)
How the Bull Credit Spread payoff is normally shown ...

<table>
<thead>
<tr>
<th>Underlying</th>
<th></th>
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<tbody>
<tr>
<td>SPY</td>
<td></td>
</tr>
<tr>
<td>290.06</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Short</th>
<th></th>
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</thead>
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<td>SPY Put</td>
<td>289</td>
</tr>
<tr>
<td>days</td>
<td>32</td>
</tr>
<tr>
<td>Credit:</td>
<td>$2.87</td>
</tr>
<tr>
<td>Delta:</td>
<td>unk</td>
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</table>

<table>
<thead>
<tr>
<th>Long</th>
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<tbody>
<tr>
<td>SPY Put</td>
<td>285</td>
</tr>
<tr>
<td>days</td>
<td>32</td>
</tr>
<tr>
<td>Debit:</td>
<td>$1.84</td>
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<tr>
<td>Delta:</td>
<td>unk</td>
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<table>
<thead>
<tr>
<th>Specs</th>
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<tr>
<td>Max gain:</td>
<td>$1.03</td>
</tr>
<tr>
<td>Max Loss:</td>
<td>-$2.97</td>
</tr>
</tbody>
</table>

Once again, The Bull Credit Spread trader also must face assignment risk! If the original put option that was written goes into the money (if the underlying goes above 288), then the put at any point can be assigned. This implies that the amount of cash required to cover a Bear Credit Spread is, with a margin account, 50% of the value of 100 shares at the strike, which in this example is $14,600!
Strategy ... [some of these are alternatives]

• Use your scanners to find anomalous short-term prices, where IV is considerably above short-term (30-day or 90-day) HV.
• Find stocks (like AMD) that have consistently expensive options (IV consistently above short-term HV).
• If using index ETFs (and stocks that are correlated with index ETFs) jump into these when the VIX shoots up, avoid when the VIX falls (and here we are referring to very-short-term)

... and specifically Bull (Put) Credit Spreads

• In a strong bull market, and especially a momentum market, models using BSM-style calculators that do not include drift are overestimating put values and puts are trading at a consistent premium. In a momentum market, symmetric puts should be less expensive than their call counterparts and they are not!!
• There may be a large insurance premium built into put hedge positions, especially in the index ETF puts (including SPX).
• Write puts when this is true

... and ignore Reddit recommendations to do this with cash-secured puts.
Unlike what is often implied on Reddit, writing options does not guarantee gains and you are not merely harvesting premium. The standard is not to merely make a profit, it is, at a minimum, to outperform SPX. (If writing covered calls, the goal is not to make a profit, it is to beat the gain that you would have made by holding a mere long position in the underlying)! Therefore, this will not likely work unless you use a computer-assisted approach. At a minimum, you must have programs that will:

- Evaluate the full range of HVs for the underlying.
- Either a good options pricing model that makes a reasonable delta estimate or a direct ITM probability estimator (like our first model).
- A variation of the model used in this lecture, that will turn payoffs into expected values (your final HW), preferably in automated form.
- Scanning model(s) similar to the ib-strangle model that we have that will automate the search of you are searching for anomalies.

... and this leads into our final Homework.
You are not accountable for anything past this point in 2019, but I include older slides about more esoteric strategies in case you care to review them. In addition, if curious about this, make sure you review the Aruba slides about writing covered calls, which was actually Prof E’s specialty (but we never got to it).
Strategy 7: The Iron Condor

The primary bet was **writing** a strangle consisting of a 132 call for $1.25 and a 128 put for $1.64 when DIA was at $130.36.

Possible Prices of DIA on May 19, 2012

This is a cash-positive bet on low (and lower) volatility. You are net cash positive and want to stay that way.

Lower floor provided by 124 Long Put, which cost $0.80.

Upper floor provided by 135 Long Call, which cost $0.35.
**Strategy 8: Butterfly spreads (call)**

Betting on no or little price movement: (1) Buy one ITM call, (2) buy one OTM call, (3) write two ATM calls. This is done normally for near-term expiration dates.

<table>
<thead>
<tr>
<th>Strike</th>
<th>Bid</th>
<th>Ask</th>
<th>Exp Date</th>
<th>Last</th>
<th>Delta</th>
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</thead>
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<td>5.86</td>
<td>5.94</td>
<td>0.68</td>
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SPY: 187.44

- W: 2 187 for 2.02
- B: 1 184 for 4.21
- B: 1 191 for 0.39

Net: $1.80

Exam 2 question: When would you use this strategy and what role is played by each leg??
Butterfly (Call) payoff grid

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<td>Mar 191 Call</td>
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<td>Net</td>
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SPY stock 187.44
Mar 184 Call 4.21 Buy
Mar 187 Call 2.02 Write 2X
Mar 191 Call 0.39 Buy
Net -0.56
Butterfly (Put) payoff grid

On a butterfly, it doesn’t much matter whether you use calls or puts, payoff format is about the same.

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<td>Mar 191 Put</td>
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<td><strong>Net</strong></td>
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Note: Section 1256 taxes

Added in July 2018 – A section 1256 contract, which includes futures but excludes options but does include SPX options, allows gains in SPX options no matter what duration, to be taxed at 40% short-term and 60% long term. See the Wikipedia entry under “1256 contract.”