

## ***Independence: Diversification***

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## Portfolio Management

- Goals of Portfolio Management
  - Maximize returns while minimizing risk
  - Remember risk =  $\sigma$
  
- How? Doing Models!!
  - MPT
  - CAPM
  - Treynor etc.



## Portfolio Variance

- In a portfolio with many securities:

$$\sigma_p^2 = \sum_i w_i^2 \sigma_i^2 + \sum_i \sum_j w_i w_j \sigma_i \sigma_j \rho_{ij}$$

- Alternatively, it can be written as

$$\mathbf{wCw}^T$$

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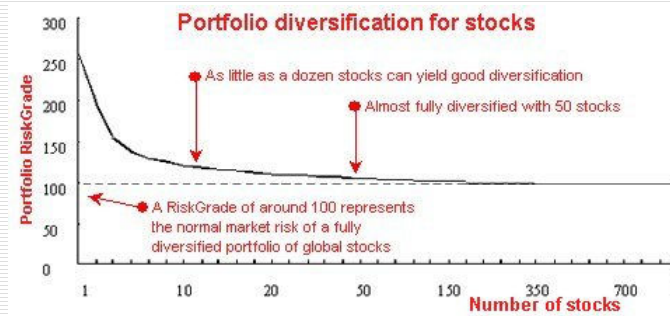
## Diversification: Minimizing Risk

- Kinds of Diversification
  - Vertical: across asset classes
  - Horizontal: within asset classes
- Benefits of Diversification
  - Eliminate Firm Specific Risk
  - Exposure to various asset classes

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## Diversification is King



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## Caveats

- Diversification is biased
  - Funds tend to have large portfolios
  - Fund's operating costs increase
- Hard to gauge manager skill
- $\alpha$  becomes quest for diversification

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## Gorun Capital

- Say Mike starts a fund in April 07
  - Putting his NYU-Quant education to use
  - Invests in all S&P 500stocks
  
- Was this a wise move?
  - Depends.
  - Let's look at his portfolio first

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## Ouch!



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## Fund Evaluation

### Information Ratio

- Excess Return = 0%
- Tracking error....um 0 but let's say =  $\epsilon$

### Except real returns would have been negative



## Another point of view

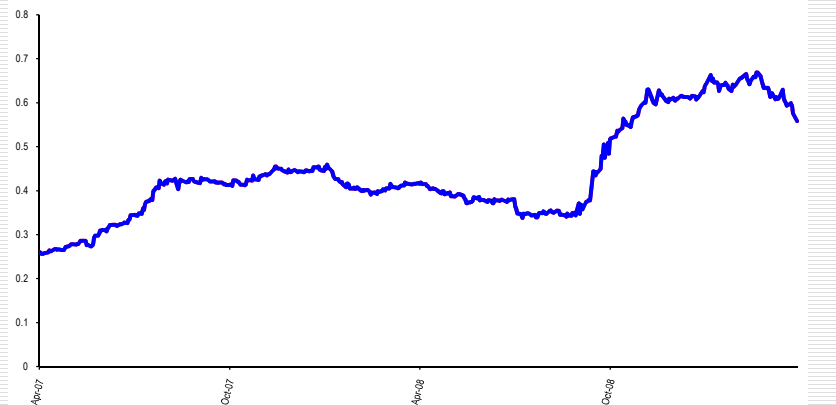
### Total Portfolio Variance

$$\sigma_p^2 = \sum_i w_i^2 \sigma_i^2 + \sum_i \sum_j w_i w_j \sigma_i \sigma_j \rho_{ij}$$

### Or we can look at a proxy, Intra Portfolio Correlation



## Intra Portfolio Correlation (SPX)



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## What now?

- First, look at independence
  - Is it possible for stocks to be independent in this market?
  - Consider IPC...
  
- How to find Independence?
  - If you came to Varun's workshops, w00t
  - If not, fail.

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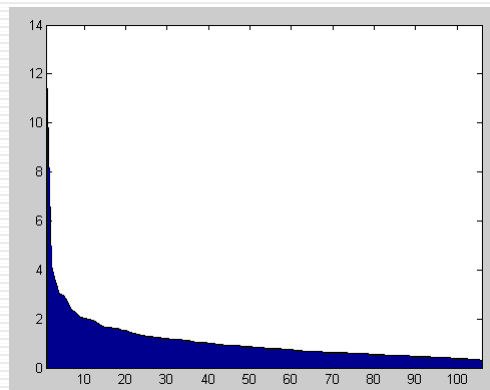
## Singular Value Decomposition

- A measure of independence in a matrix
  - Every column represents stock returns
  
- How to find SVD? We have choices
  - It's a long story.
  - Look at slides from workshop!!
  - $A = \text{svd}(B) \rightarrow \text{Matlab!}$

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## SVD of SPX

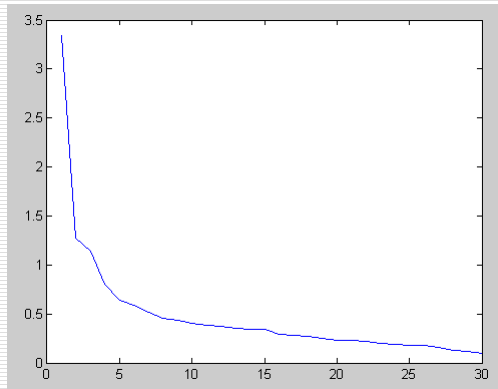


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## SVD of DJIA

- Shows that there are *maybe 10-15* indep.



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## So about independence

- It Depends on your error tolerance
  - Kaiser-Kriterium  $s \geq 1$
- To find actual independent stocks,
  - Multiply  $spx$  with its transpose. Find spots that are  $\epsilon$  close to 0. Tada!
  - Again, depends on your tolerance

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## Final Thoughts

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- After this comes weighting method
  - BUT, independence is more important
  - In a world with correlation,  
independence trumps everything else
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