INTRODUCTION TO PORTFOLIO ANALYSIS

Welcome To The Course

Is Investing Monkey-Business?

Source: Eric Isselee, Getty Images

Who am I?

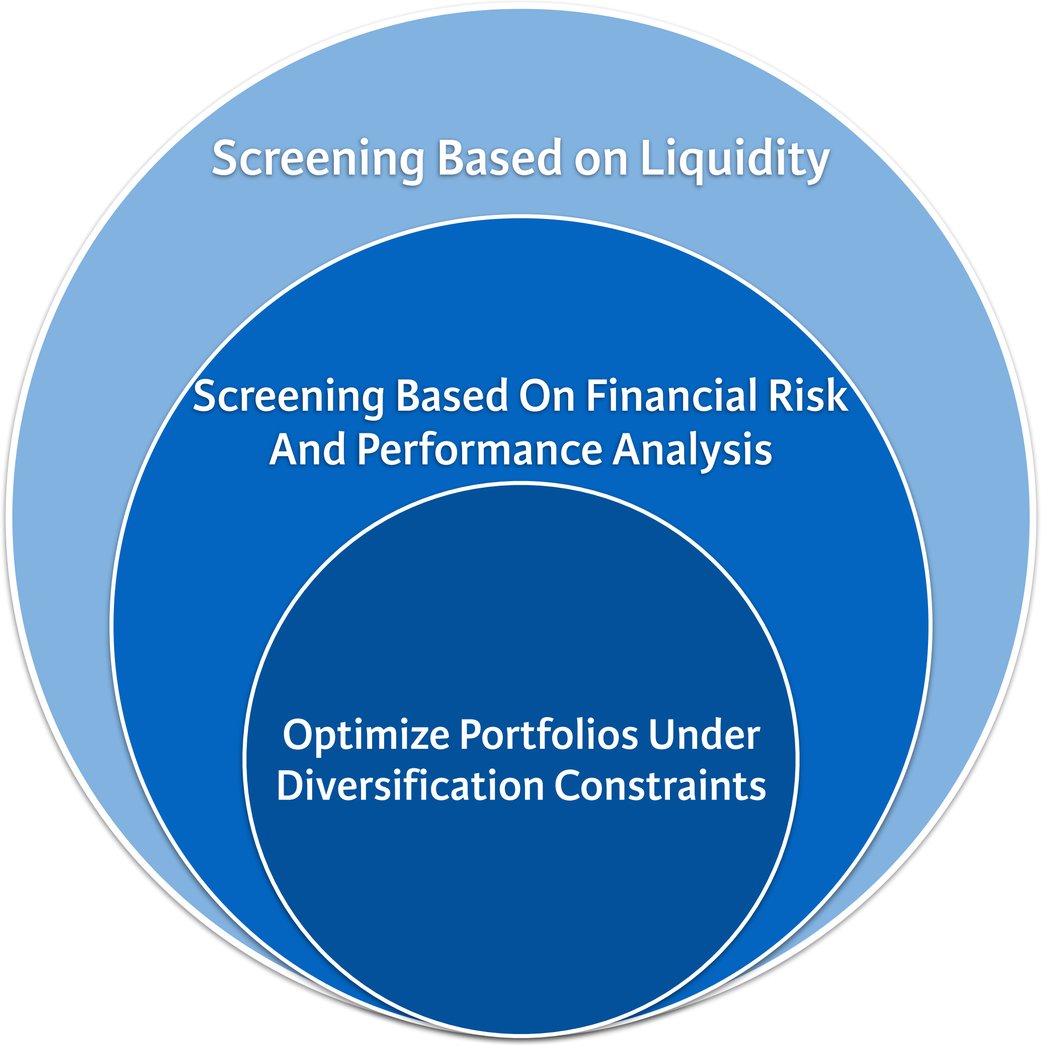
- Professor of Finance

Who am I?

- Advisor to investment companies about risk optimized investment: Winning by losing less.

Source: Finvex

Diversify To Avoid Losses

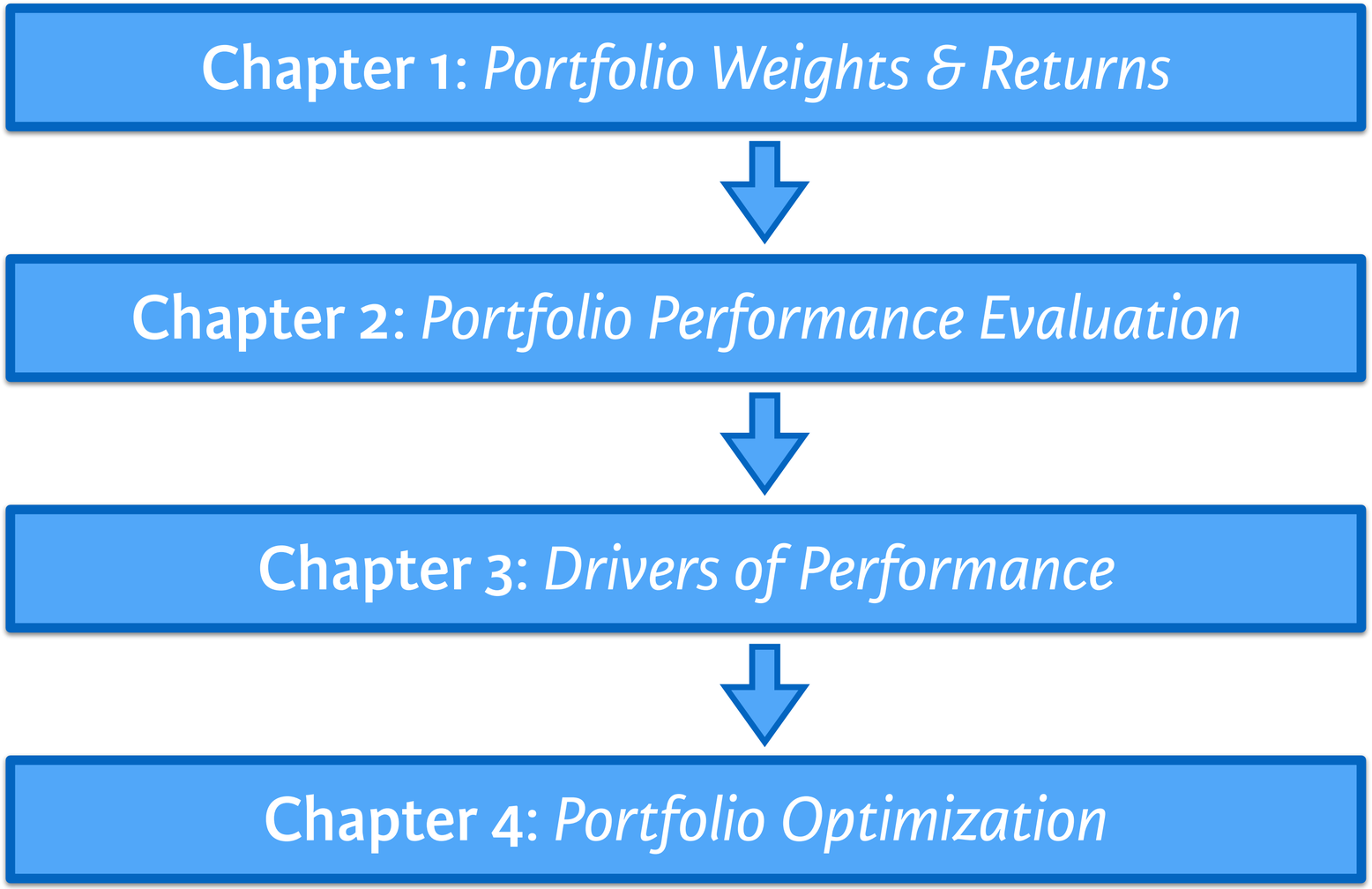


Simple Tricks

Simple Tricks

- To avoid large losses:
  - Carefully select diversified portfolios
  - Use backtesting and online performance monitoring

Course Overview



INTRODUCTION TO PORTFOLIO ANALYSIS

Let’s practice!

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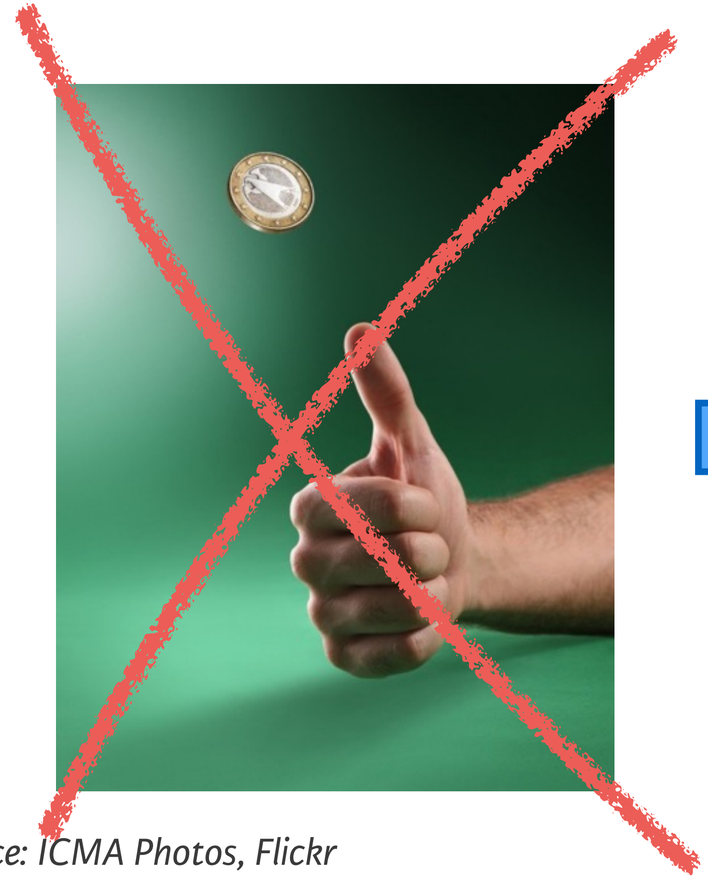
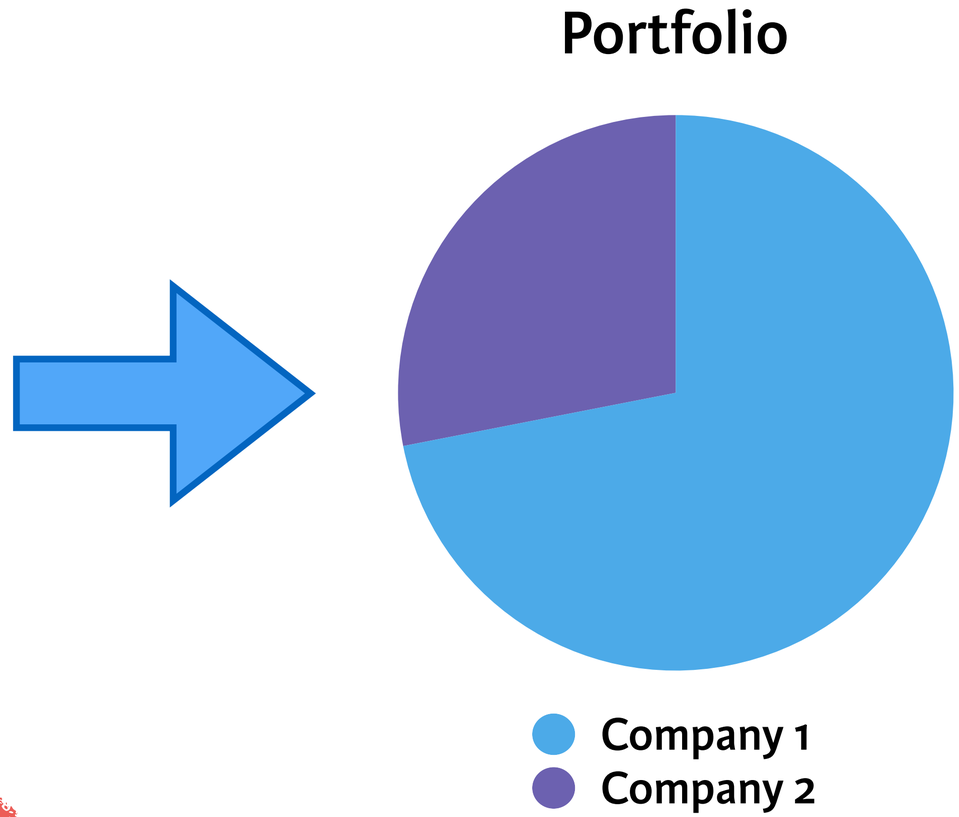
The Portfolio Weights

Investment Decision Choices

- There are two similar companies:
  - Do you invest in either of them based on a coin toss?

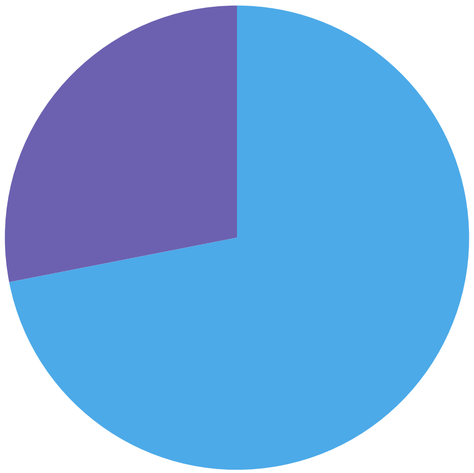


Source: ICMA Photos, Flickr



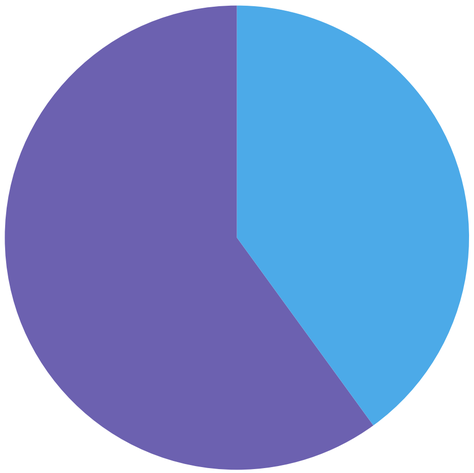
Investment Decision Choices

Portfolio



or

Portfolio



or ... ?

compute portfolio weights

Asset Weighting

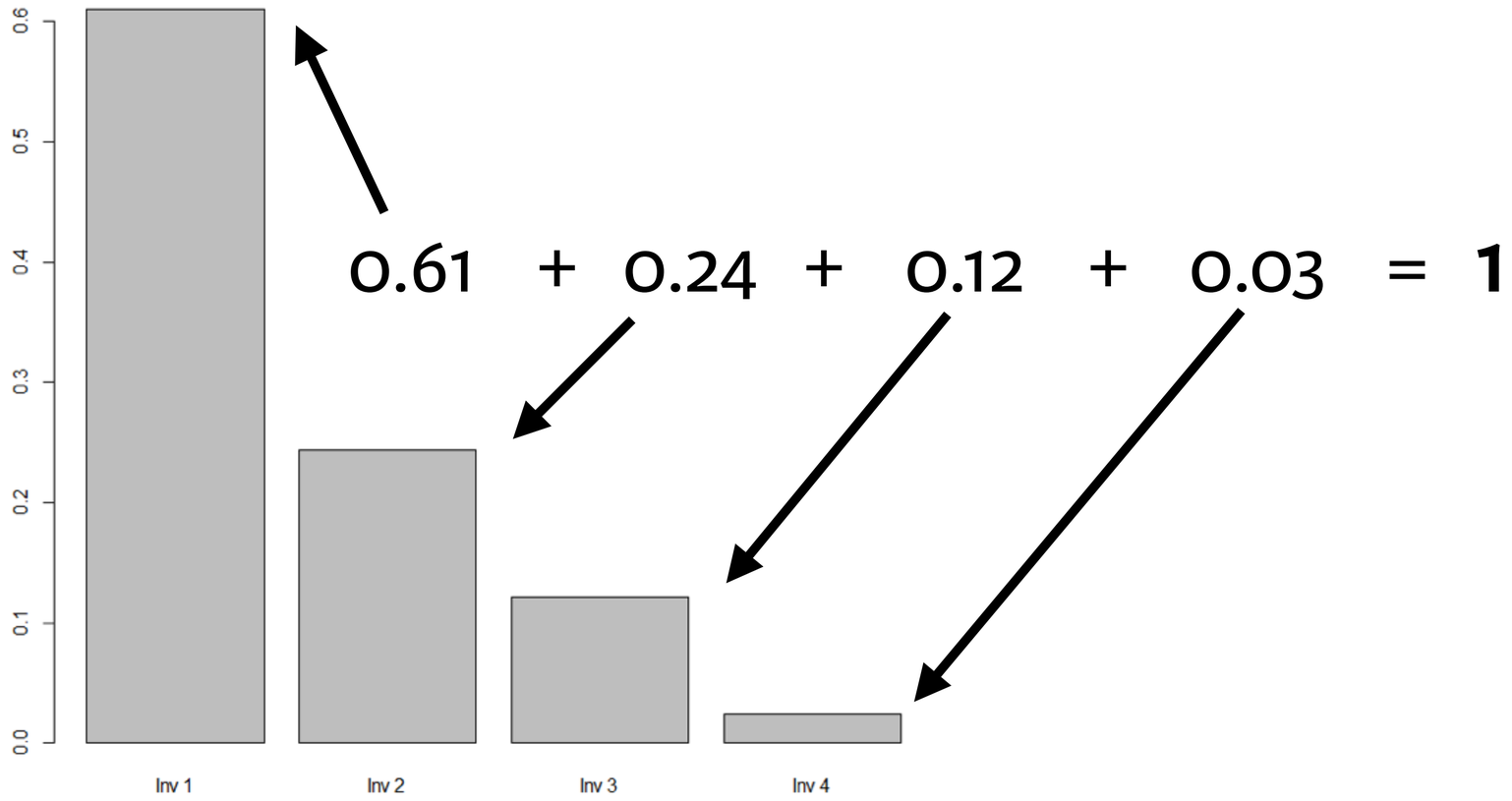
Investment	Value Invested	Weight
1	V_1	$w_1 = \frac{V_1}{V_1 + \ldots + V_N}$
2	V_2	$w_2 = \frac{V_2}{V_1 + \ldots + V_N}$
⋮	⋮	⋮
N	V_N	$w_N = \frac{V_N}{V_1 + \ldots + V_N}$

Calculating Weight

```
values <- c(500000, 200000, 100000, 20000)
names(values) <- c("Inv 1", "Inv 2", "Inv 3", "Inv 4")
weights <- values/sum(values)

barplot(weights)
```

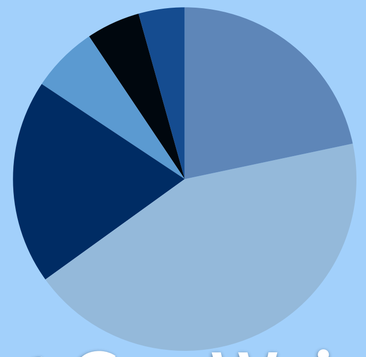
Calculating Weight



Allocation Strategies

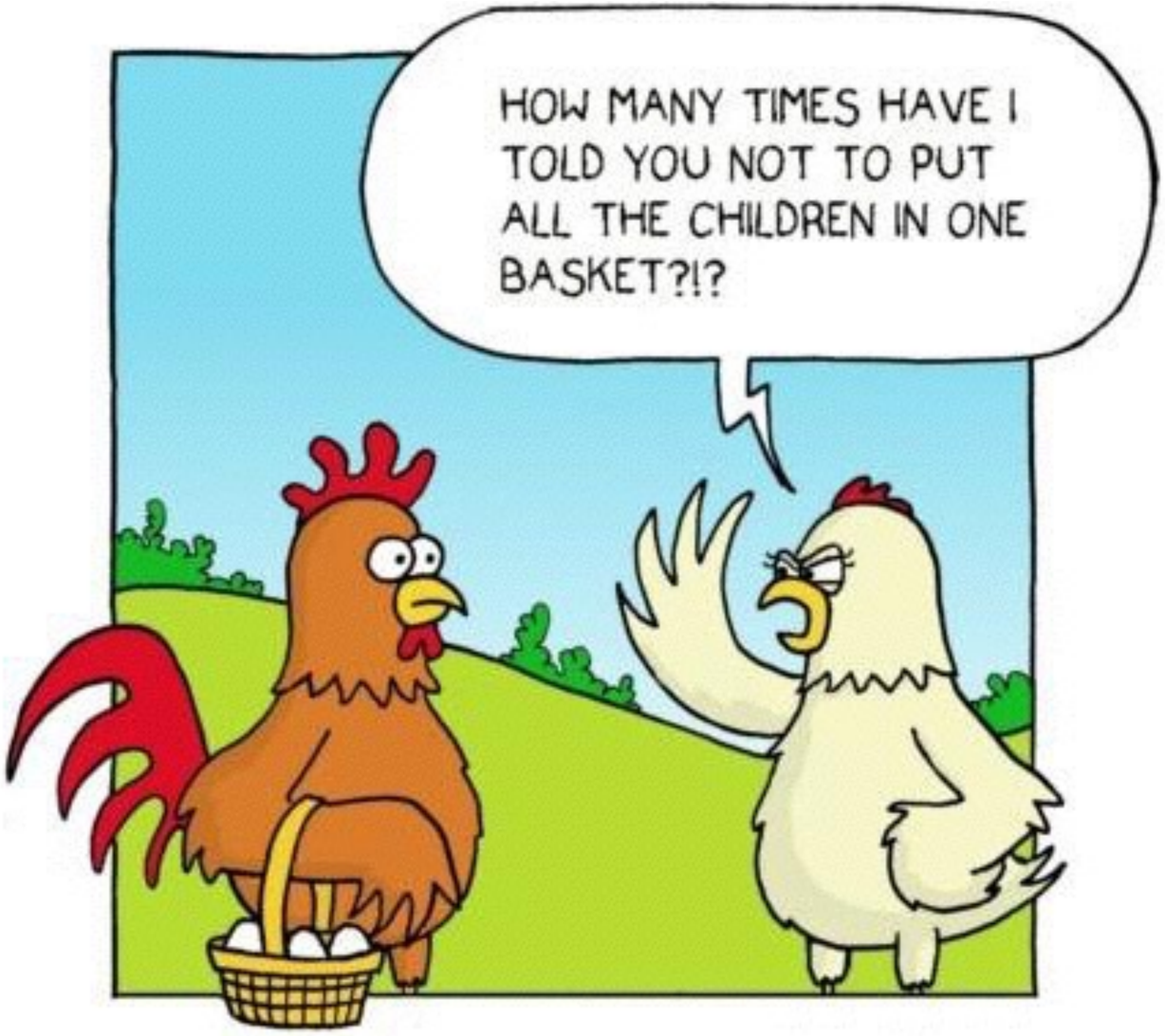
Betting On 1 Asset

Equal Weighting



Market Cap Weighting

Optimize
Mean & Variance
(Ch. 4)



Source: http://www.falibo.com/vocabulary/idiom-dont-put-all-your-eggs-in-one/

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The Portfolio Return

Portfolio Returns: Relative Value

- Weights reveal active investment bets
- Returns are the relative changes in value:

$$\frac{final\ value\ -\ initial\ value}{initial\ value}$$

Initial Value	100
Final Value	120

$$\frac{120 - 100}{100} = 20\%$$

Three Steps

Asset $_1$	...	Asset$_N$
InValue.Asset$_1$	...	InValue.Asset$_N$
FinValue.Asset$_1$	...	FinValue.Asset$_N$

InValue.Portfolio = InValue.Asset$_1$ + ... + InValue.Asset$_N$
FinValue.Portfolio = FinValue.Asset$_1$ + ... + FinValue.Asset$_N$

$$Portfolio\ Return = \frac{FinValue.Portfolio - InValue.Portfolio}{InValue.Portfolio}$$

Example: Two Assets

$Asset_1$	$Asset_2$
$InValue.Asset_1 = \$200$	$InValue.Asset_2 = \$300$
$FinValue.Asset_1 = \$180$	$FinValue.Asset_2 = \$330$

InValue.Portfolio = $200 + $300 = $500
FinValue.Portfolio = $180 + $330 = $510

$$Portfolio\ Return = \frac{FinValue.Portfolio - InValue.Portfolio}{InValue.Portfolio} = \frac{510-500}{500} = 2\%$$

Portfolio Returns: Weighted Average Return

$$Portfolio\ Return = w_1 R_1 + w_2 R_2 + ... + w_n R_n$$

Where:

$$w_i = \frac{InValue.Asset_i}{\sum_{j=1}^{N} InValue.Asset_j}$$

$$R_i = \frac{FinValue.Asset_i - InValue.Asset_i}{InValue.Asset_i}$$

Three Steps

Asset $_1$	...	Asset$_N$
InValue.Asset$_1$	...	InValue.Asset$_N$
FinValue.Asset$_1$	...	FinValue.Asset$_N$

Asset $_1$	Asset$_N$
$w_1 = \frac{InValue.Asset_1}{InValue.Portfolio}$	$w_n = \frac{InValue.Asset_n}{InValue.Portfolio}$
$R_1 = \frac{FinValue.Asset_1 - InValue.Asset_1}{InValue.Asset_1}$	$R_n = \frac{FinValue.Asset_n - InValue.Asset_n}{InValue.Asset_n}$

$$Portfolio\ Return = w_1R_1 + w_2R_2 + \ldots + w_nR_n$$

Example: Two Assets

Asset $_1$	Asset$_2$
InValue.Asset$_1$ = $200	InValue.Asset$_2$ = $300
FinValue.Asset$_1$ = $180	FinValue.Asset$_2$ = $300

Asset $_1$	Asset$_2$
$w_1 = \frac{200}{500} = 40\%$	$w_2 = \frac{300}{500} = 60\%$
$R_1 = \frac{180 - 200}{200} = -10\%$	$R_2 = \frac{330 - 300}{300} = 10\%$

$$Portfolio\ Return = 0.4^*(-10\%) + 0.6^*(10\%) = 2\%$$

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PerformanceAnalytics

The Practitioner's Challenge

- In practice, time series of portfolio returns
- Longer history ⟶ more info on portfolio
- Good package = **PerformanceAnalytics**

The Creators

- PerformanceAnalytics is the go-to package for portfolio return analysis in R

Peter Carl

Brian Peterson

Calculating Returns

Calculating Returns

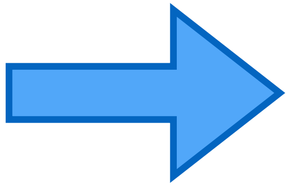
- **Return.calculate**: to compute the asset returns
- **Return.portfolio**: to compute the portfolio return
- Return.calculate(prices)

xts-object

- Dates structure: **YYYY-MM-DD**

Calculating Returns

Return.calculate



In: Prices

Out: Returns

```
> returns <- Return.calculate(prices)
> returns <- returns[(-1),]
```

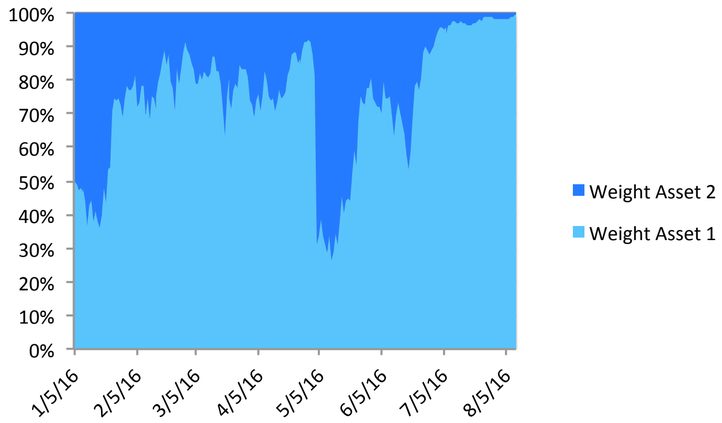
```
> head(prices)
>                 AAPL    MSFT
> 2006-01-03 9.829465  21.07395
> 2006-01-04 9.858394  21.17603
> 2006-01-05 9.780810  21.19173
> 2006-01-06 10.033286 21.12891
> 2006-01-09 10.000411 21.08966
> 2006-01-10 10.632916 21.19958
```

```
> head(returns)
>                   AAPL          MSFT
> 2006-01-03          NA            NA
> 2006-01-04  0.002943090  0.0048434670
> 2006-01-05 -0.007869842  0.0007415934
> 2006-01-06  0.025813404 -0.0029640809
> 2006-01-09 -0.003276594 -0.0018579752
> 2006-01-10  0.063247901  0.0052121756
```

Dynamics of Portfolio Weights

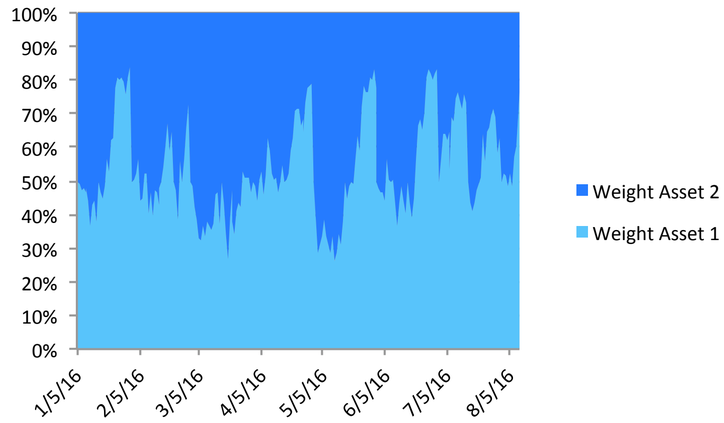
Set Initial Weights & Do Not Intervene

Example: Initial 50/50 weight



Actively Change Portfolio Weights

Example: 50/50 Weight With Rebalance



Portfolio Returns

```
> Return.portfolio <- function(R, weights = NULL,
        rebalance_on = c(NA, “years”, “quarters”, “months”, “weeks”, “days”))
```

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