OTS05 Lecture Summary

Overview

This document summarises the OTS-05 lecture on hedging and trade evaluation. The lecture talks about various strategies such as early exercise, expiration trading and how to evaluate them using performance metrics.

The following topics are covered -

- Hedging in practice
- Early exercise
- Expiration trading
- Trade planning and evaluation
- Performance metrics
- Putting it all together

Hedging in practice

- In order to convert an option into a volatility trade, we need to maintain delta neutrality.
- In theory, we hedge continuously. However, in practice that leads to infinite transaction costs.

Example -

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

Utility-based methods

Utility is the concept of balancing risk and reward. Since BSM really prices replication, we can do the same thing with costs. Redo the BSM model but allow for a spread in the underlying. Hedge to the edge of a band that is gamma-dependent. Hedge short gamma more aggressively. The PDE using this theory is difficult to solve in real-time and hence, using an asymptotic expansion, we can come up with an easily used approximation.

Wilmott-Whalley Approximation

$$\Delta = \frac{\partial V}{\partial S} \pm \left(\frac{3}{2} \frac{exp\big(-r(T-t)\big)\lambda S \Gamma^2}{\kappa} \right)^{\frac{1}{3}}$$

Where

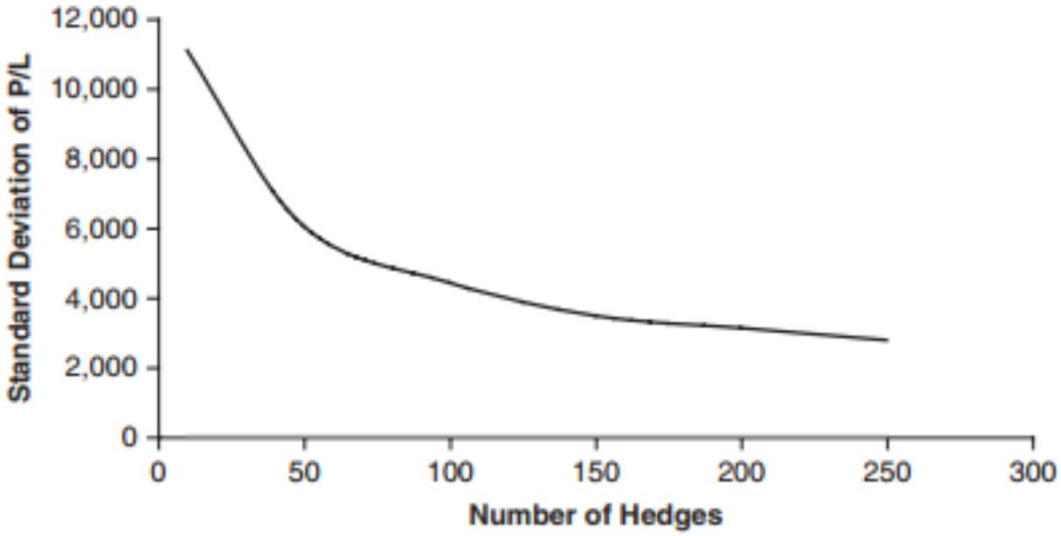
- Lambda is proportional transaction cost,
- Kappa is risk aversion.

- So, choose a risk aversion parameter for a position you understand, the use this for all positions. This can save about 10% of costs over ad hoc methods.

Path dependency

- Discrete hedging creates path dependence.
- For example - A big move on the day of expiration will give a different PnL than the same move a year out. In each case, the volatility is the same, but the result isn't.
- Dispersion is roughly inversely proportional to the square root of no. of hedges.

The following snapshot shows an example - $1000 vega of 1-year options traded with no volatility edge has an expected PnL of zero.



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Early exercise

Early exercise means buying or selling an option between its expiration date. You should exercise early if what you'll receive is worth more than what you forgo.

Exercising a put on a stock

A put option is exercised to avoid the interest costs of holding the shares until expiration.

Exercising a call on a stock

Turning a call into a share is a way to get dividends. Exercise as close as possible to the record date. If you exercise, you get intrinsic value and dividends but lose time value. However, if you hold, the value of the option decreases due to dividends.

For example: An 80 strike call on a $100 stock is worth 20.10. Stock is going to pay a $1 dividend. Exercise and get $19 intrinsic and the $1 dividend. Don't exercise and the next day the call is worth $19.10. So exercising the call is better (dividend is bigger than extrinsic value).

There are 2 ways in which you can capture dividends -

When a stock pays a dividend, the call price doesn't drop by that amount in reality. However, futures are priced as if all the dividends were accounted for. So, buy stock and hedge with futures. This captures the dividend discrepancy.

The second way is to buy a deep ITM call spread. Exercise all long calls correctly and collect 100% of the dividend. Some of the shorts won't be exercised so you won't need to pay the dividend on all of them.

Exercising a call on a future

Turning a call into a long future is a way to avoid paying interest. Exercise the call if the interest income is more than the time value.

Expiration trading

The phenomenon of the underlying stock closing at the strike of the option on the day of expiry is known as pinning. However, if the market settles at the strike, it's very hard to predict which options will be exercised. This is called pin risk.

Cash settlement is a process in which the seller of the option or future doesn't deliver the underlying asset for the transfer of the cash amount.

Option Greeks can be misleading in expiration trading. As an example, gamma is actually infinite right at the strike. A one-hour straddle will often have theta 20 times higher than its value.

Trade Evaluation

A good trade requires a positive expected value and an acceptable level of risk. The expected value is risk-neutral but the acceptable risk varies between traders. Repeated trades of the same strategy eventually give us enough data to analyze.

Pre-trade planning

Pre-trade planning is crucial to building a successful trading strategy. If you don't know what to expect, you can't tell if you have succeeded. If you haven't backtested your idea, you're just guessing. You need to make sure that your strategy has an edge. If you can't prove what and why your edge is, it probably doesn't exist.

It's hard to evaluate a single trade. Luck dominates one idea or trade. Your real results will not be as good as backtests because of transaction costs and slippages.

Evaluating a strategy

There are 2 issues while evaluating a strategy -

1. Is the backtested strategy good enough?
2. Is the strategy's result good enough?

Factors that can be considered for evaluation are - Trade frequency, average PnL, win percentage, the worst loss in a given period, worst drawdown, and Sharpe ratio.

A strategy comparison

Here's a comparison of 2 strategies based on various evaluation parameters -

Statistic	Strategy A	Strategy B
Profit/Year	$2,000,000	$600,000
Average Profit/Trade	$10,000	$500
Win %	30%	90%
W/L	4/1	1/8
Sharpe Ratio	1.2	2.0
Max Draw Down	40%	6%

Performance metrics

There are various metrics using which the risk-reward profile can be evaluated.

Sharpe ratio

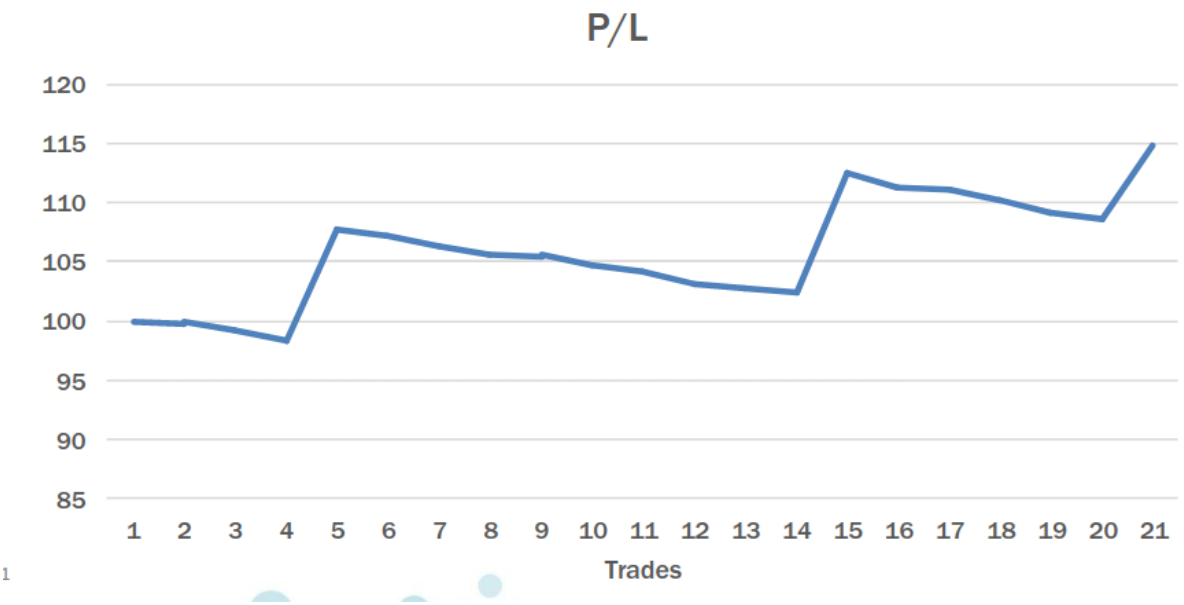
It is the ratio of excess return to volatility. It was developed by William Sharpe who won the Nobel prize in 1990. However, the Sharpe ratio has the following weaknesses -

1. Volatility penalized large upward movements as heavily as a downward movement.

2. It ignores the higher-order moments. As an example, positive skew should be rewarded but it isn't.
3. It has a fairly large sampling error as it is a composite statistic and the components each have sampling errors.
4. The uncertainty is usually the same magnitude as the measured ratio.
5. It is assumed that the underlying process is constant.

Sortino ratio

It can be defined as the ratio of excess returns to the standard deviation of losses.
For example - The following trading strategy has a Sharpe ratio of 3.5 and a Sortino ratio of 37.4



Calmar ratio

It is defined as the excess return divided by the maximum drawdown. However, a drawback of using the maximum drawdown is that the sampling error is enormous.

Generalized Sharpe ratio

As the name suggests, it is a generalized version of the Sharpe ratio which takes into account the higher-order moments as well. The formula is given by -

$$GSR = SR\left(1 + \frac{\lambda_3}{6}SR - \frac{\lambda_4 - 3}{24}SR^2\right)$$

Performance persistence

A good way to measure the reliability of a strategy is to measure its performance over time. It helps in separating skill from luck. You can use a t-test to compare the means of different periods. Another way is to use the Kolmogorov-Smirnov test which doesn't have any distributional assumptions.

Putting it all together

The summary of the steps is as follows -

- We are going to sell SPY options to collect the variance premium.
- We need to select an expiration date.
- We need to select a structure and strike.
- We need to choose a hedging methodology.
- We need to establish an expected profit and the expected variance around that amount.
- After the trade, we do a post-trade analysis.

Choosing an expiration

An example -
On Monday, June 3rd, 2019, the one-month, three-month and six-month options had the same ATM implied volatility for SPY. So, you sell the options expiring on the 28th of June. The ATM implied volatility was 18.8%.

Choosing a structure

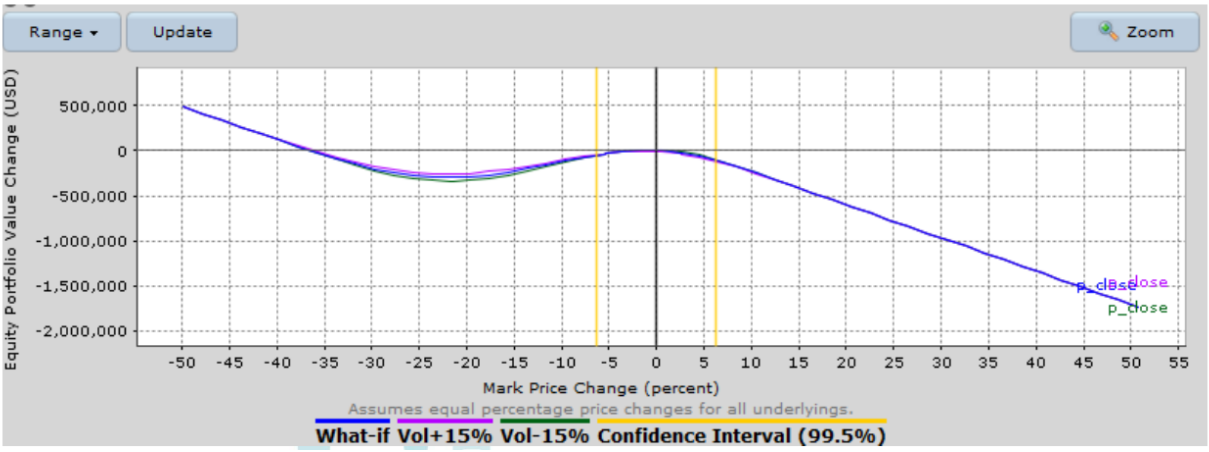
An example -
You sell 100 of the 262/286 strangles (20/19 delta) for 3.09. The put strike had an implied volatility of 23.5% and the call strike had an implied volatility of 16%. SPY was at 275. The risk profile is as follows -

Spy Change	-30%	-25%	-20%	-15%	-10%	-5%	0%	5%	10%
Vega	-$0	-$13	-$130	-$710	-$1925	-$3170	-$4220	-$3950	-$1520
P/L ($)	-$564,100	-$457,600	-$345,600	-$228,600	-$123,400	-$38,200	0	-$35,200	-$143,500

To cap my crash risk, you buy 100 of the 232 puts. This changes the risk profile to:

Spy Change	-30%	-25%	-20%	-15%	-10%	-5%	0%	5%	10%
Vega	$670	$1,480	$2,150	$1,780	$15	-$2,100	-$3820	-$3,830	-$1,490
P/L ($)	-$262,200	-$252,900	-$222,000	-$167,600	-$99,000	-$31,500	0	$37,200	-$145,200

Most trading systems can display this visually. Here's an example -



Hedging methodology

An example -
Used the previously estimated risk aversion parameter of 0.24 to calculate the current hedging band. The band will change mainly due to my gamma. The forecasted volatility is 14.1%. The GARCH model gave a forecast of 13.7%. Hedging volatility is the average of these: 13.9%.

Expectations

- Theoretical profit:

$$PL = Vega(\sigma_I - \sigma_R)$$

- For short put: $2040 x (23.5 - 13.9)
- For short call: $1875 x (16 - 13.9)
- For long put: $330 x (13.9 - 34)
- So the total expected P/L is $16,900 (assuming our forecast volatility is correct).
- To get the standard deviation of results, run a Monte Carlo simulation. This gives $8,200.

Results

- Actual profit: $24,218.
- We did better than our forecast because realized volatility was 10.6% (much lower than our forecast).
- The average profit with a 10.6% realized volatility would be $28,700.

Psychology

To be a good trader -

- Find an edge.
- Find a strategy and business model that monetizes that edge.
- Manage risk, so you can get to the long run.
- Knowing how to be good won't mean you will always be good. Sometimes you will be tired or sick.

- You need to accept that your real results will always be “worse than they should be”.