Asset Management 2024 - Pomante

lunedì 4 novembre 2024 13:21

- Me
- Website/Materials
- Exams: you have to follow all the lessons (live o via recordings)
  - Doc: Written
  - Oral
- Lesson: from 2pm to 3:50pm
- Tutor: Stefania Hosszu

Macro-Agenda:

1) Introduction to portfolio construction
2) Financial Markets Analysis
3) Strategic Asset Allocation
4) Tactical Asset Allocation
5) Product Selection

---

1) Introduction to Portfolio Construction

A portfolio is the output of a well organised process where you have to performe many stages.

Ex-ante stage: Client Profiling
- → Risk Tolerance
- → Holding Period

HP/Risk Tol	low	medium	medium-high	high
1 yr				
3 yrs				
5 yrs				
10 yrs				
+10 yrs				

Portfolio Construction: 20 investment solutions

1) Strategic Asset Allocation (**SAA**)

A combination of asset classes (fin. markets) that is expected to be maintained, on average, in the long run.

Examples:

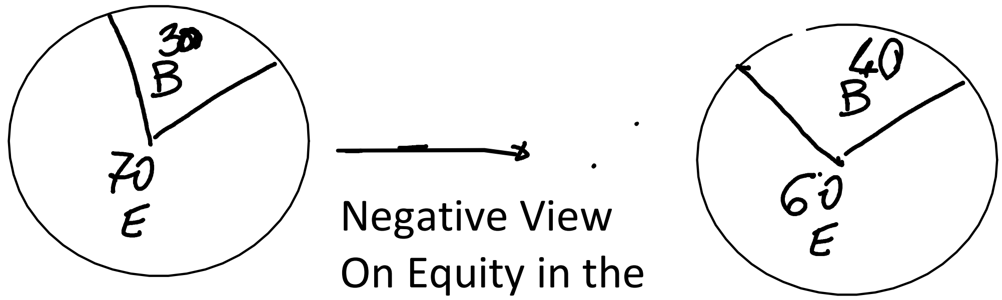
https://www.nbim.no/
https://quantalys.it/ → 20 SAA

Strategic Committee: create SAAs

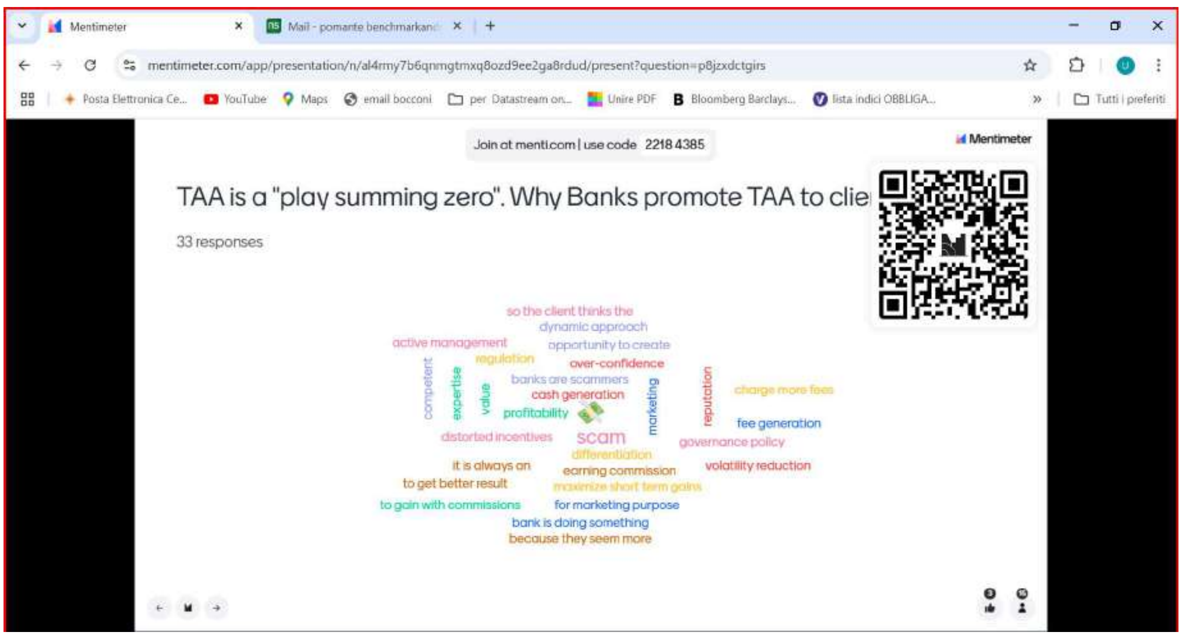
- Forecasts / Views Strategic (Analists)
- Optimization Model

2) Tactical Asset Allocation (TAA) - Market Timing

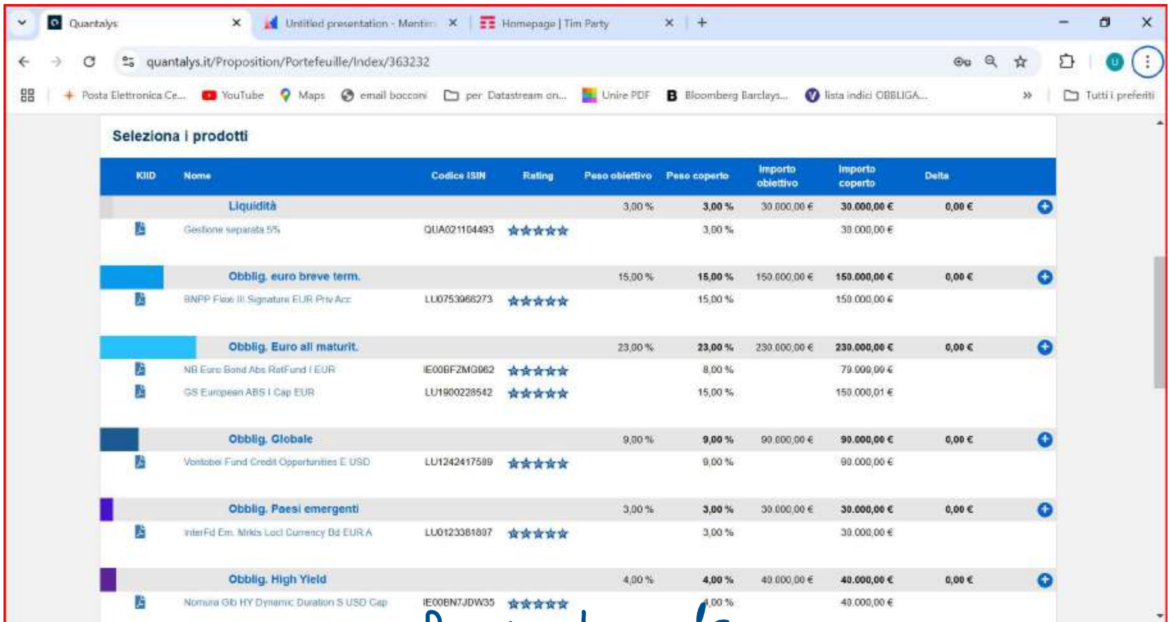
Short-run change of the Strategy where you overweight asset classes with a + View and underweight tactically asset classes with a - View.



Negative View
On Equity in the
Next Quarter



3) Product Selection: you have to select product in order to "give life" to the portfolio. In order to invest in every single asset class



Seleziona i prodotti

KIID	Nome	Codice ISIN	Rating	Peso obiettivo	Peso coperto	Importo obiettivo	Importo coperto	Delta
	Liquidità			3,00 %	**3,00 %**	30.000,00 €	**30.000,00 €**	**0,00 €**
	Gestione separata 5%	QUA021104493	★★★★★		3,00 %		30.000,00 €	
	Obblig. euro breve term.			15,00 %	**15,00 %**	150.000,00 €	**150.000,00 €**	**0,00 €**
	BNPP Flexi III Signature EUR Priv Acc	LU0753968273	★★★★★		15,00 %		150.000,00 €	
	Obblig. Euro all maturit.			23,00 %	**23,00 %**	230.000,00 €	**230.000,00 €**	**0,00 €**
	NB Euro Bond Abs RetFund I EUR	IE00BFZMG062	★★★★★		8,00 %		79.999,99 €	
	GS European ABS I Cap EUR	LU1900228542	★★★★★		15,00 %		150.000,01 €	
	Obblig. Globale			9,00 %	**9,00 %**	90.000,00 €	**90.000,00 €**	**0,00 €**
	Vontobel Fund Credit Opportunities E USD	LU1242417589	★★★★★		9,00 %		90.000,00 €	
	Obblig. Paesi emergenti			3,00 %	**3,00 %**	30.000,00 €	**30.000,00 €**	**0,00 €**
	InterFd Em. Mrkts Locl Currency Bd EUR A	LU0123381807	★★★★★		3,00 %		30.000,00 €	
	Obblig. High Yield			4,00 %	**4,00 %**	40.000,00 €	**40.000,00 €**	**0,00 €**
	Nomura Glb HY Dynamic Duration S USD Cap	IE00BN7JDW35	★★★★★		4,00 %		40.000,00 €	

Select stock / bonds

2 Choices

Select Funds

Selection of stocks/bonds → Transaction fee → 0.1%

BOND 6054
1 MLN €
Fee 1,000 €

Cost 1,000 €
33 € × year

Selection of Asset Managers (Funds)

BNY Mellon Euroland Bd EUR C

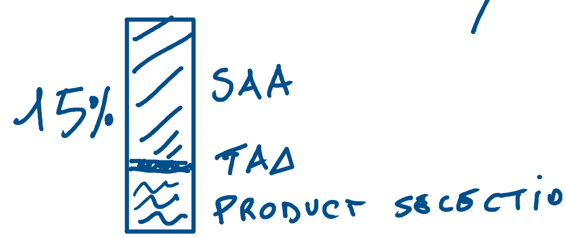
MF = 0,5% → 50% → 0,25%

Fee 2.500 € × year

⇓

Ex-Post Stage: Monitoring: Return - Risk

Performance Decomposition/Attribution



2) Financial Markets Analysis

2.1) Benchmark / Market Indexes

Equity USA

Definition: Artificial basket of stocks/bonds which composition is a *good* proxy of the composition of a market

Properties:

- **Rapresentativiness**: the composition oh the index must be a good proxy of the market composition
- **Replicability**: easy to be replicated
- **Transparency/Objectivisness:**

Construction

- Weighting → ~~Price Weighted~~ ⇒ DOW JONES INDUSTRIAL AVERAGE

SP 500 EW

Construction

- Weighting
  - PRICE Weighted → AVERAGE
  - ~~Equally Weighted~~ ⇒ SP 500 EW → STRATEGY
  - Value Weighted
  - Free-Float Weighted

- Cash Flow Management

https://www.msci.com/end-of-day-data-search
https://www.msci.com/constituents

2.2) Statistical indicators in order to capture return/risk of the Financial Markets

How to capture RETURN

	Money Mkt in €	€ Bond Mkt Short Term	€ Bond Mkt	Global Bond Dev Mkts	Global Corp Bond High Yield	Em Mkts Bond Mkt	Equ. Europe	Equ. North America	Equ. Pacific	Equ. Em Mkts
IN €	ICE Bofa Euro 0-1 yr	ICE Bofa Bond Euro 1-3 Y	ICE Bofa Bond. Euro	ICE Bofa Bond. Global	ICE Bofa Global HY	ICE Bofa Bond Emerging	MSCI Europe	MSCI North America	MSCI Pacific	MSCI Emerging Markets
2000	4,32%	4,79%	8,39%	10,49%	0,57%	17,38%	-1,93%	-5,79%	-20,61%	-25,92%
2001	4,74%	5,94%	6,25%	4,75%	8,73%	6,93%	-15,26%	-7,63%	-21,15%	2,94%
2002	3,53%	6,00%	8,49%	0,31%	-16,13%	-4,97%	-30,50%	-34,11%	-22,79%	-20,24%
2003	2,54%	3,34%	3,77%	-4,92%	8,74%	1,47%	15,76%	8,26%	15,63%	30,02%
2004	2,18%	3,40%	7,56%	2,09%	4,33%	5,10%	12,65%	3,27%	10,71%	16,88%
2005	2,20%	2,05%	5,67%	7,93%	16,94%	24,11%	26,68%	23,23%	41,75%	55,04%
2006	3,02%	1,77%	-0,28%	-5,11%	1,54%	-0,19%	20,18%	3,30%	0,64%	18,60%
2007	4,42%	3,79%	0,97%	-0,86%	-7,09%	-0,53%	3,17%	-2,89%	-4,75%	26,07%
2008	5,75%	7,00%	9,97%	18,47%	-24,13%	-1,30%	-43,29%	-34,58%	-32,87%	-50,76%
2009	2,31%	4,25%	4,32%	-1,28%	56,93%	14,66%	32,55%	25,32%	20,47%	73,44%
2010	1,11%	0,90%	1,14%	14,10%	21,80%	17,28%	11,75%	24,04%	24,14%	27,48%
2011	1,59%	0,25%	2,18%	13,58%	6,06%	5,15%	-7,51%	3,92%	-10,72%	-15,44%
2012	1,19%	4,34%	11,42%	-0,66%	17,48%	10,50%	18,09%	13,79%	12,84%	16,80%
2013	0,23%	1,79%	2,15%	-9,07%	2,17%	-10,93%	20,51%	24,75%	13,31%	-6,49%
2014	0,31%	1,86%	13,50%	18,79%	6,00%	27,90%	7,40%	28,19%	11,07%	11,81%
2015	0,10%	0,74%	1,71%	8,61%	6,74%	12,89%	8,78%	11,09%	14,97%	-4,87%
2016	-0,15%	0,41%	3,13%	4,90%	18,53%	13,22%	3,22%	15,66%	7,59%	14,94%
2017	-0,32%	-0,30%	0,41%	-6,10%	-3,22%	-4,82%	10,88%	6,83%	9,76%	21,00%
2018	-0,32%	-0,12%	0,88%	4,05%	1,25%	-0,84%	-10,00%	-0,41%	-7,33%	-9,91%
2019	-0,31%	0,47%	6,94%	8,06%	15,92%	14,77%	26,88%	33,90%	21,81%	21,07%
2020	-0,47%	0,18%	3,99%	-0,06%	-0,89%	-1,16%	-2,82%	10,64%	2,98%	8,89%
2021	-0,49%	-0,51%	-2,79%	1,55%	8,47%	5,06%	25,85%	36,61%	10,70%	5,20%
2022	-0,75%	-4,97%	-18,22%	-12,27%	-7,20%	-12,22%	-8,92%	-13,83%	-7,06%	-14,47%
2023	2,80%	4,02%	7,09%	0,77%	10,40%	7,42%	16,57%	22,31%	11,68%	6,53%

$$R = (1 + R_{MKT})(1 + \Delta\%_{Exch\ Rate}) - 1$$

$$\bar{R} = \sum_{i=1}^{n} \frac{R_i}{n}$$

= MEDIA()
= AVERAGE()

$$\bar{R}_{AC} \longrightarrow \bar{R}_{PORT}$$

Weighted Average Approach

$$\bar{R}_{PORT} = \sum_{i=1}^{K} w_i \cdot \bar{R}_i$$

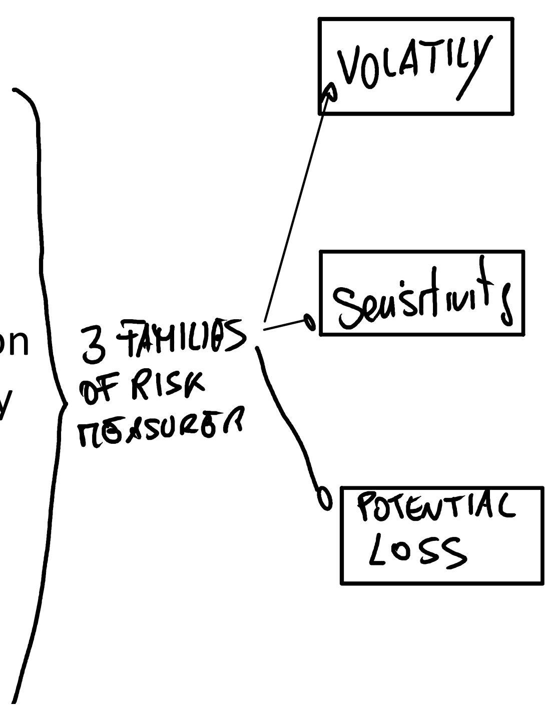
=sumproduct(weights; av returns)

$$\bar{R}_{PORT} = \left[w_1, w_2, \ldots, w_K \right] \times \begin{bmatrix} \bar{R}_1 \\ \bar{R}_2 \\ \vdots \\ \bar{R}_K \end{bmatrix}$$

=mmult(B30:K30;transpose(B28:K28))
- ENTER
- CTRL + ⇧ + ENTER

Risk Analysis

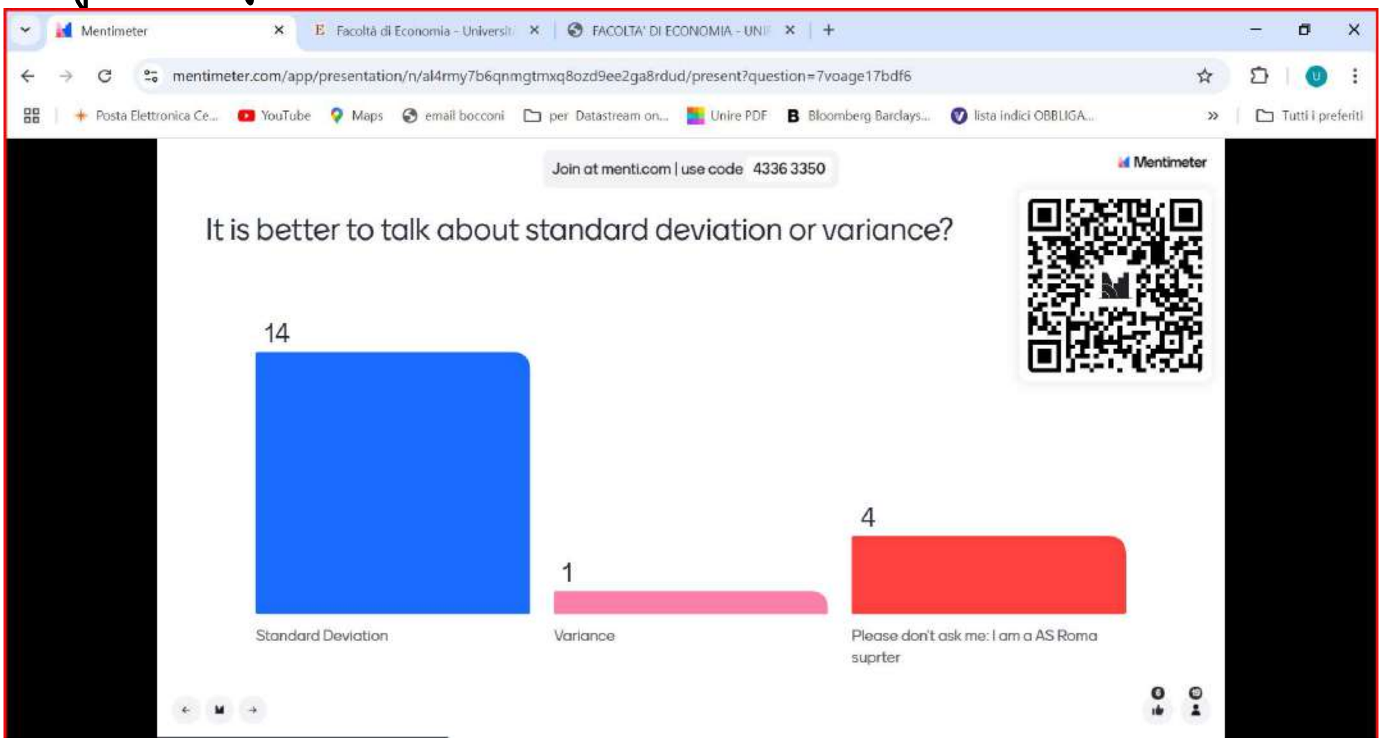
- Standard Deviation
- Absolute mean Error
- Value at Risk
- Expected Shorfall
- Semi-standard deviation
- Tracking Error Volatility
- Downside Risk
- Modified Duration
- Beta
- Greeks
- Maximum Drawdown



- Greeks
- Maximum Drawdown
- Rating

Standard Deviation of the calculation (σ)

_σ of a single asset class



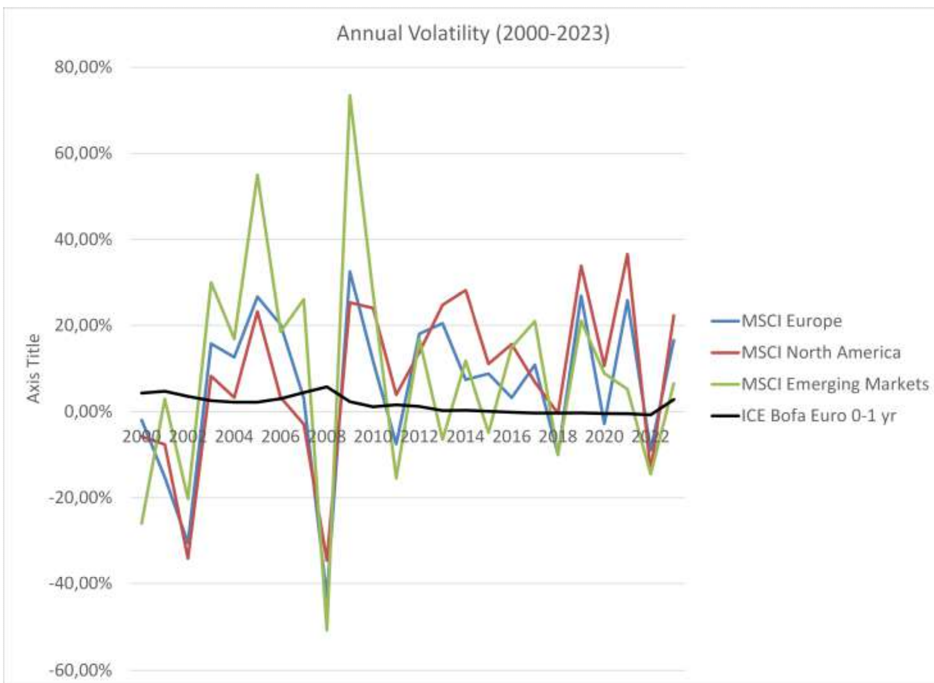
PERSPECTIVES

The Early History of Portfolio Theory: 1600–1960

Harry M. Markowitz

Jully/August 1999

Problems with Markowitz (1952). I am tempted to include a disclaimer when I send requested copies of Markowitz (1952) that warns the reader that the 1952 piece should be considered only a historical document—not a reflection of my current views about portfolio theory. There are at least four reasons for such a warning. The first two are two technical errors described in this section. A third is that, although the article noted that the same portfolios that minimize standard deviation for given *E* also minimize variance for given *E*, it failed to point out that standard deviation (rather than variance) is the intuitively meaningful measure of dispersion. For example, "Tchebychev's inequality" says



=stdev(timeseries)

	Money Mkt in €	€ Bond Mkt Short Term	€ Bond Mkt	Global Bond Dev Mkts	Global Corp Bond High Yield	Em Mkts Bond Mkt	Equ. Europe	Equ. North America	Equ. Pacific	Equ. Em Mkts
SIGMA	1,93%	2,67%	6,14%	8,15%	15,25%	10,32%	18,50%	18,68%	17,39%	25,99%

D=0,5 y
100% Investment
Full €

D=2

D=7.5

Exchange Risk

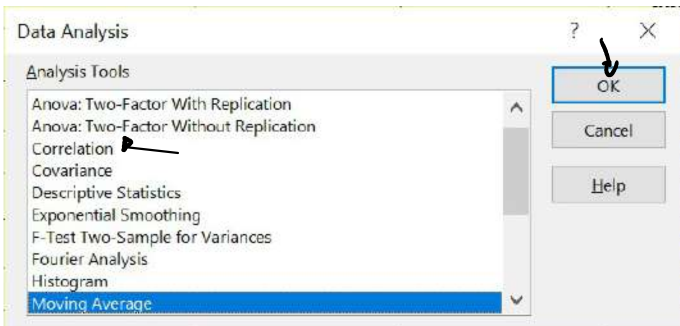
Credit Risk

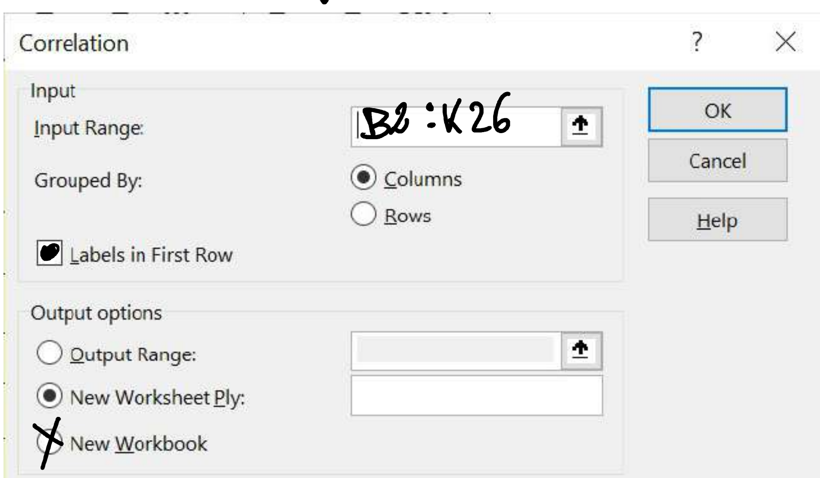
Equity Risk

From the volatility of a single asset class to the volatility of a Portfolio

$$\sigma_{PORT} = \sum_{i=1}^{K} w_i \cdot \sigma_i$$

Correlation (ρ)   numb $\rho = \frac{K(K-1)}{2} = \frac{10 \cdot 9}{2} = 45$





	Bofa ML Euro 0-1 yr	Bofa ML Bond Euro 1-3 Y	Bofa ML Bond. Euro	Bofa ML Bond. Global	ML Global HY	Bofa ML Bond Emerging	MSCI Europe	MSCI North America	MSCI Pacific	MSCI Emerging Markets
Bofa ML Euro 0-1 yr	1,00									
Bofa ML Bond Euro 1-3 Y	0,85	1,00								
Bofa ML Bond. Euro	0,41	0,76	1,00							
Bofa ML Bond. Global	0,23	0,28	0,55	1,00						
ML Global HY	-0,22	-0,04	0,09	0,00	1,00					
Bofa ML Bond Emerging	0,02	0,17	0,52	0,67	0,57	1,00				
MSCI Europe	-0,40	-0,26	-0,05	-0,28	0,71	0,37	1,00			
MSCI North America	-0,56	-0,35	0,05	0,02	0,69	0,51	0,88	1,00		
MSCI Pacific	-0,50	-0,33	-0,01	-0,12	0,65	0,45	0,87	0,84	1,00	
MSCI Emerging Markets	-0,17	-0,07	0,03	-0,23	0,78	0,41	0,77	0,62	0,79	1,00

2 Risky Bond

1 Equ ; 1 Risky Bonds

2 Equ. MKTS

Recover the diversification LOST

Selecting Alternative Investments / Opportunitise

ILLIQUID
- Real Estate
- Infrastructure
- Private Equity / Venture Capital

- Private Debt
- Commodities
- Criptocurrencies
- Hedge Funds
- Thematic Investments

https://www.msci.com/our-solutions/indexes/thematic-investing/

σ_{PORT} 2 Asset Classes

Inputs:
w_1 σ_1
w_2 σ_2 ρ_{12}

$$\Rightarrow \sigma_{PORT} = \sqrt{(w_1 \sigma_1)^2 + (w_2 \sigma_2)^2 + 2 \cdot w_1 w_2 \underbrace{\sigma_1 \sigma_2 \cdot \rho_{12}}_{COV_{12}}}$$

σ_{PORT} 3 A. Classes

Input

$w_1 \quad \sigma_1 \quad \rho_{12}$

$w_2 \quad \sigma_2 \quad \rho_{13}$

$w_3 \quad \sigma_3 \quad \rho_{23}$

$$\Rightarrow \sigma_{PORT} = \sqrt{(w_1\sigma_1)^2 + (w_2\sigma_2)^2 + (w_3\sigma_3)^2 + 2w_1w_2\sigma_1\sigma_2\cdot\rho_{12} + 2w_1w_3\sigma_1\sigma_3\rho_{13} + 2w_2w_3\sigma_2\sigma_3\rho_{23}}$$

σ_{PORT} → K Asset Classes

Inputs:

$w_1 \quad \sigma_1 \quad \rho_{12}$

$w_2 \quad \sigma_2 \quad \vdots \quad \frac{K\cdot(K-1)}{2}$

$\vdots \quad \vdots \quad \vdots$

$w_K \quad \sigma_K \quad \rho_{K-1,K}$

$$\sigma_{PORT} = \sqrt{\sum_{i=1}^{K}\sum_{j=1}^{K} w_i w_j \sigma_i \sigma_j \cdot \rho_{i,j}}$$

$$\sigma_{PORT} = \sqrt{\begin{bmatrix} w_1 & w_2 & \cdots & w_K \end{bmatrix} \cdot \begin{bmatrix} \sigma_1^2 & & & \\ & \sigma_2^2 & & \\ & & \ddots & \\ & & & \sigma_K^2 \end{bmatrix} \cdot \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_K \end{bmatrix}}$$

$$\sigma_{PORT} = \sqrt{\underbrace{\begin{bmatrix} w_1\sigma_1 & w_2\sigma_2 & \cdots & w_K\sigma_K \end{bmatrix} \cdot \begin{bmatrix} 1 & & & \\ & 1 & & \\ & & 1 & \\ & & & \ddots & \\ & & & & 1 \end{bmatrix}} \cdot \begin{bmatrix} w_1\sigma_1 \\ w_2\sigma_2 \\ \vdots \\ w_K\cdot\sigma_K \end{bmatrix}}$$

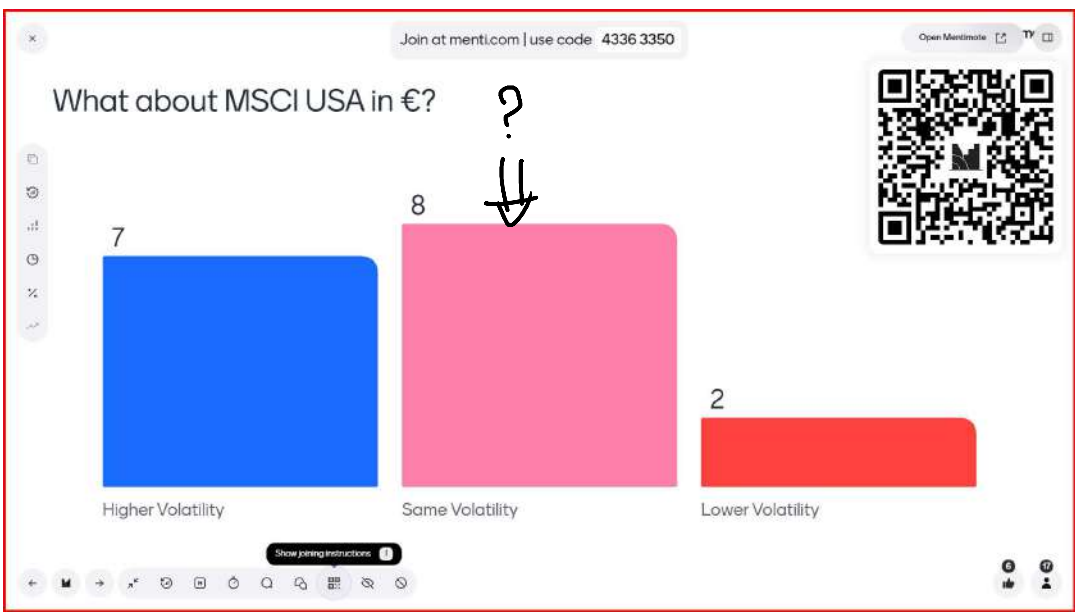
=sqrt(mmult(mmult(B31:K31;B34:k43);TRANSPOSE(B31:K31)))

2020	-0,47%	0,18%	3,99%	-0,06%	-0,89%	-1,16%	-2,82%	10,64%	2,98%	8,89%
2021	-0,49%	-0,51%	-2,79%	1,55%	8,47%	5,06%	25,85%	36,61%	10,70%	5,20%
2022	-0,75%	-4,97%	-18,22%	-12,27%	-7,20%	-12,22%	-8,92%	-13,83%	-7,06%	-14,47%
2023	2,80%	4,02%	7,09%	0,77%	10,40%	7,42%	16,57%	22,31%	11,68%	6,53%

Av Return 1yr	1,65%	2,14%	3,69%	3,25%	6,41%	6,12%	5,86%	8,16%	4,28%	8,69%	**4,74%**
SIGMA	1,93%	2,67%	6,14%	8,15%	15,25%	10,32%	18,50%	18,68%	17,39%	25,99%	7,24%
Weigths	3,00%	5,00%	11,00%	42,00%	4,00%	5,00%	5,00%	17,00%	3,00%	5,00%	100,00%
W*S	0,06%	0,13%	0,68%	3,42%	0,61%	0,52%	0,92%	3,18%	0,52%	1,30%	**11,34%**

	Bofa ML Euro 0-1 yr	**Bofa ML Bond Euro 1-3 Y**	**Bofa ML Bond. Euro**	**Bofa ML Bond. Global**	**ML Global HY**	**Bofa ML Bond Emerging**	**MSCI Europe**	**MSCI North America**	**MSCI Pacific**	**MSCI Emerging Markets**
Bofa ML Euro 0-1 yr	1,00	0,85	0,41	0,23	-0,22	0,02	-0,40	-0,56	-0,50	-0,17
Bofa ML Bond Euro 1-3 Y	0,85	1,00	0,76	0,28	-0,04	0,17	-0,26	-0,35	-0,33	-0,07
Bofa ML Bond. Euro	0,41	0,76	1,00	0,55	0,09	0,52	-0,05	0,05	-0,01	0,03
Bofa ML Bond. Global	0,23	0,28	0,55	1,00	0,00	0,67	-0,28	0,02	-0,12	-0,23
ML Global HY	-0,22	-0,04	0,09	0,00	1,00	0,57	0,71	0,69	0,65	0,78
Bofa ML Bond Emerging	0,02	0,17	0,52	0,67	0,57	1,00	0,37	0,51	0,45	0,41
MSCI Europe	-0,40	-0,26	-0,05	-0,28	0,71	0,37	1,00	0,88	0,87	0,77
MSCI North America	-0,56	-0,35	0,05	0,02	0,69	0,51	0,88	1,00	0,84	0,62
MSCI Pacific	-0,50	-0,33	-0,01	-0,12	0,65	0,45	0,87	0,84	1,00	0,79
MSCI Emerging Markets	-0,17	-0,07	0,03	-0,23	0,78	0,41	0,77	0,62	0,79	1,00

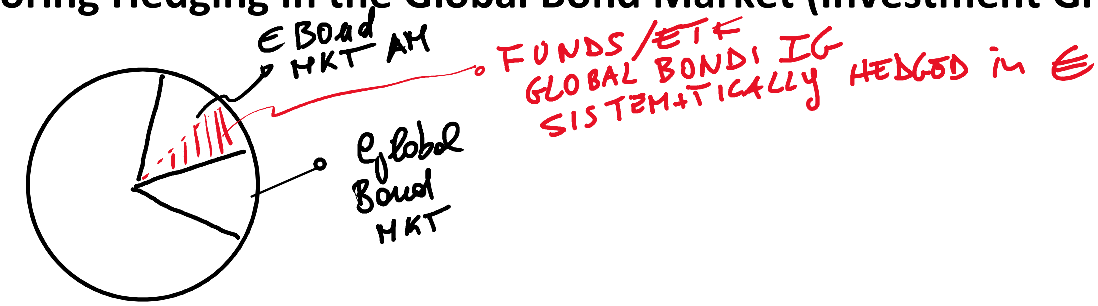
Exploring Hedging in USA Equity Market



	MSCI USA €	MSCI USA $	MSCI USA HEDGED €	€/$

	MSCI USA €	MSCI USA $	MSCI USA HEDGED €	correl eq USA e €/$	
31/10/2023	-2,23%	-2,39%	-2,52%		0,17%
30/11/2023	5,80%	9,21%	8,79%		-3,13%
29/12/2023	3,29%	4,58%	4,38%		-1,23%
31/01/2024	3,19%	1,47%	1,35%		1,69%
29/02/2024	5,60%	5,20%	5,09%		0,38%
29/03/2024	3,27%	3,07%	2,94%		0,20%
30/04/2024	-3,24%	-4,20%	-4,36%		1,01%
31/05/2024	3,05%	4,62%	4,46%		-1,51%
28/06/2024	4,79%	3,46%	3,38%		1,29%
31/07/2024	0,20%	1,17%	1,02%		-0,96%
30/08/2024	-0,02%	2,27%	2,04%		-2,24%
30/09/2024	1,20%	2,04%	1,88%		-0,82%
31/10/2024	1,97%	-0,81%	-0,96%		2,80%
Monthly Sigma	4,37%	4,45%	4,48%	-0,335	2,71%

Exploring Hedging in the Global Bond Market (Investment Grade)



Potential Loss: VaR (Value at Risk)

Hist. Simulation

VaR-CoV Method. → $VaR = \bar{R} - K \cdot \sigma$

G.L	K
99%	2,326
98%	2.05
95%	1.645

	MSCI US
giu-02	-13,1%
mar-20	-12,5%
set-02	-11,5%
dic-02	-11,1%
ago-01	-10,7%
nov-00	-10,7%
dic-18	-9,7%
giu-08	-9,6%
apr-02	-9,4%
dic-22	-9,3%
feb-09	-9,0%
feb-01	-8,5%
ago-15	-8,1%
feb-20	-7,5%
set-01	-7,4%
dic-08	-7,4%
set-03	-7,3%
nov-08	-7,2%
ott-08	-7,1%
gen-08	-7,0%
set-22	-6,8%

Time horizon	1 month	1 month	1 month
VaR(%) Hist sim	-11,1%	-9,7%	-7,4%
Confidence Level	99%	98%	95%

Time horizon	1 month	1 month	1 month
VaR(%) Var-Cov	-9,7%	-8,5%	-6,6%
Confidence Level	99%	98%	95%
k	2,326	2,05	1,645

MEAN	0,7%	8,3%		97%
SIGMA	4,4%	15,4%	Annual VaR	-20,6%
	monthly	Annual		
		E(r) 1yr	sigma 1yr	VaR 1yr (95%
	Portfolio	6%	35%	-52%
		E(r) 1day	sigma 1day	VaR 1day (95%
		0,02%	2,2%	-4%

	Money Mkt in €	€ Bond Mkt Short Term	€ Bond Mkt	Global Bond Dev Mkts	Global Corp Bond High Yield	Em Mkts Bond Mkt	Equ. Europe	Equ. North America	Equ. Pacific	Equ. Em Mkts	PORT	
Av Return 1yr	1,65%	2,14%	3,69%	3,25%	6,41%	6,12%	5,86%	8,16%	4,28%	8,69%	4,74%	4,74%
SIGMA	1,93%	2,67%	6,14%	8,15%	15,25%	10,32%	18,50%	18,68%	17,39%	25,99%	7,24%	
Weigths	3,00%	5,00%	11,00%	42,00%	4,00%	5,00%	5,00%	17,00%	3,00%	5,00%	100,00%	
W*S	0,06%	0,13%	0,68%	3,42%	0,61%	0,52%	0,92%	3,18%	0,52%	1,30%	11,34%	
⇒ Annual VaR 95%	-1,53%	-2,26%	-6,41%	-10,16%	-18,68%	-10,86%	-24,57%	-22,57%	-24,32%	-34,06%	-7,17%	

Routine in Matlab with a replication of all the calculation in Excel

```
clear
clear all

[DATASET LABELS]=xlsread('File excel.xlsx','Time Series','B2:K26')
ANN_RET=mean(DATASET)

figure(1)
barh(ANN_RET)
title('Average Annual Returns')
ylabel('Markets')
xlabel('Average Returns')
set(gca,'YTickLabel',LABELS)
grid on


WEIGHTS=xlsread('File excel','Time Series','B30:K30')
figure(2)
pie(WEIGHTS)
title('Portfoglio Weights')
```

```
LEGEND=legend(LABELS,'Location','SouthOutside')

AV_RET_PORT=WEIGHTS*ANN_RET'

figure(3)
plot(DATASET(:,1))
hold on
plot(DATASET(:,4),'r')
hold on
plot(DATASET(:,6),'g')
hold on
plot(DATASET(:,7),'y')
hold off
grid on
title('Volatility')
ylabel('Annual return')
xlabel('Time')
LEGEND= legend([LABELS(1,1) LABELS(1,4) LABELS(1,6)
LABELS(1,7)],'Location','SouthOutside')

SIGMA=std(DATASET)
figure(4)
subplot(1,2,1)
barh(SIGMA,'r')
title('Standard Deviations')
ylabel('Markets')
xlabel('Standard Deviations')
set(gca,'YTickLabel',LABELS)
grid on
subplot(1,2,2)
scatter(SIGMA,ANN_RET,'filled')
title('Risk-Return')
ylabel('Av Ret')
xlabel('Standard Deviation')
grid on
```

```
figure(5)
subplot(2,2,1)
scatter(DATASET(:,7),DATASET(:,8))
title('Corr MSCI Europe - MSCI NA')
ylabel('MSCI North America')
xlabel('Msci Europe')
grid on
lsline
subplot(2,2,2)
scatter(DATASET(:,7),DATASET(:,10))
title('Corr MSCI Europe - MSCI EM')
ylabel('MSCI EM')
xlabel('Msci Europe')
grid on
lsline
subplot(2,2,3)
scatter(DATASET(:,7),DATASET(:,5))
title('Corr MSCI Europe - Global HY Corp')
ylabel('Global HY Corp')
xlabel('Msci Europe')
grid on
lsline
subplot(2,2,4)
scatter(DATASET(:,7),DATASET(:,3))
title('Corr MSCI Europe - Bond Area €')
ylabel('Bond € Area')
xlabel('Msci Europe')
grid on
lsline

CORRELATIONS=corr(DATASET)
COVARIANCES=cov(DATASET)


SIGMA_PORT=sqrt(WEIGHTS*COVARIANCES*WEIGHTS')
```

```
K1=norminv([0.95])
K2=norminv([0.99])
VAR_95=ANN_RET-K1.*SIGMA
VAR_99=ANN_RET-K2.*SIGMA
AGGR_VAR=[VAR_95' VAR_99']
figure(6)
barh([AGGR_VAR])
title('VaR (conf lev=95% & 99%)')
ylabel('Mkts')
xlabel('VaR')
set(gca,'YTickLabel',LABELS)
legenda= legend({'VaR 95%', 'VaR 99%'},'Location','SouthOutside')
grid on

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%THE END
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

STRATEGIC ASSET ALLOCATION (SAA)

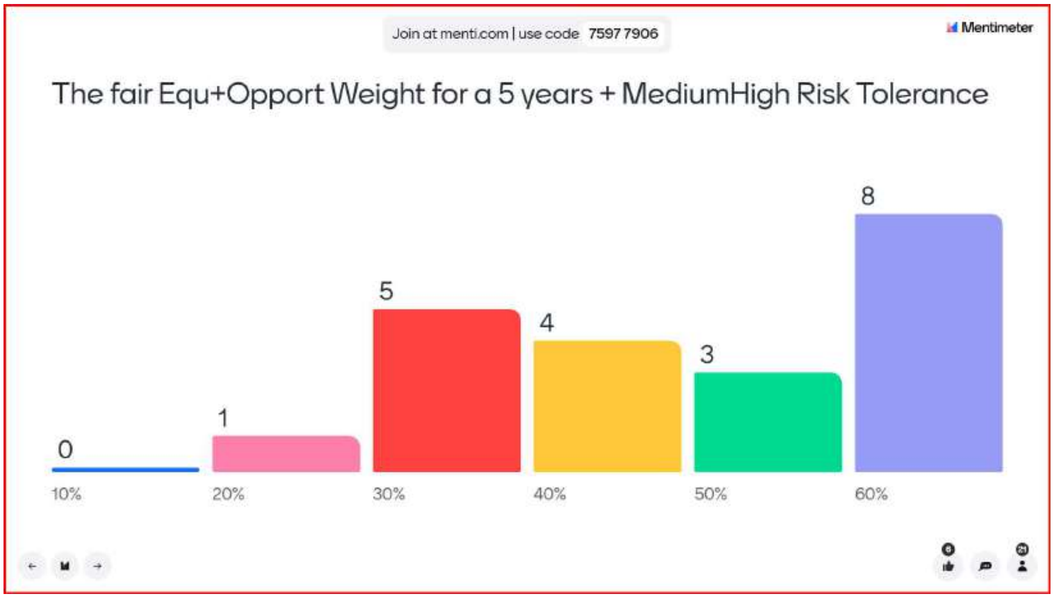
SAA via a Qualitative Approach - Naïve Approach
An Approach that is Statistics & Mathematics Free

Asset Classes
Money Mkt in €
€ Bond Mkt Short Term
€ Bond Mkt

2 Rules driving the Selection
- No overlapping

Money Mkt in €
€ Bond Mkt Short Term
€ Bond Mkt
Global Bond Dev Mkts
Global Corp Bond High Yiel
Em Mkts Bond Mkt
Equ. Europe
Equ. North America
Equ. Pacific
Equ. Em Mkts
Opportunities

- No overlapping
- Think global



(THE) Question 1: "Assume that you don't have view about the next 5 years. **What it is necessary to do?**"

Golden Rule 1: Without views the SAA must be Market Neutral

Asset Classes	SAA Neutral HBA	SAA Naive	Weights
Money Mkt in €	2%		
€ Bond Mkt Short Term	4%		
€ Bond Mkt	9%		
Global Bond Dev Mkts	33%		55,0%
Global Corp Bond High Yiel	3%		
Em Mkts Bond Mkt	4%		
Equ. Europe	8%		
Equ. North America	25%		

Em Mkts Bond Mkt	4%		
Equ. Europe	8%		
Equ. North America	25%		
Equ. Pacific	4%		
Equ. Em Mkts	6%		
Opportunities	2%		

45,0%

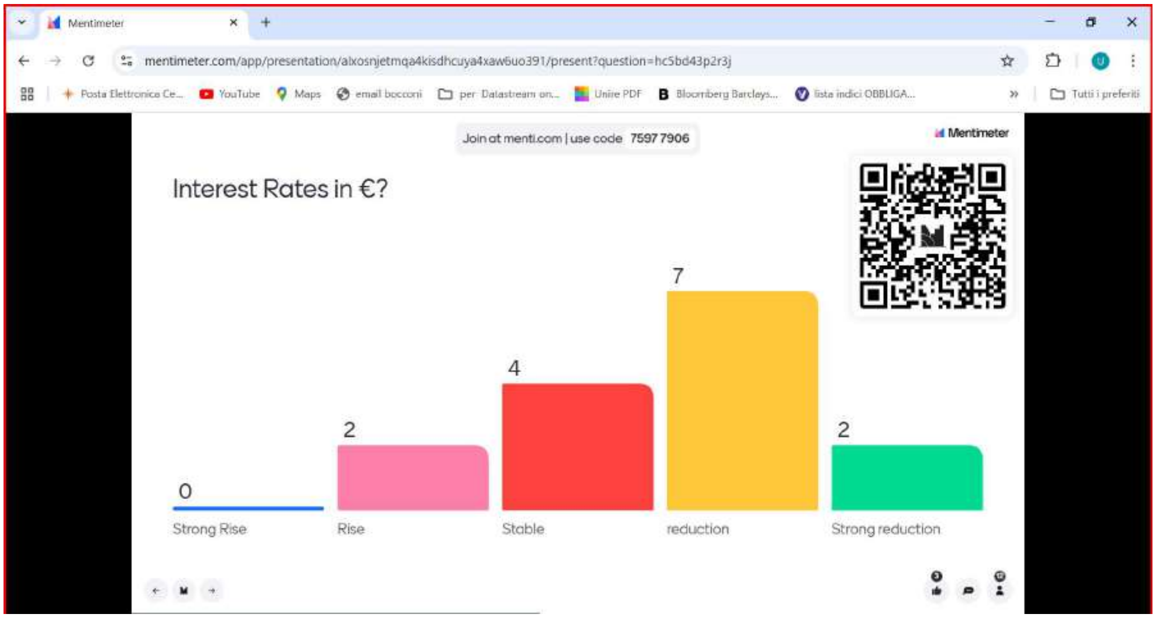
Question 2: "An average investor consider this Mkt Neutral solution reasonable or unreasonable?"

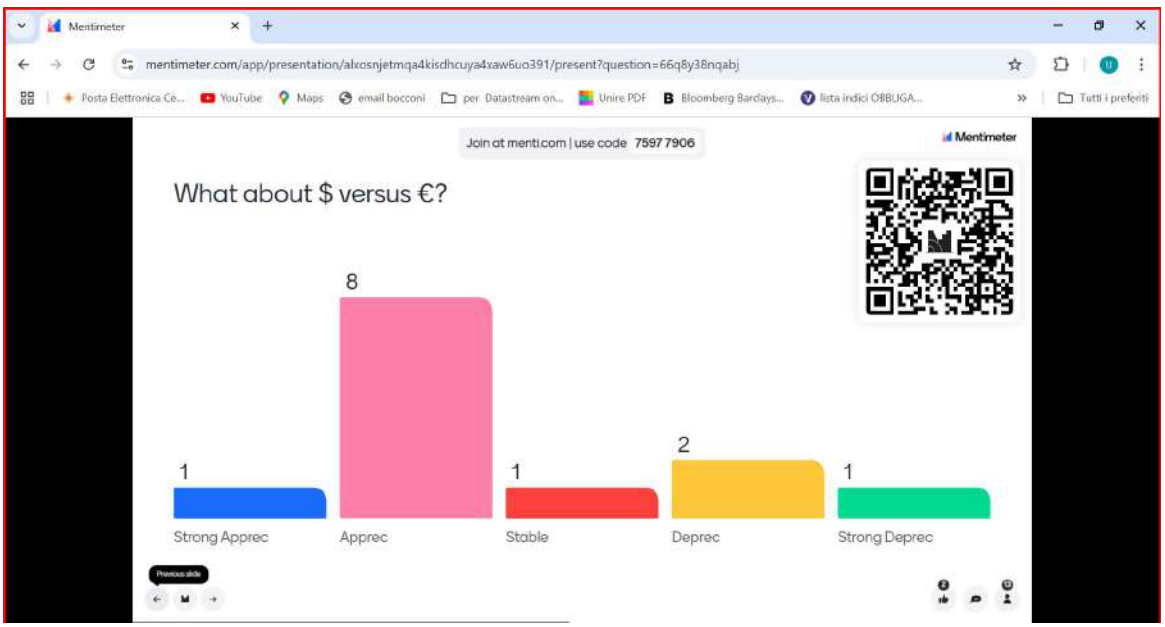
Golden Rule 2: If you can not fight Home Bias with Financial Education, you have to adjust Market Neutrality in order to make an incorporation of Home Bias.

L. SAA MARKET NEUTRAL HOME BIAS ADJUSTED

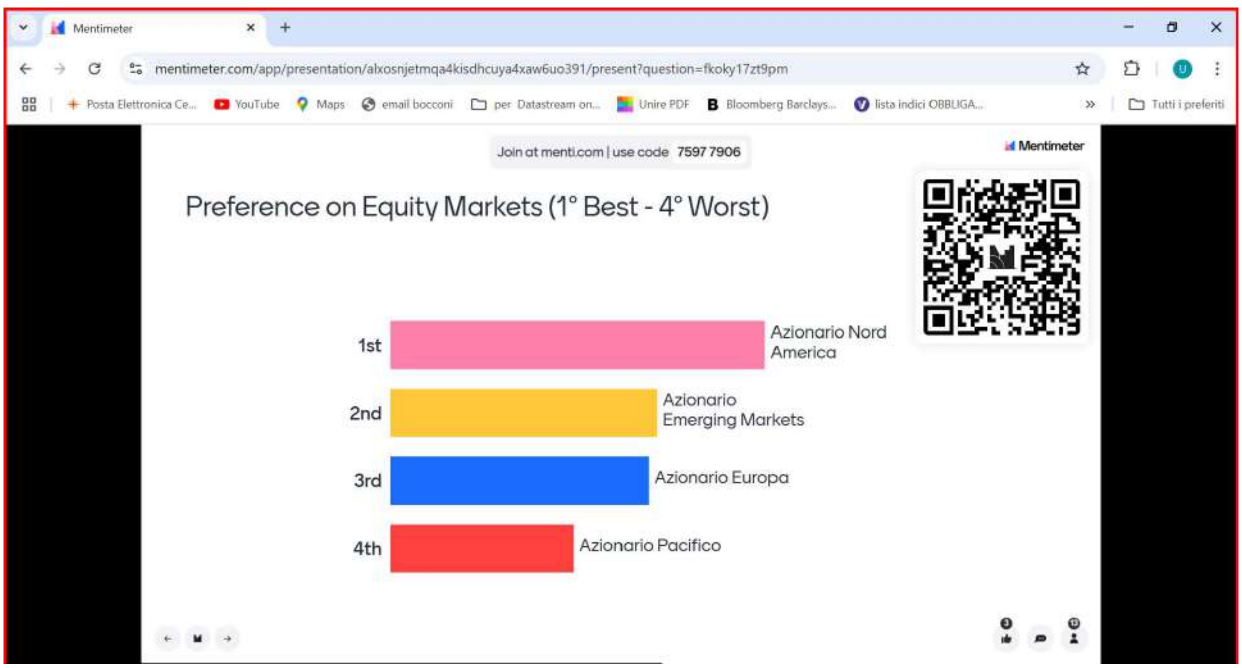
Golden Rule £: Only if we have Views with a good confidence, we are justified to diverge from the Neutrali HBA.

- **View +, good confidence: set a weight larger than the Mkt Neutr Weight**
- **View -, good confidence: set a weight lower than the Mkt Neutr Weight**


Mentimeter
mentimeter.com/app/presentation/alxosnjetmqa4kisdhcuya4xaw6uo391/present?question=hc5bd43p2r3j
Join at menti.com | use code 7597 7906
Mentimeter
Interest Rates in €?
0
2
4
7
2
Strong Rise
Rise
Stable
reduction
Strong reduction


Mentimeter
mentimeter.com/app/presentation/alxosnjetmqa4kisdhcuya4xaw6uo391/present?question=66q8y38nqabj
Join at menti.com | use code 7597 7906
Mentimeter
What about $ versus €?
1
8
1
2
1
Strong Apprec
Apprec
Stable
Deprec
Strong Deprec


Join at menti.com | use code 7597 7906
Mentimeter
Views on Risky Bonds
0
4
5
4
1
++
+
=
-
--


Join at menti.com | use code 7597 7906
Mentimeter
Preference on Equity Markets (1° Best - 4° Worst)
1st
Azionario Nord America
2nd
Azionario Emerging Markets
3rd
Azionario Europa
4th
Azionario Pacifico

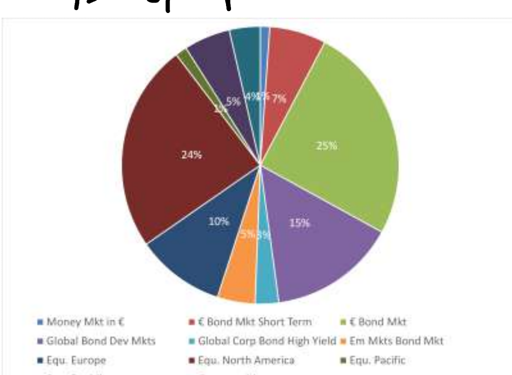
Asset Classes	SAA Neutral HBA	SAA Naive
Money Mkt in €	2%	1%
€ Bond Mkt Short Term	11%	7%
€ Bond Mkt	22%	25%
Global Bond Dev Mkts	13%	15%
Global Corp Bond High Yiel	3%	3%
Em Mkts Bond Mkt	4%	4%
Equ. Europe	10%	10%
Equ. North America	23%	24%
Equ. Pacific	4%	1%
Equ. Em Mkts	5%	5%
Opportunities	2%	4%

Weights	Naive	neutral HBA	
55,0%	2%	4%	Money Mkt in €
	12%	20%	€ Bond Mkt Short Term
	46%	40%	€ Bond Mkt
	27%	23%	Global Bond Dev Mkts
	5%	5%	Global Corp Bond High Yield
	8%	8%	Em Mkts Bond Mkt
45,0%	23%	23%	Equ. Europe
	54%	52%	Equ. North America
	3%	8%	Equ. Pacific
	12%	12%	Equ. Em Mkts
	8%	5%	Opportunities

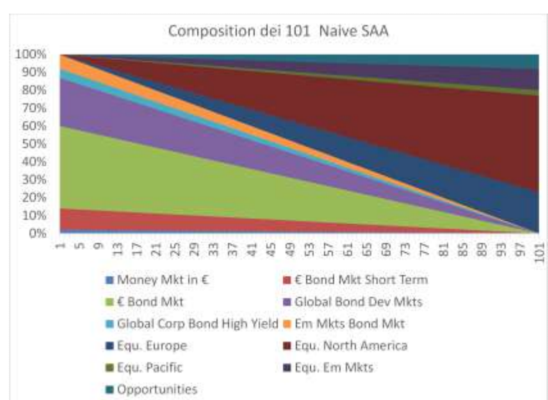
5 year views

	view	confidence
€ interest rate	reduction	Med-Hig
strong currencies	Apprec $	Medium
spread low rating bonds	Neutral	-
Equ. Europe	=	
Equ. North America	+	Medium
Equ. Pacific	-	Medium
Equ. Em Mkts	=	
Opportunities	+	Med-Hig

45% Eq+Op



=>



Naive Solution:
- Reasonable
- Naive
- Well diversified
- Good solution, not optimal

If we want an optimal solution, we need an Optimization

Quantitative Approach to SAA

↳ MODERN PORTFOLIO THEORY (MPT)

1st Quantitative Approach: Markowitz Model

↳

Markowitz's "Portfolio Selection": A Fifty-Year Retrospective

Mark Rubinstein

The Journal of Finance, Vol. 57, No. 3. (Jun., 2002), pp. 1041-1045.

Near the end of his reign in 14 AD, the Roman emperor Augustus could boast that he had found Rome a city of brick and left it a city of marble. Markowitz can boast that he found the field of finance awash in the imprecision of English and left it with the scientific precision and insight made possible only by mathematics.

Presents by Markowitz:
- Investors love return and are risk adverse
- Standard Deviation was a way to measure Risk
- The first to talk about correlation
- The first capture/measure the diversification effect
- The first to show that a portfolio could be the output of an optimization process.

FOUNDATIONS OF PORTFOLIO THEORY

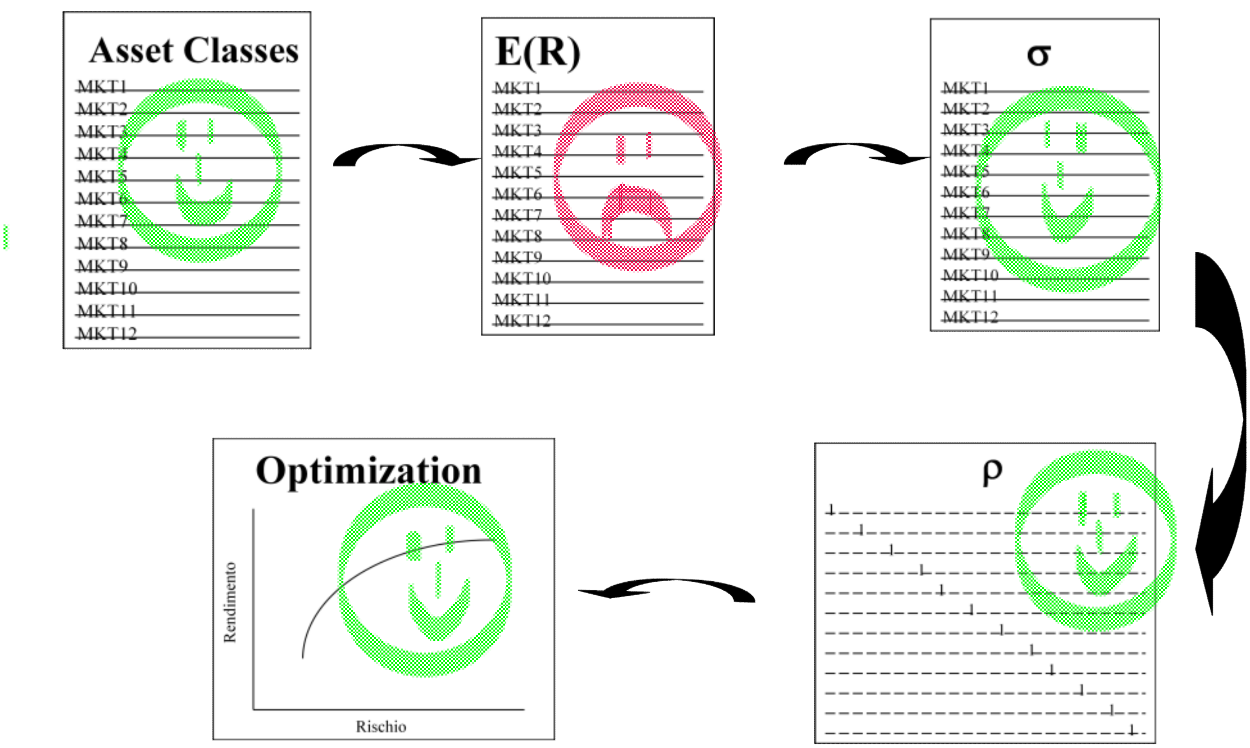
Nobel Lecture, December 7, 1990

by

HARRY M. MARKOWITZ

Finally, I would like to add a comment concerning portfolio theory as a part of the microeconomics of action under uncertainty. It has not always been considered so. For example, when I defended my dissertation as a student in the Economics Department of the University of Chicago, Professor Milton Friedman argued that portfolio theory was not Economics, and that they could not award me a Ph.D. degree in Economics for a dissertation which was not in Economics. I assume that he was only half serious, since they did award me the degree without long debate. As to the merits of his arguments, at this point I am quite willing to concede: at the time I defended my dissertation, portfolio theory was not part of Economics. But now it is.

Popularity: rigorous from a scitific point of view + easy to be applied



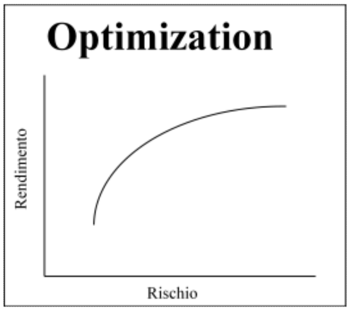
THE JOURNAL OF FINANCE
Vol. VII, No. 1, March 1952
PRINTED IN U.S.A.

PORTFOLIO SELECTION*

HARRY MARKOWITZ

To use the E-V rule in the selection of securities we must have procedures for finding reasonable μ_i and σ_{ij}. These procedures, I believe, should combine statistical techniques and the judgment of practical men. My feeling is that the statistical computations should be used to arrive at a tentative set of μ_i and σ_{ij}. Judgment should then be used in increasing or decreasing some of these μ_i and σ_{ij} on the basis of factors or nuances not taken into account by the formal computations. Using this revised set of μ_i and σ_{ij}, the set of efficient E, V combinations could be computed, the investor could select the combination he preferred, and the portfolio which gave rise to this E, V combination could be found.

One suggestion as to tentative μ_i, σ_{ij} is to use the observed μ_i, σ_{ij} for some period of the past. I believe that better methods, which take into account more information, can be found. I believe that what is needed is essentially a "probabilistic" reformulation of security analysis. I will not pursue this subject here, for this is "another story." It is a story of which I have read only the first page of the first chapter.



$$\min_{W} \sigma_{PORT}$$

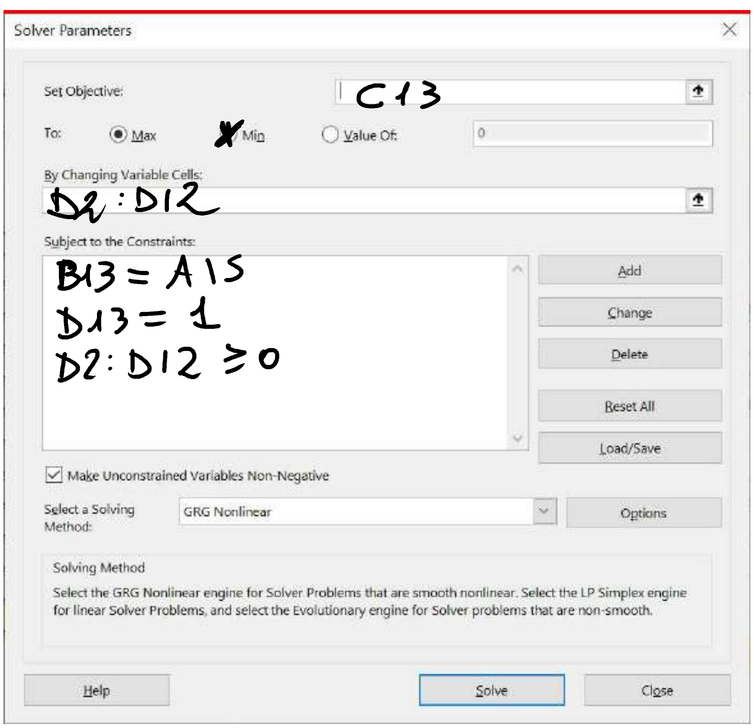
Constraints:

$$E(R)_{PORT} = R^*$$

$$\sum_{i=1}^{N} w_i = 1$$

$$w_i \geq 0 \quad \forall_i \in [1;2;\dots;K]$$

Application of the "pure" Markowitz via excel



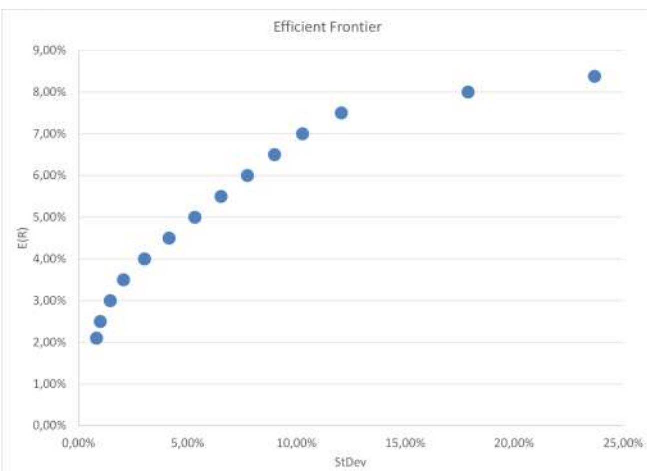
Asset Classes	E(r) pred	σ (ts)	Pesi
Money Mkt in €	2,00%	0,87%	25,06%
€ Bond Mkt Short Term	2,90%	1,69%	67,38%
€ Bond Mkt	3,26%	4,17%	0,00%
Global Bond Dev Mkts	3,01%	6,92%	0,00%
Global Corp Bond High Yield	7,30%	11,07%	4,48%
Em Mkts Bond Mkt	6,00%	12,72%	0,00%
Equ. Europe	6,50%	17,53%	0,00%
Equ. North America	7,50%	17,80%	0,98%
Equ. Pacific	6,81%	18,56%	0,00%
Equ. Em Mkts	8,38%	23,69%	0,00%
Opportunities	6,87%	15,36%	2,11%
PORTFOLIO	3,00%	1,45%	100,00%

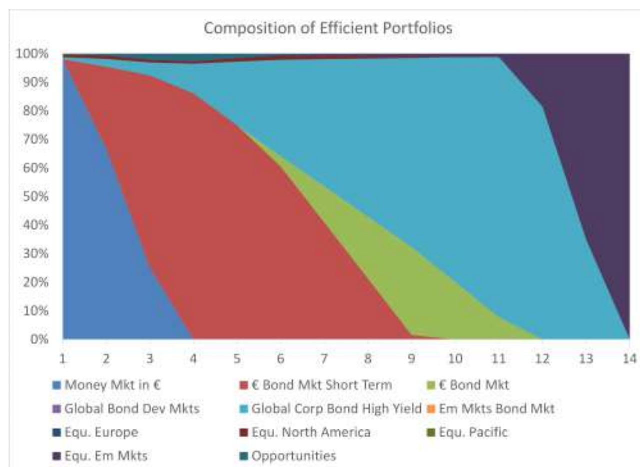
3,00%
Targeted Return (R*)

cov (ts)	Money Mkt in €	d Mkt Short	€ Bond Mkt	al Bond Dev	orp Bond Hi
Money Mkt in €	**0,0001**	0,0001	0,0001	0,0001	- 0,0002
€ Bond Mkt Short Te	0,0001	**0,0003**	0,0005	0,0003	- 0,0000
€ Bond Mkt	0,0001	0,0005	**0,0017**	0,0012	0,0004
Global Bond Dev Mkt	0,0001	0,0003	0,0012	**0,0048**	0,0024
Global Corp Bond Hi	- 0,0002	- 0,0000	0,0004	0,0024	**0,0122**
Em Mkts Bond Mkt	- 0,0001	0,0001	0,0008	0,0026	0,0098
Equ. Europe	- 0,0003	- 0,0004	- 0,0004	- 0,0023	0,0108
Equ. North America	- 0,0004	- 0,0006	- 0,0003	0,0009	0,0129
Equ. Pacific	- 0,0003	- 0,0003	- 0,0002	0,0003	0,0109
Equ. Em Mkts	- 0,0003	- 0,0005	- 0,0004	- 0,0019	0,0149
Opportunities	- 0,0003	- 0,0005	- 0,0007	- 0,0006	0,0114

corr (ts)					
	1,0000	0,5739	0,2304	0,1188	-0,1811
	0,5739	**1,0000**	0,7507	0,2577	-0,0011
	0,2304	0,7507	**1,0000**	0,4200	0,0952
	0,1188	0,2577	0,4200	**1,0000**	0,3092
	-0,1811	-0,0011	0,0952	0,3092	**1,0000**
	-0,0557	0,0364	0,1559	0,2927	0,6989
	-0,2183	-0,1496	-0,0497	-0,1903	0,5556
	-0,2641	-0,1990	-0,0472	0,0752	0,6780
	-0,2123	-0,0842	-0,0309	0,0219	0,5330
	-0,1638	-0,1284	-0,0437	-0,1187	0,5698
	-0,1957	-0,2115	-0,1044	-0,0523	0,6695

Sigma	E(R)	Money Mkt	€ Bond Mk	€ Bond Mk	Global Bond	Global Cor	Em Mk	Equ. E	Equ. N	Equ. Pa
0,82%	2,10%	98,04%	0,00%	0,00%	0,00%	0,66%	0,00%	0,15%	0,80%	0,34%
1,00%	2,50%	66,70%	28,74%	0,00%	0,00%	2,71%	0,00%	0,00%	1,25%	0,07%
1,45%	3,00%	25,06%	67,38%	0,00%	0,00%	4,48%	0,00%	0,00%	0,98%	0,00%
2,06%	3,50%	0,00%	86,15%	0,00%	0,00%	10,31%	0,00%	0,00%	0,93%	0,00%
3,02%	4,00%	0,00%	74,95%	0,00%	0,00%	22,27%	0,00%	0,00%	1,23%	0,00%
4,15%	4,50%	0,00%	60,49%	3,61%	0,00%	33,74%	0,00%	0,00%	1,39%	0,00%
5,33%	5,00%	0,00%	40,94%	12,59%	0,00%	44,58%	0,00%	0,00%	1,14%	0,00%
6,54%	5,50%	0,00%	21,25%	21,67%	0,00%	55,37%	0,00%	0,00%	0,75%	0,00%
7,75%	6,00%	0,00%	1,57%	30,75%	0,00%	66,17%	0,00%	0,00%	0,37%	0,00%
8,99%	6,50%	0,00%	0,00%	20,11%	0,00%	78,65%	0,00%	0,00%	0,00%	0,00%
10,28%	7,00%	0,00%	0,00%	7,74%	0,00%	91,04%	0,00%	0,00%	0,00%	0,00%
12,07%	7,50%	0,00%	0,00%	0,00%	0,00%	81,44%	0,00%	0,00%	0,00%	0,00%
17,89%	8,00%	0,00%	0,00%	0,00%	0,00%	35,04%	0,00%	0,00%	0,00%	0,00%
23,69%	8,38%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%



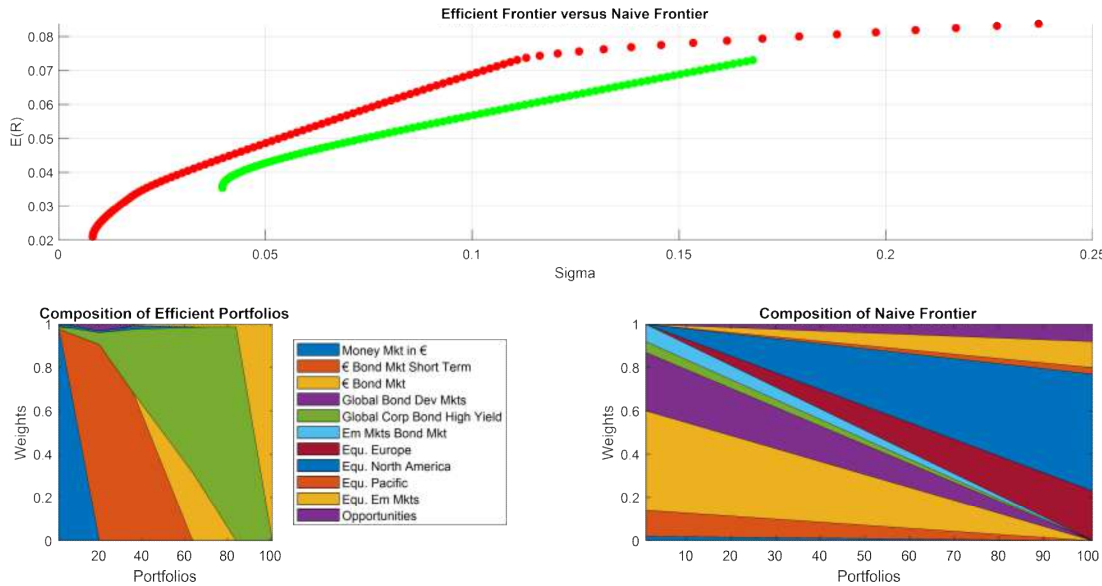


Markowitz optimization via Matlab®

```
clear all
close all
% Inputs trasferred on Matlab
[EXP_RET LABELS]=xlsread('File Excel','Mark opt','A2:B12')
COVARIANCE=xlsread('File Excel.xlsx','Mark opt','H2:R12')
[RISKPORT RETPORT,
```

```
WEIGHTS]=portopt(EXP_RET,COVARIANCE,101)
figure(1)
subplot(2,1,1)
scatter(RISKPORT, RETPORT, 'filled', 'r')
title('Efficient Frontier')
ylabel('E(R)')
xlabel('Sigma')
grid on
subplot(2,1,2)
area(WEIGHTS)
title('Composition of Efficient Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 101]);
% Naive Frontier
EQUITY_PORTION=[0:0.01:1]'
NAIVE_QUALITATIVE_WEIGHTS=xlsread('File Excel.xlsx','Naive
Strategy','F2:F12')
NAIVE_PORTFOLIOS_COMPOSITION=zeros(101,11);
for i=1:101
NAIVE_PORTFOLIOS_COMPOSITION(i,:)=[((1-
EQUITY_PORTION(i,1))*NAIVE_QUALITATIVE_WEIGHTS(1:6,1))'
((EQUITY_PORTION(i,1))*NAIVE_QUALITATIVE_WEIGHTS(7:end,
1))'];
end

EXP_RET_NAIVE=(EXP_RET'*NAIVE_PORTFOLIOS_COMPOSITI
ON')'
SIGMA_NAIVE=zeros(101,1);
for j=1:101
SIGMA_NAIVE(j,1)=sqrt(NAIVE_PORTFOLIOS_COMPOSITION(j,:)*
COVARIANCE*NAIVE_PORTFOLIOS_COMPOSITION(j,:)');
end
figure(2)
```

```
subplot(2,2,[1 2])
scatter(RISKPORT, RETPORT, 'filled', 'r')
hold on
scatter(SIGMA_NAIVE, EXP_RET_NAIVE, 'filled', 'g')
title('Efficient Frontier versus Naive Frontier')
ylabel('E(R)')
xlabel('Sigma')
grid on
hold off
subplot(2,2,3)
area(WEIGHTS)
title('Composition of Efficient Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 101]);
subplot(2,2,4)
area(NAIVE_PORTFOLIOS_COMPOSITION)
title('Composition of Naive Frontier')
ylabel('Weights')
xlabel('Portfolios')
%legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 101]);
```



MARKOWITZ
- MAX E(R)
- Concentrated

Naive
- Rinounce to MAX E(R)
- DIVERSIFICATION

It Glitters but……..

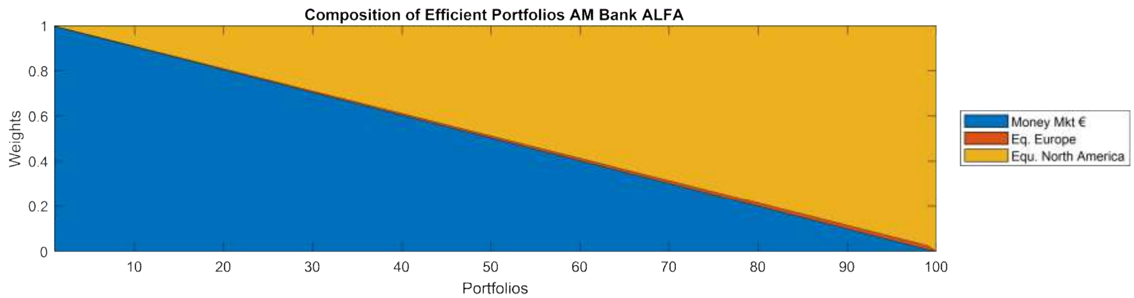
Limitation of Markowitz from a practical point of view:

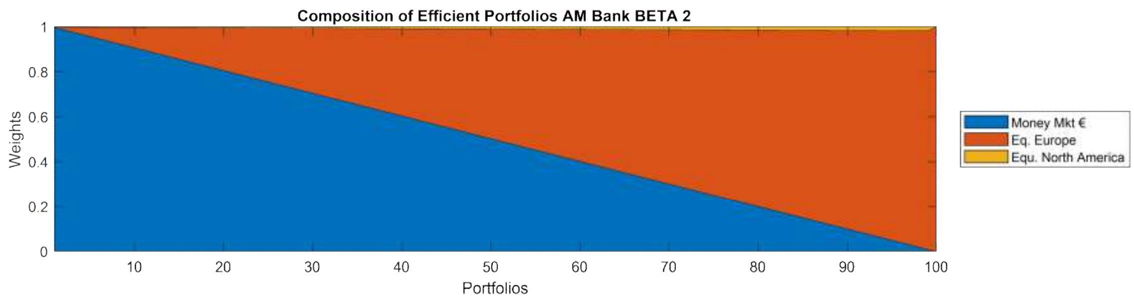
1) Markowitz portfolios are often *unreasonable*

2) Markowitz portfolios are *unstable*

% Strategic Committe ALFA

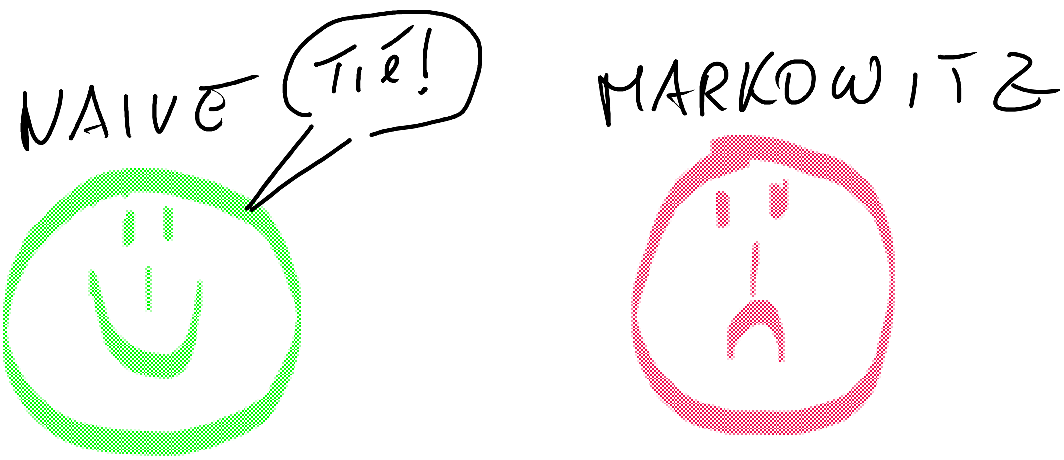
```
LABELS={'Money Mkt €';'Eq. Europe';'Equ. North America'}
EXP_RET1=[0.005; 0.07; 0.074]
SIGMA=[0.01; 0.2; 0.2]
CORR=[1 0 0; 0 1 0.94; 0 0.94 1]
COV=corr2cov(SIGMA, CORR)
[RISK1 REND1 W1]=portopt(EXP_RET1,COV,100)

figure(1)
subplot(2,1,1)
area(W1)
title('Composition of Efficient Portfolios AM Bank ALFA')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
% Strategic Committe BETA
EXP_RET2=[0.005; 0.074; 0.07]
[RISK2 REND2  W2]=portopt(EXP_RET2,COV,100)

subplot(2,1,2)
area(W2)
title('Composition of Efficient Portfolios AM Bank BETA 2')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
```





3) Markowitz Model assumes that estimation error doesn't exist
In other word Analysts are assumed to be clairvoyant
YOU CAN NOT TRUST A MODEL THAT IS NOT ABLE TO MANAGE THE EFFECTS OF AN ESTIMATION ERROR!

4) Markowitz portfolios are also "Estimation Error Maximizers"



We need to find a way to improve the Markowitz Optimization in order to minimize the limitations listed!

PUTTING MARKOWITZ "AT WORK"
↳ PROMOTE DIVERSIFICATION !

PUTTING MARKOWITZ AT WORK

↳ PROMOTE DIVERSIFICATION!

EURISTIC	BAYESIAN
↓ OPTIMIZATION	↓ E(R) estimation

1) Setting additional constaints
2) Resampling®

1) Black-Litterman Approach
2) Shrinkage ~~Estimators~~

Euristic Model 1: Setting additional Constraints

$$\min_{W} \sigma_{PORT}$$

Constraints:

$$E(R)_{PORT} = R^*$$

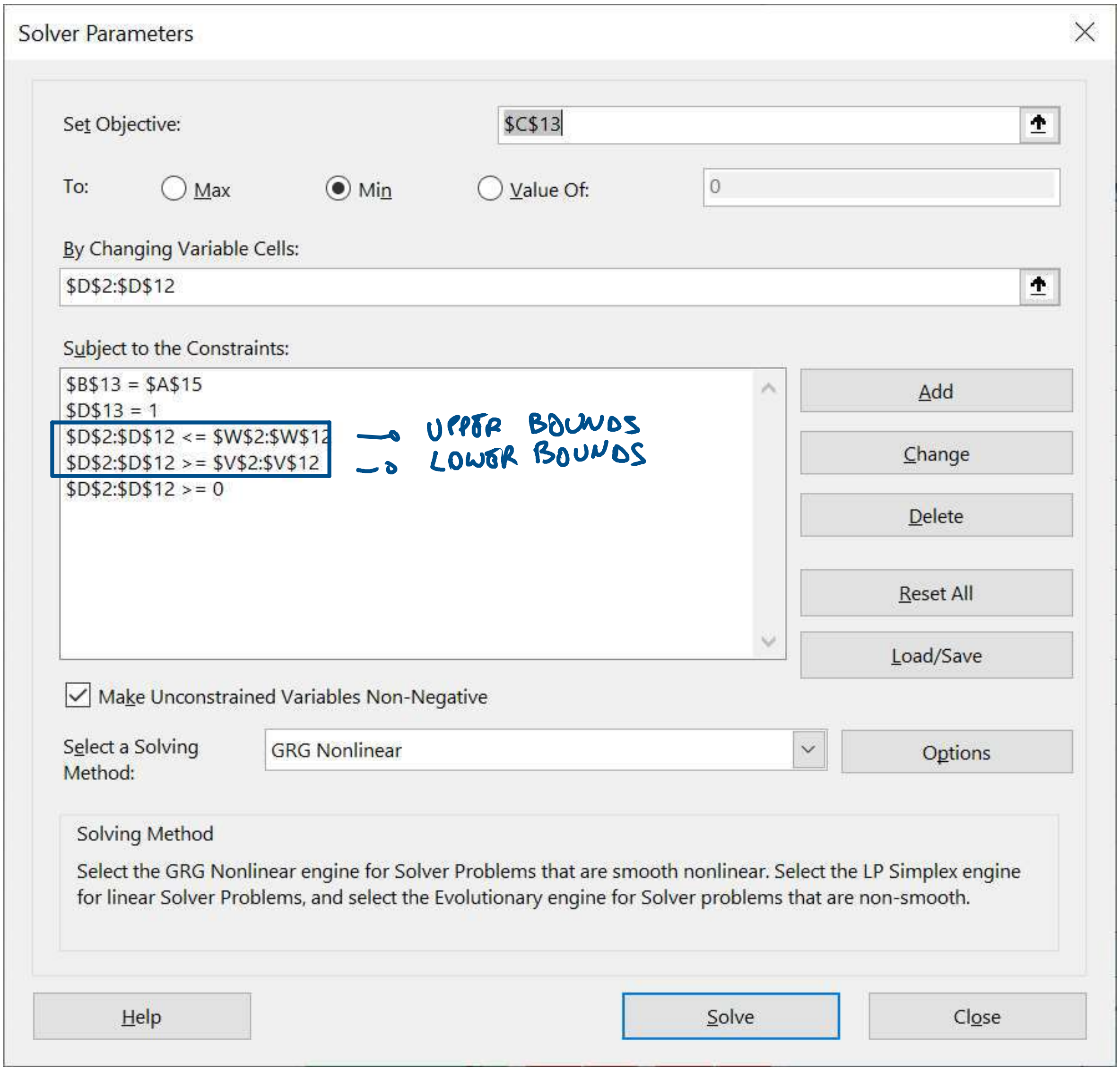
$$\sum_{i=1}^{K} w_i = 1$$

$$w_i \geq 0 \quad \forall_i \in [1;2;...;K]$$

ABSOLUTE CONSTRAINTS

$$w_i \geq h_i$$

$$w_i \leq K_i$$



Asset Class	E(r)	σ	Weights
Money Mkt in €	2,00%	0,87%	73,0%
€ Bond Mkt Short Term	2,90%	1,69%	0,0%
€ Bond Mkt	3,26%	4,17%	0,0%
Global Bond Dev Mkts	3,01%	6,92%	0,0%
Global Corp Bond High Yie	7,30%	11,07%	0,0%
Em Mkts Bond Mkt	6,00%	12,72%	0,0%
Equ. Europe	6,50%	17,53%	7,0%
Equ. North America	7,50%	17,80%	18,0%
Equ. Pacific	6,81%	18,56%	2,0%
Equ. Em Mkts	8,38%	23,69%	0,0%
Opportunities	6,87%	15,36%	0,0%
PORTFOLIO	**3,40%**	**4,39%**	**100,0%**

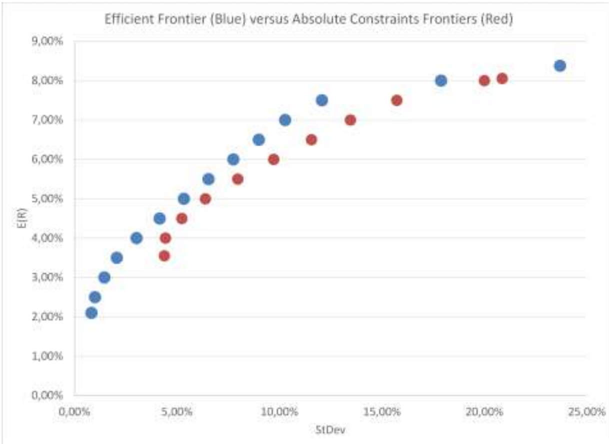
COV	Money Mkt in €	€ Bond Mkt Short T	€ Bond Mkt	Global Bond Dev	Global Corp Bond Hig	Em Mkts Bond M	Equ. Europe	Equ. North Amer	Equ. Pacific	Equ. Em Mkts	Opportunities
Money Mkt in €	**0,0001**	0,0001	0,0001	0,0001	-0,0002	-0,0001	-0,0003	-0,0004	-0,0003	-0,0003	-0,0003
€ Bond Mkt Sh	0,0001	**0,0003**	0,0005	0,0003	-0,0000	0,0001	-0,0004	-0,0006	-0,0003	-0,0005	-0,0005
€ Bond Mkt	0,0001	0,0005	**0,0017**	0,0012	0,0004	0,0008	-0,0004	-0,0003	-0,0002	-0,0004	-0,0007
Global Bond De	0,0001	0,0003	0,0012	**0,0048**	0,0024	0,0026	-0,0023	0,0009	0,0003	-0,0019	-0,0006
Global Corp Bo	-0,0002	-0,0000	0,0004	0,0024	**0,0122**	0,0098	0,0108	0,0129	0,0109	0,0149	0,0114
Em Mkts Bond	-0,0001	0,0001	0,0008	0,0026	0,0098	**0,0162**	0,0110	0,0131	0,0125	0,0192	0,0111
Equ. Europe	-0,0003	-0,0004	-0,0004	-0,0023	0,0108	0,0110	**0,0307**	0,0246	0,0227	0,0305	0,0229
Equ. North Ame	-0,0004	-0,0006	-0,0003	0,0009	0,0129	0,0131	0,0246	**0,0317**	0,0221	0,0285	0,0238
Equ. Pacific	-0,0003	-0,0003	-0,0002	0,0003	0,0109	0,0125	0,0227	0,0221	**0,0344**	0,0341	0,0217
Equ. Em Mkts	-0,0003	-0,0005	-0,0004	-0,0019	0,0149	0,0192	0,0305	0,0285	0,0341	**0,0561**	0,0283
Opportunities	-0,0003	-0,0005	-0,0007	-0,0006	0,0114	0,0111	0,0229	0,0238	0,0217	0,0283	**0,0236**

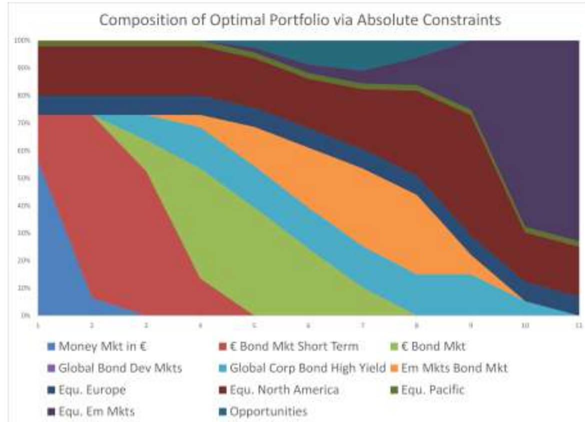
Asset Class	Lower Bounds	Upper Bounds
Money Mkt euro	0%	100%
Bond € Short Term	0%	100%
Bond € MLT	0%	100%
Global Bond Dev Mkts	0%	100%
Bond Corp. High Yield	0%	15%
Bond Emerg. Markets	0%	100%
Equ Europe	7%	100%
Equ North America	18%	100%
Equ Pacific	2%	100%
Equ Emerg. Markets	0%	100%
Opportunities	0%	100%

3,00%
Targeted Return (R*)

σ	E(r)
4,38%	3,55%
4,44%	4,00%
5,24%	4,50%
6,39%	5,00%
7,97%	5,50%
9,72%	6,00%
11,56%	6,50%
13,46%	7,00%
15,73%	7,50%
20,00%	8,00%
20,87%	8,06%

Weights										
Money Mkt in	€ Bond Mkt S	€ Bond Mkt	Global Bond	Global Corp	Em Mkts Bon	Equ. Europe	Equ. North A	Equ. Pacific	Equ. Em Mkt	Opportunities
56,5%	16,5%	0,0%	0,0%	0,0%	0,0%	7,0%	18,0%	2,0%	0,0%	0,0%
6,5%	66,5%	0,0%	0,0%	0,0%	0,0%	7,0%	18,0%	2,0%	0,0%	0,0%
0,0%	52,6%	11,3%	0,0%	9,1%	0,0%	7,0%	18,0%	2,0%	0,0%	0,0%
0,0%	13,5%	40,0%	0,0%	15,0%	4,5%	7,0%	18,0%	2,0%	0,0%	0,0%
0,0%	0,0%	39,4%	0,0%	15,0%	14,2%	7,0%	18,0%	2,0%	1,8%	2,6%
0,0%	0,0%	24,3%	0,0%	15,0%	21,8%	7,0%	18,0%	2,0%	3,2%	8,7%
0,0%	0,0%	10,2%	0,0%	15,0%	28,3%	7,0%	21,8%	2,0%	4,7%	10,9%
0,0%	0,0%	0,0%	0,0%	15,0%	28,9%	7,0%	30,9%	2,0%	9,9%	6,2%
0,0%	0,0%	0,0%	0,0%	15,0%	7,1%	7,0%	43,8%	2,0%	25,1%	0,0%
0,0%	0,0%	0,0%	0,0%	5,3%	0,0%	7,0%	18,0%	2,0%	67,7%	0,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	7,0%	18,0%	2,0%	73,0%	0,0%

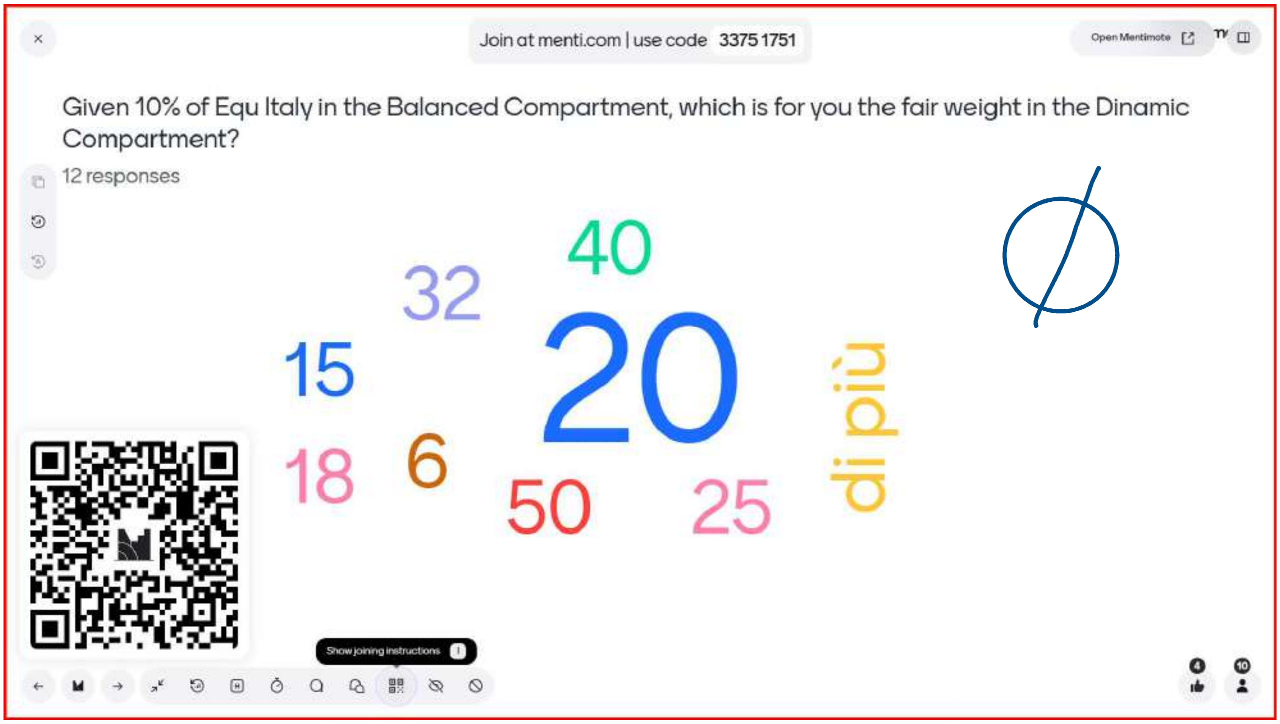


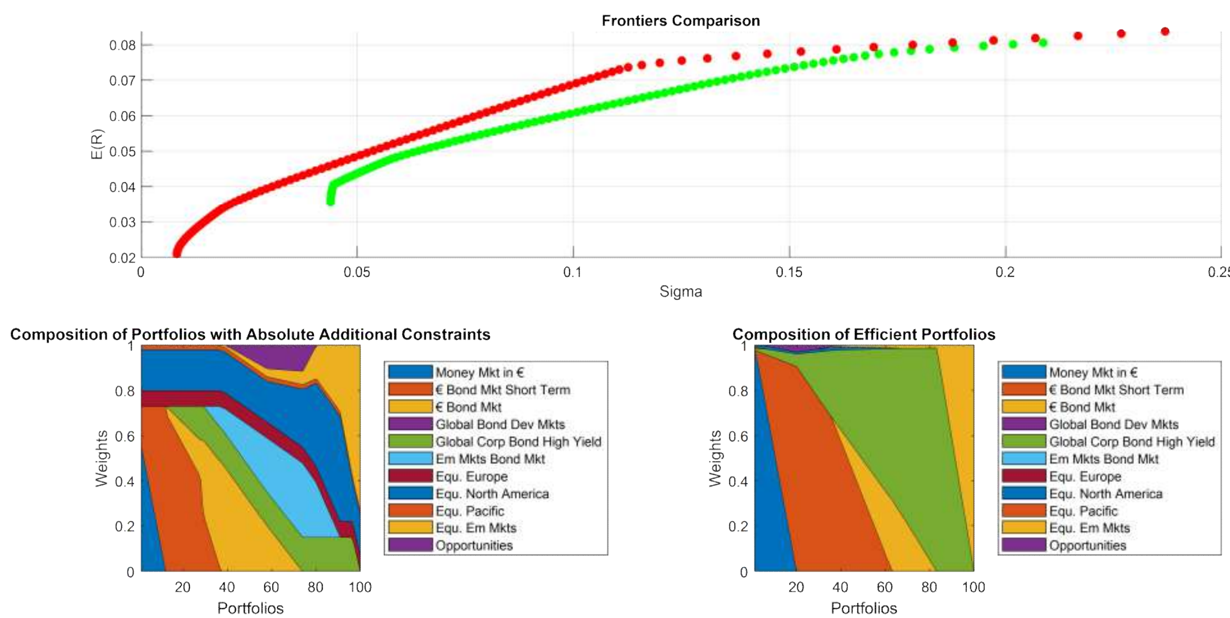


A Replication via Matlab®

```
clear
close all
% Inputs trasferred on Matlab
[EXP_RET LABELS]=xlsread('FILE EXCEL.xlsx','Mark abs','A2:B12')
COVARIANCE=xlsread('FILE EXCEL.xlsx','Mark abs','H2:R12')
[RISKPORT2 RETPORT2,
WEIGHTS2]=portopt(EXP_RET,COVARIANCE,100)

AssetMin=xlsread('FILE EXCEL.xlsx','Mark abs','V2:V12')'
AssetMax=xlsread('FILE EXCEL.xlsx','Mark abs','W2:W12')'
[Aa, ba] = pcalims(AssetMin, AssetMax);
p = Portfolio;
p = setAssetMoments(p, EXP_RET, COVARIANCE);
p = setDefaultConstraints(p);            % implement default
constraints first
p = addInequality(p, Aa, ba);            % implement bound
constraints here
WEIGHTS = estimateFrontier(p, 100);
[RISKPORT, RETPORT] = estimatePortMoments(p, WEIGHTS);
disp([RISKPORT, RETPORT]);

figure(1)
subplot(2,2,[1 2])
scatter(RISKPORT, RETPORT, 'filled', 'g')
hold on
```

```
scatter(RISKPORT2, RETPORT2, 'filled', 'r')
title('Frontiers Comparison')
ylabel('E(R)')
xlabel('Sigma')
grid on
subplot(2,2,3)
area(WEIGHTS')
title('Composition of Portfolios with Absolute Additional Constraints')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
subplot(2,2,4)
area(WEIGHTS2)
title('Composition of Efficient Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
```





Why moving forward the Absolute Constrained Optimization

- We have to avoid "truncation" on the **left**
- We want portfolios that are cohrent among Them

Move from ABSOLUTE Constraints to RELATIVE Constr.

INFRA-GROUP

min σ

INFRA-GROUP

$$\min_{W} \sigma_{PORT}$$

Constraints:

$$E(R)_{PORT} = R^*$$

$$\sum_{i=1}^{K} w_i = 1$$

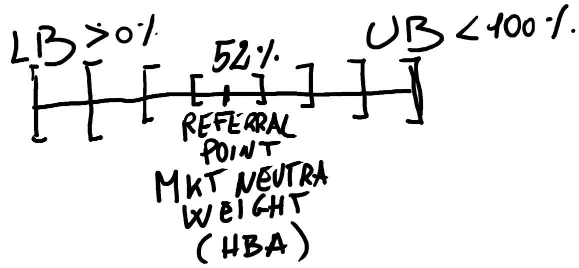
$$w_i \geq 0 \quad \forall_i \in [1; 2; \ldots; K]$$

INFRA-GROUP (Relative) CONSTRAINTS

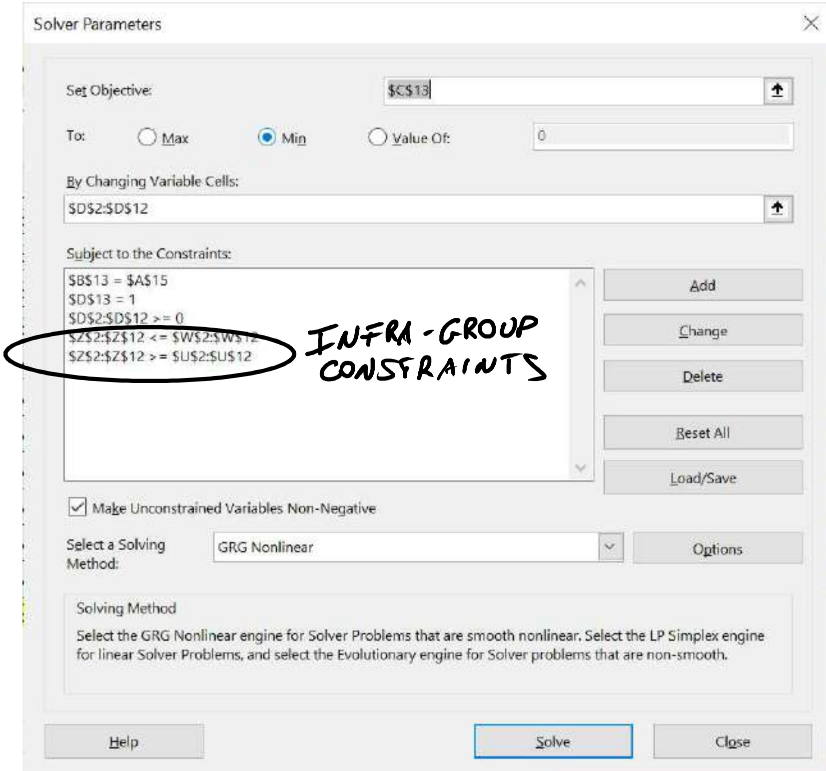
$$\begin{cases} \dfrac{w_i}{\sum W_{GROUP}} \geq h_i \\ \dfrac{w_i}{\sum W_{GROUP}} \leq K_i \end{cases}$$

- How I set these constraint IN ORDER TO INCORPORATE THE GOLDEN RULES

NORTH AMERICA EQUITY MKT



Range of variation proportional to CONFIDENCE



Asset Class	min	MKT NEUTR (hba)	MAX
Money Mkt in €	2,0%	4%	45,0%
€ Bond Mkt Short Term	10,0%	20%	45,0%
€ Bond Mkt	15,0%	40%	60,0%
Global Bond Dev Mkts	10,0%	23%	28,0%
Global Corp Bond High Yield	3,0%	5%	12,0%
Em Mkts Bond Mkt	4,0%	8%	14,0%
Equ. Europe	18,0%	23%	35,0%
Equ. North America	35,0%	52%	60,0%
Equ. Pacific	4,0%	8%	15,0%
Equ. Em Mkts	6,0%	12%	21,0%
Opportunities	3,0%	5%	15,0%

ASSET CLASSES	E(r)	σ	Pesi
Money Mkt in €	2,00%	0,87%	1,63%
€ Bond Mkt Short Term	2,90%	1,69%	27,51%
€ Bond Mkt	3,26%	4,17%	25,93%
Global Bond Dev Mkts	3,01%	6,92%	8,16%
Global Corp Bond High Yie	7,30%	11,07%	9,79%
Em Mkts Bond Mkt	6,00%	12,72%	8,59%
Equ. Europe	6,50%	17,53%	3,31%
Equ. North America	7,50%	17,80%	8,61%
Equ. Pacific	6,81%	18,56%	0,74%
Equ. Em Mkts	8,38%	23,69%	2,97%
Opportunities	6,87%	15,36%	2,76%
PORTFOLIO	**4,50%**	**5,07%**	**100,00%**

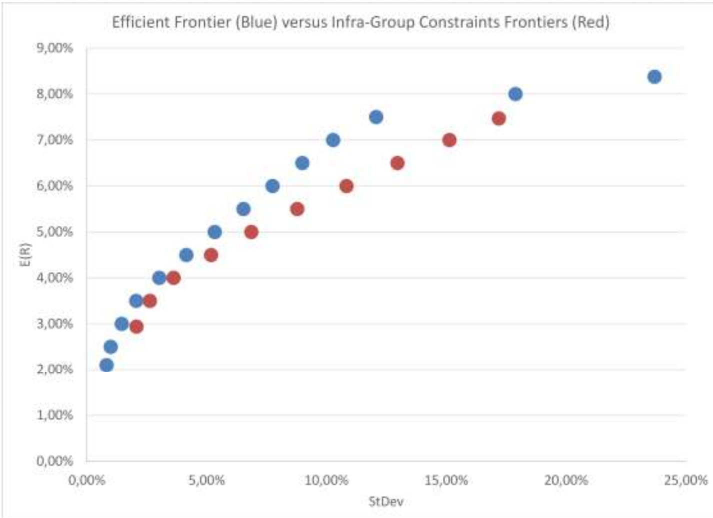
4,50%
Targeted Return (R*)

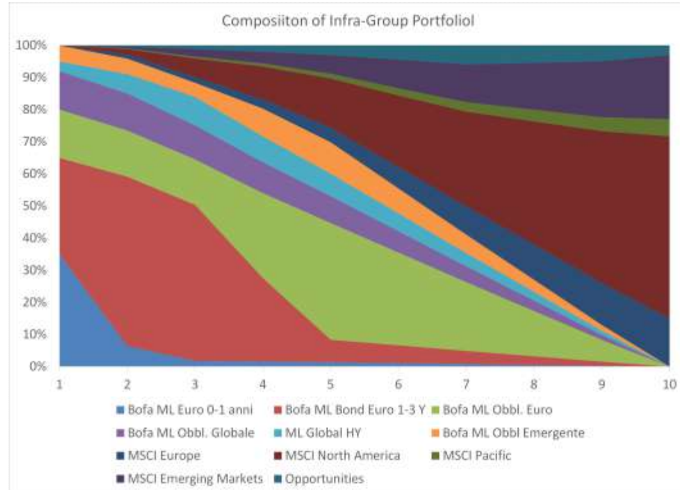
σ	E(r)
2,07%	2,94%
2,63%	3,50%
3,62%	4,00%
5,18%	4,50%
6,87%	5,00%
8,78%	5,50%
10,84%	6,00%
12,96%	6,50%
15,13%	7,00%
17,19%	7,47%

cov	ML Euro 0-1	ML Bond Euro	ML Obbl. E	ML Obbl. Glo	ML Global HY	ML Obbl Emer	MSCI Europe	CI North Ame	MSCI Pacific	Emerging M	Opportunities
Money Mkt	**0,0001**	0,0001	0,0001	0,0001	-0,0002	-0,0001	-0,0003	-0,0004	-0,0003	-0,0003	-0,0003
€ Bond Mkt	0,0001	**0,0003**	0,0005	0,0003	-0,0000	0,0001	-0,0004	-0,0006	-0,0003	-0,0005	-0,0005
€ Bond Mkt	0,0001	0,0005	**0,0017**	0,0012	0,0004	0,0008	-0,0004	-0,0003	-0,0002	-0,0004	-0,0007
Global Bon	0,0001	0,0003	0,0012	**0,0048**	0,0024	0,0026	-0,0023	0,0009	0,0003	-0,0019	-0,0006
Global Cor	-0,0002	-0,0000	0,0004	0,0024	**0,0122**	0,0098	0,0108	0,0129	0,0109	0,0149	0,0114
Em Mkts B	-0,0001	0,0001	0,0008	0,0026	0,0098	**0,0162**	0,0110	0,0131	0,0125	0,0192	0,0111
Equ. Europ	-0,0003	-0,0004	-0,0004	-0,0023	0,0108	0,0110	**0,0307**	0,0246	0,0227	0,0305	0,0229
Equ. North	-0,0004	-0,0006	-0,0003	0,0009	0,0129	0,0131	0,0246	**0,0317**	0,0221	0,0285	0,0238
Equ. Pacifi	-0,0003	-0,0003	-0,0002	0,0003	0,0109	0,0125	0,0227	0,0221	**0,0344**	0,0341	0,0217
Equ. Em M	-0,0003	-0,0005	-0,0004	-0,0019	0,0149	0,0192	0,0305	0,0285	0,0341	**0,0561**	0,0283
Opportuniti	-0,0003	-0,0005	-0,0007	-0,0006	0,0114	0,0111	0,0229	0,0238	0,0217	0,0283	**0,0236**

Weights										
Bofa ML Euro	*Bofa ML Bon*	*Bofa ML Obb*	*Bofa ML Obb*	*ML Global H*	*Bofa ML Obb*	*MSCI Europe*	*MSCI North A*	*MSCI Pacific*	*MSCI Emerg*	*Opportunities*
35,0%	30,0%	15,0%	12,0%	3,0%	5,0%	0,0%	0,0%	0,0%	0,0%	0,0%
6,4%	52,7%	14,4%	11,5%	6,1%	4,8%	1,3%	1,7%	0,2%	0,5%	0,4%
1,8%	48,6%	14,1%	10,6%	8,8%	4,4%	1,7%	5,8%	0,6%	2,3%	1,2%
1,6%	26,0%	26,4%	9,6%	8,0%	8,6%	3,0%	10,1%	1,0%	3,6%	2,0%
1,4%	7,0%	36,3%	8,4%	7,0%	9,8%	4,5%	15,3%	1,5%	5,8%	3,0%
1,1%	5,6%	28,9%	6,7%	5,6%	7,8%	6,7%	22,2%	2,2%	8,9%	4,4%
0,8%	4,1%	21,4%	4,9%	4,1%	5,8%	8,8%	29,4%	2,9%	11,8%	5,9%
0,5%	2,7%	14,1%	3,2%	2,7%	3,8%	10,9%	38,3%	3,6%	14,6%	5,4%
0,3%	1,3%	6,8%	1,6%	1,3%	1,8%	13,0%	47,3%	4,3%	17,4%	4,9%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	15,0%	56,7%	5,3%	20,0%	3,0%

Asset Class	min	MKT NEUTR (hba)	MAX			
Money Mkt in €	2,0%	4%	45,0%			2,0%
€ Bond Mkt Short Term	10,0%	20%	45,0%			33,7%
€ Bond Mkt	15,0%	40%	60,0%			31,8%
Global Bond Dev Mkts	10,0%	23%	28,0%			10,0%
Global Corp Bond High Yield	3,0%	5%	12,0%			12,0%
Em Mkts Bond Mkt	4,0%	8%	14,0%			10,5%
Equ. Europe	18,0%	23%	35,0%			18,0%
Equ. North America	35,0%	52%	60,0%			46,8%
Equ. Pacific	4,0%	8%	15,0%			4,0%
Equ. Em Mkts	6,0%	12%	21,0%			16,2%
Opportunities	3,0%	5%	15,0%			15,0%





Infra-Group Constrained Optimization Via Matlab®

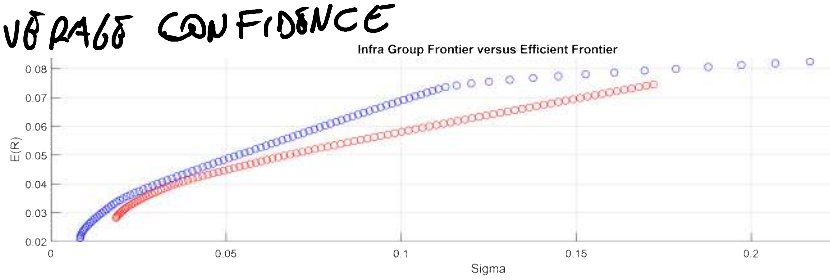
```
clear
close all

%data from the excell file
[EXP_RET LABELS]=xlsread('File Excel.xlsx','Mark infra
optim','A2:B12');
COV=xlsread('File Excel.xlsx','Mark infra optim','H2:R12');
LB1=xlsread('File Excel.xlsx','Mark infra optim','U2:U12');
UB1=xlsread('File Excel.xlsx','Mark infra optim','W2:W12');
%setting P and the constraints for positive weights
P=Portfolio;
P=Portfolio('AssetMean',
EXP_RET,'AssetCovar',COV,'Assetlist',LABELS,'LowerBudget', 1,
'UpperBudget', 1);
LB=-zeros(1,length(EXP_RET));
b=-eye(length(EXP_RET));
P = setInequality(P,b,LB);

POSITION = eye(length(EXP_RET))
GROUP = [1 1 1 1 1 1 0 0 0 0 0;1 1 1 1 1 1 0 0 0 0 0;1 1 1 1 1 1 0 0 0
0 0;1 1 1 1 1 1 0 0 0 0 0;1 1 1 1 1 1 0 0 0 0 0;1 1 1 1 1 1 0 0 0 0 0;0 0
0 0 0 0 1 1 1 1 1;0 0 0 0 0 0 1 1 1 1 1;0 0 0 0 0 0 1 1 1 1 1;0 0 0 0 0 0
1 1 1 1 1;0 0 0 0 0 0 1 1 1 1 1]
```

```
P = setGroupRatio(P, POSITION, GROUP, LB1, UB1);


PORT_WEIGHT=estimateFrontier(P,100)

[RISK_INFRA, EXP_RET_INFRA] = estimatePortMoments(P,
PORT_WEIGHT);


% Standard Optimization
[RISKPORT, RETPORT, WEIGHTS]=portopt(EXP_RET,COV,100)


% Naive Frontier
EQUITY_PORTION=[0:0.01:1]'
NAIVE_QUALITATIVE_WEIGHTS=xlsread('File Excel.xlsx','Naive
Strategy','F2:F12')
NAIVE_PORTFOLIOS_COMPOSITION=zeros(101,11);
for i=1:101
NAIVE_PORTFOLIOS_COMPOSITION(i,:)=[((1-
EQUITY_PORTION(i,1))*NAIVE_QUALITATIVE_WEIGHTS(1:6,1))'
((EQUITY_PORTION(i,1))*NAIVE_QUALITATIVE_WEIGHTS(7:end,
1))'];
end

EXP_RET_NAIVE=(EXP_RET'*NAIVE_PORTFOLIOS_COMPOSITI
ON')'
SIGMA_NAIVE=zeros(101,1);
for j=1:101
SIGMA_NAIVE(j,1)=sqrt(NAIVE_PORTFOLIOS_COMPOSITION(j,:)*
COV*NAIVE_PORTFOLIOS_COMPOSITION(j,:)');
end
```

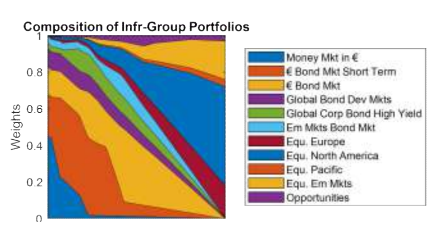
```
figure(1)
subplot(2,2,[1 2])
scatter(RISK_INFRA, EXP_RET_INFRA, 'o', 'r')
hold on
scatter(RISKPORT, RETPORT, 'o', 'b')
%hold on
%scatter(SIGMA_NAIVE, EXP_RET_NAIVE, 'o', 'g')
hold off
title('Infra Group Frontier versus Efficient Frontier')
ylabel('E(R)')
xlabel('Sigma')
grid on
subplot(2,2,3)
area(PORT_WEIGHT')
title('Composition of Infr-Group Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
subplot(2,2,4)
area(WEIGHTS)
title('Composition of Efficient Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);

figure(2)
subplot(2,2,[1 2])
scatter(RISK_INFRA, EXP_RET_INFRA, 'o', 'r')
hold on
```

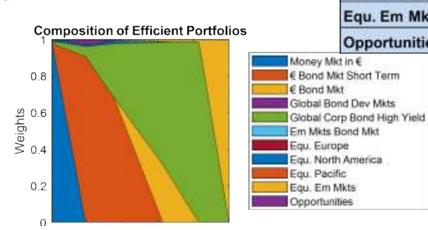
```
scatter(SIGMA_NAIVE, EXP_RET_NAIVE, 'o', 'g')
hold off
title('Infra Group Frontier versus Naive Frontier')
ylabel('E(R)')
xlabel('Sigma')
grid on
subplot(2,2,3)
area(PORT_WEIGHT')
title('Composition of Infr-Group Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
subplot(2,2,4)
area(NAIVE_PORTFOLIOS_COMPOSITION)
title('Composition of Naive Portfolios')
ylabel('Weights')
xlabel('Portfolios')
legenda= legend(LABELS,'Location','EastOutside')
ylim([0 1]);
xlim([1 100]);
```

AVERAGE CONFIDENCE

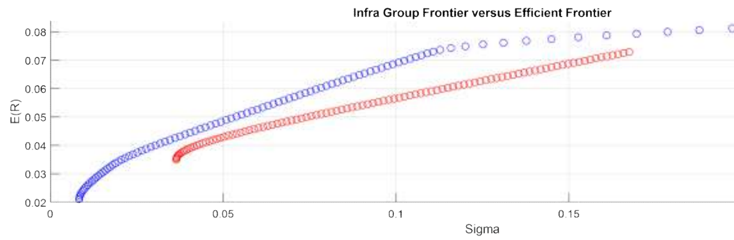


Asset Class	min	MKT NEUTR (hba)	MAX
Money Mkt in €	2,0%	4%	45,0%
€ Bond Mkt Short Term	10,0%	20%	45,0%
€ Bond Mkt	15,0%	40%	60,0%
Global Bond Dev Mkts	10,0%	23%	28,0%
Global Corp Bond High Yield	3,0%	5%	12,0%
Em Mkts Bond Mkt	4,0%	8%	14,0%
Equ. Europe	18,0%	23%	35,0%
Equ. North America	35,0%	52%	60,0%
Equ. Pacific	4,0%	8%	15,0%
Equ. Em Mkts	6,0%	12%	21,0%
Opportunities	3,0%	5%	15,0%

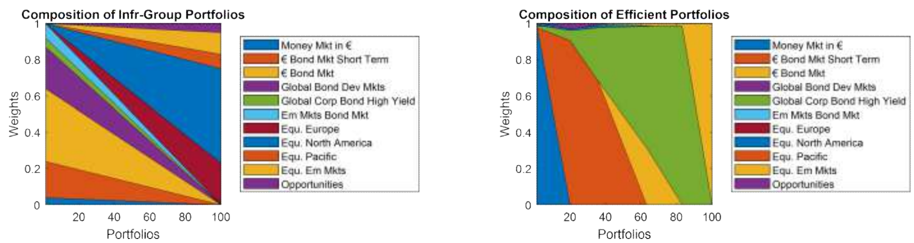




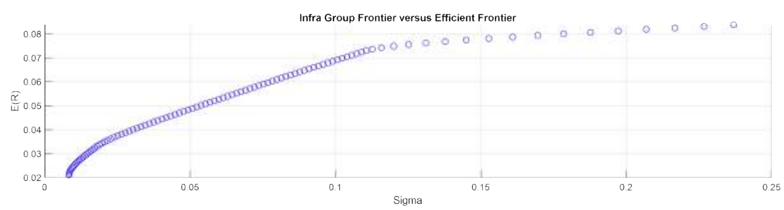
ZERO CONFIDENCE



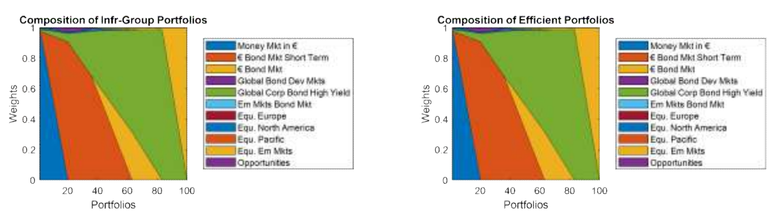
Asset Class	min	MKT NEUTR (hba)	MAX
Money Mkt in €	4,0%	4%	4,0%
€ Bond Mkt Short Term	20,0%	20%	20,0%
€ Bond Mkt	40,0%	40%	40,0%
Global Bond Dev Mkts	23,0%	23%	23,0%
Global Corp Bond High Yield	5,0%	5%	5,0%
Em Mkts Bond Mkt	8,0%	8%	8,0%
Equ. Europe	23,0%	23%	23,0%
Equ. North America	52,0%	52%	52,0%
Equ. Pacific	8,0%	8%	8,0%
Equ. Em Mkts	12,0%	12%	12,0%
Opportunities	5,0%	5%	5,0%



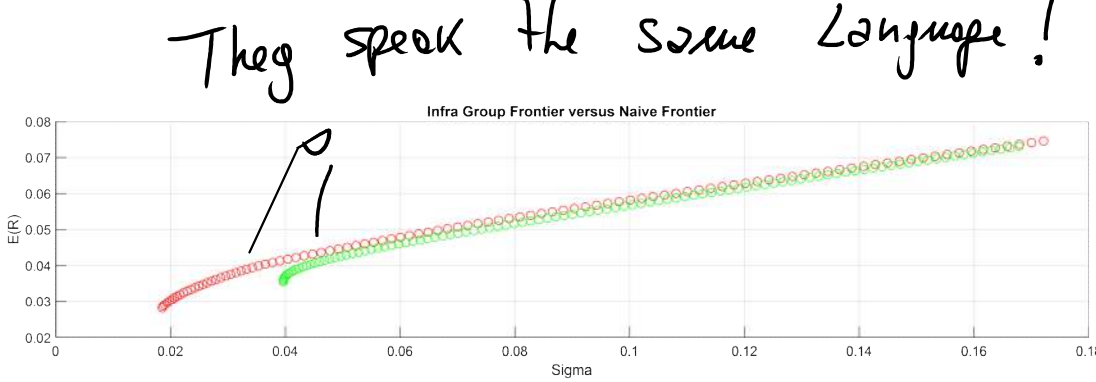
CONFIDENCE 100% (TIME MACHINE)

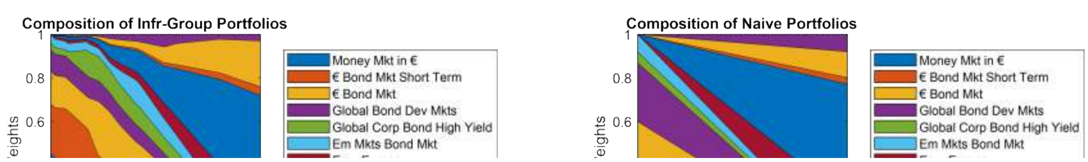


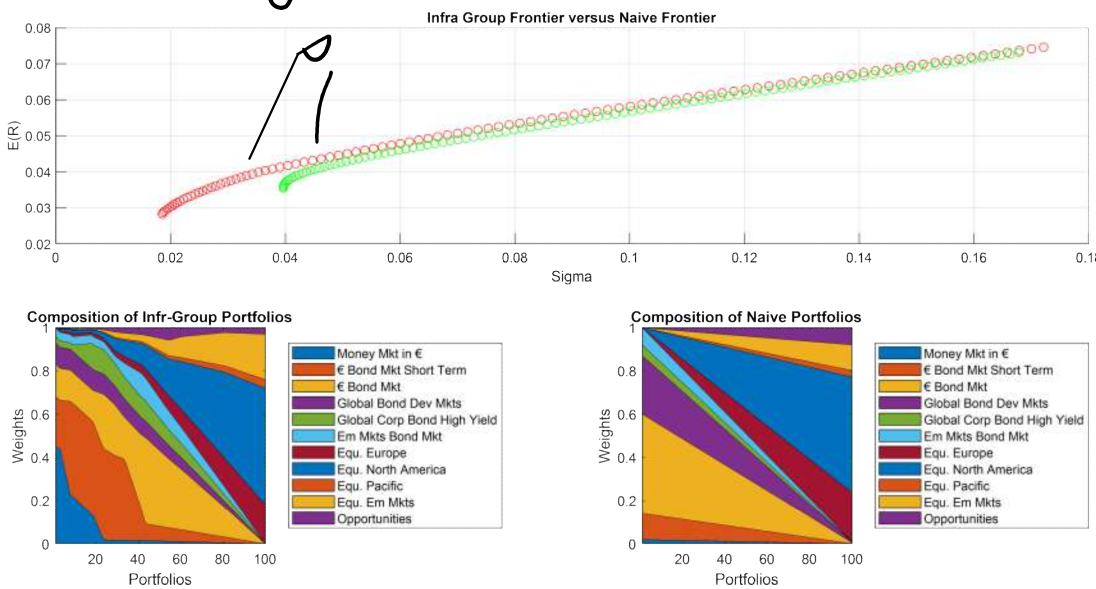
Asset Class	min	MKT NEUTR (hba)	MAX
Money Mkt in €	0,0%	4%	100,0%
€ Bond Mkt Short Term	0,0%	20%	100,0%
€ Bond Mkt	0,0%	40%	100,0%
Global Bond Dev Mkts	0,0%	23%	100,0%
Global Corp Bond High Yield	0,0%	5%	100,0%
Em Mkts Bond Mkt	0,0%	8%	100,0%
Equ. Europe	0,0%	23%	100,0%
Equ. North America	0,0%	52%	100,0%
Equ. Pacific	0,0%	8%	100,0%
Equ. Em Mkts	0,0%	12%	100,0%
Opportunities	0,0%	5%	100,0%



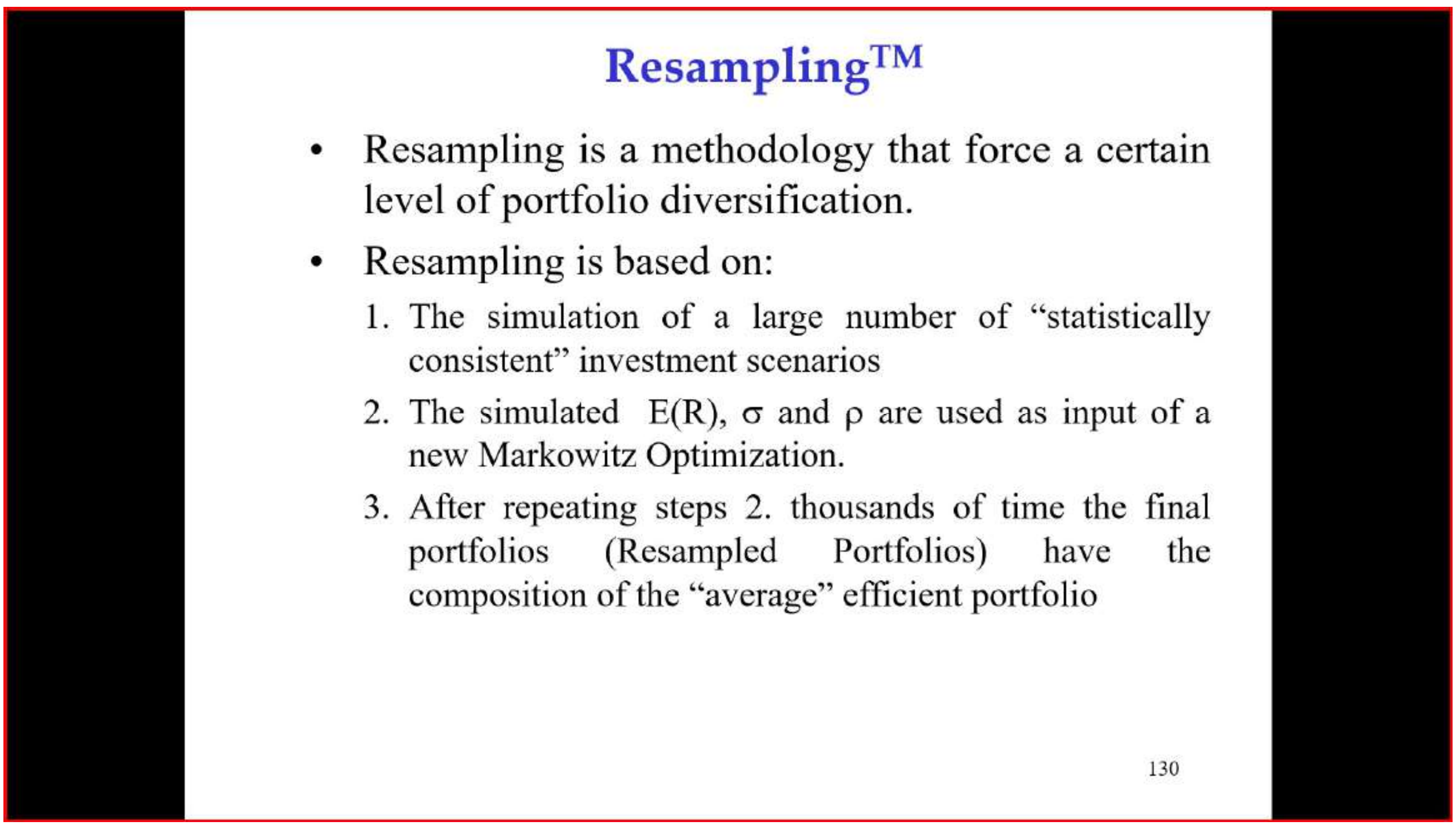
They speak the same Language!





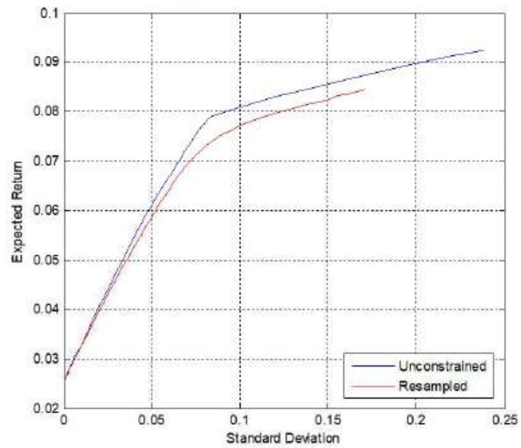


The 2nd Euristic Approach : Resampling™



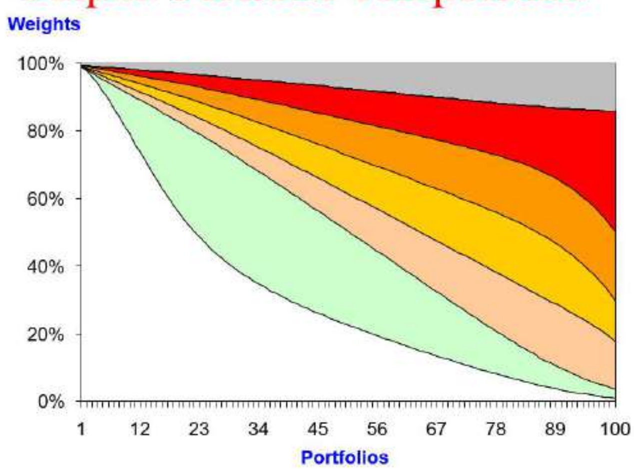
Resampling: Example (2/3)

Output: Resampled Frontier



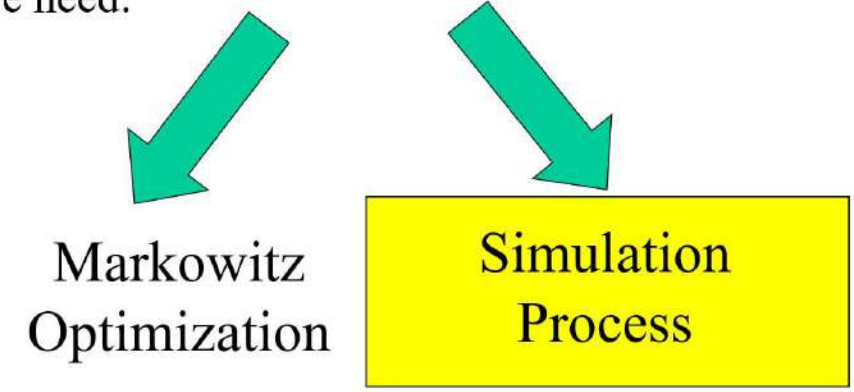
Resampling: Example (3/3)

Output: Portfolio composition



Extra-argument 3: A deeper analysis of Resampling (1/7)

In order to process the resampling technique we need:



135

Extra-argument 3: A deeper analysis of Resampling (2/7)

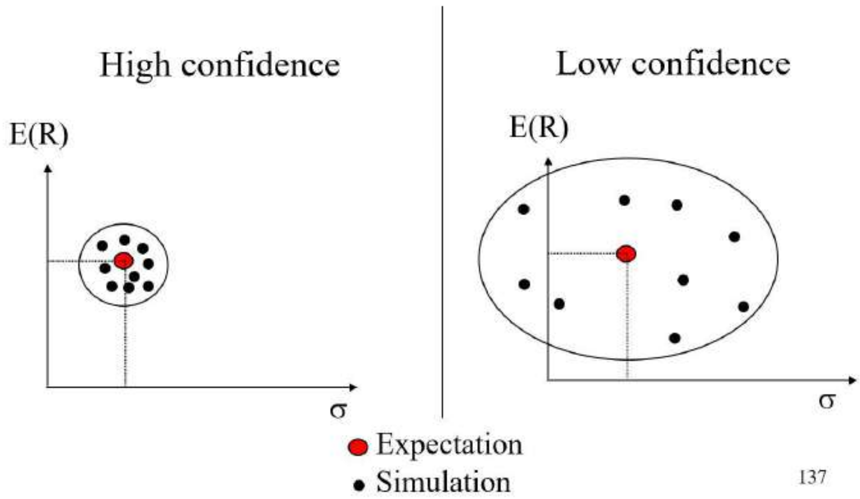
The need to simulate returns:

- We know that our expectations can be wrong;
- So in order to incorporate uncertainty, we can run a simulation process that return behaviours of market returns that are different from our expectation.

136

Extra-argument 3: A deeper analysis of Resampling (3/7)

Simulation: A graphical representation



137

Extra-argument 3: A deeper analysis of Resampling (4/7)

What do we need in order to simulate?

- Forecasts (⇒ E(R), σ, ρ) E
- Confidence on estimations α
- Random process that is able to make deviations from the expectation. ε

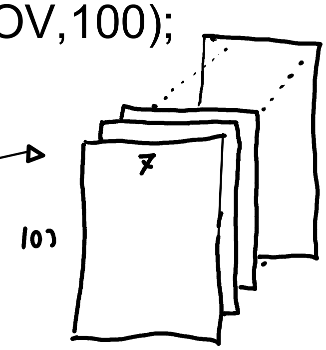
Simulation $= \alpha \cdot E + (1-\alpha)\varepsilon$

138

CONFIDENCE	SIZE
LOW	10-12
MEDIUM	20-25
[illegible]	35-40

MEDIUM	20-25
HIGH	35-40

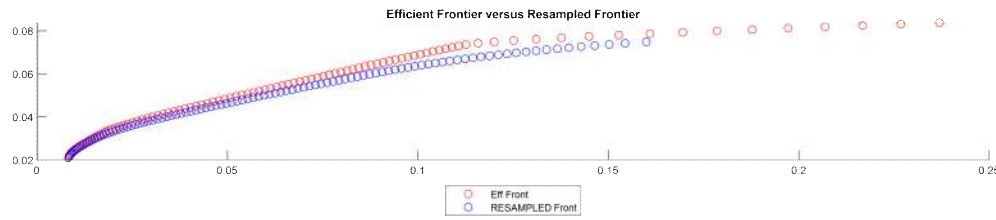
```
clear
close all
% Inputs trasferred on Matlab
[EXP_RET LABELS]=xlsread('File Excel.xlsx','Mark opt','A2:B12')
COV=xlsread('File Excel.xlsx','Mark opt','H2:R12')

ASSET=11;
SIZE=25;
SIM= 1000; %Better if 3,000

% Efficient Frontier
[RISK2,ROR2,WTS2]=portopt(EXP_RET,COV,100);

STORE_WTS=zeros(100,ASSET,SIM);
```

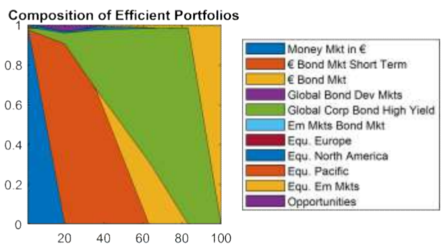


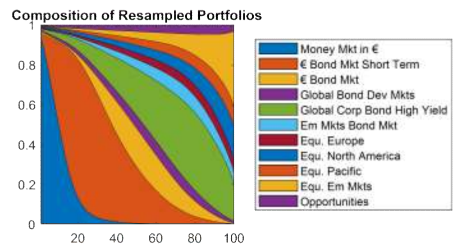

```
for i = 1:SIM
i
SIM_RET= mvnrnd(EXP_RET, COV,SIZE);
EXP_RET_SIM=mean(SIM_RET);
COV_SIM=cov(SIM_RET);
[RISK,ROR,WTS]=portopt(EXP_RET_SIM,COV_SIM,100);
if i<=25
figure(1)
subplot(5,5,i)
area(WTS)
ylim([0 1]);
xlim([1 100]);
pause
end
STORE_WTS(:,:,i)= WTS;
```

```
end

RESAPL_WEIGHTS=mean(STORE_WTS,3);

EXP_RET_RESAMPL= RESAPL_WEIGHTS*EXP_RET;
RISK_RESAMPL = zeros(100,1);
for i = 1 :100
RISK_RESAMPL(i,1) =
sqrt(RESAPL_WEIGHTS(i,:)*COV*RESAPL_WEIGHTS(i,:)');
end

figure(2)
subplot(2,2,[1 2])
scatter (RISK2,ROR2,'R')
hold on
scatter (RISK_RESAMPL,EXP_RET_RESAMPL,'B')
hold off
title('Efficient Frontier versus Resampled Frontier')
legenda= legend({'Eff Front','RESAMPLED
Front'},'Location','SouthOutside')
subplot(2,2,3)
area(WTS2)
legenda= legend(LABELS,'Location','EastOutside')
title('Composition of Efficient Portfolios')
ylim([0 1]);
xlim([1 100]);
subplot(2,2,4)
area(RESAPL_WEIGHTS)
legenda= legend(LABELS,'Location','EastOutside')
title('Composition of Resampled Portfolios')
ylim([0 1]);
xlim([1 100]);
```

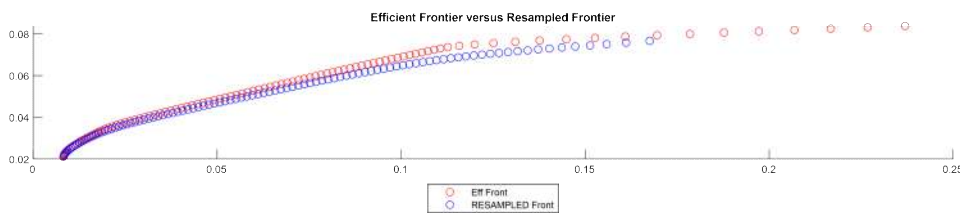
1st Case Size = 25 (AVERAGE CONFIDENCE)

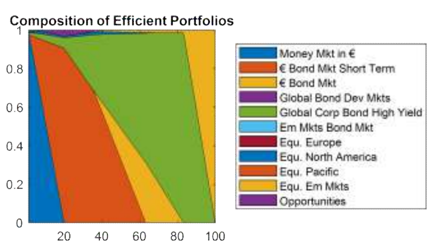


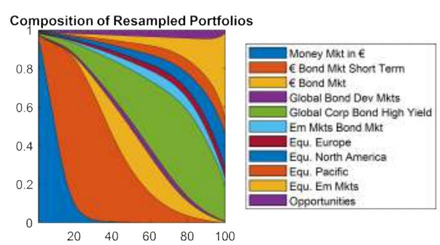




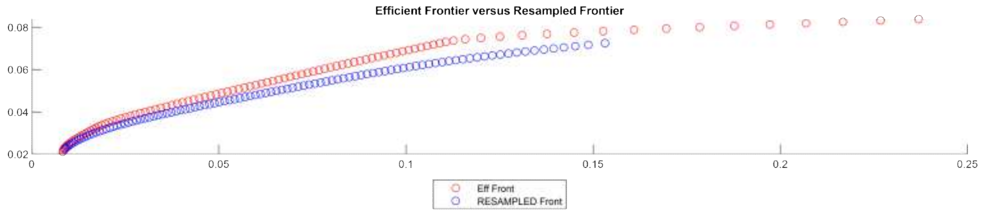
2nd Case : Size = 40 (HIGH CONFIDENCE)

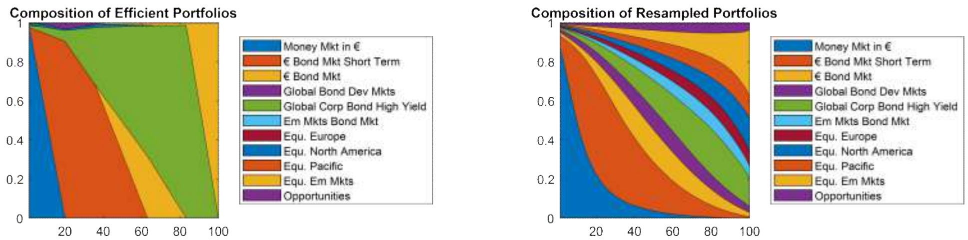




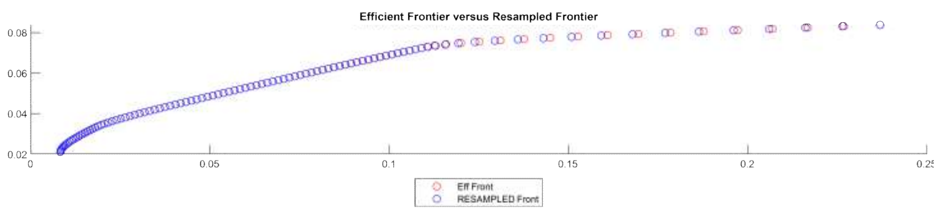


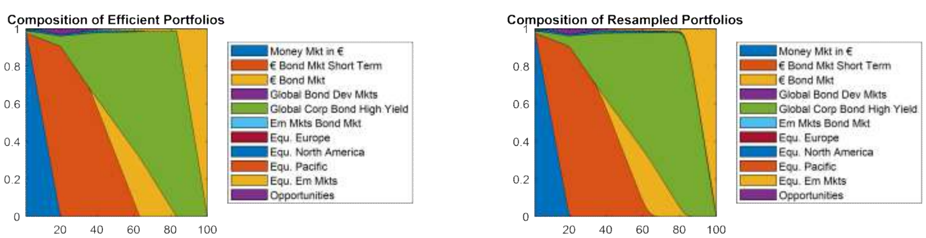
3rd Case Size = 10 (Low Confidence)



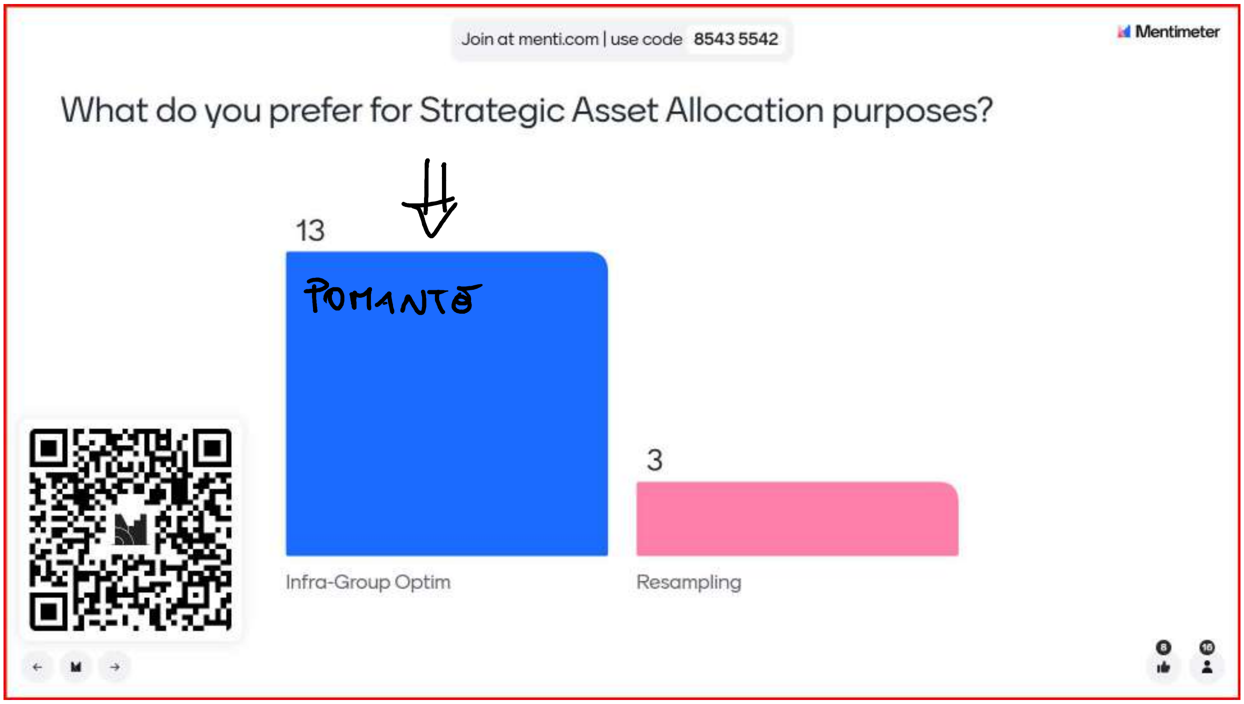


4th Case Size: 10,000 (Equivalent)



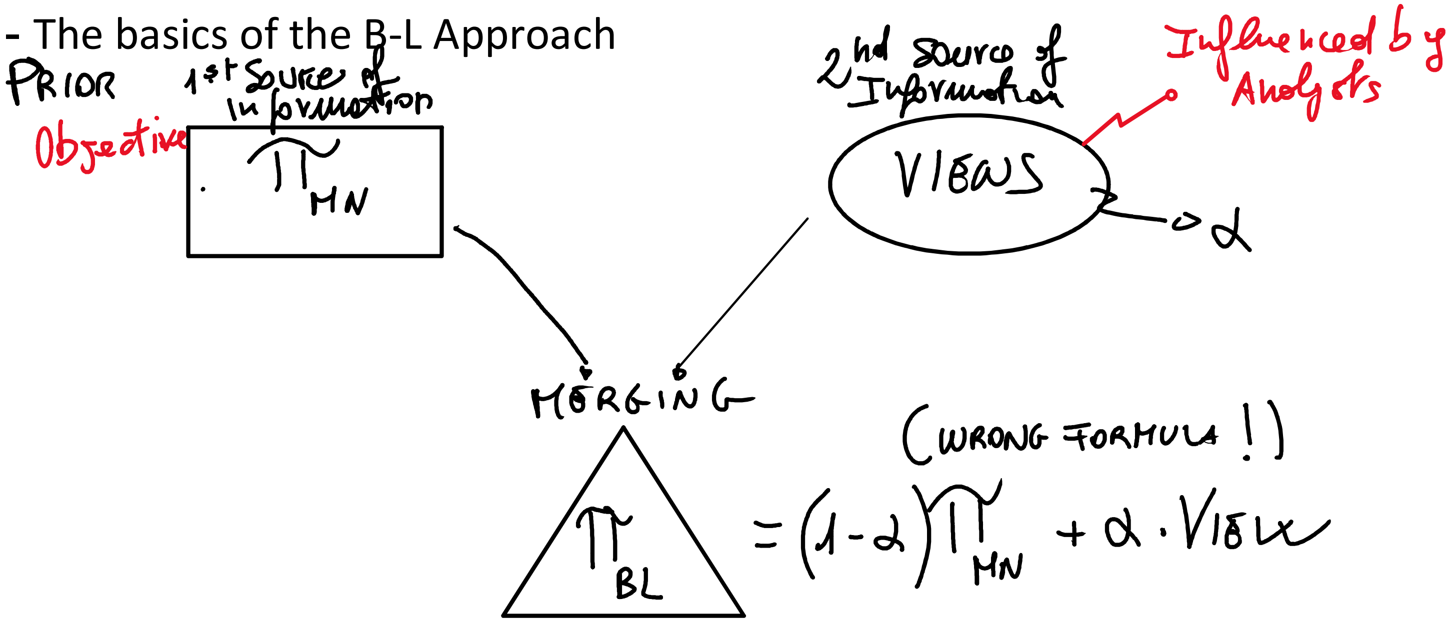


What you prefer: The Infragroup Optimization or the Resampling®? Why?



The Black-Litterman Model

- The basics of the B-L Approach



Analytics of the Model : PRIOR

5 Inputs to manage : r_f ; λ ; Σ ; W_{MN} ; τ

r_f = risk-free Rate

rf	2,00%

r_f = risk-free rate

Σ = Variance-Covariance Matrix of RETURNS

Σ								
0,00006	0,00008	0,00006	0,00007	-0,00017	-0,00006	-0,00033	-0,00039	-0,00034
0,00008	**0,00029**	0,00053	0,00030	0,00000	0,00008	-0,00044	-0,00058	-0,00026
0,00006	0,00053	**0,00174**	0,00121	0,00044	0,00083	-0,00036	-0,00034	-0,00024
0,00007	0,00030	0,00121	**0,00479**	0,00237	0,00258	-0,00231	0,00089	0,00028
-0,00017	0,00000	0,00044	0,00237	**0,01225**	0,00984	0,01078	0,01285	0,01094
-0,00006	0,00008	0,00083	0,00258	0,00984	**0,01618**	0,01098	0,01310	0,01251
-0,00033	-0,00044	-0,00036	-0,00231	0,01078	0,01098	**0,03072**	0,02460	0,02275
-0,00039	-0,00058	-0,00034	0,00089	0,01285	0,01310	0,02460	**0,02933**	0,02214
-0,00034	-0,00026	-0,00024	0,00028	0,01094	0,01251	0,02275	0,02214	**0,03443**
-0,00034	-0,00051	-0,00043	-0,00195	0,01494	0,01918	0,03046	0,02853	0,03411
-0,00026	-0,00055	-0,00067	-0,00066	0,01138	0,01110	0,02294	0,02375	0,02170

W_{MN} = Column Vector of Mkt Neutral Weights (MKT NEUTRAL PORTFOLIO)

Wmn
2%
12%
25%
14%
3%
5%
7%
21%
3%
5%
2%

$$\lambda = \text{Risk Adversion Coefficient} = \frac{E(R)_{MN} - r_f}{\sigma^2_{MN}}$$ = Measure of OPTIMISM about the future performance of the MARKET

lambda	5,00

REVERSE Optimization:

$$\Pi_{MN} = r_f + \lambda \cdot \Sigma \cdot W_{MN}$$

	Π MN
Bofa ML Euro 0-1 anni	1,95%
Bofa ML Bond Euro 1-3 Y	2,01%
Bofa ML Obbl. Euro	2,29%
Bofa ML Obbl. Globale	2,58%
ML Global HY	5,03%
Bofa ML Obbl Emergente	5,38%
MSCI Europe	7,18%
MSCI North America	7,72%
MSCI Pacific	7,18%
MSCI Emerging Markets	8,74%
Opportunities	6,85%

Conclusion of the PRIOR Analysis:

$$\text{Expected Returns (of Asset Classes)} \sim N(\Pi_{MN} ; \tau \cdot \Sigma)$$

Σ → VARIANCE Covariance Matrix of EXPECTED RETURNS

VARIANCE COVARIANCE MATRIX OF EXPECTED RETURNS

τ = scalar able to transform the Var-Cov Matrix of Returns in a Var-Cov Matrix of Expected Returns

$\tau = \frac{1}{T}$ → Applying the properties of the sample mean

T → size (in years) of time series used to estimate Σ

$\tau = \frac{1}{24} =$

τ	0,042

r → TS "T" → σ_r^2

$\bar{r}$ → TS "T" → $\sigma_r^2 \cdot \frac{1}{T}$

Analytics of the B-L Model : Views

Inputs : P ; Q ; C ; Ω

P: { num. of columns: numb. of Asset Classes previously selected; num. of Rows: numb. of Views expressed }

Function: Identify the asset class involved in every View.

1st is European Equity will perform ..... K % — P_1

2nd is N.A. Equity will overperform Pacific Equity ..... h % — P_2

P

Money Mkt in €	€ Bond Mkt Short Term	€ Bond Mkt	Global Bond Dev Mkts	Global Corp Bond High	Em Mkts Bond Mkt	Equ. Europe	Equ. North America	Equ. Pacific	Equ. Em Mkts	OPPORT	
0	0	0	0	0	0	1	0	0	0	0	P_1
0	0	0	0	0	0	0	1	-1	0	0	P_2

Q - Column Vector — num. rows = numb. of Views

↳ which are the Views:

K %
h %

C - Column Vector — numb. rows = numb of Views

C - Column Vector — numb. rows = numb of views

↳ which are the confidence levels of the views

30%	c_1
35%	c_2

$c_1; c_2; \dots; c_K$ → $T \in]0; 100\%[$; → $P \in [15\%; 40\%]$

Conclusion of the 2nd source of Information

$$\text{Views} \sim N(Q; \Omega)$$

Ω by Meucci

$$\Omega = \begin{bmatrix} \left(\frac{1}{c_1}-1\right)\cdot p_1\cdot(\tau\Sigma)\cdot p_1^T & 0 & 0 & 0 \\ 0 & \left(\frac{1}{c_2}-1\right)\cdot p_2\cdot(\tau\Sigma)\cdot p_2^T & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & \left(\frac{1}{c_K}-1\right)\cdot p_K\cdot(\tau\Sigma)\cdot p_K^T \end{bmatrix}$$

↳ Assumption: Views NOT correlated

Ω = Quadratic Matrix numb of row = numb of column = numb of Views

PRIOR:

$$\text{Exp Ret} \sim N(\Pi_{MN}; \tau\Sigma)$$

VIEWS:

$$\text{Views} \sim N(Q; \Omega)$$

$$\Pi_{BL} = (1-\alpha)\cdot \Pi_{MN} + \alpha \cdot Q$$

$$= \frac{\tau\Sigma^{-1}\cdot\Pi_{MN} + \Omega^{-1}\cdot Q}{\tau\Sigma^{-1} + \Omega^{-1}}$$

$$\left(\tau\Sigma^{-1} + \Omega^{-1}\right)^{-1}\cdot\left(\tau\Sigma^{-1}\cdot\Pi_{MN} + \Omega^{-1}\cdot Q\right)$$

$$\Pi_{BL} = \left[(\tau\Sigma)^{-1} + P^{T}\cdot\Omega^{-1}\cdot P\right]^{-1} \times \left[(\tau\Sigma)^{-1}\cdot\Pi_{MN} + P^{T}\cdot\Omega^{-1}\cdot Q\right]$$

Excel:

VIEWS	view	confidence
North America Equ. Mkt overperformes European Equity Mkt	2,0%	30,00000000000000%
HY Corp Bond Mkt overperforms Global Bond	3,5%	30,00000000000000%

ASSET CLASS	Wmn
Money Mkt in €	2%
€ Bond Mkt Short Term	4%
€ Bond Mkt	10%
Global Bond Dev Mkts	36%
Global Corp Bond High Yield	3%
Em Mkts Bond Mkt	5%
Equ. Europe	7%
Equ. North America	22%
Equ. Pacific	4%
Equ. Em Mkts	5%
Opportunities	2%

Σ				
0,00008	0,00008	0,00008	0,00007	-0,00017
0,00008	**0,00029**	0,00053	0,00030	0,00000
0,00008	0,00053	**0,00174**	0,00121	0,00044
0,00007	0,00030	0,00121	**0,00479**	0,00237
-0,00017	0,00000	0,00044	0,00237	**0,01225**
-0,00006	0,00008	0,00083	0,00258	0,00984
-0,00033	-0,00044	-0,00036	-0,00231	0,01078
-0,00039	-0,00058	-0,00034	0,00089	0,01285
-0,00034	-0,00026	-0,00024	0,00028	0,01094
-0,00034	-0,00051	-0,00043	-0,00195	0,01494
-0,00026	-0,00055	-0,00067	-0,00056	0,01138

rf	2,00%
lambda	5,00

	Π MN	Rend BL
Money Mkt in €	**1,94%**	**1,93%**
€ Bond Mkt Short Term	**1,99%**	**1,97%**
€ Bond Mkt	**2,27%**	**2,25%**
Global Bond Dev Mkts	**2,99%**	**3,02%**
Global Corp Bond High Yield	**5,37%**	**5,71%**
Em Mkts Bond Mkt	**5,71%**	**5,98%**
Equ. Europe	**7,22%**	**7,40%**
Equ. North America	**8,12%**	**8,61%**
Equ. Pacific	**7,47%**	**7,75%**
Equ. Em Mkts	**8,89%**	**9,31%**
Opportunities	**7,09%**	**7,45%**

MN Exp	View Exp	View Finale
2,38%	3,50%	**2,69%**

MN Exp	View Exp	View Finale
0,90%	2,00%	**1,21%**

τ	0,043

τ*Σ

3,27597E-06	3,65759E-06	3,62514E-06	3,10187E-06	-7,5641E-06	-2,67577E-06	-1,44379E-05	-1,70686E-05	-1,48648E-05	-1,46461E-05	-1,1341E-05
3,65759E-06	1,23999E-05	2,29786E-05	1,30898E-05	-8,53905E-08	3,40114E-06	-1,92512E-05	-2,502E-05	-1,14737E-05	-2,23308E-05	-2,3849E-05
3,62514E-06	2,29786E-05	7,55601E-05	5,26642E-05	1,90966E-05	3,5933E-05	-1,57961E-05	-1,46512E-05	-1,03816E-05	-1,8783E-05	-2,9057E-05
3,10187E-06	1,30898E-05	5,26642E-05	0,000208049	0,000102891	0,00011198	-0,000100304	3,87223E-05	1,22146E-05	-8,45913E-05	-2,4173E-05
-7,5641E-06	-8,53905E-08	1,90966E-05	0,000102891	0,000532404	0,000427649	0,000468503	0,000558714	0,000475863	0,00064947	0,000494718
-2,67577E-06	3,40114E-06	3,5933E-05	0,00011198	0,000427649	0,000703339	0,000477533	0,000569582	0,000543976	0,000833878	0,000482792
-1,44379E-05	-1,92512E-05	-1,57961E-05	-0,000100304	0,000468503	0,000477533	0,001335673	0,001069467	0,000989103	0,001324529	0,000997553
-1,70686E-05	-2,502E-05	-1,46512E-05	3,87223E-05	0,000558714	0,000569582	0,001069467	0,001275386	0,000962793	0,001240542	0,001032756
-1,48648E-05	-1,14737E-05	-1,03816E-05	1,22146E-05	0,000475863	0,000543976	0,000989103	0,000962793	0,001496974	0,001482943	0,00094331
-1,46461E-05	-2,23308E-05	-1,8783E-05	-8,45913E-05	0,00064947	0,000833878	0,001324529	0,001240542	0,001482943	0,002440623	0,001230523
-1,13406E-05	-2,38487E-05	-2,90574E-05	-2,41734E-05	0,000494718	0,000482792	0,000997553	0,001032756	0,00094331	0,001230523	0,001025552

Money Mkt in €	€ Bond Mkt Short Term	€ Bond Mk	Global Bon	Global Corp Bond	Em Mkts Bond Mk	Equ. Europe	Equ. North Americ	Equ. Pacific	Equ. Em Mkts	Opportunities
0	0	0	0	0	0	-1	1	0	0	0
0	0	0	-1	1	0	0	0	0	0	0

2,00%
3,50%

30%
30%

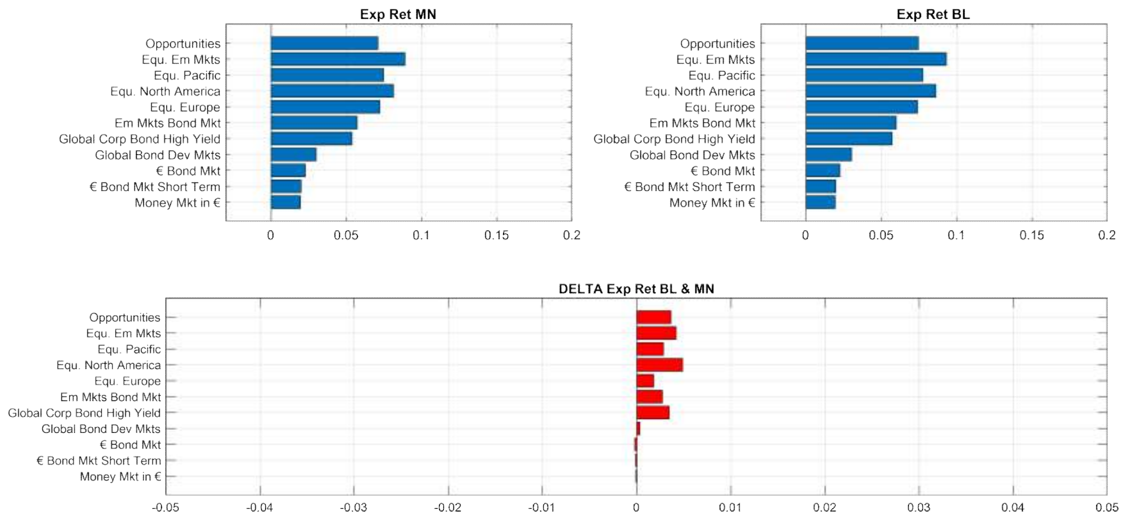
0,001101624875543700000	0
0	0,001247566863017590 0

Matlab :

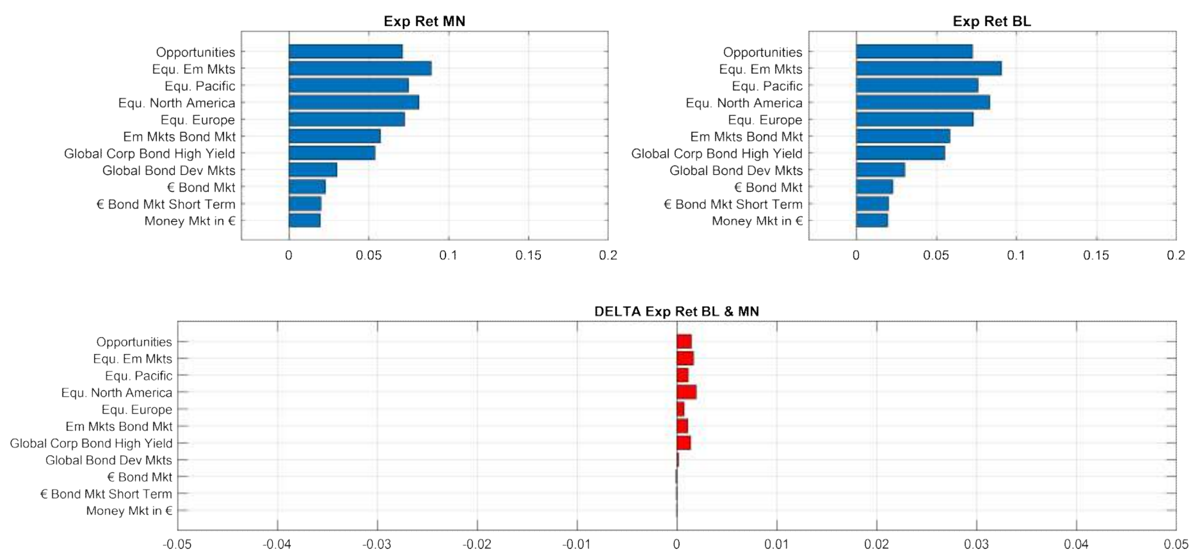
```
clear
close all
SIGMA=xlsread('File Excel.xlsx','BL','D6:N16')
[W_MN LABELS]=xlsread('File Excel.xlsx','BL','A6:B16')

RISK_FREE=0.02
LAMBDA=5;
EXP_RET_MN=RISK_FREE+LAMBDA*SIGMA*W_MN
TAU=1/24
TAU_SIGMA=TAU*SIGMA
P=[0 0 0 -1 1 0 0 0 0 0 0;
   0 0 0 0 0 0 -1 1 0 0 0];
Q=[0.035;0.02]
C=[0.30; 0.30]
OMEGA=zeros(2,2);
for f=1:2
for g=1:2
if f==g
OMEGA(f,g)=((1/C(f,1)-1)*P(f,:)*(TAU_SIGMA)*P(f,:)');
end
end
end

REND_BL=inv(inv(TAU_SIGMA)+P'*inv(OMEGA)*P)*(inv(TAU_SIG
MA)*EXP_RET_MN+P'*inv(OMEGA)*Q)
```

```
GAP=REND_BL-EXP_RET_MN;


figure(1)
subplot(2,2,1)
barh (EXP_RET_MN)
xlim([-0.03 0.20]);
set(gca,'YTickLabel',LABELS)
grid on
title('Exp Ret MN')
subplot(2,2,2)
barh (REND_BL)
xlim([-0.03 0.20]);
title('Exp Ret BL')
set(gca,'YTickLabel',LABELS)
grid on

subplot(2,2,[3 4])
barh (GAP,'r')
title('DELTA Exp Ret BL & MN')
xlim([-0.05 0.05]);
set(gca,'YTickLabel',LABELS)
grid on
```

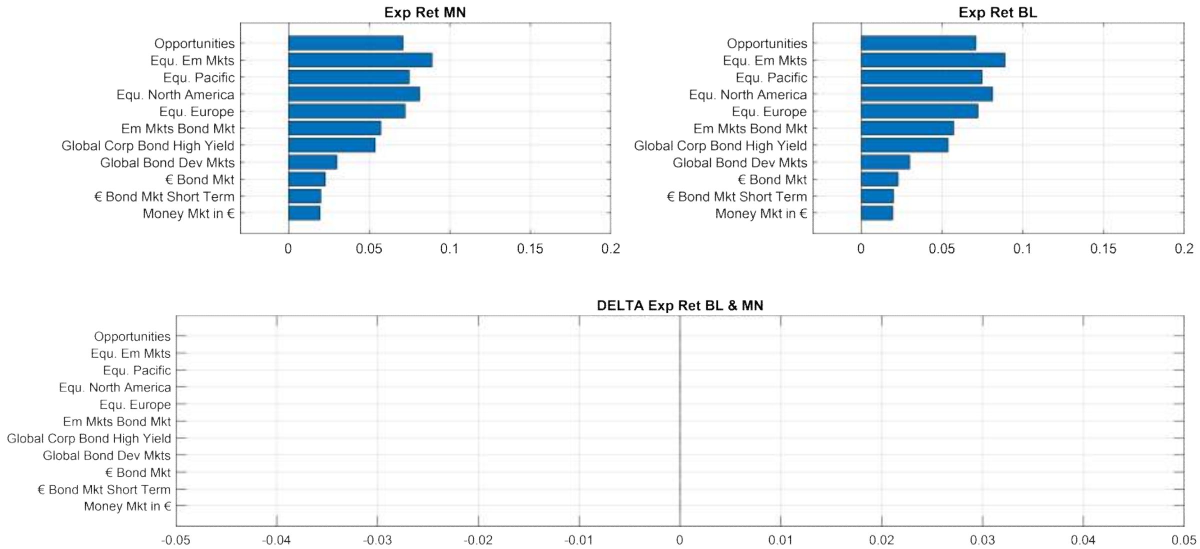
$c_1 = c_2 = 30\%$



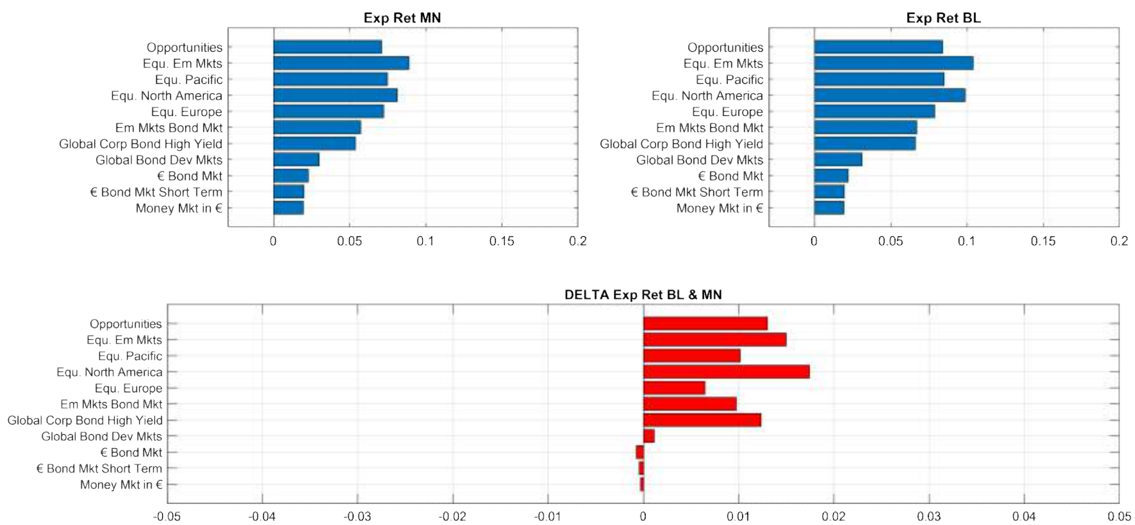
$C_1 = C_2 = 12\%$



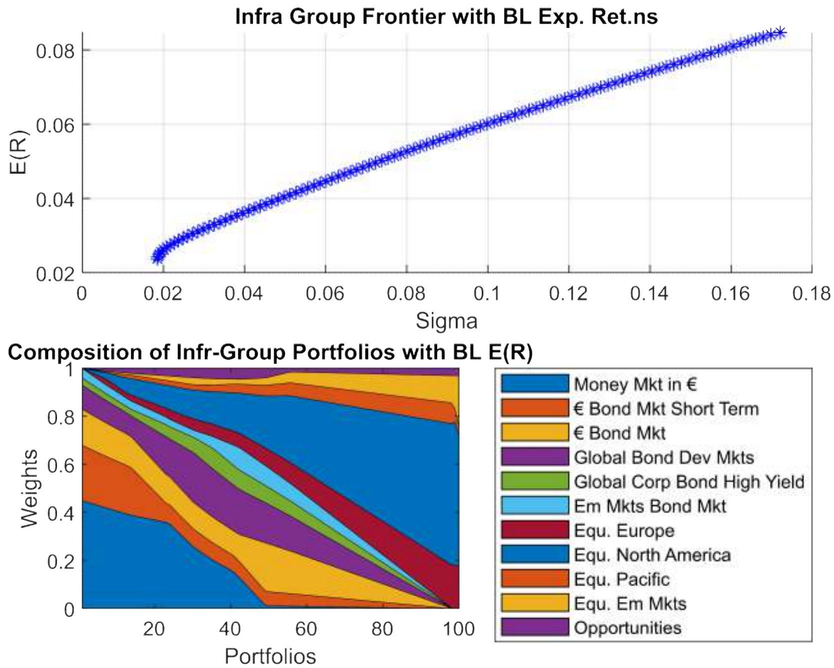
$C_1 = C_2 \cong \emptyset$



$c_1 = c_2 = 99,99999\ \%$



Final SAA : Combination {
- Intra group constrained Optimization
+
- Black-Litterman Model



SAA and Value at Risk (VaR)

HP/Risk Tol	low	medium	medium-high	high
1 yr				
3 yrs				
5 yrs			-9,2%	
10 yrs				

0%	0	0%
-2,5%	1	7%
-5%	1	7%
-7,5%	6	40%
-10%	4	27%
-15%	3	20%

ASSET CLASSES	E(r) BL	σ	Pesi
Money Mkt in €	1,93%	0,87%	1,10%
€ Bond Mkt Short Term	1,97%	1,69%	5,50%
€ Bond Mkt	2,25%	4,17%	18,72%
Global Bond Dev Mkts	3,02%	6,92%	15,41%
Global Corp Bond High Yie	5,71%	11,07%	6,61%
Em Mkts Bond Mkt	5,98%	12,72%	7,71%
Equ. Europe	7,40%	17,53%	8,09%
Equ. North America	8,61%	17,80%	26,97%
Equ. Pacific	7,75%	18,56%	4,61%
Equ. Em Mkts	9,31%	23,69%	3,93%
Opportunities	7,45%	15,36%	1,35%
PORTFOLIO	**5,60%**	**8,87%**	**100,00%**

Tolerated Loss	-9%
VaR (95%)	-9,00%

COV	ML Euro 0-1	ML Bond Euro	fa ML Obbl. E
Money Mkt	**0,0001**	0,0001	0,0001
€ Bond Mk	0,0001	**0,0003**	0,0005
€ Bond Mk	0,0001	0,0005	**0,0017**
Global Bon	0,0001	0,0003	0,0012
Global Cor	-0,0002	-0,0000	0,0004
Em Mkts B	-0,0001	0,0001	0,0008
Equ. Europ	-0,0003	-0,0004	-0,0004
Equ. North	-0,0004	-0,0006	-0,0003
Equ. Pacifi	-0,0003	-0,0003	-0,0002
Equ. Em M	-0,0003	-0,0005	-0,0004
Opportuniti	-0,0003	-0,0005	-0,0007

Higher order moments.......

$$\max_{w} \ \alpha E(R)_{PORT} + (1-\alpha) SK_{PORT}$$

α → How much you appreciate E(R)

$(1-\alpha)$ → How much you appreciate SK

Constraints:

$\sigma_{PORT} = \sigma^*$

$\sum w_i = 1$

$w_i \geq 0 \quad \forall i \in [1;2;3...;N]$

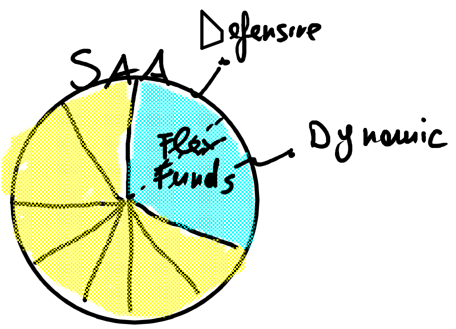
Tactical Asset Allocation (TAA)

2 ways → TAA via Flexible Funds

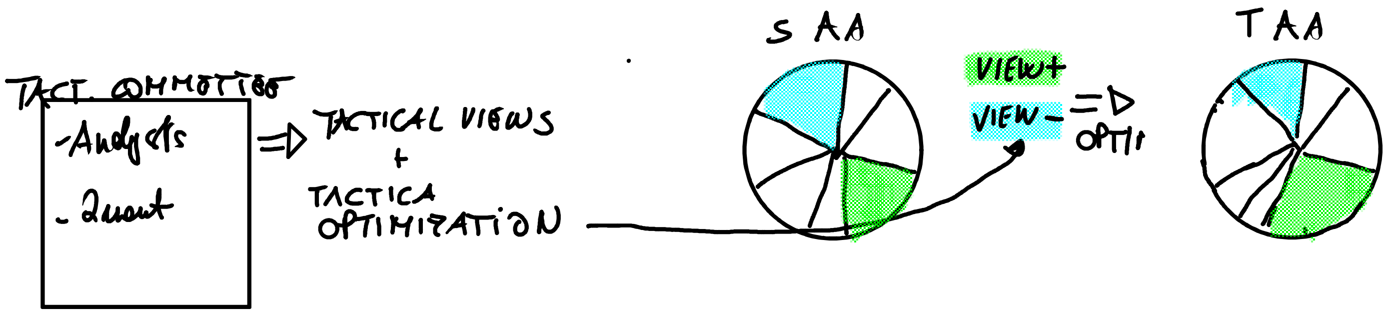
→ COMMITTEE

2 Ways
- TAA via Flexible Funds
- TAA via a Tactical Committee

Flexible Fund for TAA Purposes



Tactical Committee to Run the TAA.



3 MONTHS

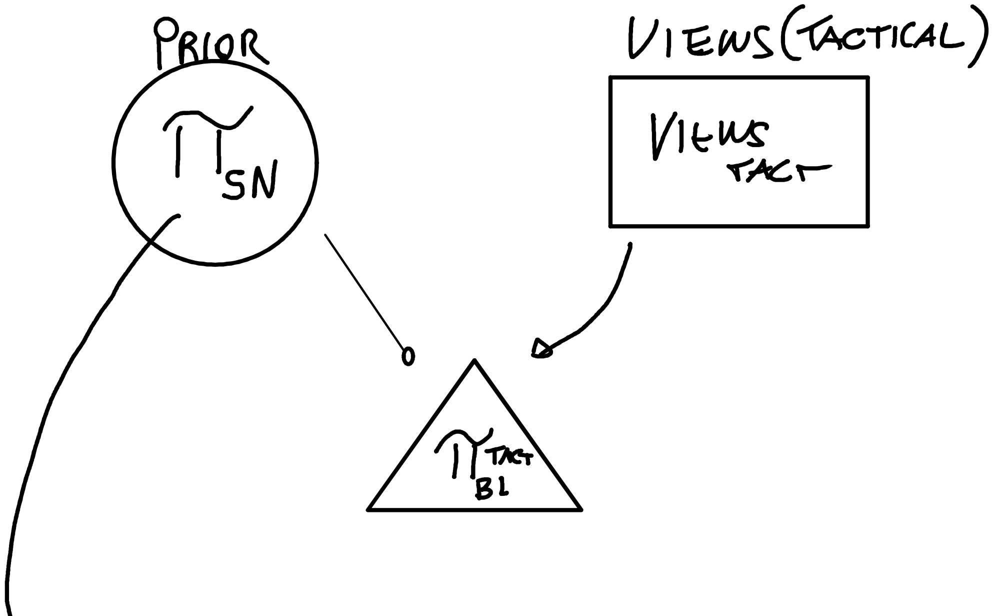
Asset Class	Fund Manager 1	Fund Manager 2	Fund Manager 3	View Finale	
Liquidità in €	=	-	nan	=	Neutrale
Obbligazionario Globale	=	=	-	=	Neutrale
Obbligazionario Paesi Emergenti	+	+	=	+	Positiva
Obbligazionario Euro Corporate	=	=	=	=	Neutrale
Obbligazionario Globale High Yield	+	+	+	+	Positiva
Obbligazionario Euro BT	-	=	=	=	Neutrale
Obbligazionario Euro MLT	-	-	=	-	Negativa
Azionario Europa	+	=	=	=	Neutrale
Azionario Pacifico	-	-	=	-	Negativa
Azionario Paesi Emergenti	+	++	=	+	Positiva
Azionario Nord America	=	+	=	=	Neutrale
Flessibili Bassa Volatilità	nan	+	nan	=	Neutrale
Flessibili Medio-Alta Volatilità	nan	=	nan	=	Neutrale
Commodities	nan	-	=	=	Neutrale
Opportunities	nan	nan	nan	=	Neutrale

Focus of TAA via a Tact. Committee

- Black-Litterman model for TAA Purposes
- Example of TACTICAL OPTIMIZATION

B-L Model for TAA

↳ What we have to change if the purpose is to have Expected Return feeding a tactical optimization



→ CHANGE THE REVERSE OPTIMIZATION

$$\Pi_{SN} = rf + \lambda \cdot \Sigma \cdot W_{SAA}$$

Example of Tactical Asset Allocation via Excel

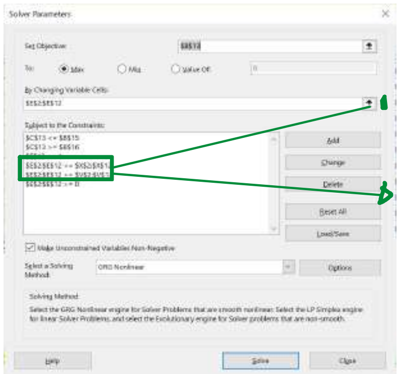
$$\max_{W_{TAA}} E(R)_{TAA}$$

Constraints:

$$w_i^{TAA} \geq 0\% \quad \forall i \in [1; 2; \ldots; K]$$

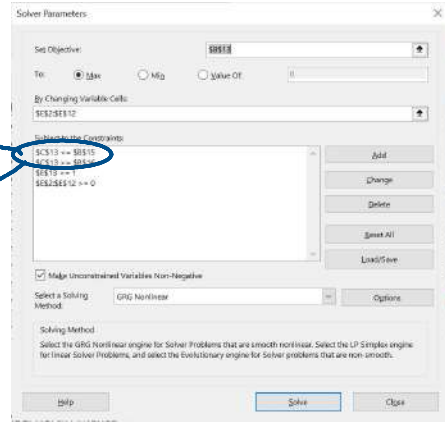
$$w_i^{TAA} \geq 0\% \quad \forall i \in [1; 2; \dots; K]$$

$$\sum w_i^{TAA} = 1$$



$$\sigma_{TAA} \leq \sigma_{MAX}$$

$$\sigma_{TAA} \geq \sigma_{min}$$



$$w_i^{TAA} \geq h_i$$

$$w_i^{TAA} \leq k_i$$

$$\sum w_{RISKY}^{TAA} \geq H_i$$

$$\sum w_{RISKY}^{TAA} \leq K_i$$

$$ReVaR \geq ReVaR^*$$

	LB (hi)	AAS	UB (ki)
Bofa ML Euro 0-1 anni	2%	2%	12%
Bofa ML Bond Euro 1-3 Y	22%	22%	35%
Bofa ML Obbl. Euro	11%	11%	22%
Bofa ML Obbl. Globale	9%	9%	18%
ML Global HY	1%	5%	5%
Bofa ML Obbl Emergente	3%	6%	6%
MSCI Europe	4%	8%	8%
MSCI North America	10%	20%	20%
MSCI Pacific	2%	5%	5%
MSCI Emerging Markets	3%	8%	8%
Opportunities	0%	4%	4%

	Hi	Risky Strat	Ki	Risky Tact
RISKY ASSETS	30%	56%	65%	36%

Relative VaR = ReVaR

TAA → $ReVaR_{1y}^{95\%} = -3\%$

Definition: Re-VaR is the potential underperformance of a TAA versus the SAA, for a specific time window and a targeted confidence level

$$w_{TAA} = [w_1^T \; w_2^T \dots w_N^T]$$

$$w_{SAA} = [w_1^S \; w_2^S \dots w_N^S]$$

↓

$$VaR = E(R) - k \cdot \sigma$$

$$W_{\substack{L-S\\PORT}} = \left[w_1^T - w_1^S,\ w_2^T - w_2^S,\ \ldots,\ w_N^T - w_N^S \right]$$

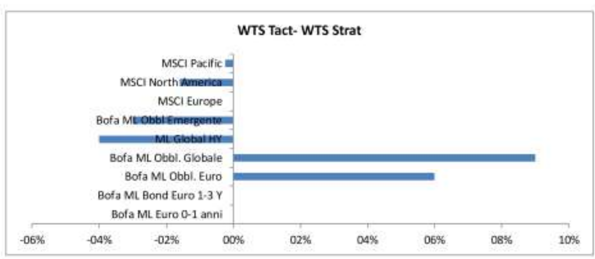
$$VaR = E(R) - K \cdot \sigma$$

$$ReVaR_{TAA} = \left[w_1^T - w_1^S, \ldots, w_N^T - w_N^S \right] \times \begin{bmatrix} E(R)_1^T \\ \vdots \\ E(R)_N^T \end{bmatrix} - K \cdot \sqrt{\left[w_1^T - w_1^S, \ldots, w_N^T - w_N^S \right] \times \left[\text{Cov Matrix} \right] \times \begin{bmatrix} w_1^T - w_1^S \\ \vdots \\ w_N^T - w_N^S \end{bmatrix}}$$

ASSET CLASSES	Rend att TATTICAL	σ Tact	SAA	TAA	Weights Tact- Weights Strat
Bofa ML Euro 0-1 anni	0,63%	0,87%	2%	2%	0,0%
Bofa ML Bond Euro 1-3 Y	1,00%	1,69%	22%	22%	0,0%
Bofa ML Obbl. Euro	2,01%	4,17%	11%	17%	6,0%
Bofa ML Obbl. Globale	2,50%	6,92%	9%	18%	9,0%
ML Global HY	-2,50%	11,07%	5%	1%	-4,0%
Bofa ML Obbl Emergente	-3,50%	12,72%	6%	3%	-3,0%
MSCI Europe	-3,00%	17,53%	8%	8%	0,0%
MSCI North America	-3,00%	17,80%	20%	18%	-1,6%
MSCI Pacific	-2,80%	18,56%	5%	5%	-0,2%
MSCI Emerging Markets	-5,00%	23,69%	8%	6%	-2,1%
Opportunities	-4,00%	15,36%	4%	0%	-4,0%
PORTFOLIO	-0,32%	6,75%	100,00%	100,00%	0,00%

Soglia Max di SIGMA	12,00%
Soglia min di SIGMA	6,00%

cov	ML Euro 0-1	ML Bond Euro	fa ML Obbl. E	ML Obbl. Glo	ML Global HY	ML Obbl Emer	MSCI Europe	CI North Ame
Bofa ML E	0,0001	0,0001	0,0001	0,0001	-0,0002	-0,0001	-0,0003	-0,0004
Bofa ML B	0,0001	0,0003	0,0005	0,0003	-0,0000	0,0001	-0,0004	-0,0006
Bofa ML O	0,0001	0,0005	0,0017	0,0012	0,0004	0,0008	-0,0004	-0,0003
Bofa ML O	0,0001	0,0003	0,0012	0,0048	0,0024	0,0026	-0,0023	0,0009
ML Global	-0,0002	-0,0000	0,0004	0,0024	0,0122	0,0098	0,0108	0,0129
Bofa ML O	-0,0001	0,0001	0,0008	0,0026	0,0098	0,0162	0,0110	0,0131
MSCI Euro	-0,0003	-0,0004	-0,0004	-0,0023	0,0108	0,0110	0,0307	0,0246
MSCI Nort	-0,0004	-0,0006	-0,0003	0,0009	0,0129	0,0131	0,0246	0,0317
MSCI Paci	-0,0003	-0,0003	-0,0002	0,0003	0,0109	0,0125	0,0227	0,0221
MSCI Eme	-0,0003	-0,0005	-0,0004	-0,0019	0,0149	0,0192	0,0305	0,0285
Opportuniti	-0,0003	-0,0005	-0,0007	-0,0006	0,0114	0,0111	0,0229	0,0238



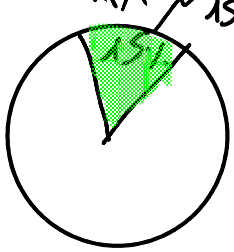
RE-VAR (cl=95%)	-2,50%
ReVaR Threshold	-2,50%

Fund Selection

1) Core vs (SWING) Satellite Fund

AA

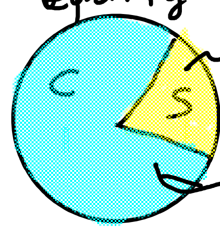
Eq Europe 150.000 €



AUM = 1 MLN €

Select European equity Funds for 150.000 €

EUROPE Equity



150.000 €

Core = C ≥ 75%

satellite funds FOCUS/

- INVEST in a portion of the MARKET
- FOCUS in SIZE
- FOCUS on ESG
- FOCUS on COUNTRIES
- FOCUS on FACTORS
- FOCUS HD
- FOCUS on Sectors
- FOCUS on STYLE
- Very Active Funds / Flexible Strategy
- SINGLE STOCK / CERTIFICATES

AUM = 1 MLN € ... 150.000 €

Core = C ≥ 75%
Satellite = S ≤ 25%

- Focus on ...
- Very Active Funds / Flexible Strategy
- SINGLE STOCK / CERTIFICATES

Funds that invest in all the market, so beeing a good proxy of it.

2) Passivo vs Active Funds

↳ Slides.....

Fund Selection

Qualitative Analysis + Quantitative Analysis

- Reputation of the MF Company
- Quality of the Team of Managers
- Quality of the Risk Manag. Model
- Quality of the Strategy
- Size of the Fund

Simulation of the Quantitative Analysis comparing 4 Funds → European Equity Funds

Stage:

0) Homogeneous Funds
1) Returns
2) Risks
3) Risk Adjusted Performance Measure (RAPM)
4) Conclusion.....

(1) Return ⟶ Good Variable

$$\overline{R}_F = \sum_{i=1}^{T} \frac{R_i^F}{T}$$

$$\overline{RP}_F = \overline{R}_F - r_f$$

TRACKING ERROR $= R_F - R_B \Rightarrow \overline{TE}_F = \overline{R}_F - \overline{R}_B$

Cumulative Return $= R_C^F = \prod_{i=1}^{T} (1+R_i^F) - 1$

Returns are monthly

Annualised Return $= R_{ANN}^F = \sqrt[T/12]{(1+R_C)} - 1$

	XTRACKERS MSCI EU	LO FUNDS - EUROPE	Fund X	MFS MERIDIAN FDS-	MSCI EUROPE	RISK FREE
Monthly Av. Return	0,69%	0,23%	0,91%	0,65%	0,73%	0,06%
Monthly Risk Premium	0,64%	0,18%	0,86%	0,59%		
Average Tracking Error	-0,03%	-0,49%	0,19%	-0,08%		
Cumulative Return	42,58%	6,31%	58,39%	38,56%	45,51%	3,43%
Annualised Return	7,35%	1,23%	9,63%	6,74%	7,79%	0,68%

⟶ Return of Fund $= f$ (Skill; ~~Risk~~; ~~Luck~~)

(2) Risk Analysis

$$\sigma_F = \sqrt{\sum_{i=1}^{T} \frac{(R_i^F - \overline{R}_F)^2}{T}}$$

DOWNSIDE RISK $= DSR_F = \sqrt{\sum (R_i^F - s)^2}$

DOWNSIDE RISK $= DSR_F = \sqrt{\sum_{R_i^F < S} \frac{(R_i^F - S)^2}{T}}$

$TE = R_F - R_B$

TRACKING ERROR VOLATILITY $= TEV = \sqrt{\sum_{i=1}^{T} \frac{(TE_i - \overline{TE})^2}{T}}$

↳ Degree/Level of "Activism"

	x tracker	LO	Fund X	MFS	MSCI EUROPE
Dev standard (monthly)	4,47%	5,05%	5,31%	4,57%	4,45%
DSR monthly	2,95%	3,67%	3,59%	3,07%	2,92%
TEV monthly	0,26%	1,65%	2,73%	0,69%	

---

3) Risk Adjusted Performance Measures

$$\frac{\text{Return}}{\text{RISK}}$$

$$\text{Sharpe Ratio} = \frac{\overline{R_F} - r_f}{\sigma_F} = \frac{\overline{RP_F}}{\sigma_F}$$

$$\text{Sortino Ratio} = \frac{\overline{R_F} - r_f}{DSR_F} = \frac{\overline{RP_F}}{DSR_F}$$

$$\text{Information Ratio} = \frac{\overline{TE_F}}{TEV_F} = \frac{\overline{R_F} - \overline{R_B}}{TEV_F}$$

XTRACK LO FUND X MKT

Sharpe Ratio	0,143	0,035	0,161	0,130
Sortino Ratio	0,216	0,048	0,238	0,194
Information Ratio	-0,128	-0,300	0,068	-0,109

Rating → MORNING STAR

FUND X

	XTRACKERS MSCI EUROPE UCITS ETF 1C - TOT RETURN IND	LO FUNDS - EUROPE ALL CAP LEADERS EUR PA - TOT RETURN IND	**BSF EUROPN OPPTYS EXTSN A2 EUR - TOT RETURN IND**	MFS MERIDIAN FDS-BLENDED RSRCH EUROP EQ A1 EUR
Isin	LU0274209237	LU1637644235	LU0313923228	LU0648597655
Morningstar	4 ☆	1☆	5☆	4☆
	BLEND/CORE	**BLEND/CORE**	**SATELLITE/SWING**	**BLEND/CORE**