



INTRODUCTION TO PORTFOLIO ANALYSIS

Welcome To The Course

Is Investing Monkey-Business?



Who am I?

- Professor of Finance

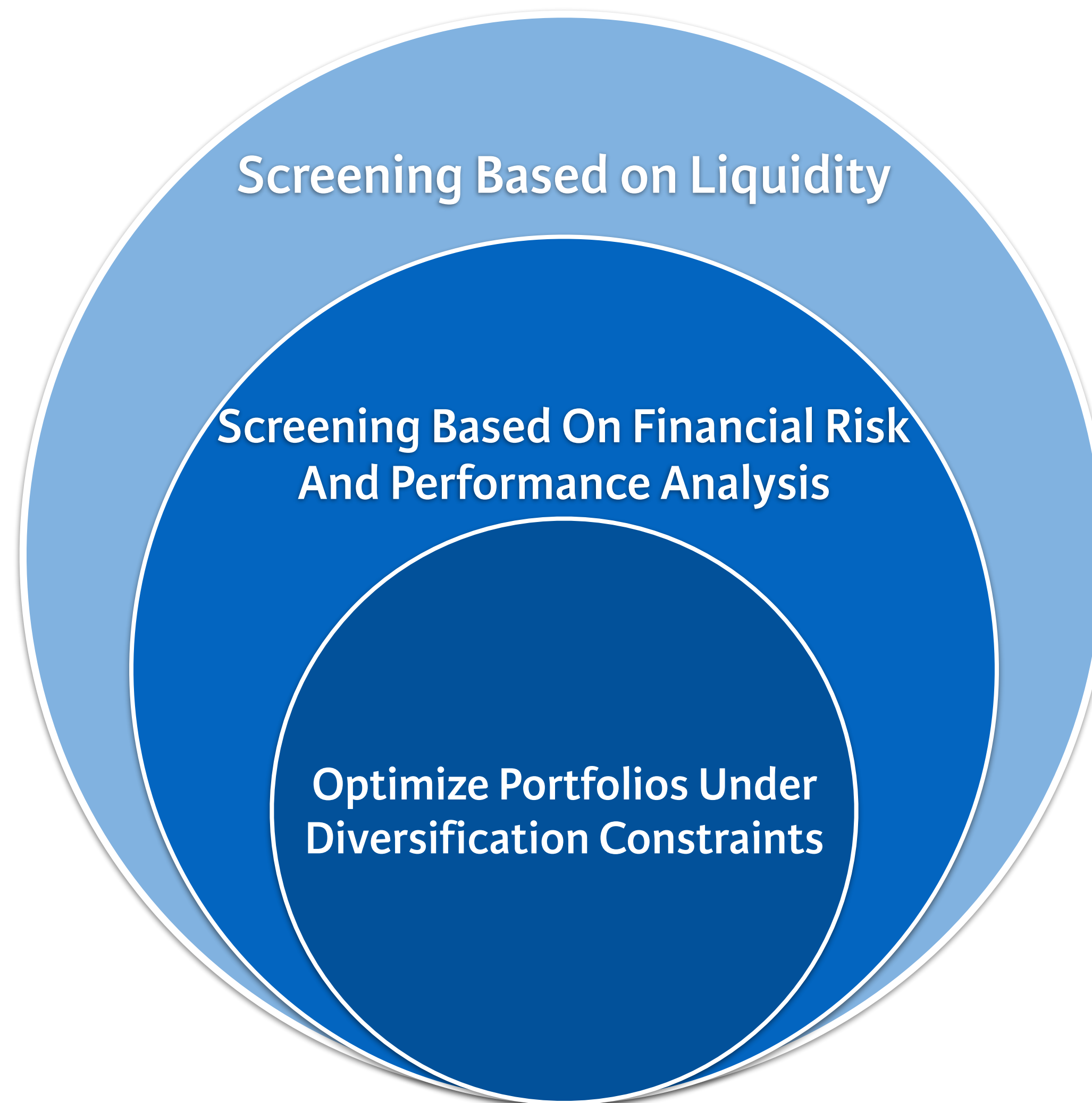


Who am I?

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



Diversify To Avoid Losses

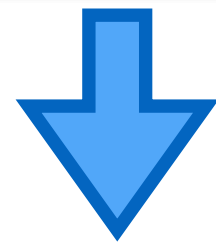


Simple Tricks

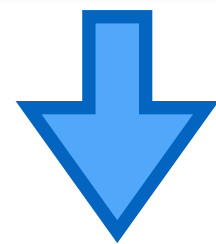
- To avoid large losses:
 - Carefully select diversified portfolios
 - Use backtesting and online performance monitoring

Course Overview

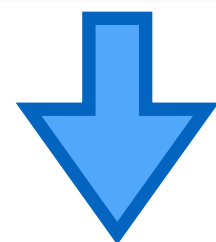
Chapter 1: *Portfolio Weights & Returns*



Chapter 2: *Portfolio Performance Evaluation*



Chapter 3: *Drivers of Performance*



Chapter 4: *Portfolio Optimization*



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Let's practice!

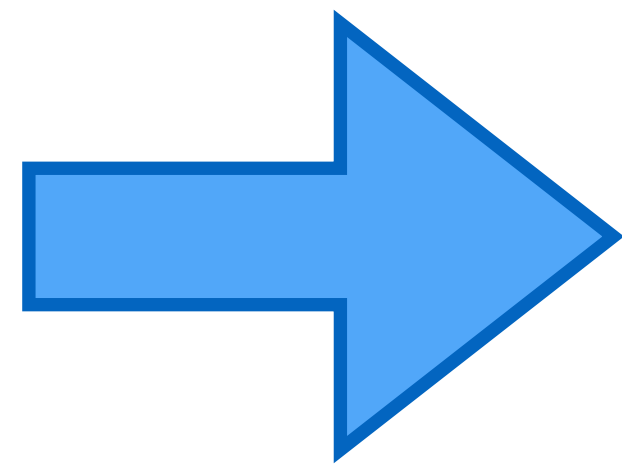
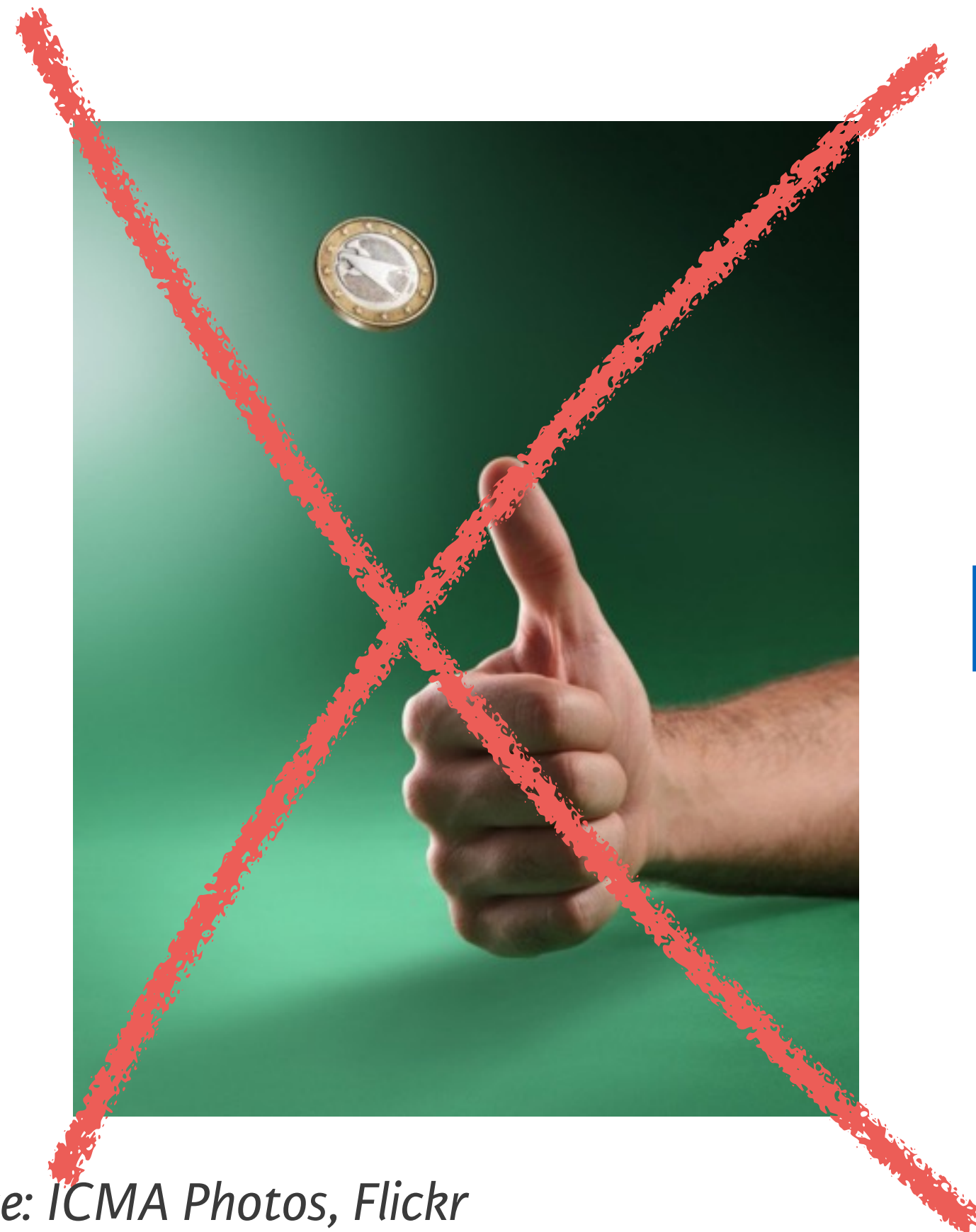


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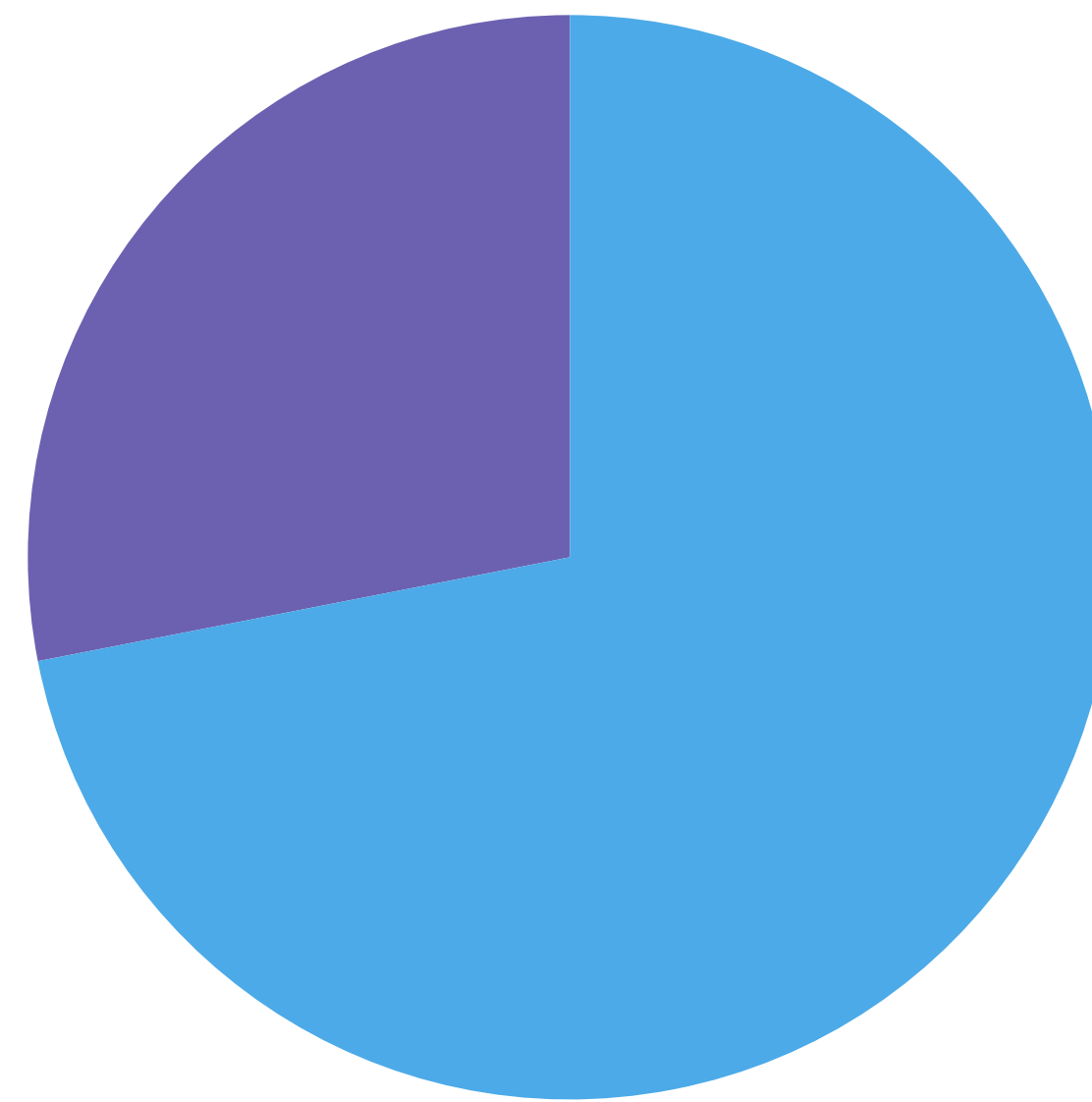
The Portfolio Weights

Investment Decision Choices

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



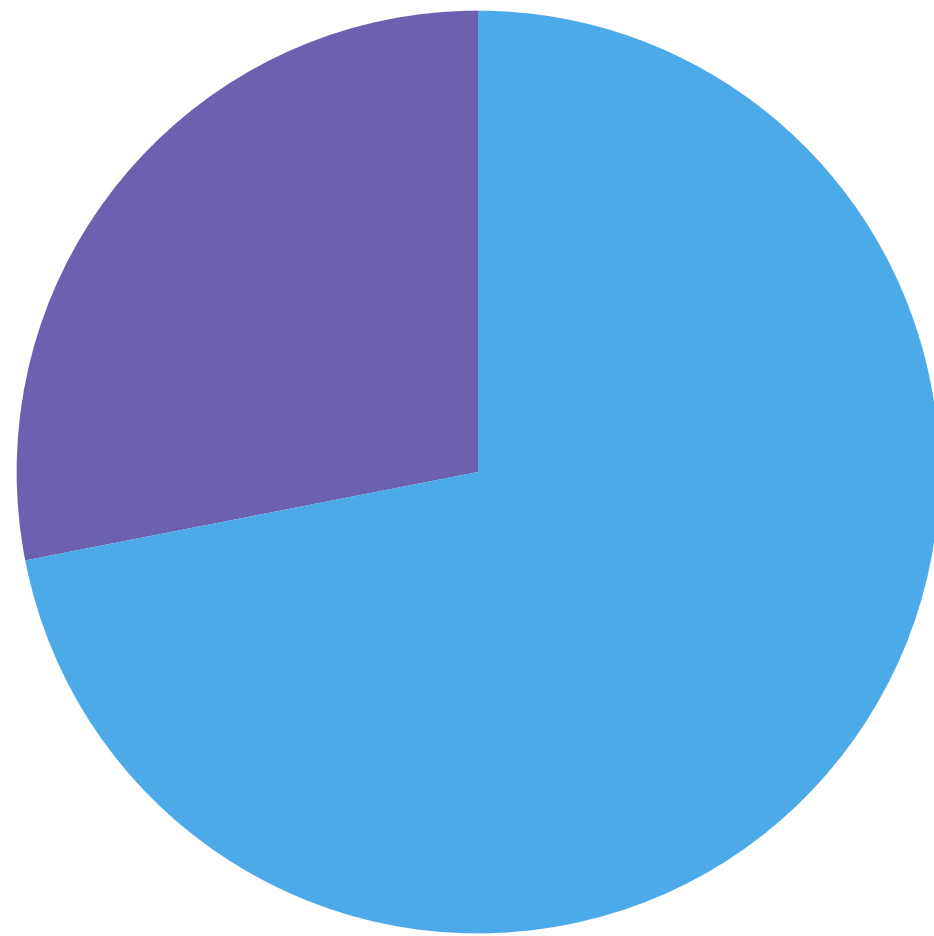
Portfolio



- Company 1
- Company 2

Investment Decision Choices

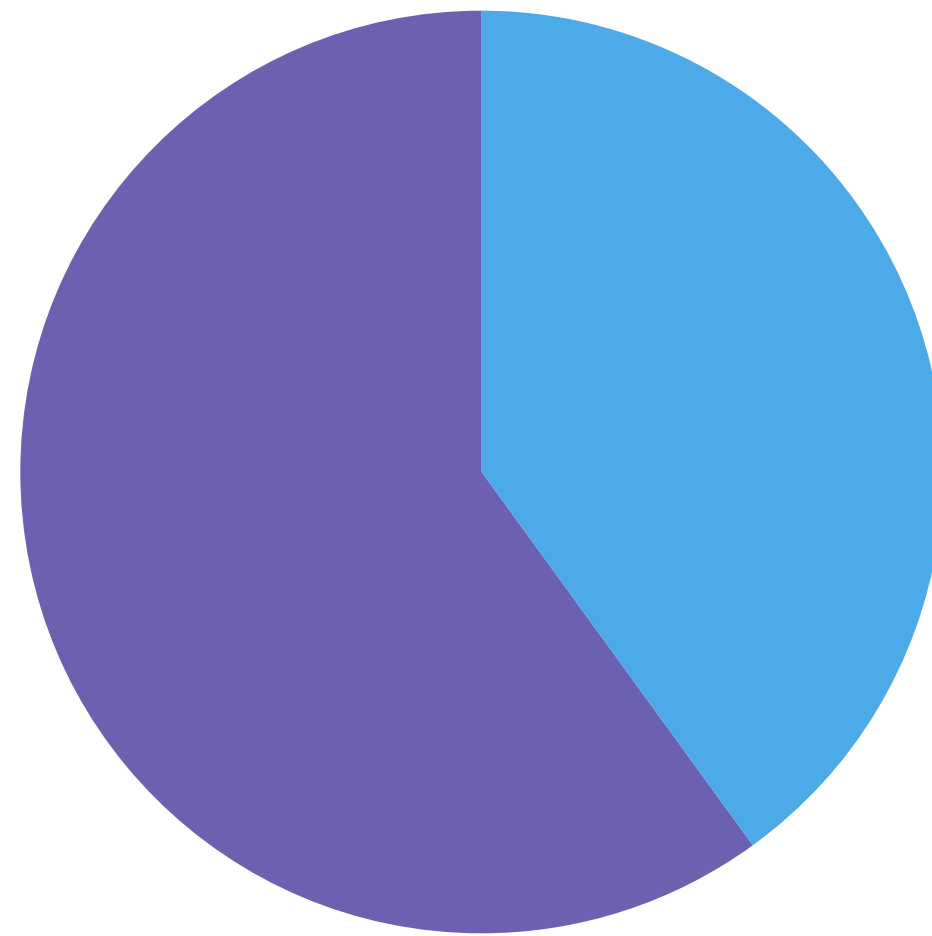
Portfolio



● Company 1
● Company 2

or

Portfolio



● Company 1
● Company 2

or ... ?

compute portfolio weights

Asset Weighting

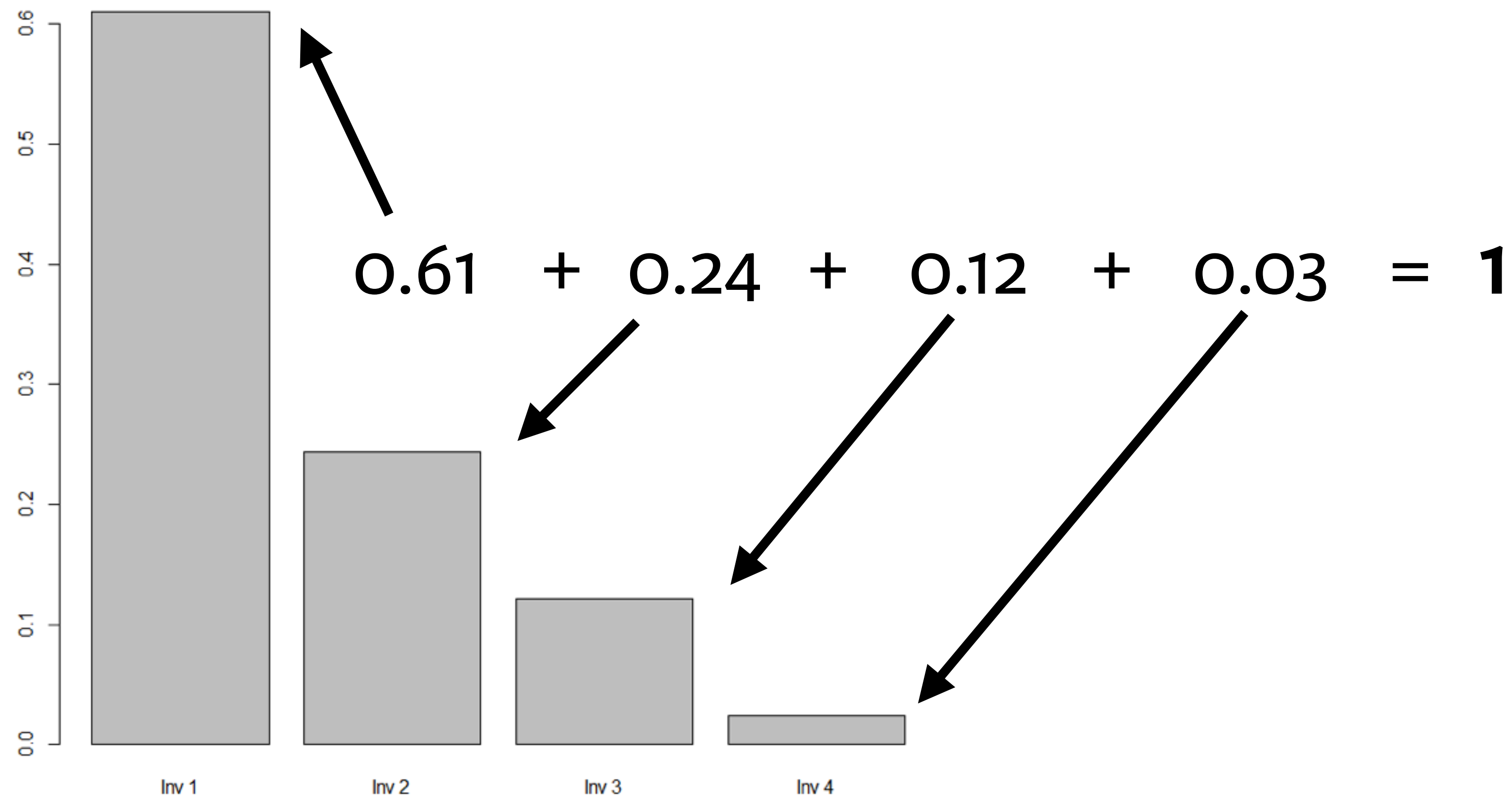
Investment	Value Invested	Weight
1	V_1	$w_1 = \frac{V_1}{V_1 + \dots + V_N}$
2	V_2	$w_2 = \frac{V_2}{V_1 + \dots + V_N}$
⋮	⋮	⋮
N	V_N	$w_N = \frac{V_N}{V_1 + \dots + V_N}$

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



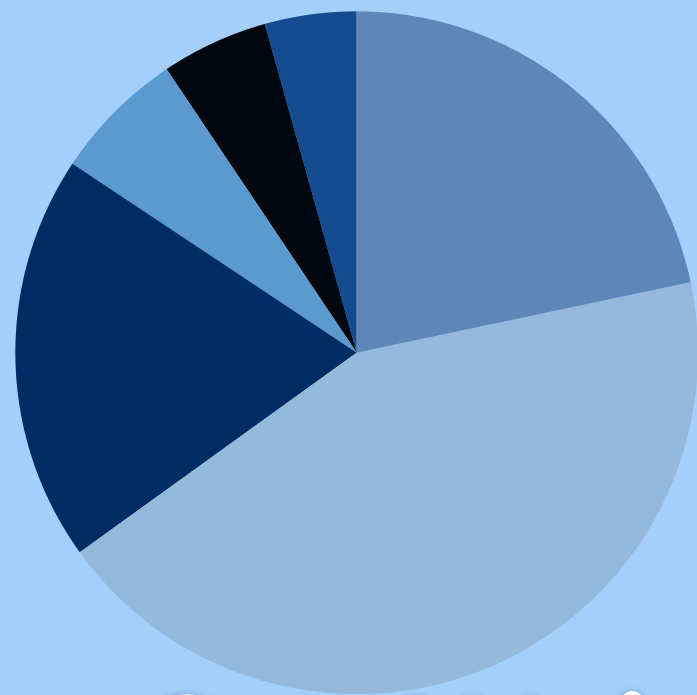
Allocation Strategies



Betting On 1 Asset



Equal Weighting



Market Cap Weighting

Optimize
Mean & Variance
(Ch. 4)





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Let's practice!



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The Portfolio Return

Portfolio Returns: Relative Value

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

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

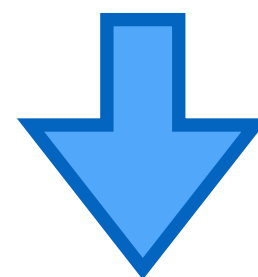
Initial Value	100
Final Value	120



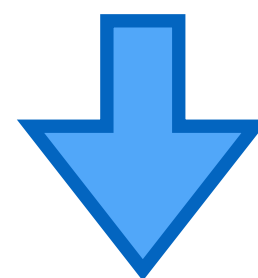
$$\frac{120 - 100}{100} = 20\%$$

Three Steps

Asset ₁	...	Asset _N
InValue.Asset ₁	...	InValue.Asset _N
FinValue.Asset ₁	...	FinValue.Asset _N



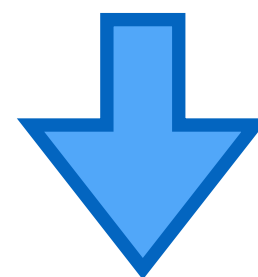
$\text{InValue.Portfolio} = \text{InValue.Asset}_1 + \dots + \text{InValue.Asset}_N$
$\text{FinValue.Portfolio} = \text{FinValue.Asset}_1 + \dots + \text{FinValue.Asset}_N$



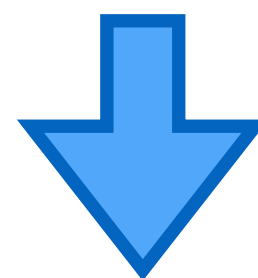
$$\text{Portfolio Return} = \frac{\text{FinValue.Portfolio} - \text{InValue.Portfolio}}{\text{InValue.Portfolio}}$$

Example: Two Assets

Asset ₁	Asset ₂
InValue.Asset ₁ = \$200	InValue.Asset ₂ = \$300
FinValue.Asset ₁ = \$180	InValue.Asset ₂ = \$330



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



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

Portfolio Returns: Weighted Average Return

$$\text{Portfolio Return} = w_1 R_1 + w_2 R_2 + \dots + w_n R_n$$

Where:

$$w_i = \frac{\text{InValue.Asset}_i}{\sum_{j=1}^N \text{InValue.Asset}_j}$$

$$R_i = \frac{\text{FinValue.Asset}_i - \text{InValue.Asset}_i}{\text{InValue.Asset}_i}$$

Three Steps

Asset ₁	...	Asset _N
InValue.Asset ₁	...	InValue.Asset _N
FinValue.Asset ₁	...	FinValue.Asset _N



Asset ₁	Asset _N
$w_1 = \frac{InValue.Asset_1}{InValue.Portfolio}$	$w_n = \frac{InValue.Asset_n}{InValue.Portfolio}$
$R_1 = \frac{FinValue.Asset_1 - InValue.Asset_1}{InValue.Asset_1}$	$R_n = \frac{FinValue.Asset_n - InValue.Asset_n}{InValue.Asset_n}$



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

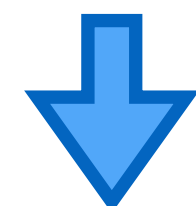
Example: Two Assets

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



$$\text{Portfolio Return} = 0.4 * (-10\%) + 0.6 * (10\%) = 2\%$$



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Let's practice!



INTRODUCTION TO PORTFOLIO ANALYSIS

The PerformanceAnalytics Package

The Practitioner's Challenge

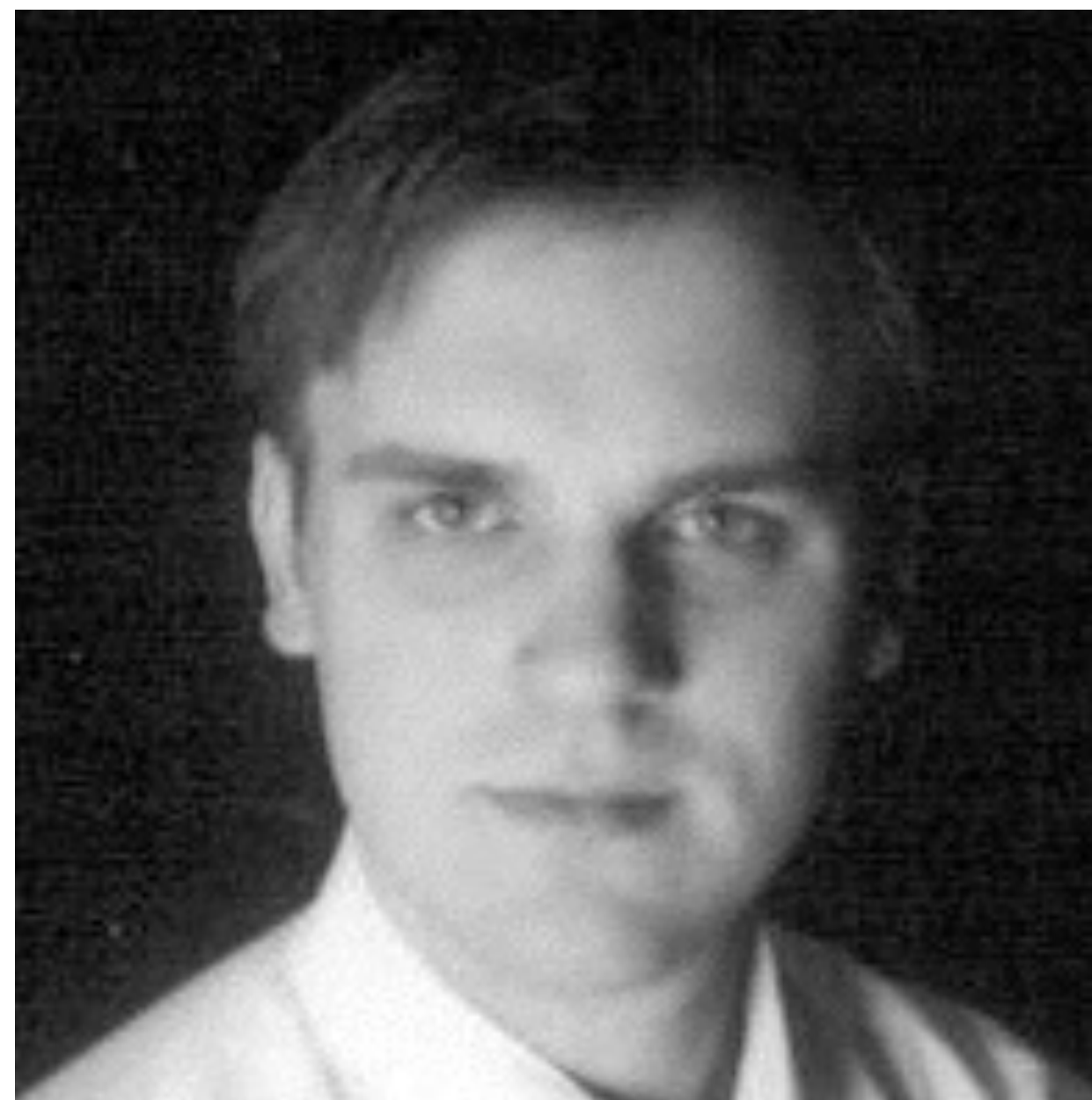
- In practice, time series of portfolio returns
- Longer history \longrightarrow more info on portfolio
- Good package = **PerformanceAnalytics**

The Creators

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

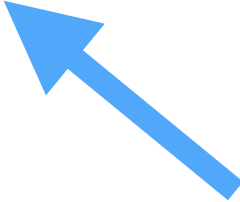


Peter Carl



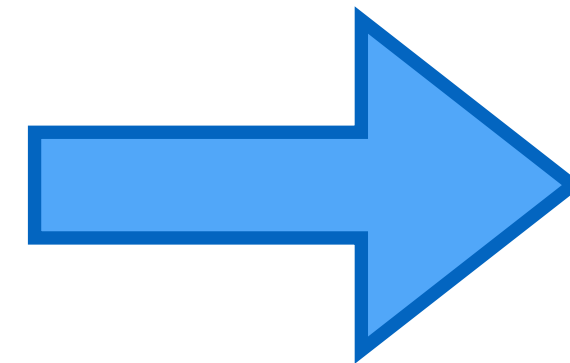
Brian Peterson

Calculating Returns

- **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),]
```

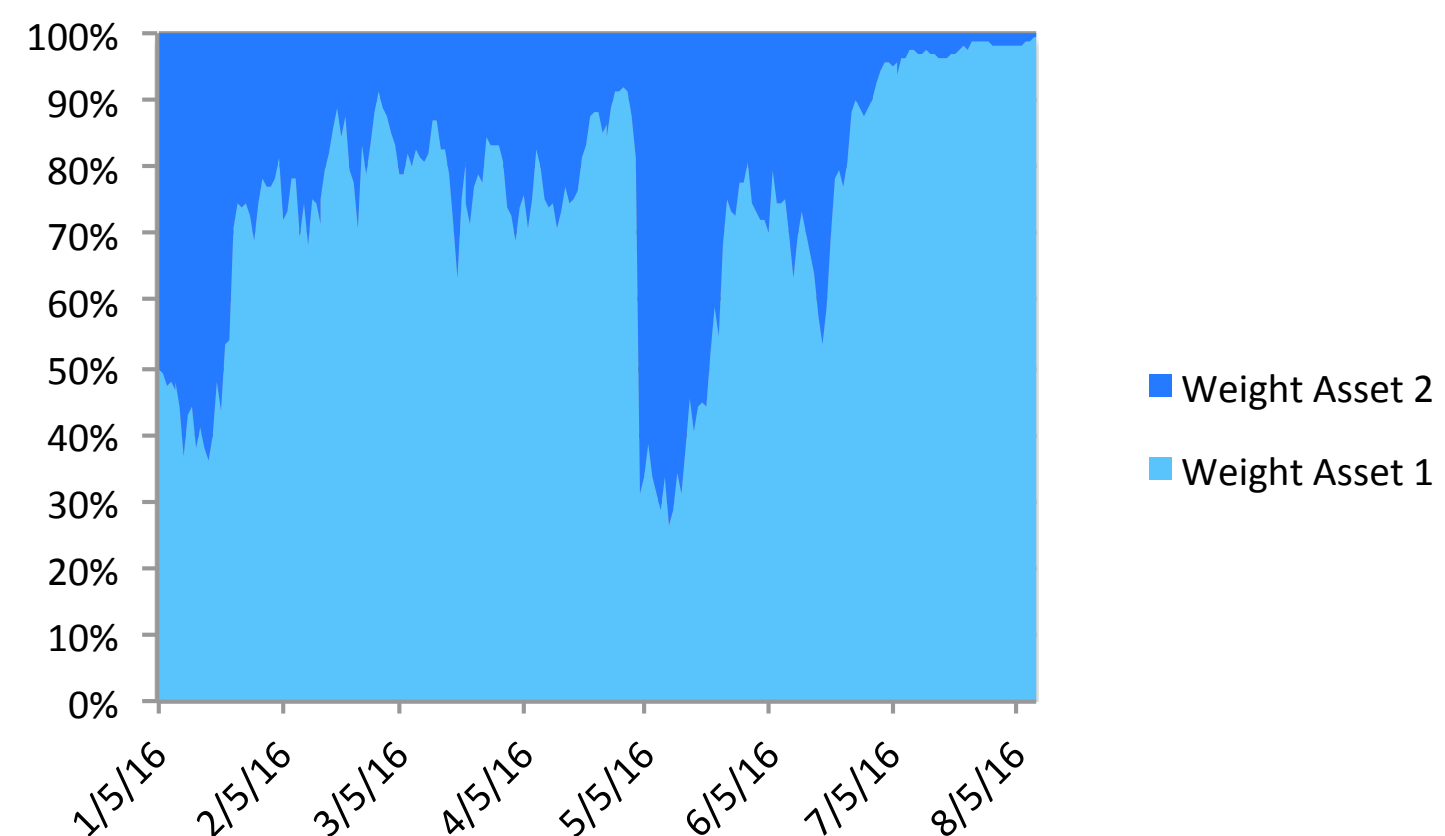
```
> head(prices)
>
> 2006-01-03  9.829465  21.07395
> 2006-01-04  9.858394  21.17603
> 2006-01-05  9.780810  21.19173
> 2006-01-06 10.033286  21.12891
> 2006-01-09 10.000411  21.08966
> 2006-01-10 10.632916  21.19958
```

```
> head(returns)
>
> 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

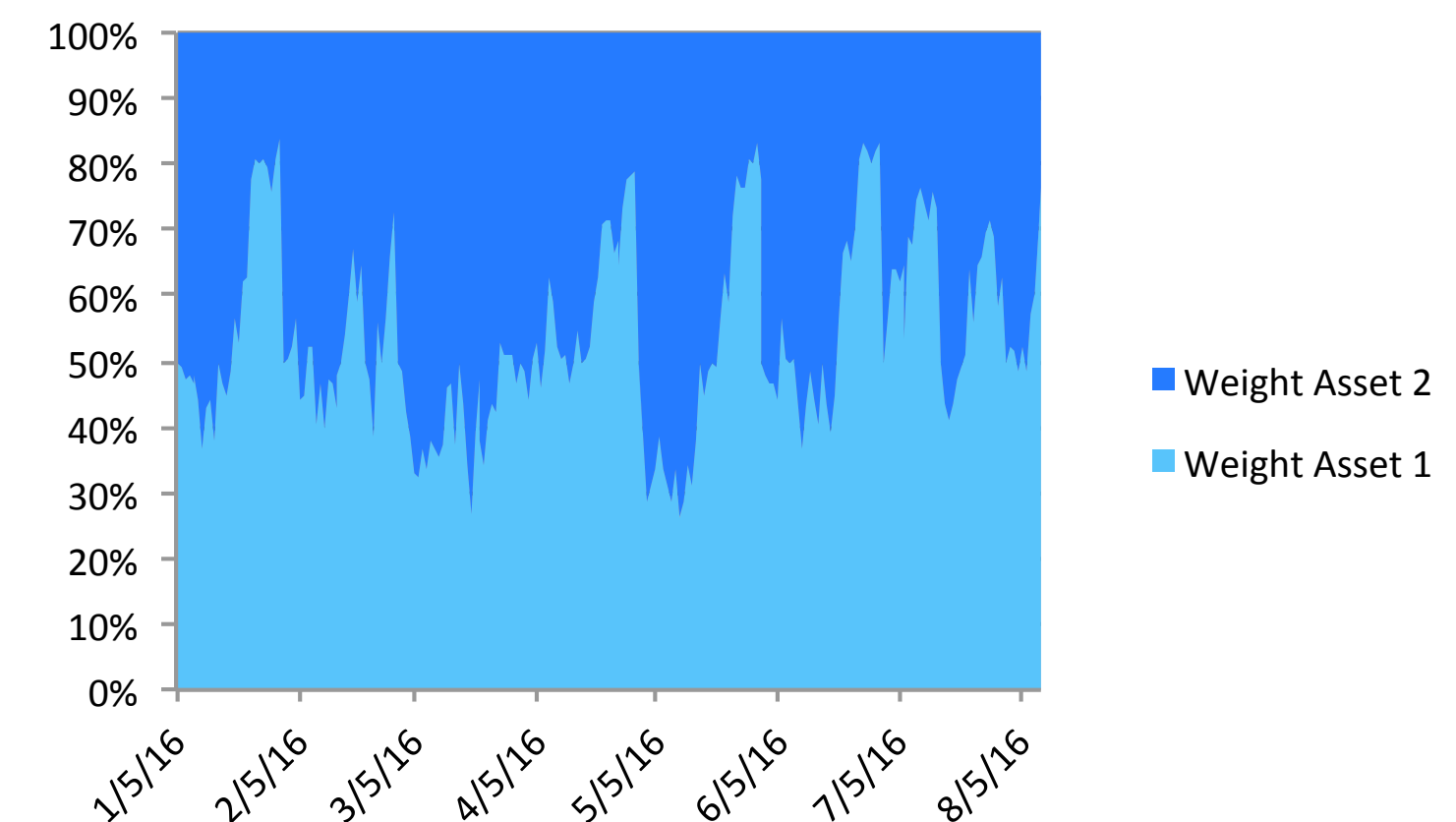
Set Initial Weights & Do Not Intervene

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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