Here is your teacher waiting for Steve Wynn to come on down so I could explain index options to him. He never showed so I guess that he will have to download this lecture and figure it out like everyone else. He was a nice host, though. And he seems very interested in math. A lot of things going on in this large curved building behind me seemed to have a connection to math.

Advanced Options Trading Strategies
... (part 1) options basics 104 review

Read chapter 7 and review lectures 8 and 9 from Econ 104 if you don’t remember this stuff.

So what are we to make of this?

Can you understand why ...

1. This is a good portfolio as is ... we have a volatility that is lower than the volatility of our least volatile stock (0.0081 compared to 0.00897)!
2. Why these numbers in the covariance matrix must be really low!
3. What we would do if we found a number in the correlation matrix above our threshold (say 0.4 or 0.5).
4. What we would do to raise our alpha!
5. What we would to get an optimal risk/yield tradeoff for these four stocks.

<table>
<thead>
<tr>
<th>Weights</th>
<th>INTC</th>
<th>BAC</th>
<th>MO</th>
<th>JWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTC</td>
<td>0.250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAC</td>
<td>0.250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MO</td>
<td>0.250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JWN</td>
<td>0.250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DCGR</th>
<th>Mean</th>
<th>Var</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTC</td>
<td>0.00093</td>
<td>0.000166</td>
<td>0.01288</td>
</tr>
<tr>
<td>BAC</td>
<td>0.00104</td>
<td>0.000216</td>
<td>0.01469</td>
</tr>
<tr>
<td>MO</td>
<td>0.00086</td>
<td>0.000080</td>
<td>0.00897</td>
</tr>
<tr>
<td>JWN</td>
<td>0.00065</td>
<td>0.000011</td>
<td>0.00810</td>
</tr>
</tbody>
</table>

| Weighted portfolio variance: 6.65674E-05 |
| Weighted portfolio volatility: 0.008139 |

<table>
<thead>
<tr>
<th>Correlation Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTC</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>INTC</td>
</tr>
<tr>
<td>BAC</td>
</tr>
<tr>
<td>MO</td>
</tr>
<tr>
<td>JWN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Covariance Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTC</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>INTC</td>
</tr>
<tr>
<td>BAC</td>
</tr>
<tr>
<td>MO</td>
</tr>
<tr>
<td>JWN</td>
</tr>
</tbody>
</table>

| Portfolio alpha: 0.00366021 |
| Annualized Portfolio alpha: 0.218123079 |
The relevance of this to the Long-Term Capital story

Remember that professional exotic investments by Hedge Funds will select very high alpha and very high beta investments like sovereign debt, distressed debt, exchange-rate dependent equity investments, emerging market equities, etc. and they know that safety is in numbers... if the investments are uncorrelated.

They are often funding out of spreads from a carry-trade of some kind, borrowing at 2% and looking for alphas of 6% or 7% or higher. The borrowing gives them leverage inverse to the percentage of their equity stake (10% equity stake gives them 10 to 1 leverage). Running to a higher-yield asset at times like 2013 and 2014 involves buying, say, sovereign debt, that has a high probability of default.

You should understand by now that given any portfolio variance, leverage modifies the volatility proportionately $L^2(V)$. This means that a 5% loss becomes a 50% loss in this scenario (ask students about the math of this).

Of those covariances go from near zero to one in a market panic, you are dead.

[Read page 188 and 149]

Standard & Poor’s Estimated Average Cumulative Default Rates for various credit ratings

... showing their estimates of the estimated cumulative default rate (e.g. the estimate of a CCC/C junk bond defaulting within 2 years is above 30%, within 7 years is above 45%).

**Source:** Standard and Poor’s Global Fixed Income Research, “The Time Dimension of Standard & Poor’s Credit Ratings,” September 22, 2001, p.3 Chart 1.
**Statistical Arbitrage (stat arb)**

Statistical Arbitrage (called stat arb) is a "quant" strategy used by many of the largest hedge funds, like Citadel. Generally stat arb involves building an equity portfolio of mixed long and short positions in stocks.

Typically the hedge fund strives to make the portfolio "market neutral," meaning that performance does not depend upon a rising or falling market.

Because the return margins on these enormous portfolios are usually pretty thin, stat arb portfolios are usually hugely leveraged (maybe 100 to 1) by cheap borrowed money (e.g. carry trade or commercial paper).

Stat Arb also uses delta hedging (theoretically) so we will come back to discuss this in the future.

---

**Stat Arb (cont.)**

<table>
<thead>
<tr>
<th>Dow Jones Industrial Averages 30 components</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
</tr>
<tr>
<td>AIG</td>
</tr>
<tr>
<td>AXP</td>
</tr>
<tr>
<td>BA</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>CAT</td>
</tr>
<tr>
<td>DD</td>
</tr>
<tr>
<td>DIS</td>
</tr>
<tr>
<td>GE</td>
</tr>
<tr>
<td>GM</td>
</tr>
</tbody>
</table>

Suppose we take a market basket of stocks, like the index above (but not restricted to indexes ... this is an example), and suppose we are bullish on the index, but not every stock in the index. We therefore decide to go long in most stocks but short some of them (shown in red in the example above, based upon late 2007 markets). But in what quantities? This is where stat arb begins, with a portfolio of longs and shorts, like any hedge fund. But stat arb also aspires to be **market neutral.**
Stat Arb Market Neutrality

Statistical Arbitrage builds an equity portfolio of longs and shorts (see previous slide) but stat arb also typically aspires to be "market neutral." This means that ideally the portfolio's performance is not improved by either a rise or decline in the overall index (or portfolio). In the previous example, this portfolio, if correctly weighted to be "market neutral," would be insensitive to a rise or fall in the DJIA. [Your teacher once asked a stab arb desk supervisor, a Mudder, whether he thought the market was going to rise or fall in emerging months. His answer was, "Who cares?"]

How do they achieve market neutrality? On the risk side, they use some very complicated algorithms to assess portfolio risk to make the portfolio risk neutral. We will learn that approach in a few weeks when we cover advanced volatility.

What therefore is the basis of profitability? Generally, you have to be more or less right about the longs and the shorts. In a rising market, the longs have to rise more than the shorts. In a falling market, the shorts have to fall more than the longs.

Stat Arb Problems??

Stat arb has been seen in recent years as the coolest of the quant strategies, but in the fall of 2007, in the midst of the sub-prime meltdown, that some stat arb hedge funds had been losing money, something they were not supposed to do.

At issue (teacher's comments):
1. They are heavily leveraged.
2. Their borrowing source is (was) a troubled market.
3. Some bullish bias may have been built into some of these funds.
4. "Quantagion?"
Financial Contagion or "Quantagion" (a dangerous new phenomenon?)


What happens when large hedge funds use huge amounts of leverage and start using identical or nearly identical trading strategies?

First, profit ranges must narrow, which may require even more leverage.

Margin calls, credit drying up, etc., may force severe correlated liquidation.

Our recent HPQ strangle

Name: Gary R. Evans
Date: February 26, 2014

I compare this to the historical daily volatility (HDV) of HPQ for 2 years, one year, 90 day and 30 day, using a model like the one we developed in HW1.

If the IDV in the model to the right is substantially higher than the HDV then the option is “priced high,” and not a good candidate for any kind of long position, but may be ideal for a short position like an iron condor or writing covered calls.
### Reading the Options Chain

#### IBM's stock info

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Open</th>
<th>Bid</th>
<th>Ask</th>
<th>Last</th>
<th>Change</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
<td>177.62</td>
<td>177.62</td>
<td>177.62</td>
<td>177.62</td>
<td>0.04</td>
<td>4,005,702</td>
</tr>
</tbody>
</table>

**Expiration date:** Nov 19, 2011

**Bid/Ask same as Strike Prices:**

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Bid</th>
<th>Ask</th>
</tr>
</thead>
<tbody>
<tr>
<td>195.00</td>
<td>3.05</td>
<td>3.15</td>
</tr>
<tr>
<td>185.00</td>
<td>1.72</td>
<td>1.82</td>
</tr>
<tr>
<td>175.00</td>
<td>0.93</td>
<td>0.98</td>
</tr>
</tbody>
</table>

**Volume & Open Interest:**

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>195.00</td>
<td>23,335</td>
</tr>
<tr>
<td>185.00</td>
<td>12,325</td>
</tr>
<tr>
<td>175.00</td>
<td>36,800</td>
</tr>
</tbody>
</table>

**In the Money**

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>180.00</td>
<td>10.25</td>
</tr>
</tbody>
</table>

**Out of the Money**

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>170.00</td>
<td>6.20</td>
</tr>
<tr>
<td>175.00</td>
<td>7.95</td>
</tr>
</tbody>
</table>

**Strike Prices**

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Call</th>
<th>Put</th>
</tr>
</thead>
<tbody>
<tr>
<td>195.00</td>
<td>3.05</td>
<td>5.75</td>
</tr>
<tr>
<td>185.00</td>
<td>1.72</td>
<td>3.03</td>
</tr>
<tr>
<td>175.00</td>
<td>0.93</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Source:** Ameritrade Options Chain

---

### Reading … (blowup from previous page)

You can buy the IBM November 19 195 Call for $1.82 (OOM), which gives you the right to **buy** IBM for $195 per share between now and Nov 19.

You can buy the IBM November 19 175 Put for $8.05 (ITM), which gives you the right to **sell** IBM for $175 per share between now and Nov 19.

**Note:** These examples assume purchases at Best Ask. Obviously you can submit a limit order at any price.

**Note the big Bid/Ask – the less the liquidity the bigger these spreads.**

**Source:** Ameritrade Options Chain
Potential Call Option Values
(upon expiration)

This shows only what the option will be worth if held to expiration, given the possible prices of IBM.

This is the Nov 19 (exp) IBM OOM 195 Call, purchased at $1.82 (BA) on Sep 29, when IBM was $177.62 (last).

This is a bet that the stock price will rise.

The all-important premium on OTM options

The premium for an in-the-money option converges to zero as the option approaches expiration.

The premium of an out-of-the-money option can be thought of as simply the price of the option because the option has an intrinsic value of 0 at the moment.

The premium for either is a function of
1. Time to maturity (shorter is smaller) – time decay
2. The underlying stock's volatility (greater is larger)
3. The degree to which the option is in the money (more is smaller)
**Issue 1: Time Decay**

This shows the actual projected time decay of a March 75 DIA call option, purchased for $1.51, when DIA was trading at $72.15 (implied daily volatility at 0.0156), calculated using an option calculator. This assumes no change in DIA price and no change in volatility.

**Issue 2: The Impact of Volatility**

Scenario: 20 days have passed, leaving 32, no change in price, so the graph above shows the sensitivity to volatility alone.

Note: This is mapped in TLT Volatility in Finance/Volatility Calc.
Issue 3: Distance

The premium on an option is determined by the three components listed on the last slide, (1) the volatility of the stock and the market in general, (2) spread from the strike price (whether in the money or out), and, (3) especially for out-of-the-money options, the time before the option expires.

It is possible to segregate these three in theory and empirically and the ability to do so is essential for advanced options trades.

Advice: Design and use your own models!!

<table>
<thead>
<tr>
<th>Strike</th>
<th>Ask</th>
<th>Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>17.10</td>
<td>0.55</td>
</tr>
<tr>
<td>80</td>
<td>12.25</td>
<td>0.70</td>
</tr>
<tr>
<td>90</td>
<td>4.45</td>
<td>2.90</td>
</tr>
</tbody>
</table>

More distant is greater

<table>
<thead>
<tr>
<th>Time</th>
<th>9-Oct-08</th>
<th>DIA at 91.55</th>
<th>DIA 94 Call Ask</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>2.37</td>
<td>2.37</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>5.10</td>
<td>5.10</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>5.90</td>
<td>5.90</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>7.60</td>
<td>7.60</td>
<td></td>
</tr>
</tbody>
</table>

Note: Premiums were unusually high in Oct 08 because of volatility in the markets.

Strategy 1: Leveraging Long with a IWM Deep-in-the-Money (DITM) rolling call

The IWM ETF tracks the Russell 2000 and trades at 10%.

<table>
<thead>
<tr>
<th>Strike</th>
<th>Call</th>
<th>Oct</th>
<th>Nov</th>
<th>Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>14.44</td>
<td>12.89</td>
<td>11.85</td>
<td>11.85</td>
</tr>
<tr>
<td>80</td>
<td>12.25</td>
<td>11.85</td>
<td>11.85</td>
<td>11.85</td>
</tr>
<tr>
<td>90</td>
<td>4.45</td>
<td>2.90</td>
<td>2.90</td>
<td>2.90</td>
</tr>
</tbody>
</table>

The call option that you buy must have adequate open interest (at least a few hundred contracts).
Complex Strategy 2: Strangles

You can buy the IBM November 19 195 Call for $1.82 (ITM), which gives you the right to buy IBM for $195 per share between now and Nov 19.

You can buy the IBM November 19 175 Put for $8.05 (ITM), which gives you the right to sell IBM for $175 per share between now and Nov 19.

Performance and Profitability of the Strangle

Note: This graph is somewhat misleading. It shows the profit and value of the position on the expiration date only if the option is held to expiration. It shows nothing about the possible value of an option between now and the expiration date.

Clearly you are playing volatility here. This example is a little asymmetric.

Do you remember these from the last lecture? If we do both it is a strangle!
Complex Strategy 3: Goldcorp GG Hedged Covered Call (Collar)

- When you write an OTM call and buy an OTM put (for insurance) this is called a **Collar**.
- Goldcorp is $21.50
- Nov 22.50 call option is $1.25
- Nov 17.50 put option is $0.25
- Buy the stock
- Write the call
- Buy the put (for insurance)

Complex Strategy 4: Writing covered calls ....

This above is a covered call I wrote specifically for this class last year. I bought AeroVironment (AVAV) last Spring for an Econ 136 experiment for around 26. I should have sold it when it popped above 35 but didn’t. So I wrote this call for us to track until November 22.

Because of high volatility this was expensive for the buyer. I pocket $1.50 per share and would actually prefer that this be exercised, allowing me to also pocket a $4 cap gain ($1.41 had I bought the stock then written the call). The $2.91 gain if executed is more than 10% absolute – not bad for 50 days. If it doesn’t execute I will just write another call.

Note: This option was exercised.
Strategy 6: 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. This is a cash-positive bet on low (and lower) volatility. You are net cash positive and want to stay that way.

Possible Prices of DIA on May 19, 2012

Strategy 7: 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.

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

<table>
<thead>
<tr>
<th>SPY Butterfly 3/4/14</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPY stock</td>
</tr>
<tr>
<td>Mar 184 Call</td>
</tr>
<tr>
<td>Buy</td>
</tr>
<tr>
<td>Mar 187 Call</td>
</tr>
<tr>
<td>Write 2X</td>
</tr>
<tr>
<td>Mar 191 Call</td>
</tr>
<tr>
<td>Buy</td>
</tr>
<tr>
<td>Net</td>
</tr>
</tbody>
</table>

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

Butterfly (Put) payoff grid

<table>
<thead>
<tr>
<th>SPY Put Butterfly 3/4/14</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPY stock</td>
</tr>
<tr>
<td>Mar 184 Put</td>
</tr>
<tr>
<td>Buy</td>
</tr>
<tr>
<td>Mar 187 Put</td>
</tr>
<tr>
<td>Write 2X</td>
</tr>
<tr>
<td>Mar 191 Put</td>
</tr>
<tr>
<td>Buy</td>
</tr>
<tr>
<td>Net</td>
</tr>
</tbody>
</table>
What you must do in HW4/5

Time is frozen to March 4, 2014, 8:52 AM. At that moment SPY is trading for 187.410.

You have bought a March 22 Call option Strike Price 190 at Best Ask for $0.63. There are 8 days to expiration.

You are to use the one-year historical volatility from HW1 to calculate:

1. The probability that the stock price will be higher than the strike price at expiration assuming a zero alpha, and
2. The probability that the stock price will be higher than the strike price at your estimated alpha (which may produce the same result).

When you ask the question, “What is the prob that price will go from 100 to 105?”, you are also asking “How many standard deviations is 105 away from 100, and what is the probability of that?”

Helpful to understand ....
Where we are going ... the actual strangle calculator that we used two weeks ago.

... a small segment of my Visual Basic code.