University of California, Los Angeles
Department of Statistics

Statistics C183/C283 **Instructor: Nicolas Christou**

Introduction

- Harry Markowitz: Father of modern portfolio theory (MPT). His dissertation at the University of Chicago in 1952 "Portfolio Selection" will become the basis for his Nobel Prize in 1990.

- MPT: would have been relevant 1000 years ago and it will be relevant 1000 years from now...
- Diversification: How to manage and reduce risk.
  "Don't put all your eggs in one basket!"
- Portfolio: a group of assets.
- Idea of diversification is not new. For example, in Shakespeare's "Merchant of Venice" written around 1600 for someone that lived around 1400-1500, the merchant Antonio was asked why he was sad. Antonio was asked "is your business not doing so well"? And Antonio replied:

```
My ventures are not in one bottom trusted,
Nor to one place; nor is my whole estate
Upon the fortune of this present year;
Therefore, my merchandise makes me not sad
```

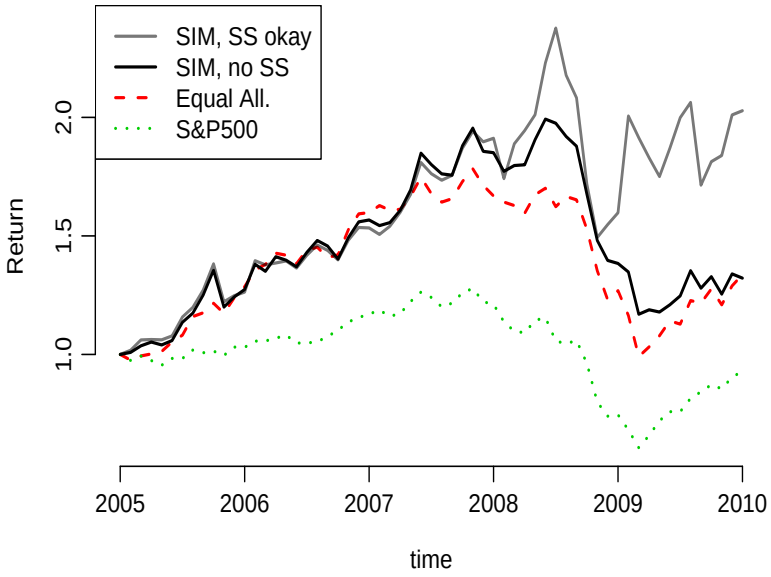
  "Against the Gods - The remarkable story of risk", Peter Bernstein (1998), Wiley.

- Before 1952 the fact that stocks are correlated was not taken into account.
- This course is not about which stocks to select. Not an easy question!
- Given a set of stocks we wish to find the optimum combination of these stocks that will minimize risk.
- It is an optimization problem: It can be solved easily under different conditions and assumptions.
- We will discuss several models:

  1. Classical Markowitz model.
  2. Single index model.
  3. Constant correlation model.
  4. Multi-group model.
  5. Multi-index model.

  Short sales not allowed, short sales allowed, and investors have access to the risk free asset.

- By the end of the 5th week we will be able to test the performance of the various portfolios and compare them with the market:



- The `R` package `stockPortfolio` will be used extensively throughout the course. Please download `R` from `http://cran.stat.ucla.edu/`. Then at the `R` command line type:

```
> install.packages("stockPortfolio")
```

To load the package into `R` type:

```
> library(stockPortfolio)
```

- It helps to be familiar with: Random variables, expected value and variance of a random variable, mean and variance of a sum of random variables, covariance and correlation, simple and multiple regression, differentiation, maximizing or minimizing a function subject to a set of constraints, basic analytic geometry, basic linear algebra, statistical inference (χ^2, t, F) distributions.

- Stock market data will obtained from `http://finance.yahoo.com/` and we will mainly use monthly close prices. The package `stockPortfolio` can get close prices for stocks listed in NYSE and NASDAQ from this website and convert them into returns. The package can also read data supplied by the user.

- Objectives of a portfolio analysis: Depends on the investor. But two objectives are common for all investors:

  1. They want "return" to be high: prefer more than less.
  2. They want this return to be stable, not subject to uncertainty (risk).

  This material is not for investors who prefer uncertainty!

- However, the highest return portfolio is associated with the highest uncertainty (risk) and the lowest uncertainty (risk) is associated with lowest return. Between these two extremes we find "efficient portfolios".