SEC Training - Risk Management
Washington, D.C., February 27, 2006

Robert J. Frey, Ph.D.
Director, Program in Quantitative Finance
Applied Mathematics and Statistics, Stony Brook University
The Concept of Risk
What Is Risk?

- How likely is a given outcome to occur?
- How much does that outcome scare you?
The Risk Equation

Risk = Uncertainty + Consequences
A 5% position loss...

- …at 1:1 leverage is an inconvenience.
- …at 5:1 leverage is a disaster.
- …at 10:1 leverage puts you out of business.
- …at 20:1 leverage bankrupts you.
MFA Sound Practices for Hedge Fund Managers
MFA
Sound Practices

• Management and Internal Trading Controls
• Responsibilities to Investors
• Valuation Policies and Procedures
• Risk Monitoring
• Regulatory Controls
• Transactional Practices
• Business Continuity and Disaster Recovery
Sources of Uncertainty

(guaranteed incomplete)

- Market
  - Economic Growth
  - Interest and Inflation Rates
  - Foreign Exchange
  - Credit and Counter-party
- Operational
  - Lack of Discipline
  - Lack of Flexibility
  - Operational Errors and Deficiencies
- Strategy
  - Non-Stationarity
  - Overfitting
  - Lack of Realism
- Event Risk
  - Regulatory Changes
  - Political Upheavals
Risk Monitoring


- Reports to Senior Management
- Develop and Implement a System of Checks and Balances
- Conduct Back Tests and Stress Tests
- Quantify and Monitor Current Exposures
Risk Classification

Source: MFA’s 2005 Sound Practices for Hedge Fund Managers, pp. IV-3 to IV-9

- Market Risk
- Liquidity Risk
- Credit Risk
- Leverage Risk
- Operational Risk
- Valuation Risk
Monitoring Risk

Source: MFA’s 2005 Sound Practices for Hedge Fund Managers, pp. AI-1 to AI-22

• General Techniques
  ▪ No one numerical or statistical measure is complete
  ▪ Employ multiple measures
    • VaR
    • Stress Testing
    • Scenario Analysis

• Funding Liquidity Risk
  ▪ The fund’s ability to absorb losses
  ▪ Volatility a key element

• Leverage (in context)
  ▪ Multiple Definitions
  ▪ Not an Independently Useful Measure
The Character of Security Returns
Real returns…

• Heteroskedastic
• Skewed
• Kurtotic
Real returns…

• Heteroskedastic
• Skewed
• Kurtotic
Outlier Analysis


<table>
<thead>
<tr>
<th>Statistic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>4,558 trading days</td>
</tr>
<tr>
<td>Return $\mu$</td>
<td>0.045%</td>
</tr>
<tr>
<td>Return $\sigma$</td>
<td>1.0%</td>
</tr>
<tr>
<td>Century “Fence”*</td>
<td>(-3.9%, -3.9 $\sigma$)</td>
</tr>
<tr>
<td>Outlier Count</td>
<td>9</td>
</tr>
<tr>
<td>Maximum Drawdown</td>
<td>(-7.1%, -7.0 $\sigma$)</td>
</tr>
<tr>
<td>Theoretical Frequency*</td>
<td>4.4 billion years</td>
</tr>
</tbody>
</table>

* Assuming a Gaussian Distribution with the same mean and standard deviation.
<table>
<thead>
<tr>
<th>Statistic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>602 trading months</td>
</tr>
<tr>
<td>Return $\mu$</td>
<td>0.83%</td>
</tr>
<tr>
<td>Return $\sigma$</td>
<td>4.2%</td>
</tr>
<tr>
<td>Century “Fence”*</td>
<td>(-12.3%, -3.1 $\sigma$)</td>
</tr>
<tr>
<td>Outlier Count</td>
<td>2</td>
</tr>
<tr>
<td>Maximum Drawdown</td>
<td>(-24.3%, -5.8 $\sigma$)</td>
</tr>
<tr>
<td>Theoretical Frequency*</td>
<td>23.2 million years</td>
</tr>
</tbody>
</table>

* Assuming a Gaussian Distribution with the same mean and standard deviation.
Controlling Risk with Hedging
Derivatives & Risk

- Derivatives transfer risk - either increasing or decreasing it.
- Hedges typically involve some form of “leverage”.
- Overconfidence and bad assumptions have serious consequences.
Systematic vs. Idiosyncratic

• Certain risk factors are systematic; i.e., they are shared across securities.
• Others are idiosyncratic; i.e., they are unique to each particular security.
• Systematic risk can not be diversified away but idiosyncratic risk can.
Arbitrage (Theory)

- Relative performance returns can be small but independent.
- Buy a long position in “undervalued” assets.
- Sell a short position in “overvalued” assets.
- Hedge out systematic factors so that only idiosyncratic risks...and returns...remain.
- Diversify aggressively; lever up to an “interesting” return.
• Risk models are not perfect, so there are always missing factors...and unhedged systematic exposures.

• Maintaining a long-short hedge must be done dynamically: Volatility exposure, trading costs, difficulty in selling shorts etc. make managing a portfolio operationally difficult.

• Markets evolve, making models obsolete.

• With many arbitrage based strategies managers experience steady and mildly positive returns punctuated by periods of extremely poor performance.
Merger Arbitrage

Case Study

- Strategy is largely uncorrelated to the market but with...
- Occasional periods of extremely poor performance associated with certain market events
- Returns experienced during sustained periods of good performance are not indicative of true risks.
Why Hedges Fail

• Following the map...not looking at the road...makes it easy to overlook the obvious.
• Models, even at their best, are not representative.
  ▪ Markets are not continuous.
  ▪ Models depend on statistical estimates; the “true” parameters are unknown.
  ▪ Markets evolve and change all the time.
• Model errors are amplified by high leverage.
  ▪ Risk is underestimated: Leverage is encouraged.
  ▪ Even small errors are deadly.
• Changes in market behavior during stress periods invalidate basic assumptions.
  ▪ Correlations increase during stress periods.
  ▪ Liquidity disappears as supply and demand become imbalanced.
• Two most dangerous comments are...
  ▪ “This time it’s different...”
  ▪ “This time it’s just like...”
A Few Useful Quotes…
The Quant’s Trap

Today’s scientists have substituted mathematics for experiments, and they wander off through equation after equation, and eventually build a structure which has no relation to reality.

Nikola Tesla (1856 – 1943)
Life is not an illogicality; yet it is a trap for logicians. It looks just a little more mathematical and regular than it is; its exactitude is obvious, but its inexactitude is hidden; its wildness lies in wait.

G.K. Chesterton (1874 – 1936)
Thank You!