



HARRY MARKOWITZ

Presented by Andrea Wagner

Background



- Born 1927 in Chicago, Illinois
- High School
 - ▣ Interested in Philosophy and Physics
 - David Hume
- The University of Chicago
 - ▣ Bachelor's Program
 - Emphasis on reading
 - Particularly interested in studying philosophers
- Upper Division
 - ▣ Economics
 - “Economics of Uncertainty”
 - ▣ Cowles Commission for Research in Economics
 - ▣ Dissertation
 - Application of Mathematics to the Stock Market

Background



- RAND Corporation (1952)
 - George Dantzig
 - Optimization Techniques
 - Computation of Mean-Variance Frontiers (1959 Book)
- Cowles Commission at Yale (1955-1956)
 - Invitation of James Tobin
 - Markowitz (1959)
 - Portfolio Allocation
- PhD in Economics (1959)

Background



- Von Nuemann Prize in Operations Theory
 - Portfolio Theory
 - Spare Matrix Theory
 - SIMSCRIPT Programming language
- Nobel Prize in Economics (1990)
 - Professor of Finance at Baruch College
- Current Involvement
 - Advisory Panel – Research Affiliates
 - Advisory Board – Index Fund Advisors

Influences



- Von Nuemann, Morgenstern, Marshak
 - ▣ Expected Utility Arguments
- Savage
 - ▣ Friedman-Savage Utility Function
 - ▣ Personal Probability Defense
- Koopman
 - ▣ Course on Activity Analysis
 - Definition of Efficiency
 - Analysis of Efficient Sets
- John William Burr
 - ▣ *Theory of Investment Value*

Contributions to Economics



- Portfolio Theory
 - Portfolio Diversification
 - Risk and Return
 - Variance as Measure of Risk
 - Portfolio Variance and Security Covariance
 - Pareto Optimal Risk-Return Combinations

Contributions to Economics

□ Example

- Suppose that we have two risky assets X and Y

- X and Y have the following distributions of returns:

$$X = \begin{cases} 2\% \text{ w.p. } .5 \\ 10\% \text{ w.p. } .5 \end{cases}$$

$$Y = \begin{cases} 2\% \text{ w.p. } .5 \\ 10\% \text{ w.p. } .5 \end{cases}$$

- The expected return on both assets is:

$$E(X) = E(Y) = .02 * .5 + .10 * .5 = .06 = 6\%$$

- The variance of return on both assets is:

$$\text{var}(X) = \text{var}(Y) = .5(.10 - .06)^2 + .5(.02 - .06)^2 = .0016$$

Contributions to Economics

- Create a portfolio Z with half asset X and half asset Y:

$$Z = .5X + .5Y$$

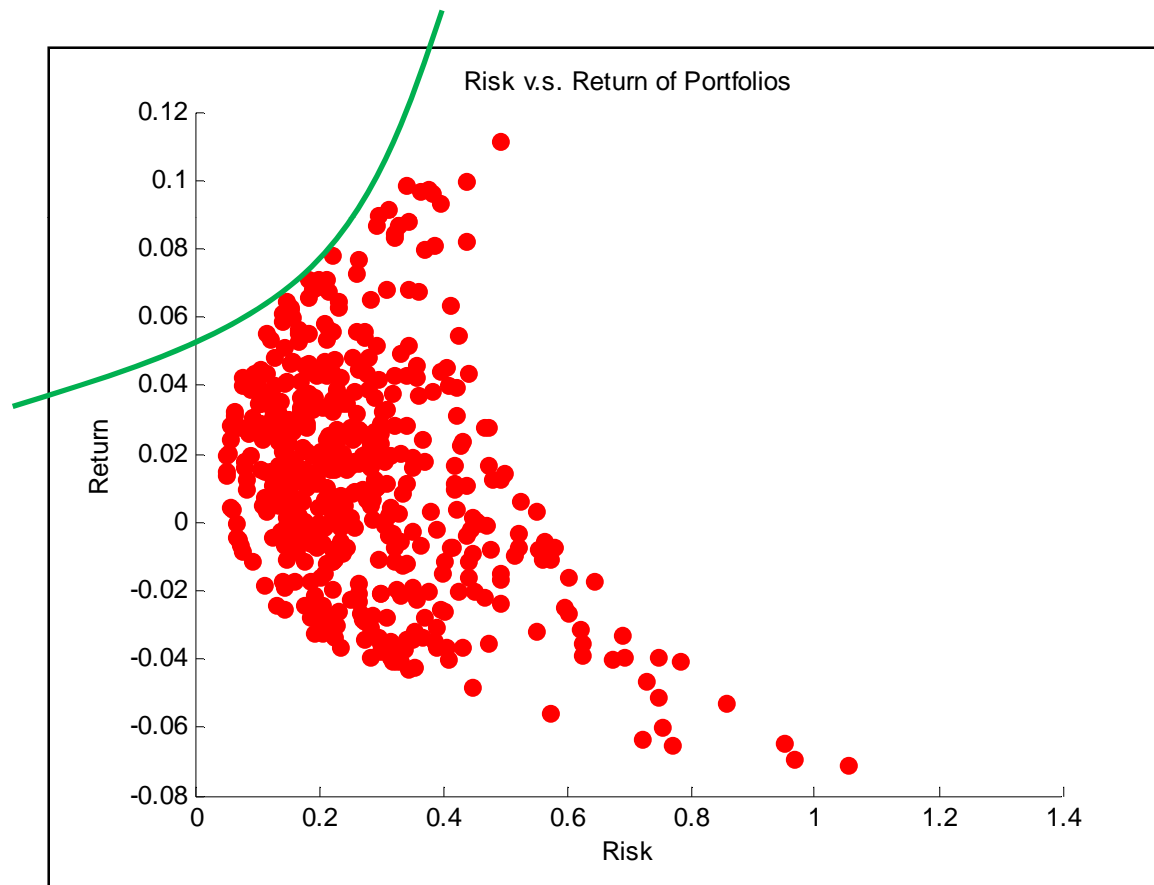
- The expected return of the portfolio is:

$$E(Z) = .5E(X) + .5E(Y) = 6\%$$

- The variance of return of the portfolio is:

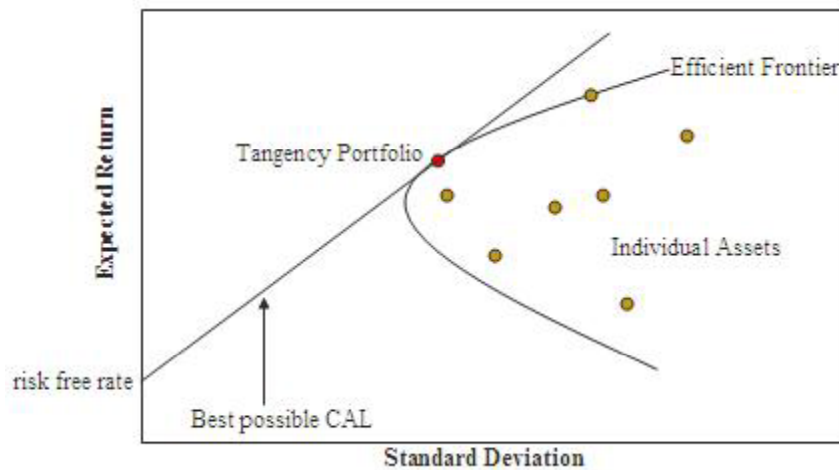
$$\begin{aligned} \text{var}(Z) &= \text{var}(.5X + .5Y) = .5^2 \text{var}(X + Y) = \\ &= .5^2 [\text{var}(X) + \text{var}(Y) + 2\text{cov}(X, Y)] \\ &= .5 [.5\text{var}(X) + .5\text{var}(Y) + \text{cov}(X, Y)] \\ &= .5 [.5\text{var}(X) + .5\text{var}(Y) + \rho\sigma_X\sigma_Y] \\ &= .5 [.5 * .0016 + .5 * .0016 + \rho * .04 * .04] \\ &= .5 [.0016 + \rho * .0016] = .0008[1 + \rho] \end{aligned}$$

Contributions to Economics



Impact

□ Markowitz (Efficiency) Frontier



□ Capital Allocation Line

$$CAL : E(r_C) = r_F + \sigma_C \frac{E(r_P) - r_F}{\sigma_P}$$

Impact



□ Financial Economics

- The allocation of economic resources in an uncertain environment

□ Financial Markets

- Price Determination: How should an asset be priced?

- Portfolio Choice: What portfolio of assets should an investor hold in order to best meet his objectives?

□ Theory

- Computer programs

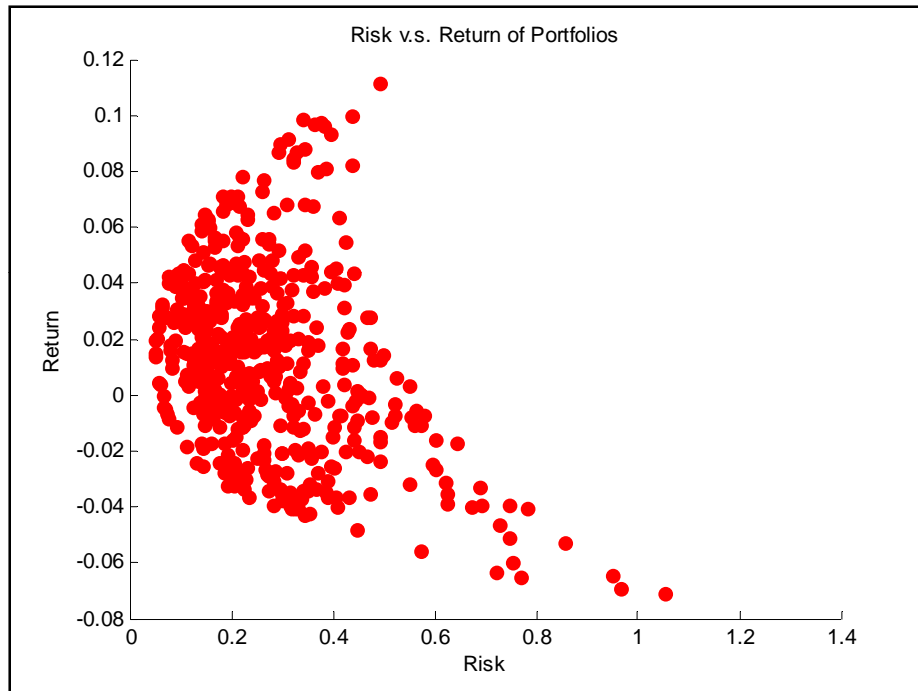
- Used to make decisions about portfolios

Critique



- Difficult to find critique, considering that his ideas are still being used to make major financial decisions.

Questions



- Which portfolios have a positive expected return?
- Which portfolio does Markowitz hold?
- Which portfolios have a negative expected return?
- Which portfolio does Fanny Mae hold?