Portfolio Management

Some History on Extreme Events

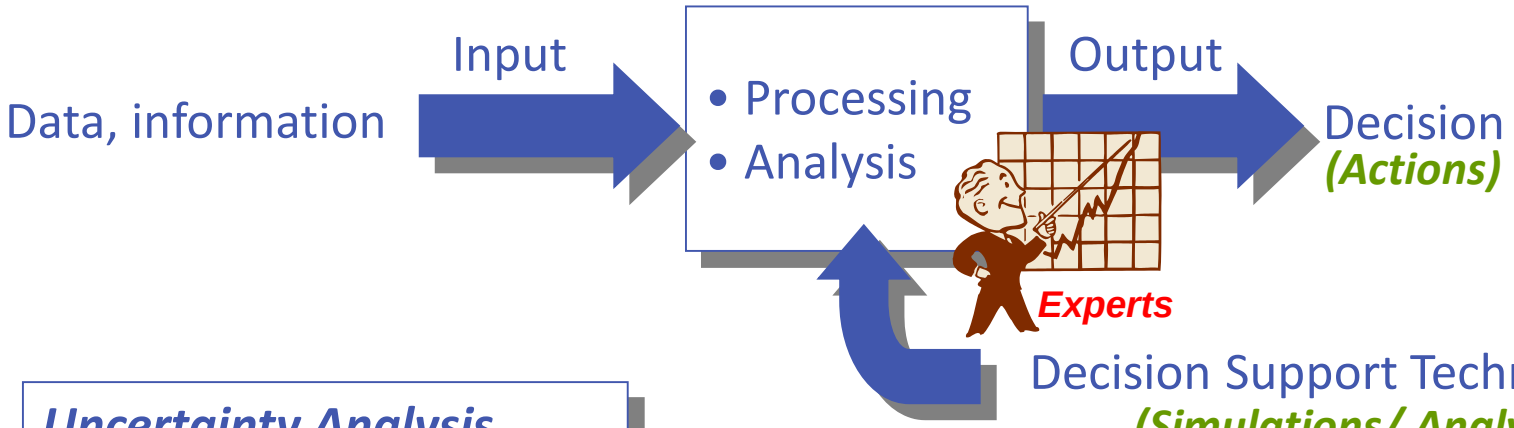
Decision Support for
- Insurance Underwriting
- Hedging Commodity Prices
- Pricing Long-Term Service Agreements

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

ARPA-E PERFORM Workshop
June 18, 2019

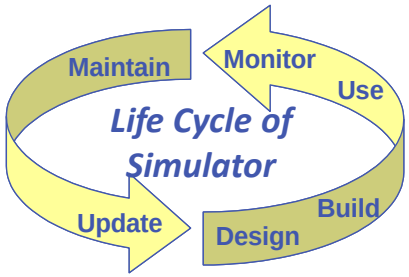
Richard P. Messmer
GE Global Research

Making Decisions and Decision Support Technologies



Uncertainty Analysis

- uncertainties in data
- uncertainties in models
- uncertainties in parameters
- uncertainties in computations



Portfolio Asset Management with Decision Support keeps things operating smoothly every day
But – rarely it does fail!

Why?

Establishing the Context

Case1: Basel II – US Banks

Portfolios & Rare Events

Federal Register

Monday,
September 25, 2006

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

Part II

Department of the Treasury
Office of the Comptroller of the Currency
Office of Thrift Supervision
12 CFR Part 3 and 566

Federal Reserve System
12 CFR Parts 208 and 225

Federal Deposit Insurance Corporation
12 CFR Part 325

Risk-Based Capital Standards: Advanced Capital Adequacy Framework and Market Risk; Proposed Rules and Notices

Figure 1 – Probability Distribution of Potential Losses

The "Real" World

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**."

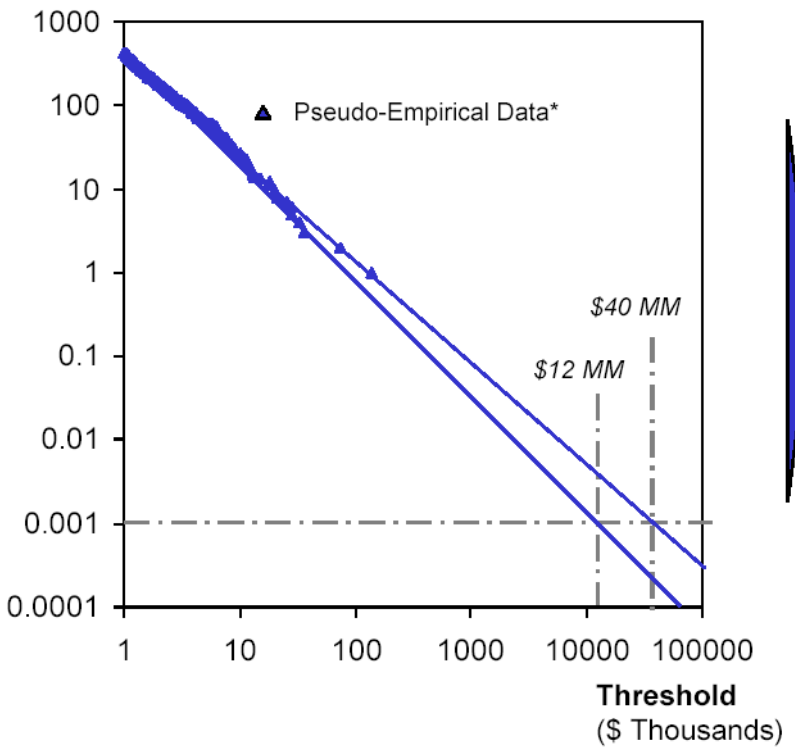
- " It is difficult to expect this data – collected during good economic times – will be sufficient to generate capital requirements **robust enough to withstand extreme losses under adverse conditions."**

Federal Reserve Meeting

citigroup

Capital Is Very Sensitive To Tail Parameter Choices

Operational Event Frequency
Annual Events over Threshold



*Simulated data similar to real internal data

Key Observations

From presentation given by

R. Dekoker and

J. Newberry

at Federal Reserve Bank of Boston Conference,

May 20, 2005.

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

Case 2: Portfolio of Stocks

This talk:

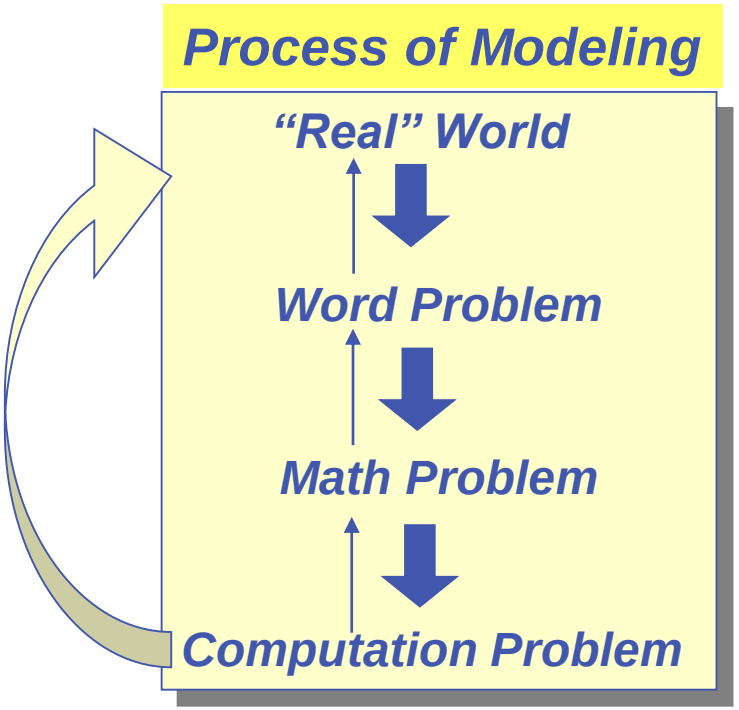
• Start simple with standard "Modern Portfolio Theory" (Markowitz) – the "Model" World

- ➢ Not state of the art – but simple math
- ➢ Allows focus on the uncertainties
- ➢ Uses portfolio of stocks as example

Objective

Explain:

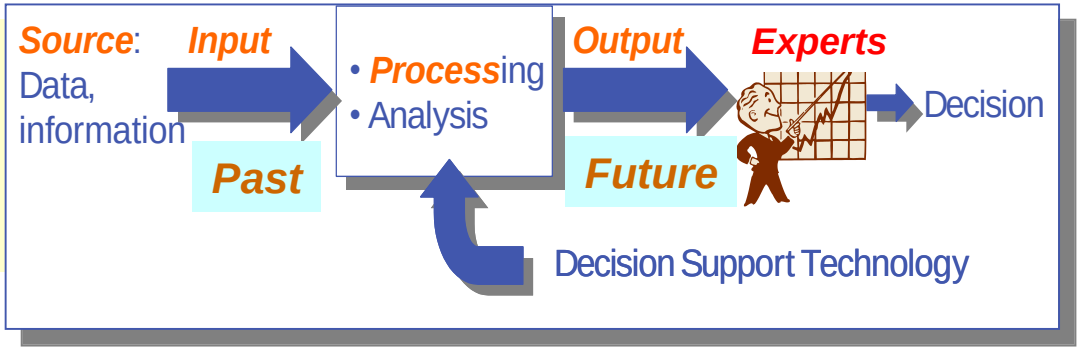
- Portfolio Risk Decisions
- What concepts / models are used
- How "certain" the models are for making decisions



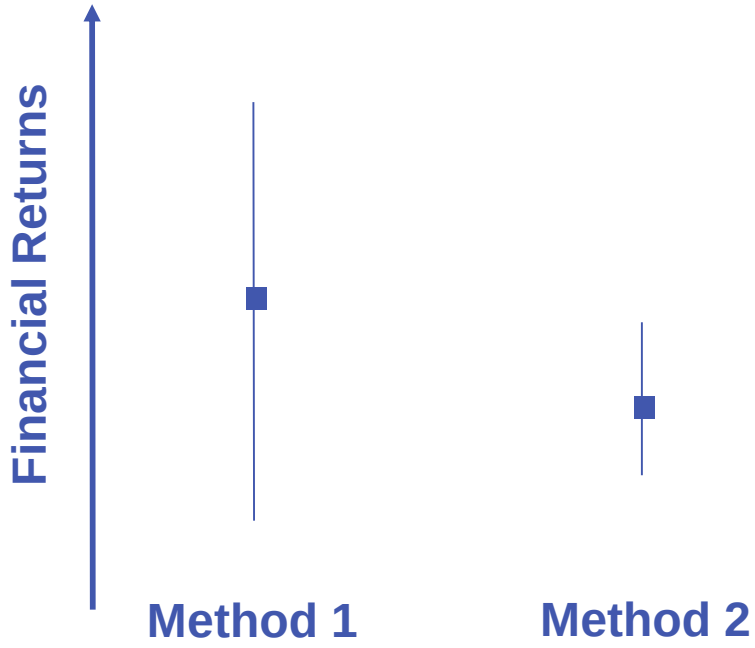
Connecting the Real World with the Model World

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



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

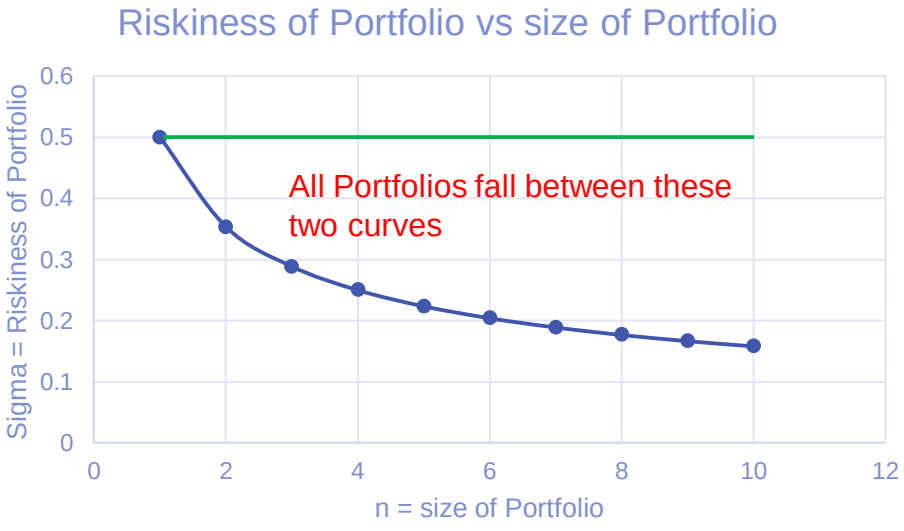
Input:
- Historical Daily Returns of Each Stock
- Pairwise Correlation between Stock Returns

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

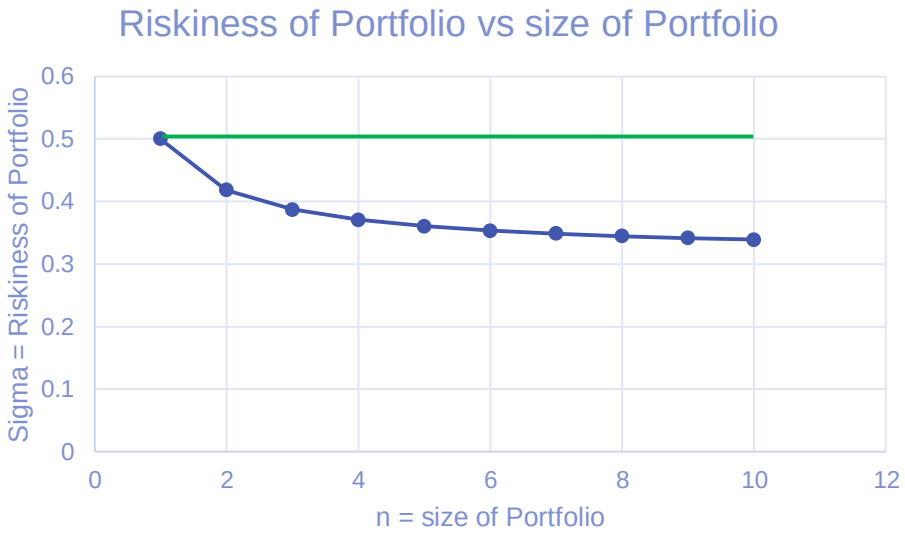
➢ neither assumption is supported by the data

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

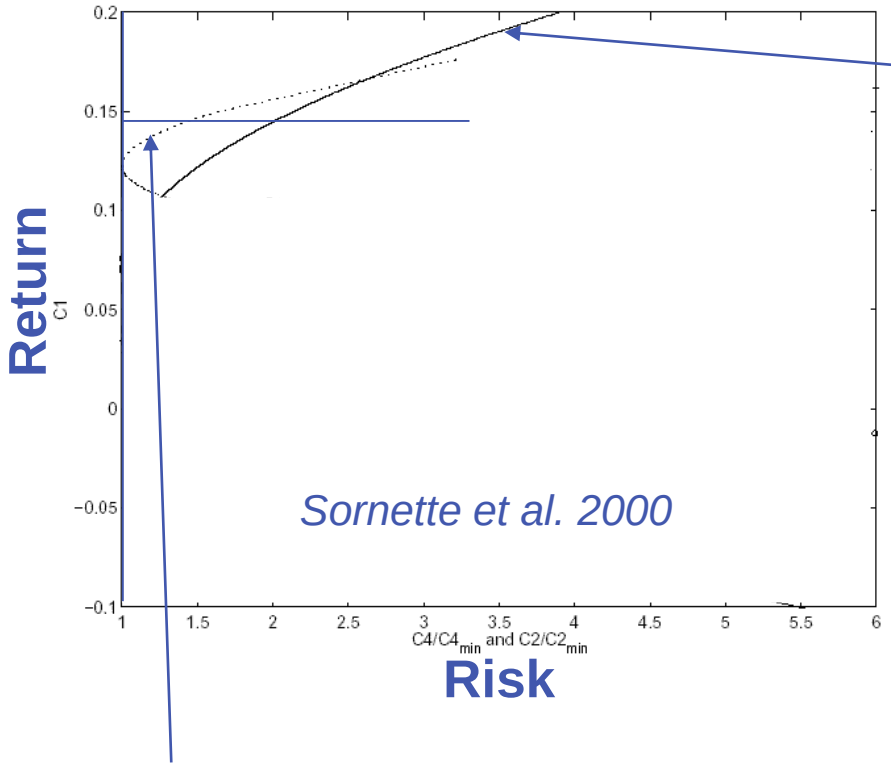


Mathematically, in both cases: Sigma approaches zero as n approaches infinity

Approach used for many asset portfolios – not just stocks

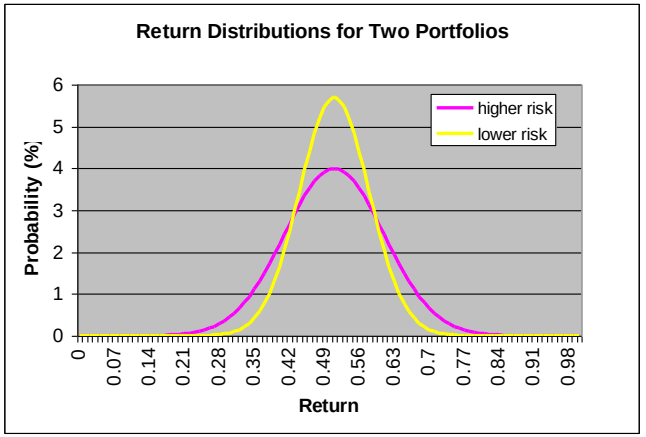
Note: Data noise in correlations can lead to underestimates of Risk – but there are ways to deal with this

Portfolio of Stocks



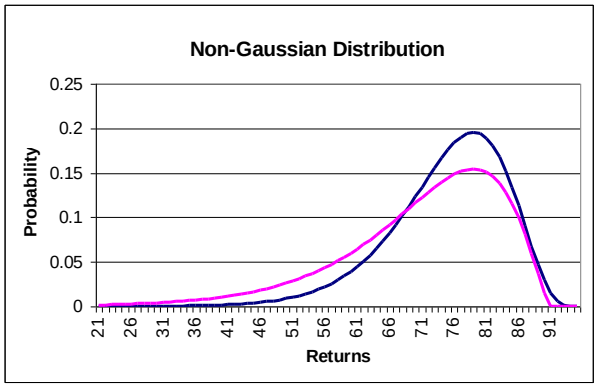
Sornette et al. 2000

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!



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 - Moving from deterministic Grid forecasts

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

Bayesian statistical analyses and Deep Learning neural net technology

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)

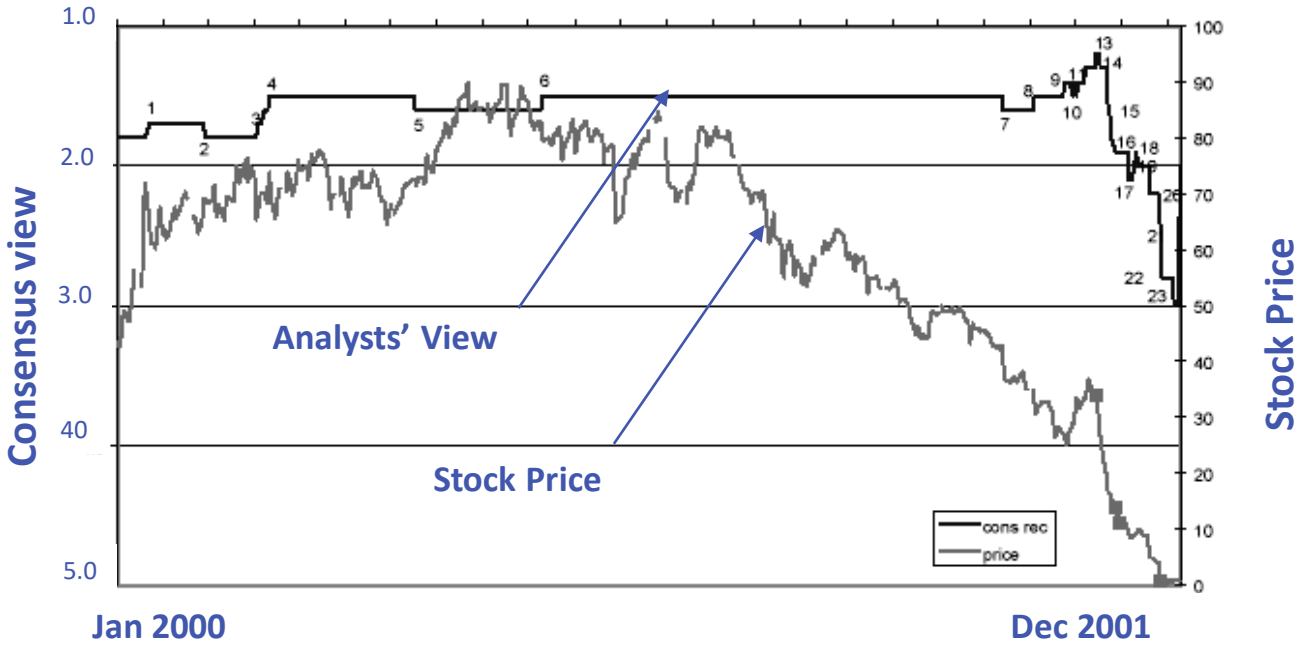
L. Hannah, in N. R. Lamoreaux, D. M. G. Raff and P. Temin (Eds), "Learning by Doing in Markets, Firms and Countries" (National Bureau of Economic Research, 1999).

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