Portfolio Strategy Selection Under Uncertainty

All businesses need a portfolio strategy to grow. But how is that portfolio strategy selected and how is it tested whether it is a "good" strategy? We will discuss a way to identify growth strategies in the upstream oil business that are consistent with company portfolio opportunities, objectives and risk preferences using a quantitative model.

Strategic Portfolio Decision Hierarchy

- Givens
  - Higher Expected Value Returns require accepting more risk
  - People and companies are risk adverse and prefer less risk, all else being equal
- Focus On Decisions
  - Oil vs. Gas
  - Light vs. Heavy oil
  - OSA (fixed margin) vs. Low Tax Rate
  - Level of Exploration
  - Technology Bets
  - M&A vs. Internal Growth
- Tactical
  - Details of implementing the strategy

# Typical Process Identifies A Strategic Portfolio, Then Tests

- By consensus, pick a strategic portfolio
- Check results of portfolio versus constraints
- Test other portfolios

Strategy Identified → Eval Model → Reserves Earnings Growth → Good or Bad Fit ← Objectives

Iterate
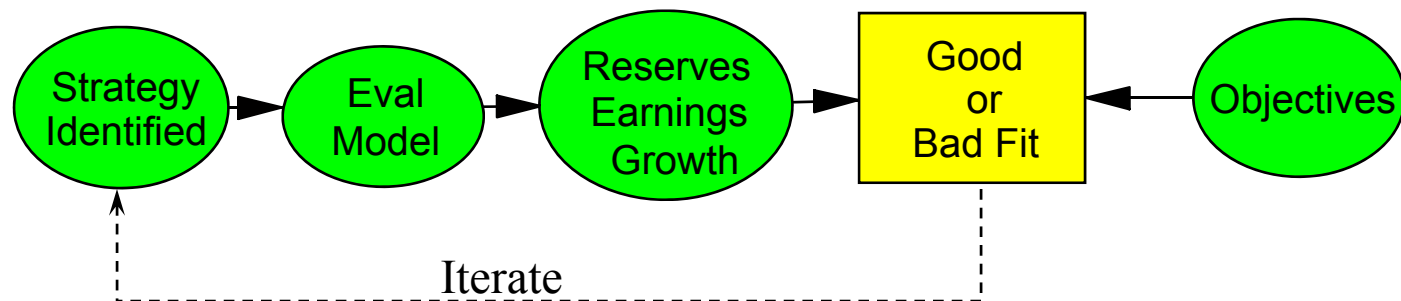
Better Process …..
Model Determines The Best Strategy That Meets Our Objectives and Constraints

Base on our constraints and objects, the probabilistic portfolio model determines the best strategy
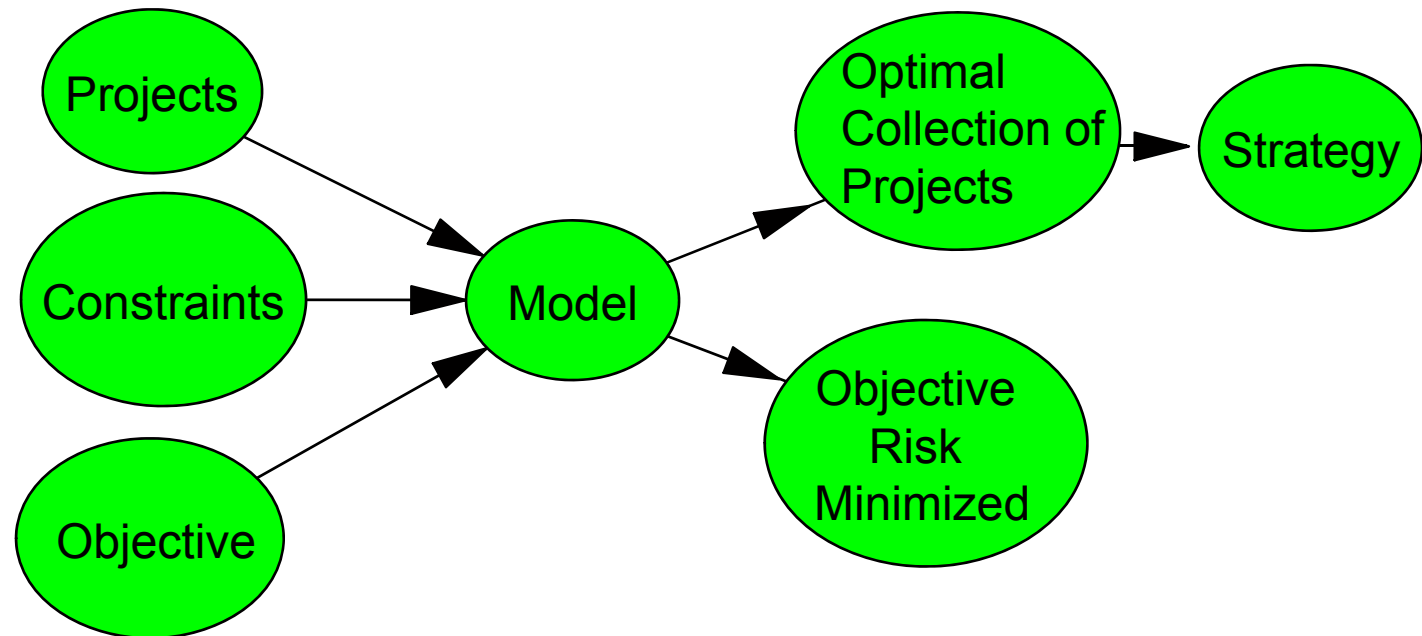
Strategic Portfolio Model Objectives

- **Objectives**
  - **Provide insights as to an optimal collection of projects (a strategy direction) taken from a broader set of projects that minimizes risk given certain constraints**
  - **Show how the optimal collection of projects might change with key constraints or a change in objective**
  - **Evaluate strategies at 100,000 feet**
  - **"Quantify" risk and reward**

- **What the Model is <u>Not</u>**
  - **Used to evaluate a specific project**
  - **Short term planning tool**
  - **Political risk model**
  - **The Answer**

Optimal Collection of Projects

Possible Projects
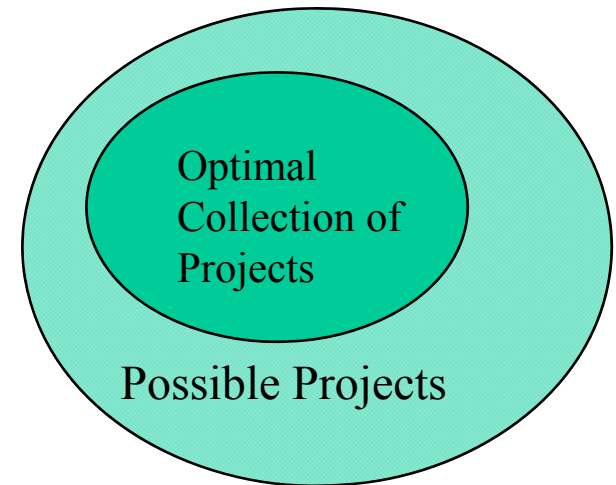
Consider A Simple Financial Portfolio Model With Bonds, Mutual Funds and Stocks

- Annualized growth data for bonds, mutual funds and stocks
- Bonds have low return but little risk
- Stocks have highest return but highest risk

How should I invest $10,000 to finance the college education of my child??

Personal Financial Portfolio
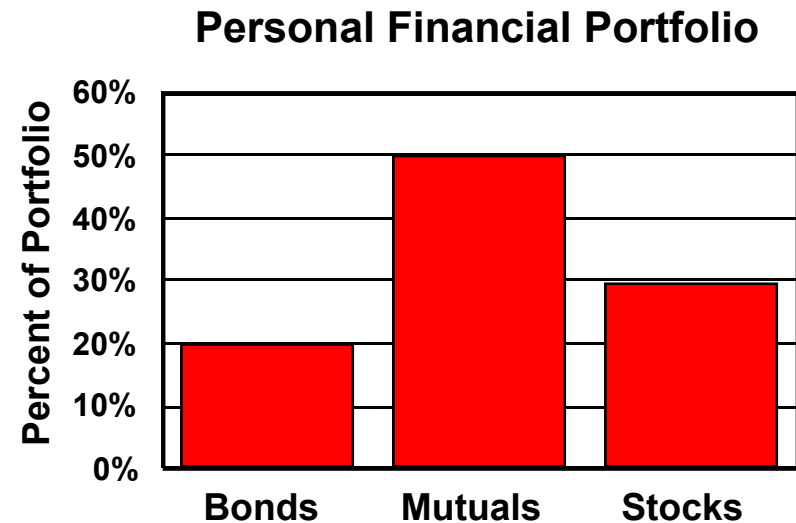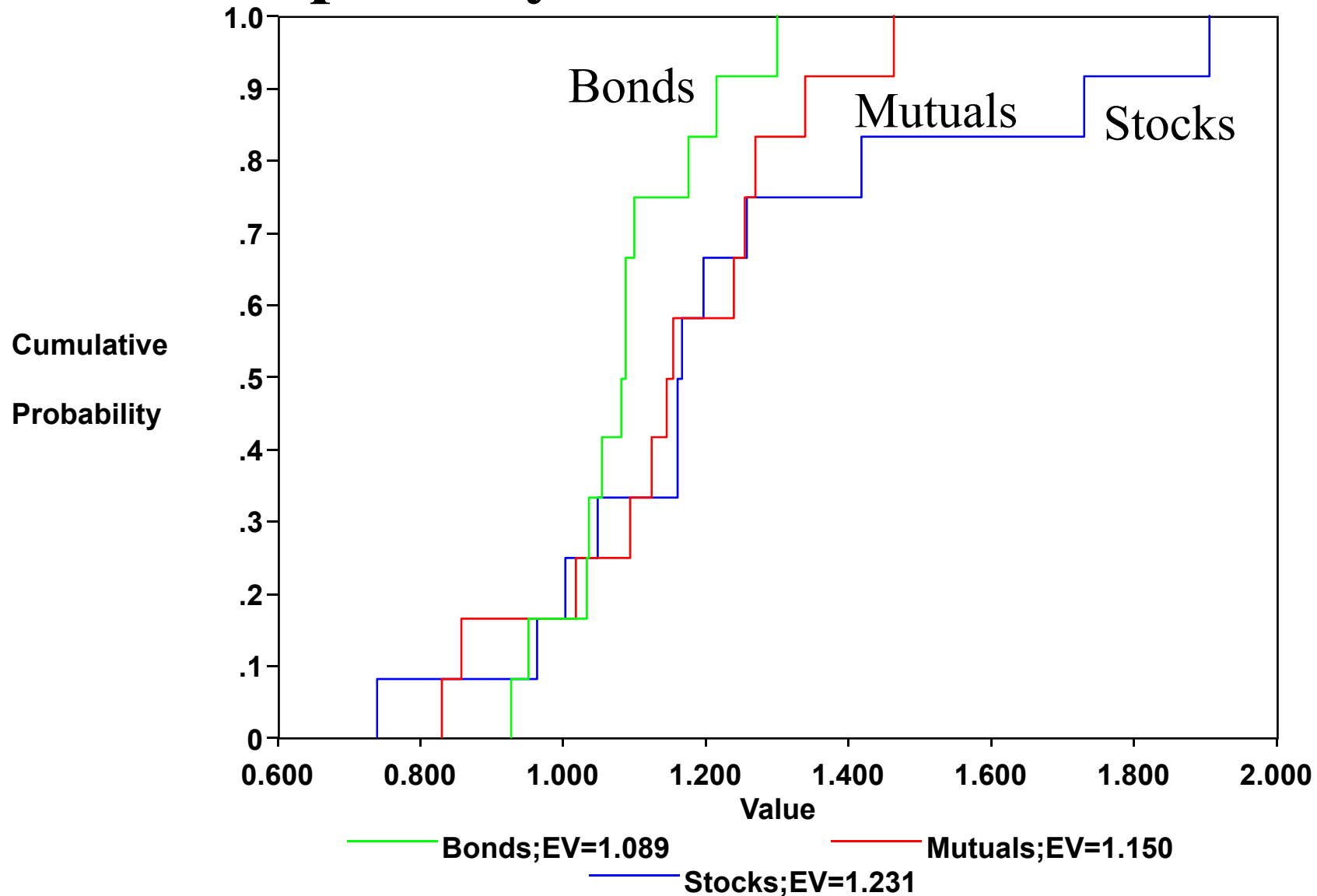
Annualized Returns For 12 Periods

	Bonds	Mutuals	Stock
1	130.0%	115.5%	119.9%
2	110.3%	124.0%	126.0%
3	121.6%	114.6%	141.9%
4	95.4%	83.2%	74.0%
5	92.9%	109.4%	116.9%
6	105.6%	102.0%	96.5%
7	103.8%	127.1%	116.3%
8	108.9%	125.5%	173.2%
9	109.0%	112.5%	105.1%
10	108.3%	134.0%	116.1%
11	103.5%	85.8%	100.6%
12	117.6%	146.5%	190.8%
Expected Values	108.91%	115.01%	123.1%
Std Dev	9.95%	17.71%	31.02%

Data Contains
Various Types of Information

- Expected return
- Volatility of return
- Synergy (covariance) among the projects

Strategic Portfolio Model Objectives

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There is uncertainty as to whether my child will attend a public or private college. How does the portfolio changes as my desired return changes? How much more risk am I assuming?
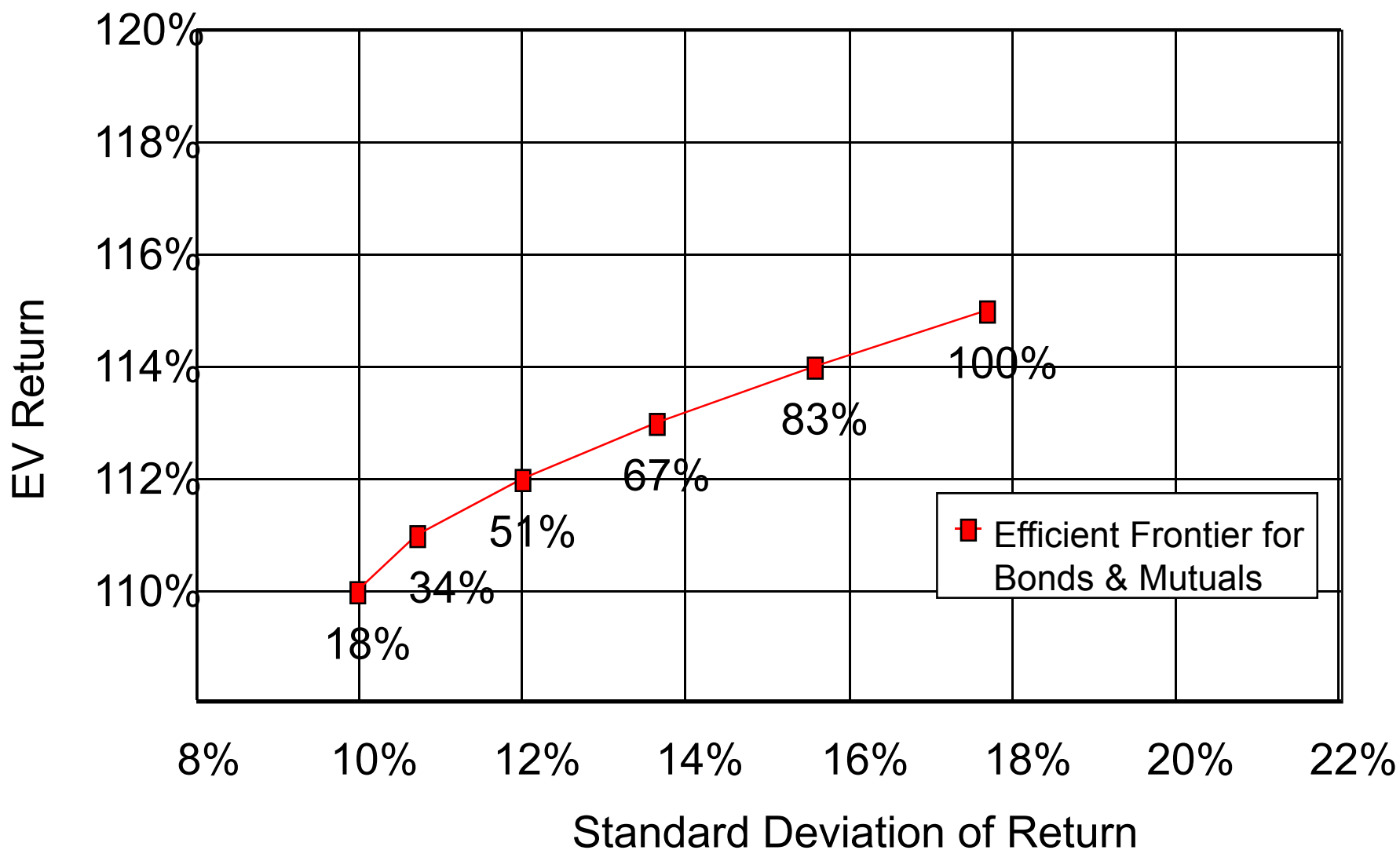
Optimal Collection of Projects

Possible Projects
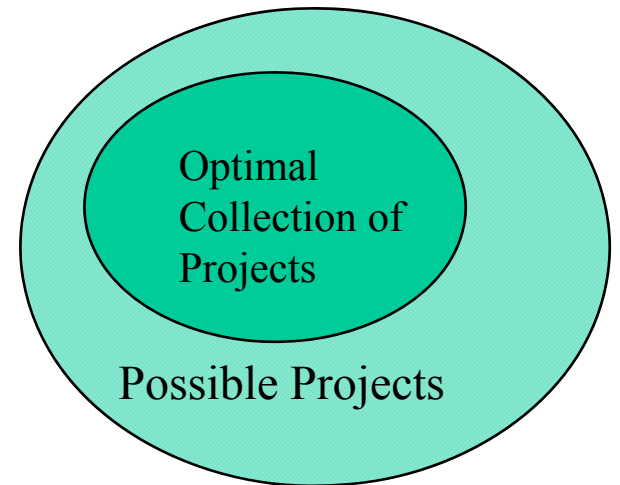
How Do I Achieve My Return Objectives Considering Only Bonds and Mutual Funds,

Portfolio Return	% Bonds	% Mutuals	Risk
108.9%	100.0%	0.0%	9.9%
110.0%	82.0%	18.0%	10.0%
112.0%	49.0%	51.0%	12.0%
114.0%	17.0%	83.0%	15.6%
115.0%	0.0%	100.0%	17.7%

Efficient Frontier Considering only Bonds and Mutuals
(Percent Mutuals Shown for Each Portfolio)

Standard Deviation of Return

EV Return

Legend: Efficient Frontier for Bonds & Mutuals

Data labels: 18%, 34%, 51%, 67%, 83%, 100%

Efficient Frontier Two vs. Three Investment Vehicles
(Percent Mutuals Shown for Each Portfolio)
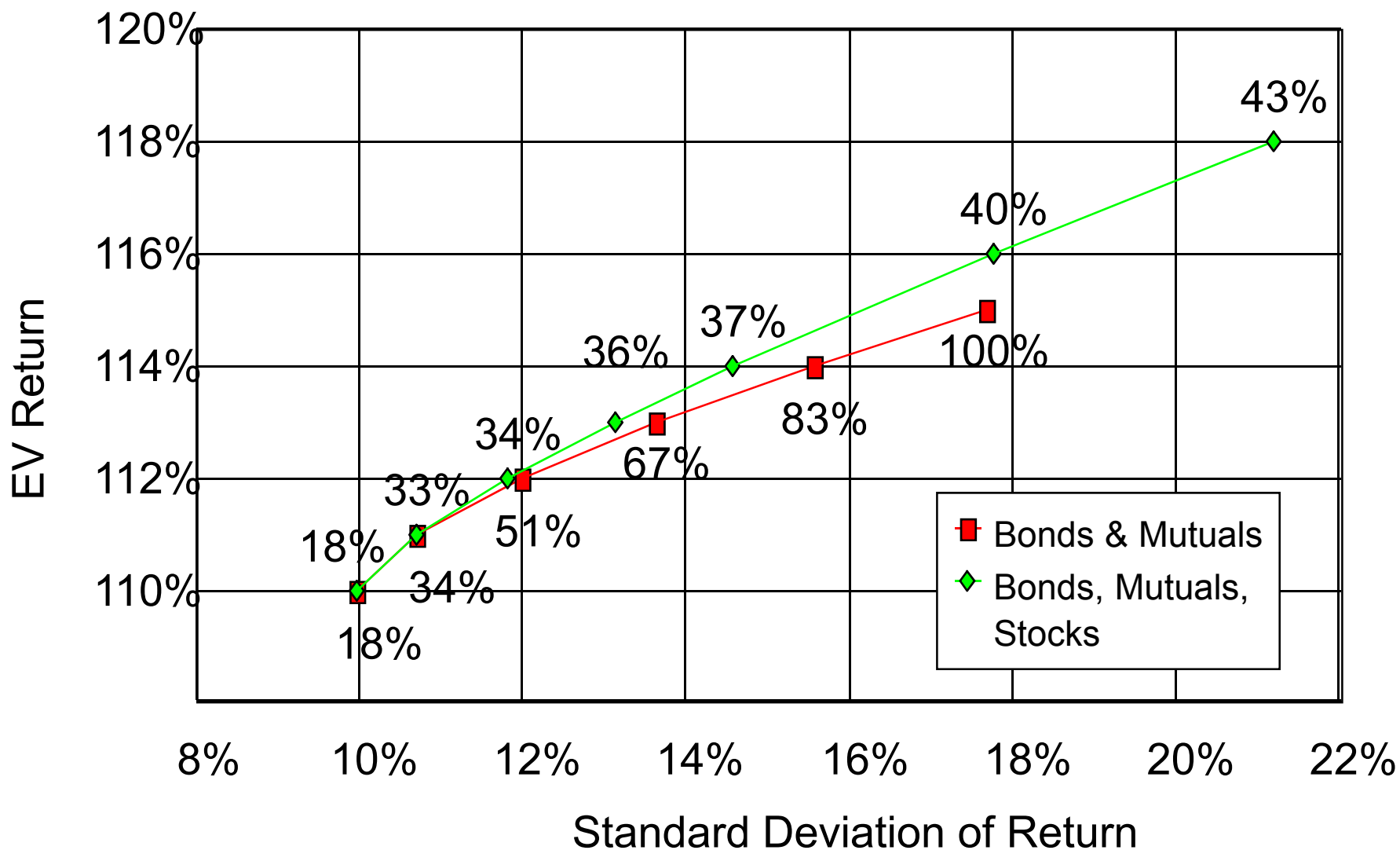
Details of Optimum Portfolios

Results					
		Three Investments			
Act Return	110%	112%	114%	116%	118%
Bonds	82%	59%	43%	27%	11%
Mutual Funds	18%	34%	37%	40%	43%
Stocks	0%	7%	20%	33%	45%

Mutuals are relatively constant. Greater return requires more investment in stocks.

Picking Your Risk Indifference Can Be Difficult
Cumulative Distribution Help Visualize Risk

12% Return has the least risk

14% Return is a compromise

16% Return has the most risk

Cumulative Probability

Value

12% Return; EV=1.120   14% Return;EV=1.140   16% Return:EV=1.160
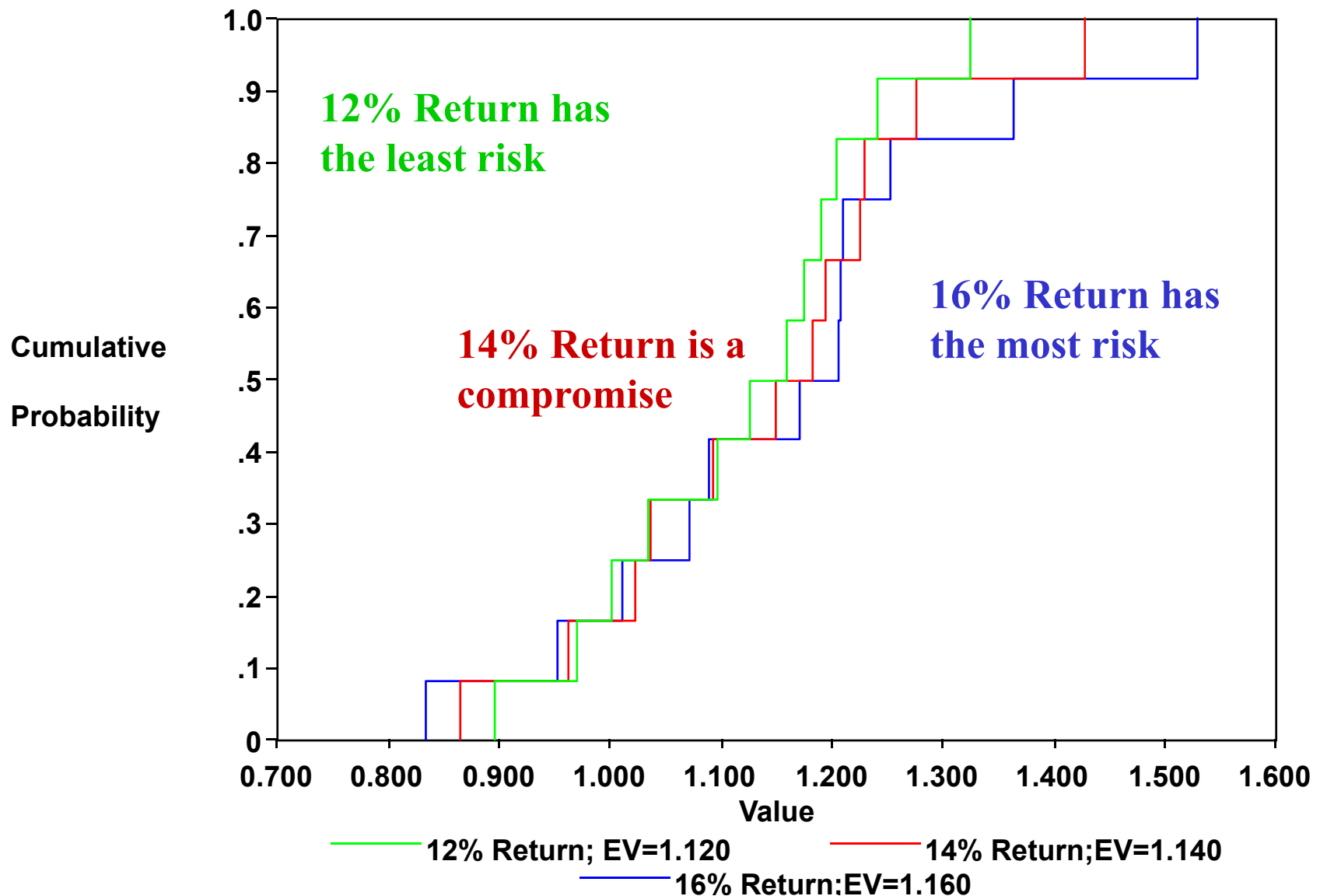
Oil and Gas
Strategic Portfolio Model Fundamentals

- Keys on Earnings or Cash Flow rather than NPV or return
- Considers only key uncertainties
  - Production
  - Crude and gas price
  - Light/Heavy Differential (LHD)
- Price synergy among projects is implicit
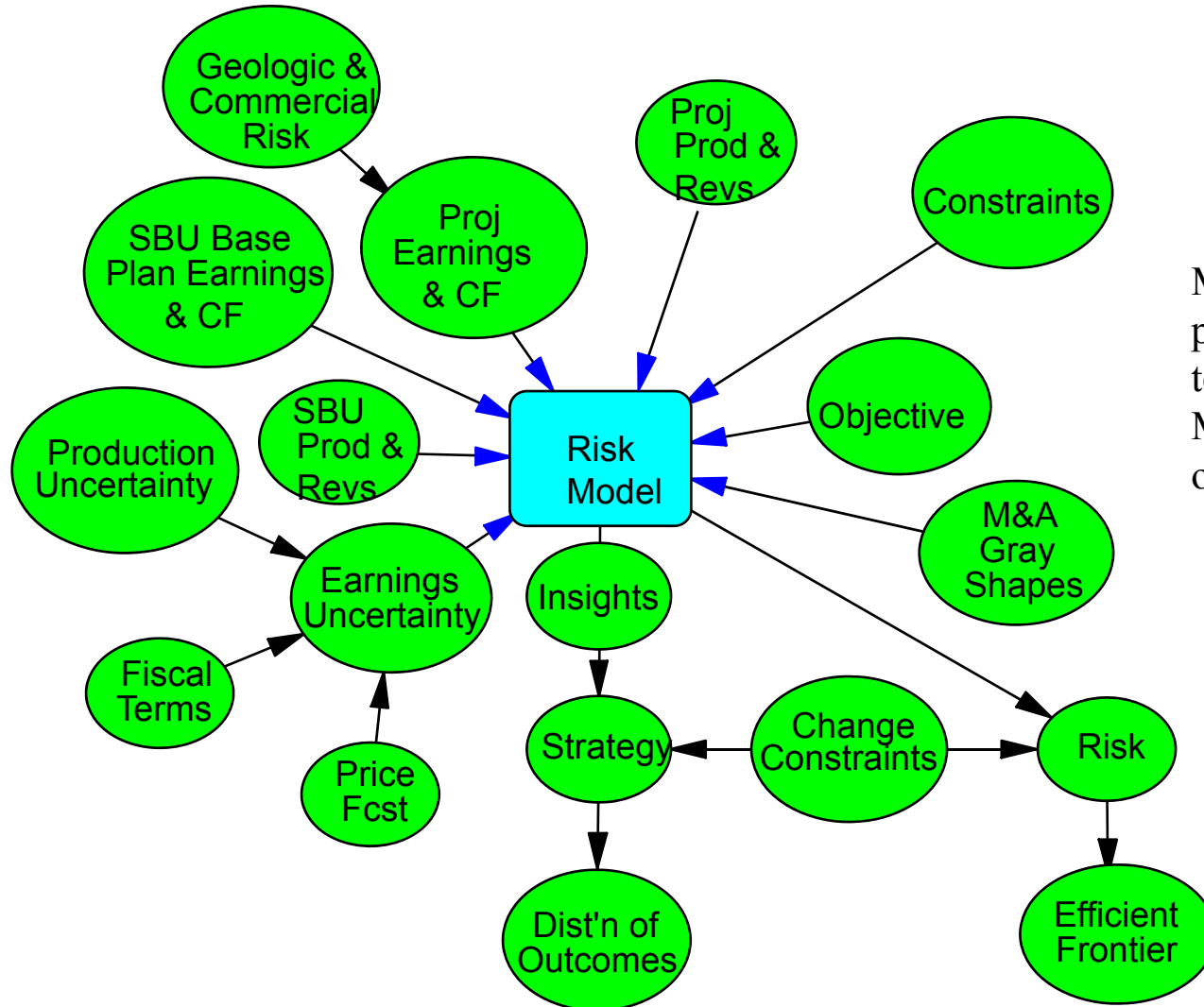
Model Inputs and Outputs

Inputs

- Objective To Minimize Risk of:

  - Earnings Growth during next 5 years

- Sample Constraints (Expected Values)

  - Earnings Growth next 5 years $\quad\quad$ >= A
  - Remaining Reserves in 5 years $\quad\quad$ >= B
  - Cum Cash flow during next 5 years $\quad$ >= X

Outputs

- Strategy (Projects to Pursue)

  - Some $\quad\quad\quad$ Yes/No $\quad\quad$ (0 or 1)
  - Some $\quad\quad\quad$ Continuous $\quad$ (0 →1) (1+?)

Portfolio Model
Influence Diagram

Manually selected portfolio strategies can be tested against the Risk Model to verify the optimality of the portfolio.

Nodes in the diagram: Geologic & Commercial Risk, SBU Base Plan Earnings & CF, Proj Earnings & CF, Proj Prod & Revs, Constraints, Production Uncertainty, SBU Prod & Revs, Risk Model, Objective, M&A Gray Shapes, Fiscal Terms, Earnings Uncertainty, Insights, Price Fcst, Strategy, Change Constraints, Risk, Dist'n of Outcomes, Efficient Frontier

Efficient Frontier Defines the Boundary of the Minimum Risk Achievable

Insufficient projects defined
to reach this level of EV NPV

No Solutions

Earning
Growth

"Efficient Frontier"

Many Solution
with same NPV
but more risk

Risk of Earnings
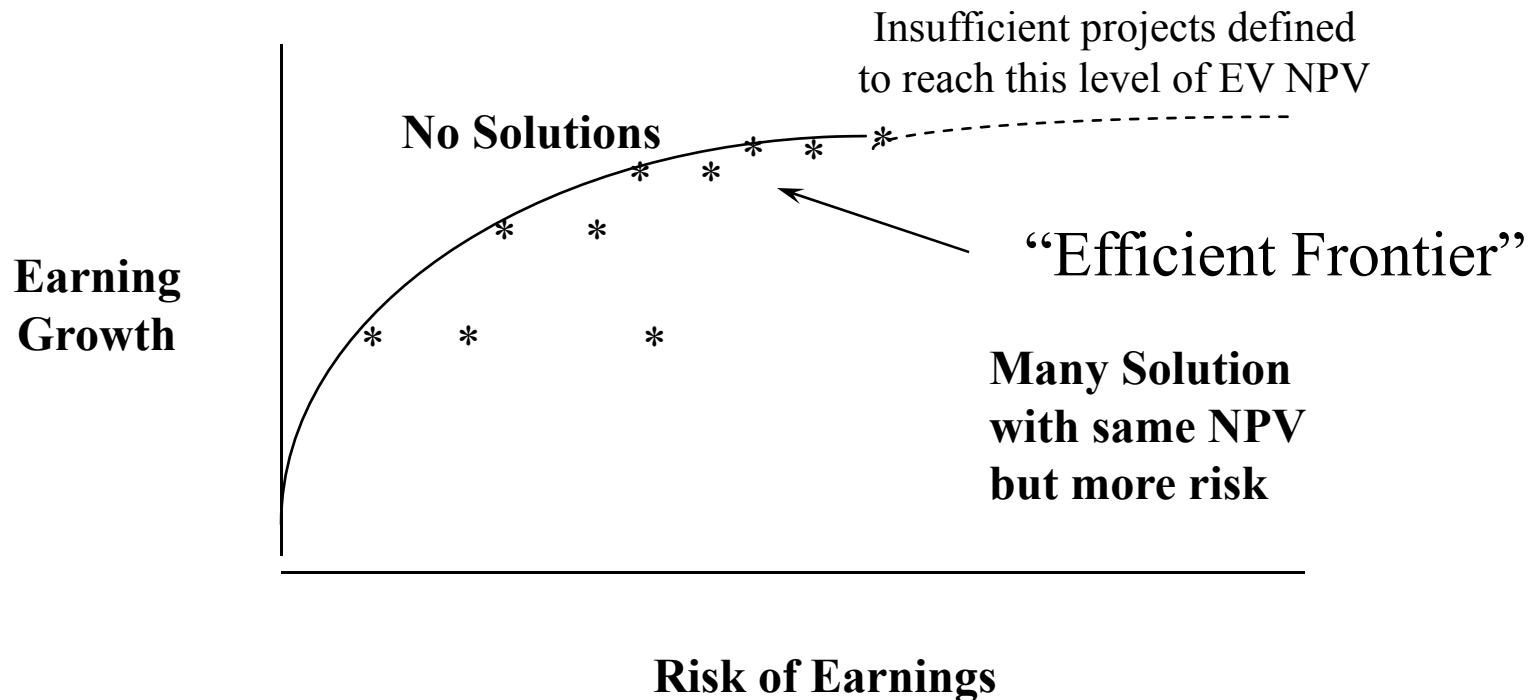
Challenges to Implementation

- Support from Business Units
- Collecting data from existing and potential project
- Identifying projects that <u>more</u> than meet the constraints
- Explaining procedure and significance of results to management

Backup Slides

Covariance Matrix

	Bonds	Mutuals	Stocks
Bonds	1.0%	0.8%	1.5%
Mutuals	0.8%	3.1%	4.3%
Stocks	1.5%	4.3%	9.6%

[Portfolio] * $\begin{bmatrix} \text{Covariance} \\ \text{Matrix} \end{bmatrix}$ * $\begin{bmatrix} \text{Portfolio} \end{bmatrix}$ = **Portfolio Variance**

Note that SQRT (3.1%) = 17.7% = Std Dev of Mutuals