Portfolio Management

Some History on Extreme Events

Decision Support for
- Insurance Underwriting
- Hedging Commodity Prices
- Pricing Long-Term Service Agreements

- Collaborated with the businesses
- Put into production
- In regular use

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Making Decisions and Decision Support Technologies

- Processing
- Analysis

Input

Output

Data, information

Decision (Actions)

Experts

Decision Support Technology (Simulations/Analyses)

Uncertainty Analysis
- uncertainties in data
- uncertainties in models
- uncertainties in parameters
- uncertainties in computations

Life Cycle of Simulator

Establishing the Context

Portfolio Asset Management with Decision Support keeps things operating smoothly every day
But – rarely it does fail!
Why?
Case 1: Basel II – US Banks

Portfolios & Rare Events

Basel II - an international banking set of standards on how to treat risks and risk analyses

On Basel II from US Regulators:

- Director of FDIC testimony before Congress (5/11/2005):
  - “Capital requirements in Basel II are very sensitive to inputs.”
  - “It is difficult to expect this data – collected during good economic times – will be sufficient to generate capital requirements robust enough to withstand extreme losses under adverse conditions.”
Capital Is Very Sensitive To Tail Parameter Choices

Operational Event Frequency
Annual Events over Threshold

Key Observations


- e.g., changing t from 0.7 to 0.8 increases capital from $12MM to nearly $40MM

*Simulated data similar to real internal data
Case 2: Portfolio of Stocks

This talk:

- Start simple with standard “Modern Portfolio Theory” (Markowitz) – the “Model” World
  - Not state of the art – but simple math
  - Allows focus on the uncertainties
  - Uses portfolio of stocks as example

Objective

Explain:

- Portfolio Risk Decisions
- What concepts / models are used
- How “certain” the models are for making decisions

Markowitz Assumptions:

- Knowing the mean and standard deviation of returns is sufficient
- The standard deviation is the measure of riskiness of the portfolio
- Maximize the return and minimize the risk

“Real” World

Word Problem

Math Problem

Computation Problem

Connecting the Real World with the Model World
Setting a Baseline; What is Better?

Two methods that maximize Financial Returns:

Q: Which is the better method, looking at the point estimates only?

Q: Or also taking account of the uncertainties?

Understanding the Uncertainties in the Numbers is Critical to Making Rational Decisions.
Model: Portfolio of Stocks

Markowitz Portfolio Optimization

Input:
- Historical Daily Returns of Each Stock
- Pairwise Correlation between Stock Returns

Assumptions:
- Distribution of Returns is Normal (Gaussian)
- Correlation Matrix is stationary (not time dependent)

➢ neither assumption is supported by the data
Benefits of Diversification

Assume:
A Portfolio of n stocks
Equal weights of each stock
Equal risks for each stock
All stocks are uncorrelated

Assume:
A Portfolio of n stocks
Equal weights of each stock
Equal risks for each stock
All stocks are partially correlated

Riskiness of Portfolio vs size of Portfolio

All Portfolios fall between these two curves

Mathematically, in both cases: Sigma approaches zero as n approaches infinity

**Approach used for many asset portfolios – not just stocks**

Note: Data noise in correlations can lead to underestimates of Risk – but there are ways to deal with this
Portfolio of Stocks

Markowitz Efficient Frontier
- minimize variance (Risk)
for a given Return with Normal Dist.

For a Normal distribution minimizing the standard deviation is sufficient

BUT, for a non-Normal distribution, minimizing the variance, can minimize the small risk and increase the large risks!

Sornette et al. 2000
Basel II and Banks

One way to look at the Financial Meltdown (2008-2010):
- Models/Processes were inadequate
- Basel II rules led to highly correlated behavior of banks

Overall – What have we learned?

there are lots of uncertainties in evaluating risks
- driven by data, models, parameters and computational uncertainties
- the “model” world vs. the “real” world difference
- real world is dynamic not static
- we can’t ignore these uncertainties and make good decisions; they need to be part of the analyses

Bayesian statistical analyses and Deep Learning neural net technology

Research advances since 2010:
• Better Tools and Processes for doing analyses with uncertainty
• Better Tools and Processes for making ROBUST decisions (not Optimal)
• Better Tools and Processes for dealing with dynamics, stress testing

- e.g., Robust Grid Reliability
Thank you!

Questions, Comments?
Appendix
History as a Guide

So what can we learn from history?

Performance of the world’s largest 100 industrial companies in 1912 over period 1912-95 (Hannah, 1999)

Bankrupt 29
Disappeared 48
Survived 52
Remained in top 100 in 1995 19


Times change and most companies don’t adapt!
Caution: On predicting the future

Enron Analysts’ Consensus view:  
1 = Strong Buy  
3 = Hold  
5 = Strong Sell
Caution: On predicting the future

“Prediction is very difficult, especially if it's about the future.”

Niels Bohr

“The future ain't what it used to be.”

Yogi Berra