Option Trading
Session Four: Structuring a Volatility Trade

This is an adapted rendition of Dr. Euan Sinclair's lecture notes

Session Three Overview

- Options basics and terminology.
- Model independent features of options: arbitrage relationships between various options, and options and underlying.
- Option pricing variables and parameters.
- A toy binomial pricing model.
- Risk-neutrality.

Session Four Overview

- Volatility Trading
- Why Does Premium Exists?
- Volatility Premium in Different Asset Classes
- Covered calls
- Weekend premium.
- Equity options and earnings.
- Selecting strikes and expirations.
- Hedging in practice.

Volatility Trading

- Recall that when we derived BSM, we actually priced the replication value of the option.
- This depends on realized volatility, because to do the replication we need to hedge by trading the stock.
- But options price in the market depends on implied volatility.
- So, if realized volatility is not equal to implied volatility, we can trade the option, replicate it in the underlying and profit.
- So next we need to find situations where we expect realized volatility to be different to the implied volatility.

PL OF A MISPRICED OPTION

$$PL = C(\sigma_{implied}) - C(\sigma_{realized})$$

Assume the volatilities are not very different and write

$$\varepsilon = \sigma_{implied} - \sigma_{realized}$$

$$PL = C(\sigma_{realized} + \varepsilon) - C(\sigma_{realized})$$

$$PL \approx C(\sigma_{realized}) + \varepsilon \frac{\partial C}{\partial S} - C(\sigma_{realized})$$

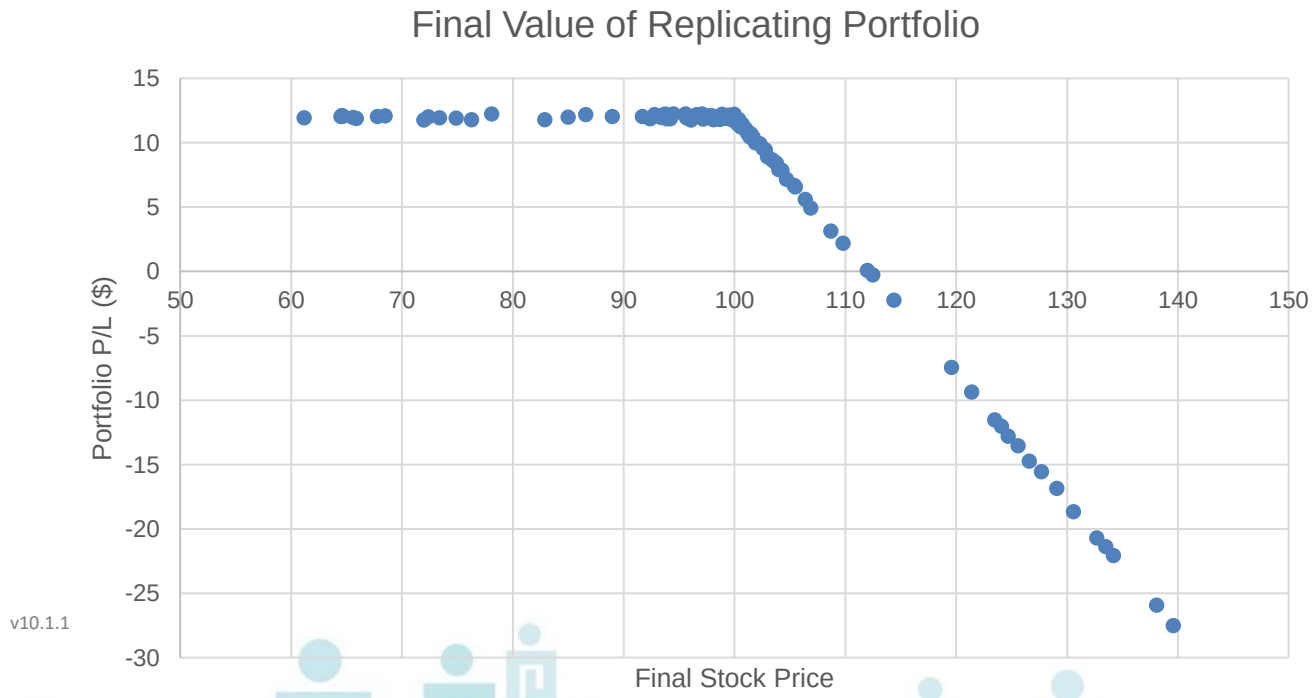
$$= Vega\,(\sigma_{implied} - \sigma_{realized})$$

Volatility Trading: Replication

- We own the one year 100 call on a $100 stock with volatility of 30%.
- It is worth $11.92 and has a delta of 0.56 so to hedge we sell short 0.56 shares.
- Now the stock jumps to$110. The call is $18.14, and the delta increases to 0.68.
- So, we need to sell 0.12 shares to stay hedged.
- At expiration this process captures the difference between implied and realized volatilities.

Volatility Trading: Replication

- The replication portfolio looks like the payoff of the opposite position.



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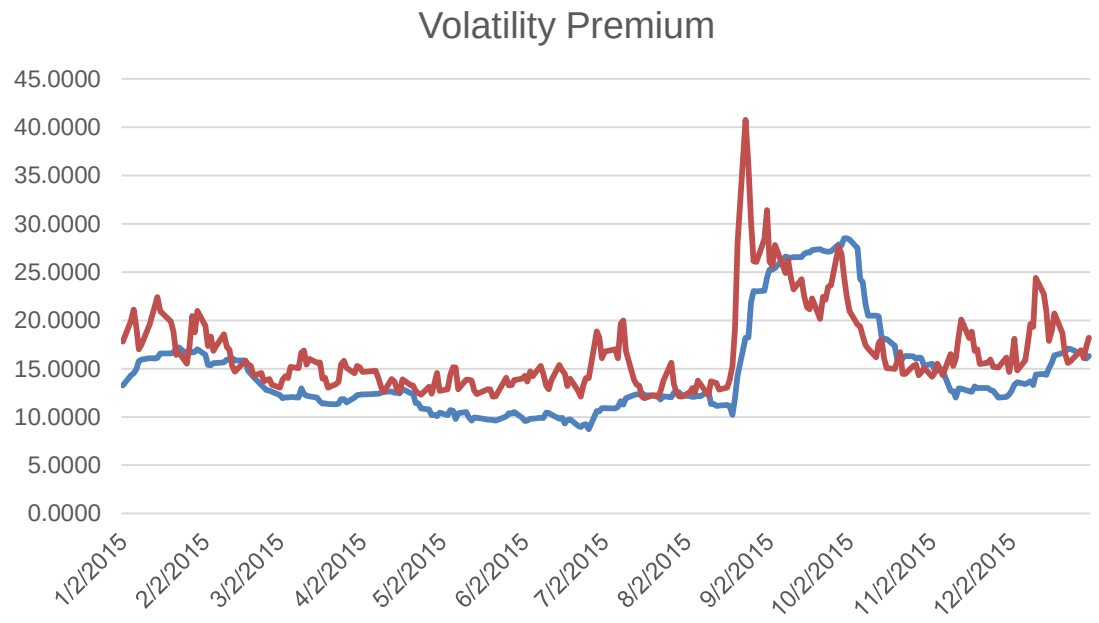
Volatility/Variance Premium

- Implied volatility > subsequent realized volatility.
- S&P shown below.



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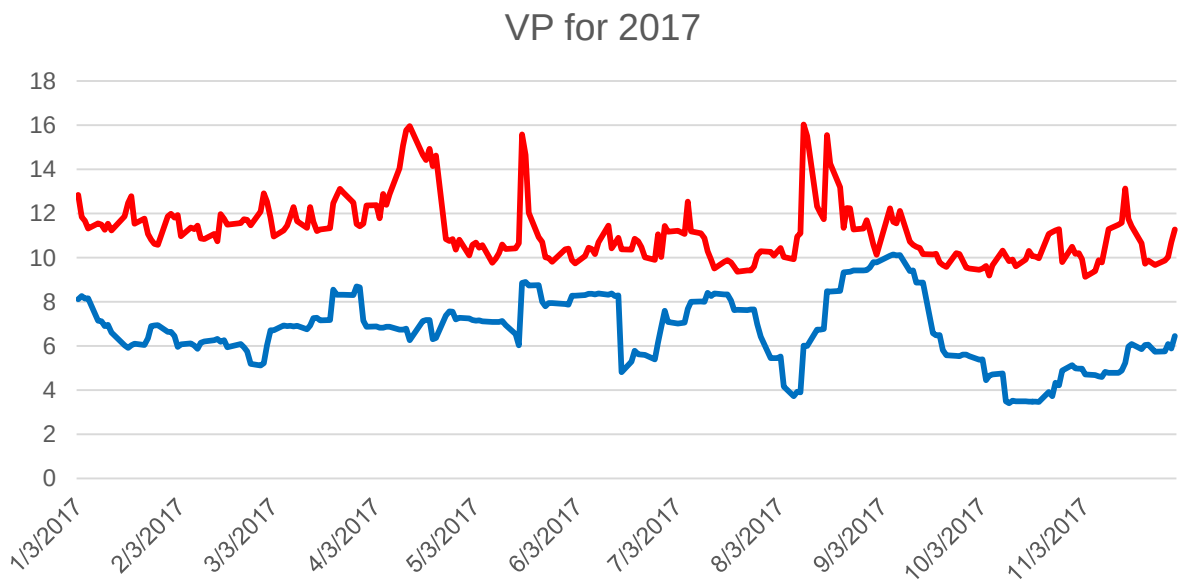
- Average premium=3.6 volatility points.
- Median premium=4.0 volatility points.

Volatility Premium

- Persistent even at very low volatility levels.
- 2017 shown below.



- Average premium=4.4 volatility points.
- (about 40% of the implied volatility level).

Volatility Premium

- As a percentage, the premium is generally *higher* at low volatility levels.
- From 1990 to 2018:

VIX Level	Volatility Premium (as %)
<15	0.27
15<20	0.26
20<25	0.20
25<30	0.20
30<35	0.18
35<40	0.14
>45	0.10

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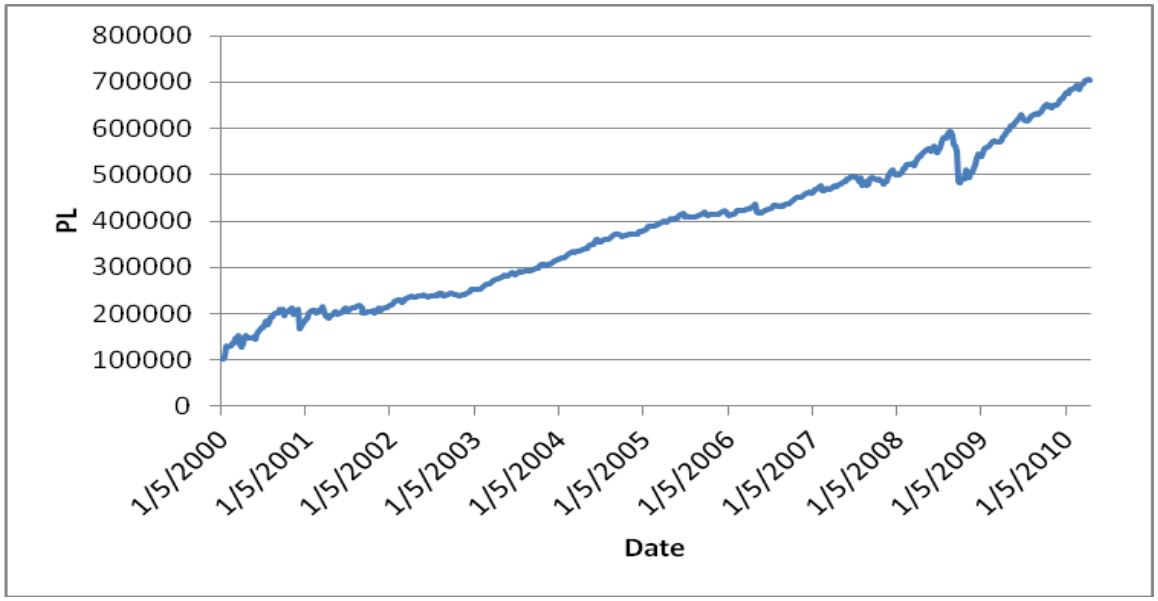
Volatility Premium



- Selling 10 delta QQQ, 2nd month strangles (using account value for margin).

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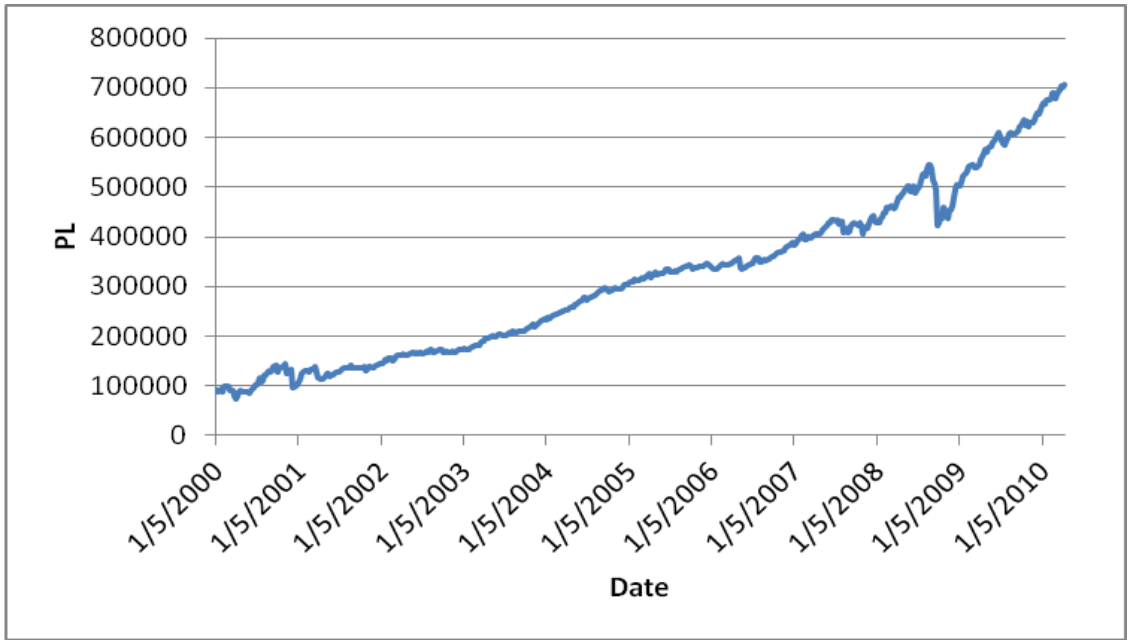
Volatility Premium



- Selling ATM QQQ, 2nd month straddles.
- (Same vega exposure as with strangles).

Why Does the Premium Exist? - Insurance Premium

- Both calls and puts provide insurance.
  - Puts against a crash hurting an existing portfolio.
  - Calls against FOMO (Fear Of Missing Out).
- All insurers charge a premium for their products so they can make a profit.
- This is no different from any other shop.

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Why Does the Premium Exist? - Fear of Atypical Events

- People vastly over-estimate the danger of extreme events.
- Terrorism kills 180 Americans a year (about 8 if we exclude 9/11).
- Heart disease kills 600,000 Americans each year.
- This mistake means options are overpriced.
- “Black Swans” don’t happen very often.

Why Does the Premium Exist? - Correlation Risk

- When bad things happen, they tend to happen to an investor's entire portfolio.
- Diversification isn't terribly effective in bad states.
- Options are the best performers and people pay a premium to have a winner in bad times.

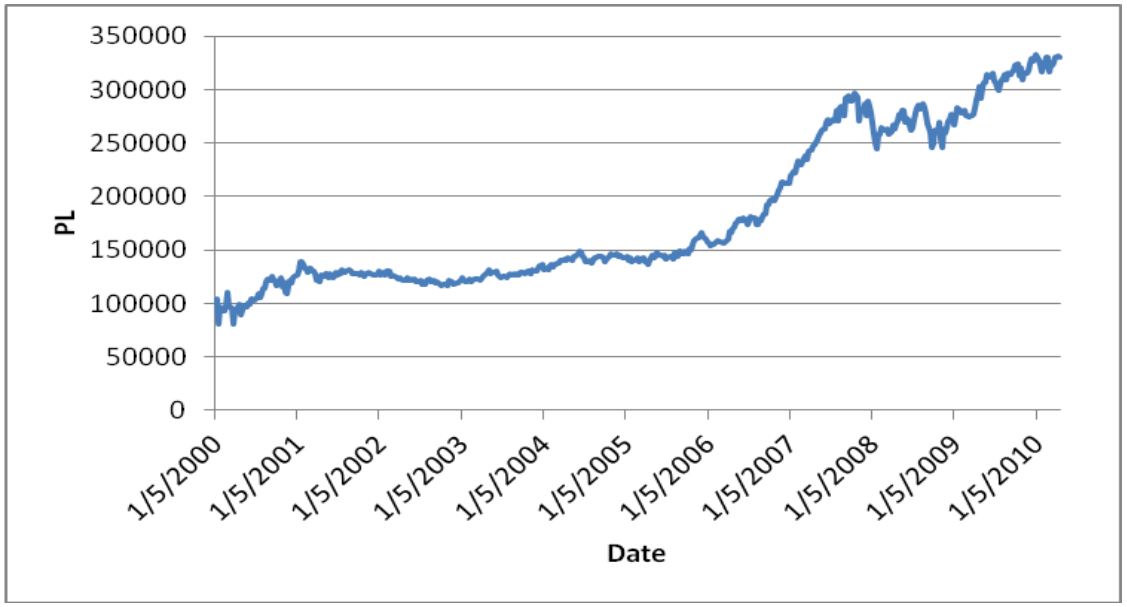
Why Does the Premium Exist? - Unpleasant Risk Profile

- A short option portfolio has negative skewness, high kurtosis, high downside deviation and large drawdowns.
- None of these are popular.
- A bad risk manager can easily blow up being short options.
- One short volatility fund lost 89% over two days in February 2018.

Why Does the Premium Exist? - Skewness Premium

- Much of the short volatility premium comes from the short puts.
- All of the reasons above are consistent with this observation.
- Should also be obvious because the implied volatility of puts is so much higher than calls.

Implied Skewness Premium



- Selling second month 30 delta QQQ risk reversals (hedged).
- https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3968542

Volatility Premium in Equities

- On average, equities also display a volatility premium.
- About half that of indices.
- Some stocks have no premium or a negative premium.
- Highest premium in small cap stocks.
- (Also, these have the least liquid options).

Volatility Premium in Commodities

- Commodities with statistically significant volatility premia.
  - Crude oil.
  - Heating oil.
  - Natural gas.
  - Corn.
  - Sugar.
  - Copper.
  - Cocoa.
  - Oats.

Volatility Premium in Commodities

- Why copper and not gold?
- Why corn and not beans?
- Be very careful with commodities.
- “Equities trade on statistics. Commodities trade on knowledge.”

Volatility Premium in Bonds

- About as persistent and as large (in percentage terms) as in indices.
- But bond volatility is much lower (typically 3% to 6% as opposed to 10% to 30%).
- So, bond options have more gamma and positions can get out of control quickly.

Volatility Premium in the VIX

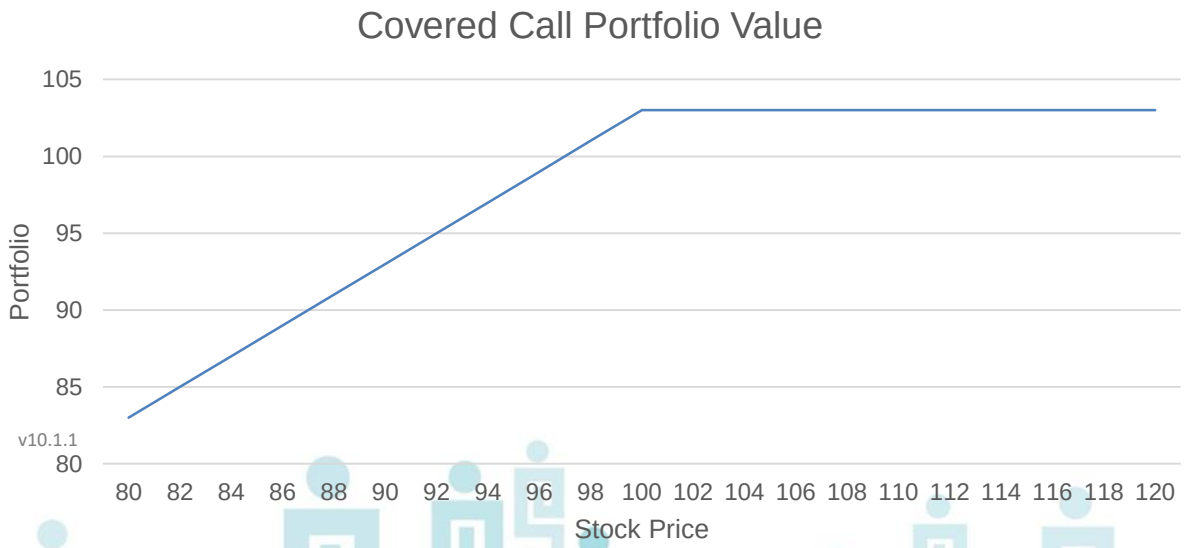
- *Probably* exists.
- Evidence is weaker as we have a shorter time period to examine and only one liquid product.
- My confidence level is 70-80%.

Volatility Premium in General

- Look for products with a significant and consistent implied skew. This shows investor fear and also embeds the skewness premium.
- Look for products with a significant and consistent term-structure where front volatility is below back volatility.
- Sellers are being compensated for risk and the level of compensation increases in time of uncertainty.

VP Trading for Retail: Covered Calls

- Rare example of an option strategy that both makes sense and is recommended by many advisors.
- Buy a stock and sell a call.
- Example: Buy stock and sell $100 call for $3.



VP Trading for Retail: Covered Calls

- You still want the stock to go up. No matter what call you sell, you are still long delta.
- You also benefit from collecting the variance premium.
- Typically, about half of the edge comes from each part.
- You actually want the stock to be called away. That means it has rallied a lot.
- Best to choose an option strike ATM or near ITM.

Covered Call Performance

1993 to August 23rd, 2022:

Statistic	BXM	S&P 500
Annual Return	7.1%	9.4%
Volatility	13.8%	18.9%
Sharpe	0.52	0.49
Max Drawdown	40%	55%

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Harvesting the Volatility Premium – Selecting an Expiration

- Trader's heuristic: "Vega wounds. Gamma kills".
- Volatility reverts, so it is reasonable to expect that an adverse move that causes Vega losses will reverse.
- So, Vega losses can be ridden out (sometimes this might not be recommended).

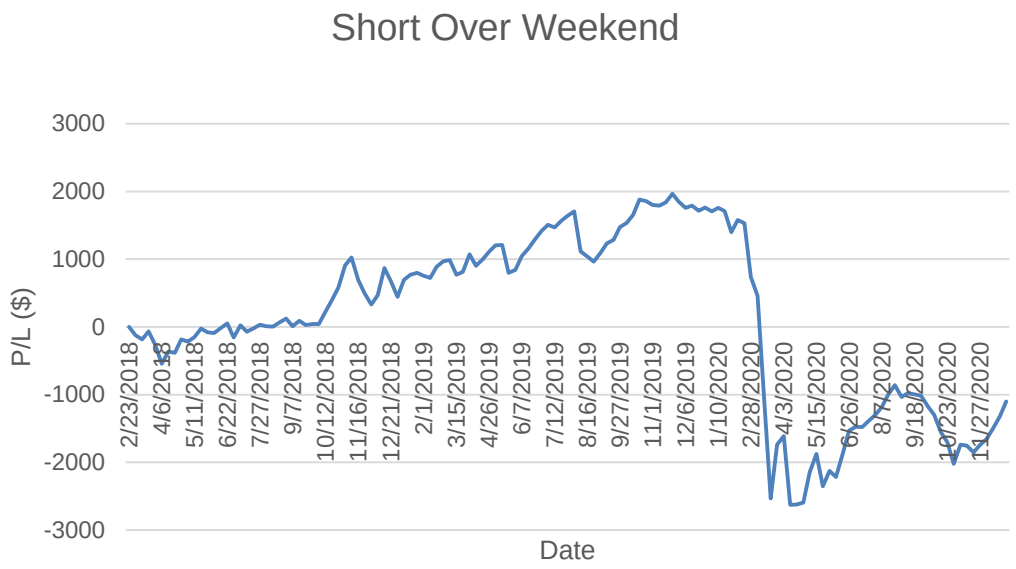
Harvesting the Volatility Premium – Selecting an Expiration

- But gamma losses will be locked in by the process of delta hedging.
- Short option positions will require selling low and buying high to hedge.
- This is why most of the premium is concentrated in the short-term options that have the most gamma.

Volatility Premium is a Risk Premium

- People are overpaying to avoid risk.
- Appears mainly overnight and at weekends
- Trade Example: Sell a weekend SPY, ATM straddle on Friday.
- Let expire on Monday.

Volatility Premium is a Risk Premium



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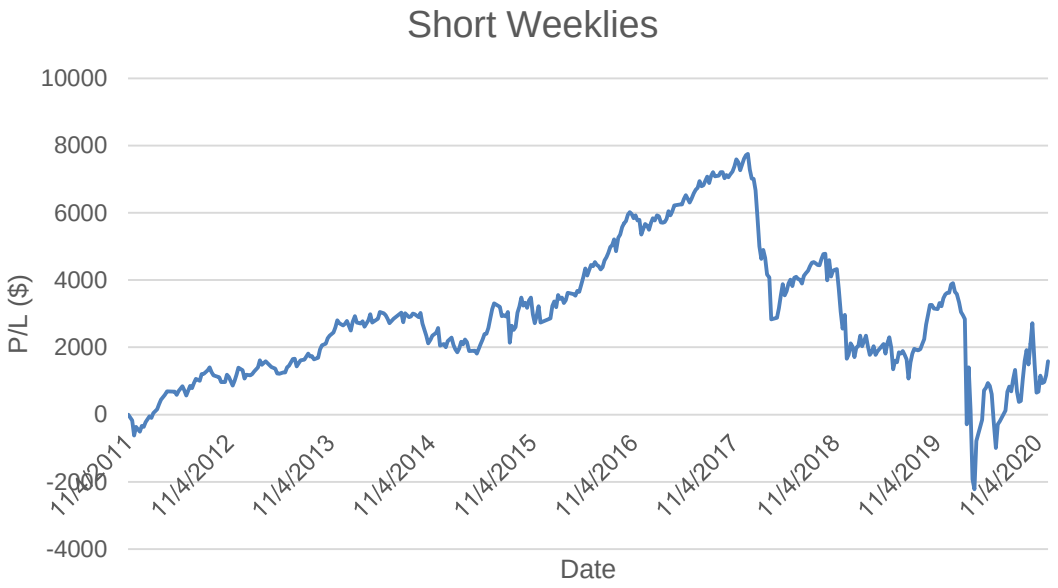
Weekend Premium

- Not good…
- But also, not the point for now.
- Unfortunately, we don’t have a long enough history to conclude much.
- If we use options expiring the next Friday and close them on Monday, we can go back to 2010.

Weekend Premium



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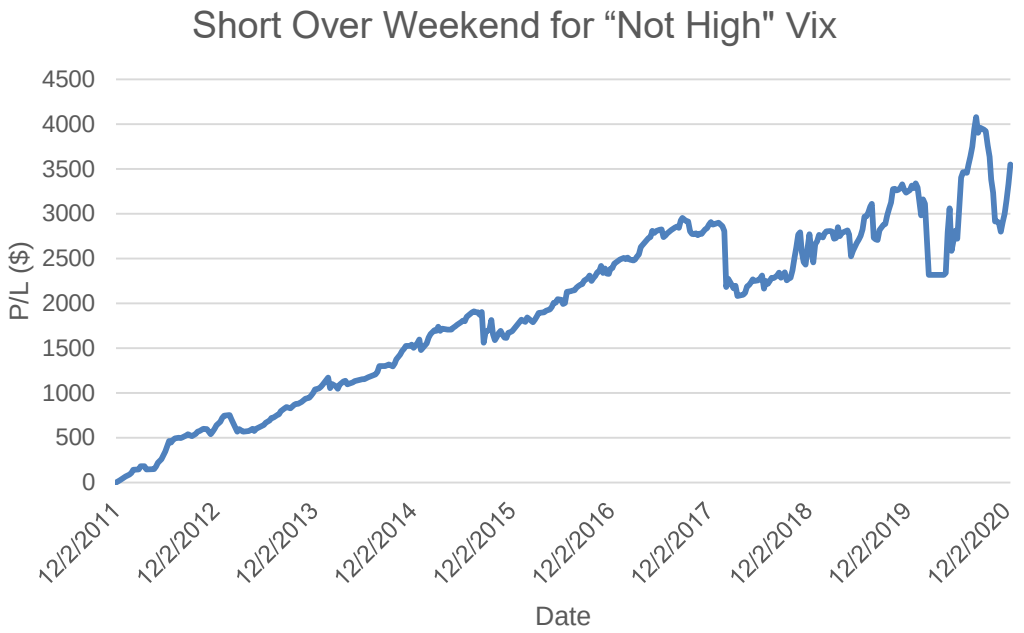
Weekend Premium if VIX <98th Percentile



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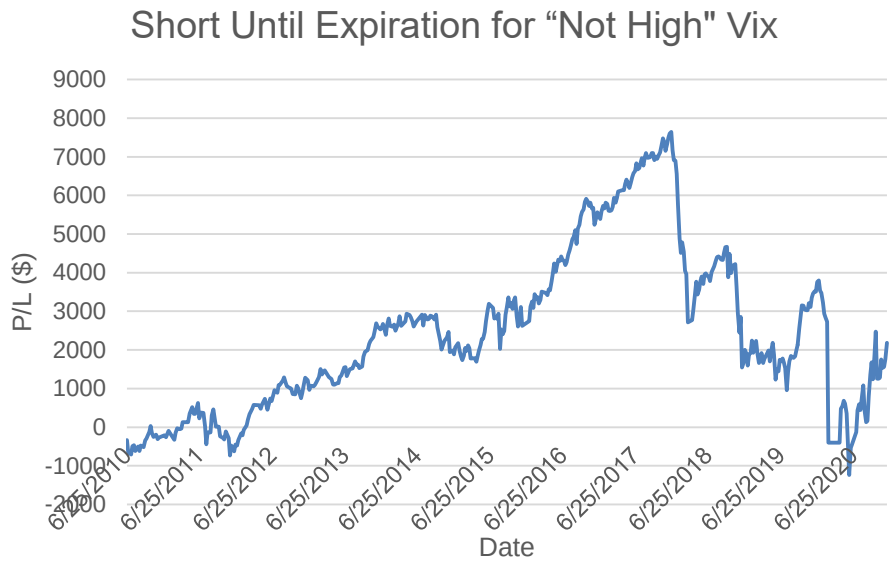
Weekend Premium



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Weekend Premium if VIX <98th Percentile

Statistic	
CAGR (on margin)	29%
volatility	27%
Win %	71%
<W>/<L>	52%
Max drawdown	33%

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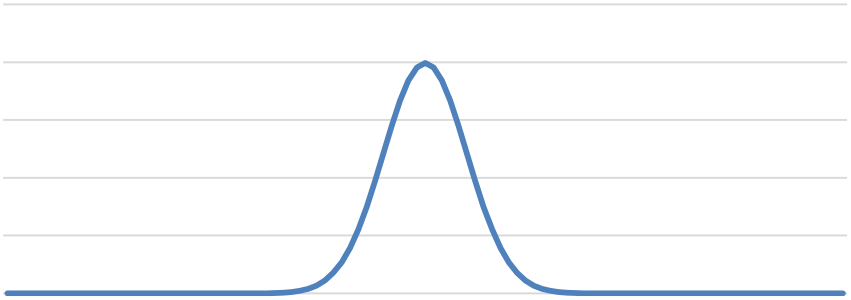
Selling Options Over Earnings

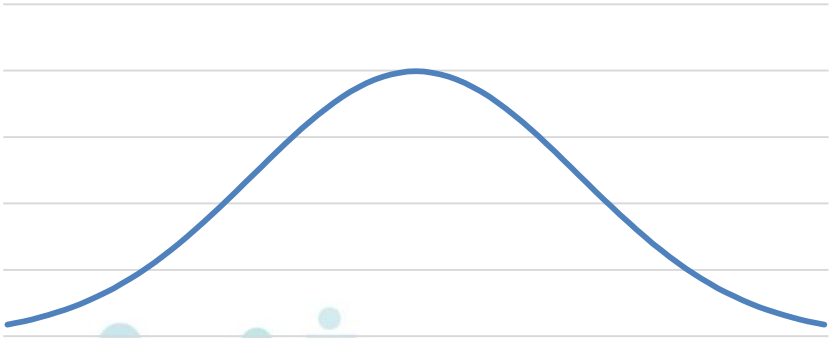
- Again, we look to profit from peoples fear of downside risk (bad earnings), and optimism about upside potential (good earnings).
- Could actually be a case where everyone agrees what fair volatility is, but they disagree about where the stock will be. Combination of two normal distributions gives a distribution with a greater variance.

Case One

Initial



More Uncertain Volatility



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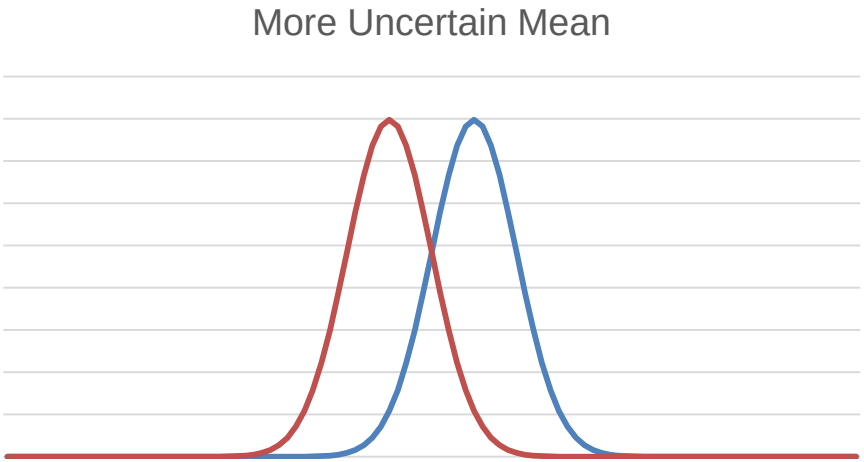
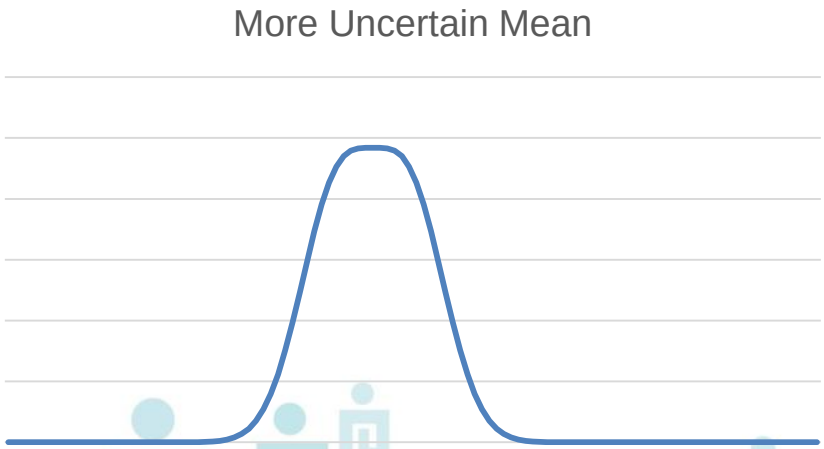
Case Two





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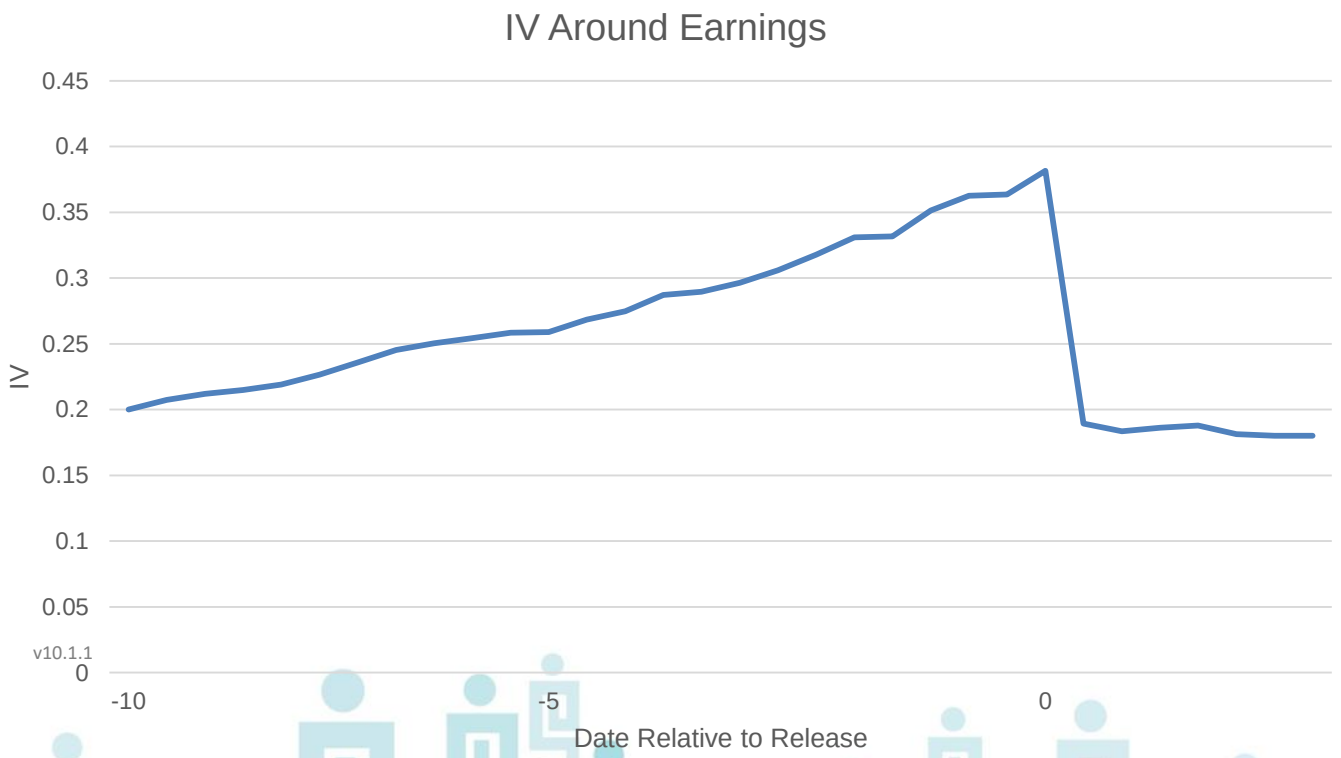
Earnings: Several Effects

- The front-week options will often have a much higher implied volatility than the second-week options.
- Implied volatility increases before earnings then collapses when the news comes out.
- Large stock moves in the week before the release often reverse.
- Price moves from earnings persist for weeks or months.

The Earnings IV

- Implied volatility increases before earnings then collapses when the news comes out.



The Earnings IV

- This IV pattern generally exists when the underlying has a source of uncertainty with a specific resolution date.
- S&P – FOMC
- Bonds – FOMC, Inflation reports, Employment reports.
- Oil – Inventory releases.
- Agricultural commodities – Crop reports.

The Earnings IV

- The increase isn't due to people adjusting expectations.
- There are two volatilities being estimated in the market.
  - A lower "normal" variance
  - A higher "earnings" variance.
- Each day the total variance is the sum of these two, and as we get closer to the event more of the total variance is due to the earnings move.

The Earnings IV

- 10 days before the release, buy the straddle that will be front expiration when the release comes out.
- Usually, the price of the straddle won't increase but the IV rises at a rate so that vega profits offset theta decay.

Historical Results (2005 to 2015)

- 43% winners.
- W/L = 1.70.
- Results positively skewed.

Implied Jump

- $$\sigma_2^2 T_2 = \sigma_1^2 T_1 + \sigma_{12}^2 (T_2 - T_1)$$

(total variance is variance up to first expiration plus variance between 1st and 2nd expirations).

$$\sigma_{12} = \sqrt{\frac{\sigma_2^2 T_2 - \sigma_1^2 T_1}{(T_2 - T_1)}}$$

Assume all the front/2nd difference is due to the earnings uncertainty. So the volatility attributed to earnings is the difference between the front volatility and this forward volatility.

Implied Jump

- $$\sigma_E = \sqrt{T_1 \left(\sigma_1^2 - \sigma_{12}^2\right)}$$

$$\sigma_E = \sqrt{\left(\sigma_1^2 - \sigma_2^2\right) \frac{T_1 T_2}{\left(T_2 - T_1\right)}}$$

- So the mean expected jump size is

$$\langle jump \rangle = \sqrt{\frac{2}{\pi}} \sigma_E$$

(relationship between sd and mean return size).

- Now we can compare implied and historical jumps.

Example

- One-day volatility is 50% and one-week volatility is 20%.
- This implies a jump size of 2.6%.
- Previous 5 years of earnings moves have had an average jump of 1.5% with a maximum of 3%.
- Possibly a good idea to sell the front straddle as it is pricing an historically large move.

Historical Results (2005-2018)

- 66% winners.
- W/L = 0.71.
- Results negatively skewed.
- Last few years have been bad.

Earning's Induced Reversals

- "Large" moves in the week before earnings tend to reverse.
- It seems that the stock price overpromises and underdelivers.
- From 1996 to 2011, a long-short portfolio constructed on this basis earned 1.45% in the four pre-earning days.
- Even if you don't trade this on its own, be aware of it when doing other earnings trades.

Post Earnings Announcement Drift (PEAD)

- A stock that beats expectations and has a price move consistent with that result will have the drift continue over weeks and even months.
- Long short portfolios can beat the market by between 9 and 27% depending on exact details.
- Probably the most studied and confirmed stock anomaly.
- Not entirely clear why the effect exists but helps with our post earnings option trade exits.

Aside: Two Points on Execution

- The straddle will not expire at its intrinsic value. There will appear to be time value left.
- The market closes, but the option holder still has time (generally a few hours) to decide to exercise. This time has optionality value.
- If we are a long way from the strike, it doesn't make sense to buy back the OTM part of the straddle. Instead, hedge with the stock assuming the ITM leg is 100 delta.
- I often do this even when delta is 75-80.

Selecting Strikes

- I'm not aware of any rigorous theoretical work on this.
- My thinking:
  - The ATM volatility is closest to fair (but still overpriced).
  - Teeny puts have most overpriced volatility, but in dollar terms the very low strikes have little premium (or vega). So you need to sell too many.
  - Sell the strike with the highest excess dollar premium.
  - Simulations tend to support this.

Selecting Strikes: Example

- One-month options: Stock=$100, ATM volatility=30%.

Strike	Implied Volatility	Price	Price at 30%	Premium
80	45%	0.2	0.01	0.19
85	41%	0.41	0.09	0.32
90	37%	0.84	0.44	0.40
95	33%	1.70	1.42	0.28

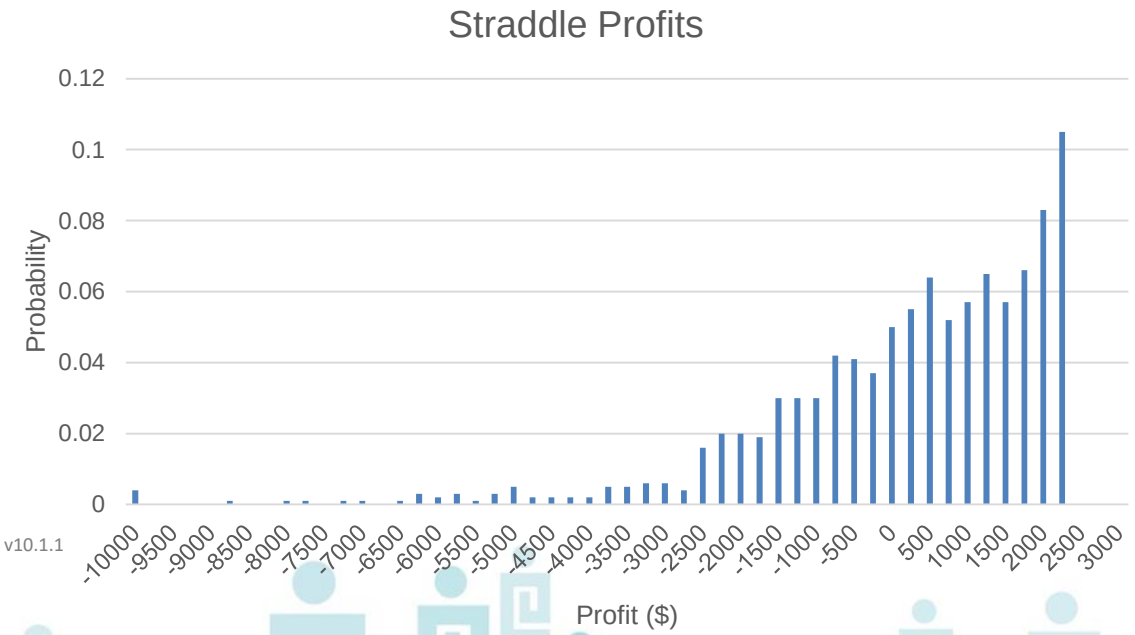
- These tend to be 15-25 delta options.
- Could now just hedge these or could sell calls as well to make a strangle.

Selecting Strikes

- If you are hedging relatively often, strike choice is less important.
- Your net vega number is the driver of your P/L.
- Selling puts will collect the skew premium but you probably also want to sell calls to maintain vega exposure as the stock moves.
- But if you hedge infrequently, the exact option structure is more important.

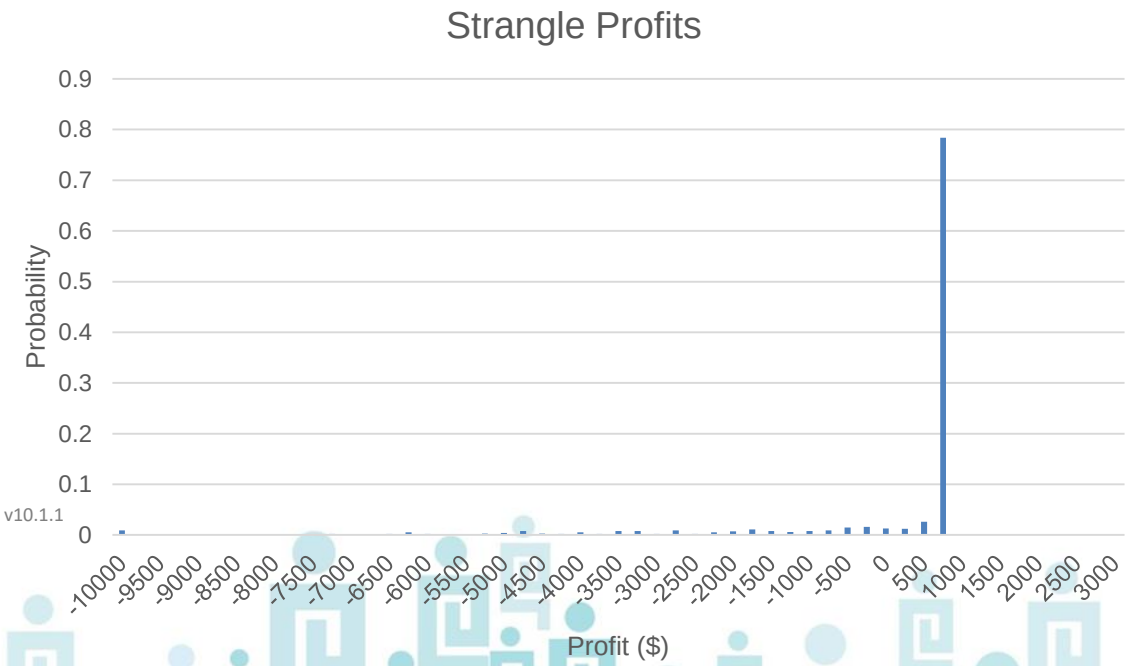
Example: A Short Straddle

- This is the P/L distribution of a short one-year straddle. S=$100. Implied and realized volatility both 30%.

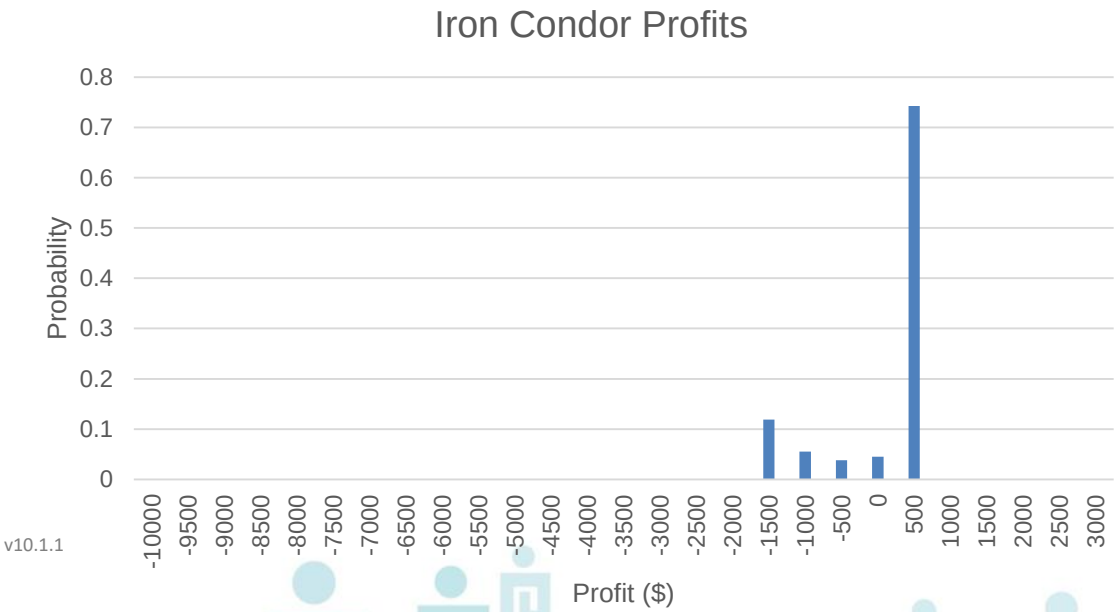


Example: A Short Strangle

- This is the P/L distribution of a short one-year 20-delta strangle. S=$100. Implied and realized volatility both 30%.



Example: A Short Iron Condor



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Straddle/Strangle Comparison

Statistic	Straddle	Strangle
Average P/L	$0	$0
Median P/L	$384	$841
10%	-$2,274	-$1,994
Minimum	-$15,700	-$24,800
Percentage Winners	57%	78%