Asset Management (Pomante)

lunedì 6 novembre 2023 13:49

Information:

- Me

- You

- The course

- The website

- Exams — WRITTEN / ORAL

- Lesson: from 2pm to 4pm

- Tutor: Luigi Barbieri

Structure:

1) Introduction to portfolio construction
2) Analysis of financial markets
3) Strategic Asset Allocation
4) Tactical Asset Allocation / market timing
5) Product Selection

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1) Introduction to portfolio construction

Ex-ante Stage) A) Investor Profile → RISK TOLERANCE → TOLERATED LOSS; → HOLDING PERIOD

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

True Portfolio Construction:

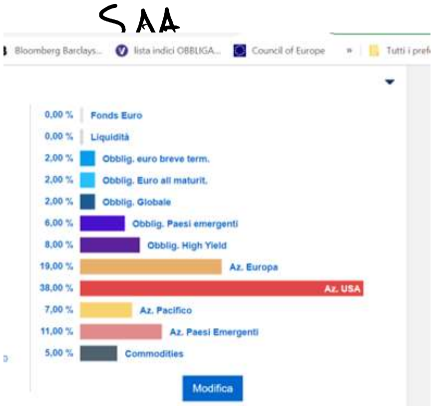
B) Strategic Asset Allocation (SAA): It is a mix of asset classes (financial markets) that is expected to be maintained **on average** "in the long run"

⇒ Strategic Committee → Analysts
→ Quant

- forcasts in the long run
- Optimization Models

C) Tactical Asset Allocation (TAA): A "short term" adjustement from the SAA, where based on tactical view, asset classes with + views area overweighted and asset classes with negative view are underweighted.

SAA

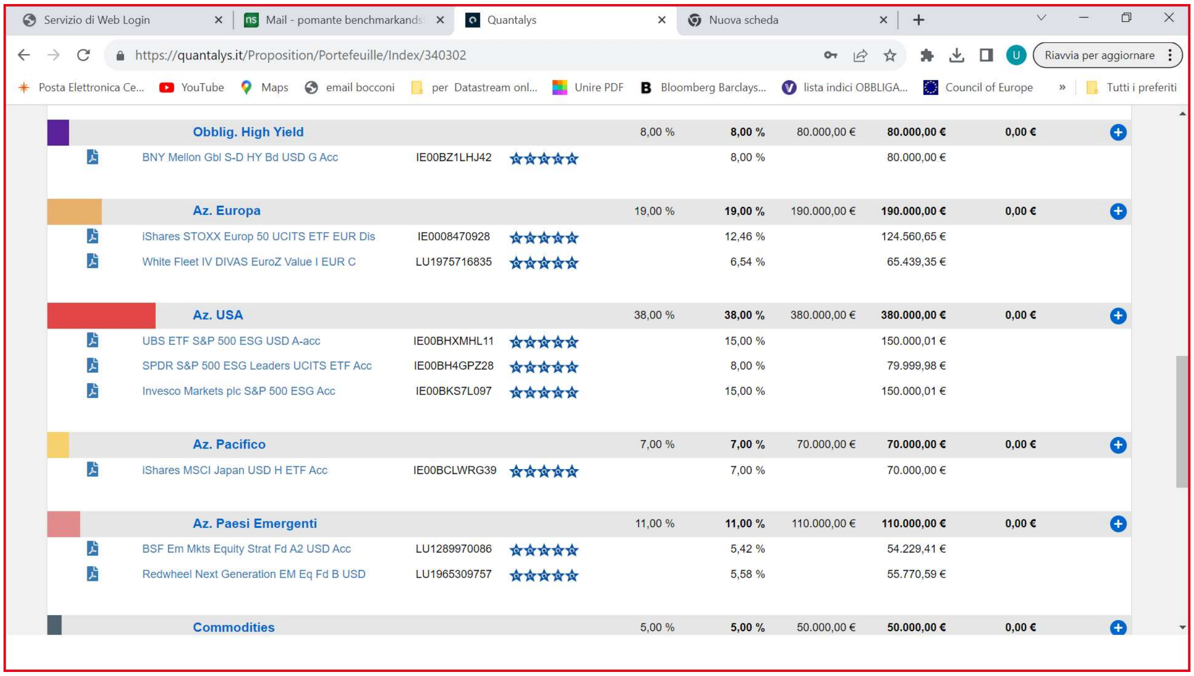


⇒

TAA

D) Product Selection → Product must confirm the asset allocation

- → DIRECTLY in stock - bond
- → INDIRECTLY VIA FUNDS



Obblig. High Yield			8,00 %	**8,00 %**	80.000,00 €	**80.000,00 €**	**0,00 €**
BNY Mellon Gbl S-D HY Bd USD G Acc	IE00BZ1LHJ42	☆☆☆☆☆		8,00 %		80.000,00 €	
Az. Europa			19,00 %	**19,00 %**	190.000,00 €	**190.000,00 €**	**0,00 €**
iShares STOXX Europ 50 UCITS ETF EUR Dis	IE0008470928	☆☆☆☆☆		12,46 %		124.560,65 €	
White Fleet IV DIVAS EuroZ Value I EUR C	LU1975716835	☆☆☆☆☆		6,54 %		65.439,35 €	
Az. USA			38,00 %	**38,00 %**	380.000,00 €	**380.000,00 €**	**0,00 €**
UBS ETF S&P 500 ESG USD A-acc	IE00BHXMHL11	☆☆☆☆☆		15,00 %		150.000,01 €	
SPDR S&P 500 ESG Leaders UCITS ETF Acc	IE00BH4GPZ28	☆☆☆☆☆		8,00 %		79.999,98 €	
Invesco Markets plc S&P 500 ESG Acc	IE00BKS7L097	☆☆☆☆☆		15,00 %		150.000,01 €	
Az. Pacifico			7,00 %	**7,00 %**	70.000,00 €	**70.000,00 €**	**0,00 €**
iShares MSCI Japan USD H ETF Acc	IE00BCLWRG39	☆☆☆☆☆		7,00 %		70.000,00 €	
Az. Paesi Emergenti			11,00 %	**11,00 %**	110.000,00 €	**110.000,00 €**	**0,00 €**
BSF Em Mkts Equity Strat Fd A2 USD Acc	LU1289970086	☆☆☆☆☆		5,42 %		54.229,41 €	
Redwheel Next Generation EM Eq Fd B USD	LU1965309757	☆☆☆☆☆		5,58 %		55.770,59 €	
Commodities			5,00 %	**5,00 %**	50.000,00 €	**50.000,00 €**	**0,00 €**

Ex-post → Monitoring of the portfolio
→ Measure the Return
→ Measure the Risk

Performance Attribution : 10%
→ SAA 12%
→ TAA −1%
→ PRODUCT SELECT −1%

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2) Analysis of Financial Market

2.1) Selection of asset classes
2.2) Market Index/Benchmark
2.3) Statistical indicators to capture ret/risk

2.1) Selection of asset classes
→ Think Global
→ No overlapping

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	OPPORTUNIT.

- Hedge Funds
- Certifites
- Commodities
- Crypto

- Thematic Funds
- Real Estate
- Infrastructure
- Private Equity/Private Debt
- Arts

2.2) Market Index/Benchmark

US EQUITY MKT → Identify MKT INDEX

→ Definition: basket of stock/bonds which compositionis a good proxy of the composition of the market

Properties:
1) **Rapresentativeness**: (derived by the definition) the basket composition must rapresent well the composition of the market
2) **Replicability:** An index must be easily replicated by an asset manager
3) **Transapency/Objectivisness**:

Construction:

$$\sqrt[10]{(1+R_{cum})}-1$$

- Weighting:
  - → PRICE Weighted
  - → Equally Weighted
  - → Value Weighted
  - → Free-float weighted

- Cash Flow Management

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

https://www.msci.com/constituents

2.3) Statistical indicators to capture ret/risk

Return → Average Return $\overline{R} = \sum_{i=1}^{T} \frac{R_i}{T}$

= media(B3:B25)
= average(B3:B25)

Av. Ret of a Portfolio $\overline{R}_{PORT} = \sum_{i=1}^{N} w_i \cdot \overline{R}_i$

$$\overline{R}_{PORT} = \begin{bmatrix} w_1 & w_2 & \cdots & w_N \end{bmatrix} \times \begin{bmatrix} \overline{R}_1 \\ \overline{R}_2 \\ \vdots \\ \overline{R}_N \end{bmatrix}$$

Statistical indicators able to capture RISK

List of Risk parameters:
- Standard deviation
- Value at Risk
- Expected Shortfall (Condition VaR)
- Beta
- Modified Duration
- Semi-standard deviation
- Down Side Risk
- Tracking Error Volatility
- Maximum drawdown

$\Downarrow$

Three Families of Risk Measures
- → VOLATILITY
- → SENSITIVITY
- → LOSS

Standard Deviation → σ

σ single Asset Class → $\sigma = \sqrt{\sum_{i=1}^{T} \frac{(R_i - \overline{R})^2}{T-1}}$

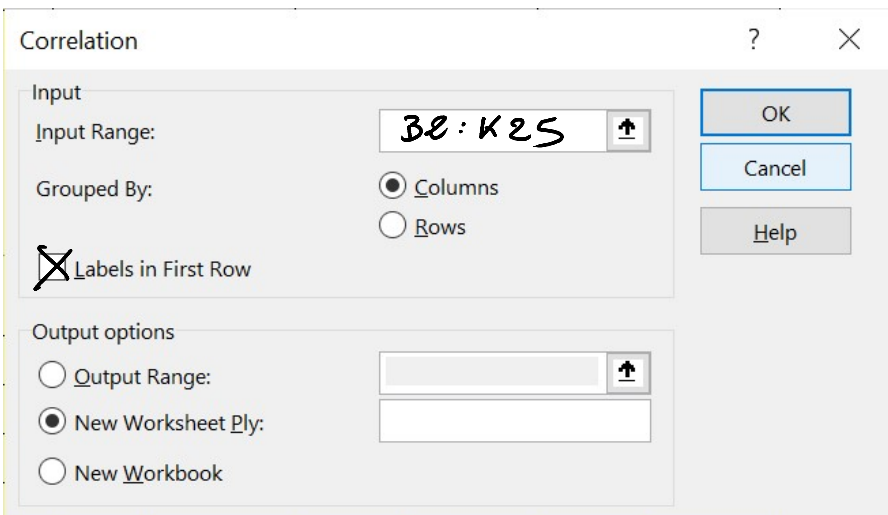
=stdev(time series)

SIGMA annual	1,96%	2,70%	6,24%	8,32%	15,57%	10,55%	18,77%	18,85%	17,71%	26,57%
	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
Portfolio	3,00%	12,00%	15,00%	12,00%	3,00%	5,00%	11,00%	30,00%	3,00%	6,00%

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

N Asset classe $\longrightarrow$ $n° p = \frac{N \cdot (N-1)}{2}$

$$\rho_{A;B} = \frac{Cov(A;B)}{\sigma_A \cdot \sigma_B} = \frac{\dfrac{\sum_{i=1}^{N} (R_i^A - \bar{R}_A) \cdot (R_i^B - \bar{R}_B)}{N-1}}{\sigma_A \cdot \sigma_B}$$



$\Downarrow$

	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	0,84	1,00								
Bofa ML Bond. Euro	0,40	0,76	1,00							
Bofa ML Bond. Global	0,24	0,29	0,57	1,00						
ML Global HY	-0,23	-0,05	0,08	0,01	1,00					
Bofa ML Bond Emerging	0,02	0,17	0,52	0,68	0,56	1,00				
MSCI Europe	-0,42	-0,29	-0,06	-0,28	0,71	0,37	1,00			
MSCI North America	-0,60	-0,38	0,03	0,03	0,69	0,51	0,87	1,00		
MSCI Pacific	-0,52	-0,34	-0,02	-0,11	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	0,78	0,64	0,79	1,00

Why the low correlations of this's

DIVERS BENEFITS ?

Markets	-0,17	-0,07	0,03	-0,23	0,78	0,41	0,78	0,64	0,79	1,00

Why the low correlations of this orange are don't provide high DIVERS. BENEFITS ?

Estimate σ_{PORT}

$$\sigma_{PORT} \to 2\,AC \begin{cases} w_1 & \sigma_1 \\ w_2 & \sigma_2 \end{cases} \quad \rho_{12}$$

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

$$\rho_{12} = 1 \Rightarrow \sigma_{PORT} = w_1 \sigma_1 + w_2 \sigma_2$$

$$\rho_{12} = -1 \Rightarrow \sigma_{PORT} = |w_1 \sigma_1 - w_2 \sigma_2|$$

$$\sigma_{PORT} \to 3\,AC \begin{cases} w_1 & \sigma_1 & \rho_{12} \\ w_2 & \sigma_2 & \rho_{13} \\ w_3 & \sigma_3 & \rho_{23} \end{cases}$$

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

$$\begin{Bmatrix} w_1 & \sigma_1 & \rho_{12} \\ w_2 & \sigma_2 & \rho_{13} \end{Bmatrix} \quad \frac{N \cdot (N-1)}{}$$

$$\sigma_{PORT} \text{ with } N \text{ A.C.} \left\{ \begin{matrix} w_1 & \sigma_1 & \rho_{12} \\ w_2 & \sigma_2 & \rho_{13} \\ \vdots & \vdots & \vdots \\ w_N & \sigma_N & \rho_{N-1,N} \end{matrix} \right\} \frac{N \cdot (N-1)}{2}$$

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

Matrices

$$\sigma_{PORT} = \sqrt{\begin{bmatrix} w_1 & w_2 & \cdots & w_N \end{bmatrix} \times \begin{bmatrix} \sigma_{11} & & \\ & \sigma_{22} & \\ & & \ddots & \\ & & & \sigma_{NN} \end{bmatrix} \times \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_N \end{bmatrix}}$$

$$\sigma_{PORT} = \sqrt{\begin{bmatrix} w_1\sigma_1 & w_2\sigma_2 & \cdots & w_N\sigma_N \end{bmatrix} \times \begin{bmatrix} 1 & & \\ & 1 & \\ & & \ddots & \\ & & & 1 \end{bmatrix} \times \begin{bmatrix} w_1\sigma_1 \\ w_2\sigma_2 \\ \vdots \\ w_N\sigma_N \end{bmatrix}}$$

Calculation :

=SQRT(MMULT(MMULT(B30:K30;B33:K42);TRANSPOSE(B30:K30)))

The effect of Hedging on Equity and Bond market

Hedging in Equity → MSCI USA

Hedging in Government World Market I.G.

Risk es Potential Loss → VaR

Parametrical Approach → Gaussian Distribution

$$VaR(\%) = \overline{R} - K \cdot \sigma$$

$$99\% \to K = 2{,}326$$
$$98\% \to K = 2{,}05$$
$$95\% \to K = 1{,}645$$

In Matlab® .....

```
close all
clear all

[DATASET LABELS]=xlsread('File_excel.xlsx','Time Series','B2:K25')
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','B29:K29')
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)

Stp 1: Naive Portfolio Formation Rule

Question 1: "Assume that you don't have expectation about markets behaviours in the next 5 years (No Strategic Views), which is the right SAA?"

Golden Rule 1: Without views the SAA should be fully consistent with the global market composition: in other words the strategic solution must be **MARKET NEUTRAL**

Question 2: "Look to this Strategic Solution. Does an average investor consider this portfolio **REASONABLE"**

Asset Classes	SAA Neutral HBA
Money Mkt in €	3%
€ Bond Mkt Short Term	5%
€ Bond Mkt	10%
Global Bond Dev Mkts	39%
Global Corp Bond High Yiel	3%
Em Mkts Bond Mkt	5%
Equ. Europe	6%
Equ. North America	19%
Equ. Pacific	3%
Equ. Em Mkts	5%
Opportunities	2%

Golden Rule 2: Given that the market neutral solution is likely to be labelled as unreasonable because of the Home Bias, it can be useful to adjust the market neutrality in order to promote reasonability of the strategic solution.

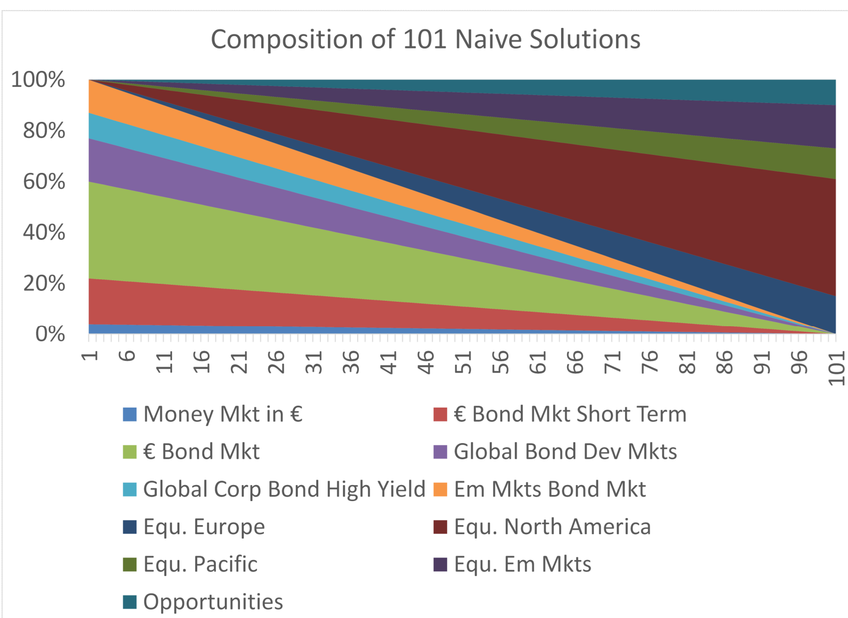
Golden Rule 3: If (and only if) you have views (with good confidence), you are justified to diverge from the mkt neutrality (HBA)

SAA Neutral HBA	SAA Naive
1%	1%
7%	6%
14%	13%
8%	6%
2%	4%
3%	5%
13%	10%
34%	30%
6%	8%
8%	11%
3%	7%

Weights	naive	neutral HBA	
35,0%	4%	4%	Money Mkt in €
	18%	20%	€ Bond Mkt Short Term
	38%	40%	€ Bond Mkt
	17%	23%	Global Bond Dev Mkts
	10%	5%	Global Corp Bond High Yield
	13%	8%	Em Mkts Bond Mkt
65,0%	15%	20%	Equ. Europe
	46%	53%	Equ. North America
	12%	9%	Equ. Pacific
	17%	13%	Equ. Em Mkts
	10%	5%	Opportunities

Lomg run views

view	confidence
stable	medium
stable dollar $	medium
credit spread reduction	high
-	medium
-	medium
+	medium
+	medium
sentiment:	
++	high



- Well diversified
- Able to incorporate Market Neutrality and Home bias
- Naive solution are "good" solution, NEVER OPTIMAL

If we want to move from a good to an optimal solution, we need a quantitative approach we need a quantitative approach

Modern Portfolio Theory

Markowitz model

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

Mark Rubinstein

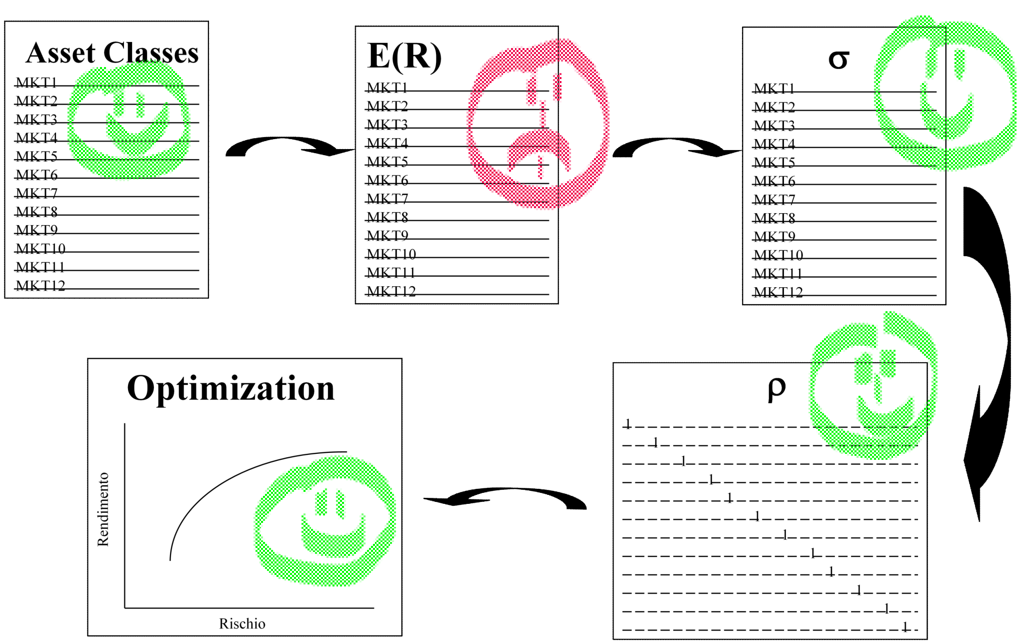
The Journal of Finance, Vol. 57, No. 3. (Jun., 2002), pp. 1041-1045.

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:

a. Investors love Return and hate Risk
b. Capture risk via standard deviation
c. First to talk about correlation and he was the first to measure correctly the diversification effect
d. First to show that a portfolio can be the output of an optimization – OPTIMIZATION with the method of the "CRITICAL LINE"

Steps of the Markowitz Model (1952):



Opinion of Markowitz about the estimation of E®, sigma and correlations…

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.

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.

OPTIMIZATION BY MARKOWITZ (1952)

$$\min_{w} \sigma_{PORT}$$

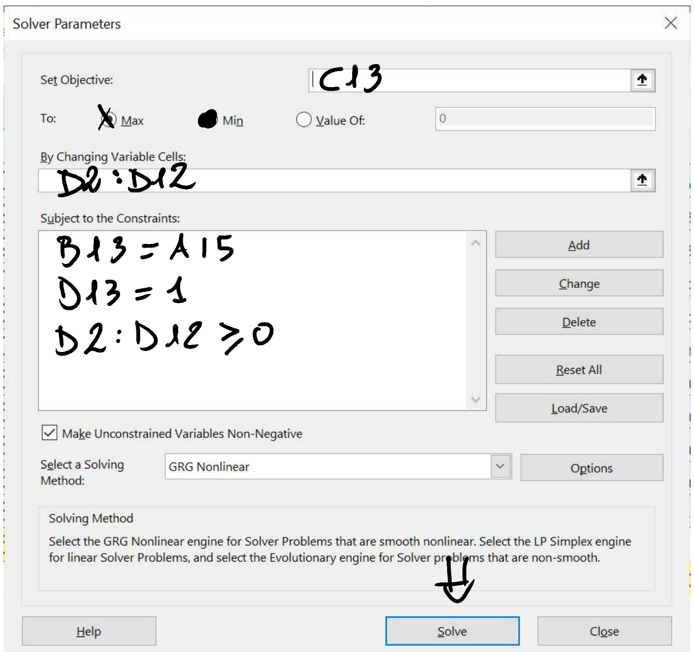
Constraints:

Constraints:

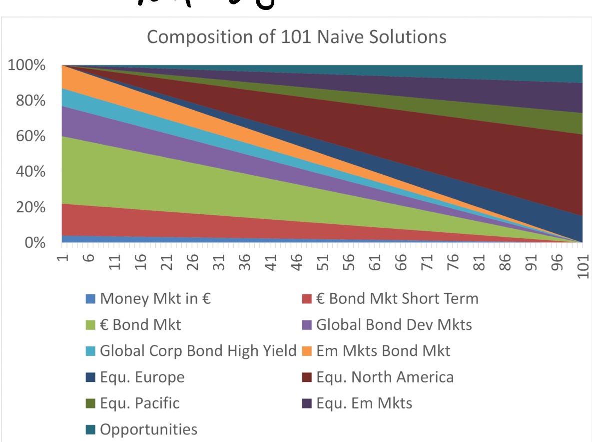
$$E(R)_{PORT} = R^*$$

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

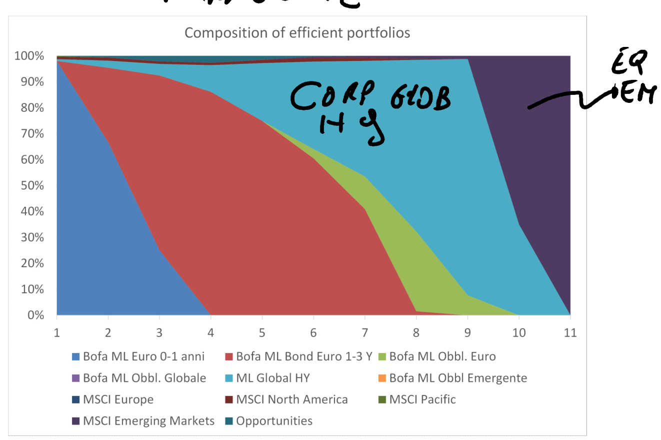
$$w_i \geq 0$$



NAÏVE



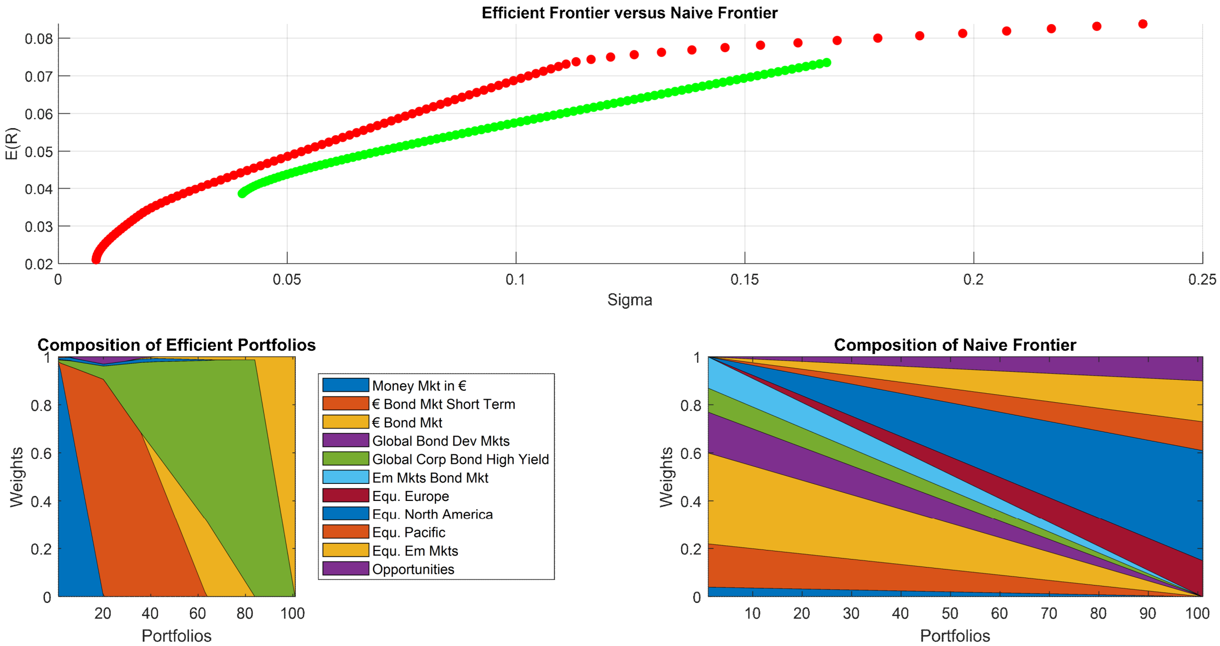
MARKOWITZ




```
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_COMPOSITION')'
SIGMA_NAIVE=zeros(101,1);
for j=1:101
SIGMA_NAIVE(j,1)=sqrt(NAIVE_PORTFOLIOS_COMPOSITION(j,:)*CO
VARIANCE*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]);
```



Potential practical problems of the Markowitz Approach:

1) Markowitz solutions have unreasonable composition (concentrated, hugely concentrated on "marginal players", not consistent with market neutrality or home bias);
2) Markowitz solution are "not stable";

```
% 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) The model assumes that inputs are True, in other words analists area assumed to be clairuioant
4) Because of the concentration markowitz solution are not only "Expected Return maximiser", but also "estimation error maximiser"

⇓ FRANKFURTHER – PHILIPS – SEAGLE

(1981): "Since estimation errors are so large portfolios selected according to the Markowitz criterior are likely no more efficient than a well diversified portfolio"

MARKOWITZ

NAIVE

"Putting Markowitz At Work" → PURPOSE: INCREASE DIVERSIFICATION

EURISTIC APPROACH

⇓

WORKING ON THE OPTIMIZATION

- ADD NEW CONSTRAINTS TO THE OPTIMIZ.
- RESAMPLING™

BAYESIAN APPROACH

⇓

WORK ON THE ESTIMATION OF EXPECTED RETURNS

- BLACK-LITTERMAN MODEL
- ~~shrinkage estimators~~

COMBINE

First Euristic Approach

↳ Additional Constraints to Markowitz Optim.

* First kind of constraints → ABSOLUTE CONSTRAINTS

$$\min_{w} \sigma_{PORT}$$

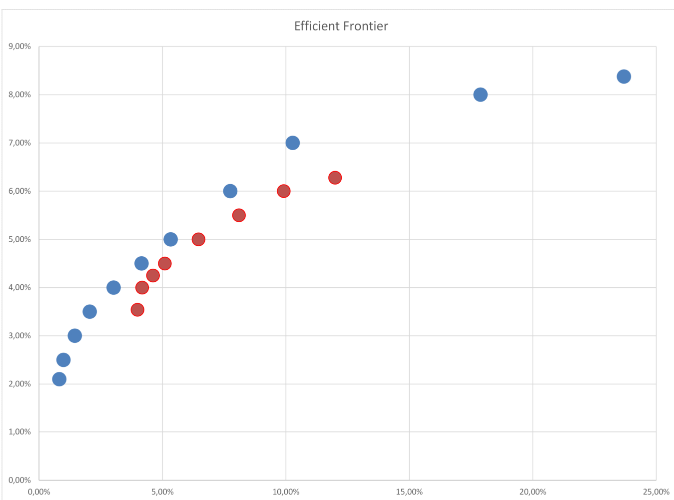
Constraints:

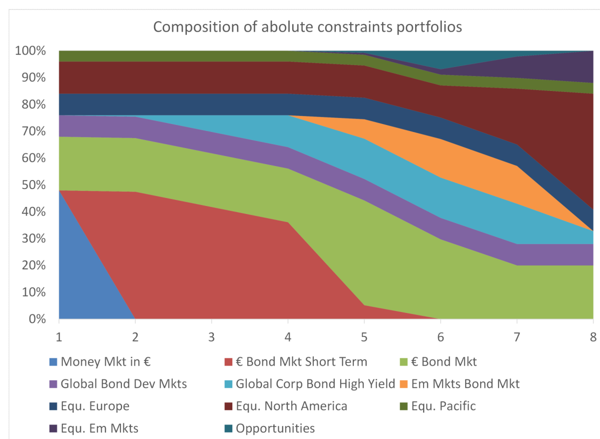
$$E(R)_{PORT} = R^*$$

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

$$w_i \geq 0$$

$$\left.\begin{array}{l} w_i \geq h_i \\ w_i \leq K_i \end{array}\right\} \text{ABSOLUTE CONSTRAINTS}$$

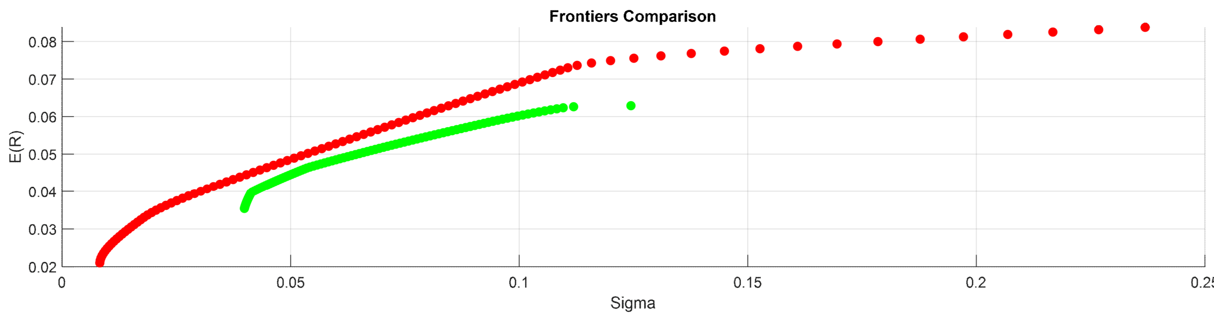


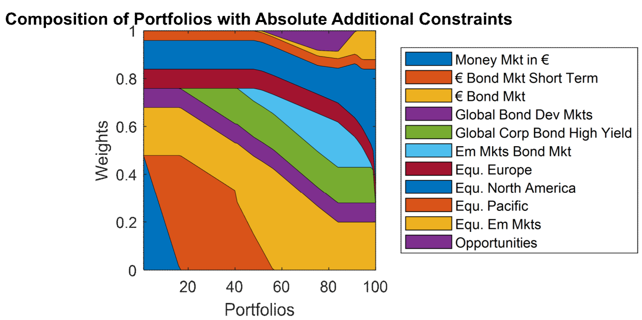


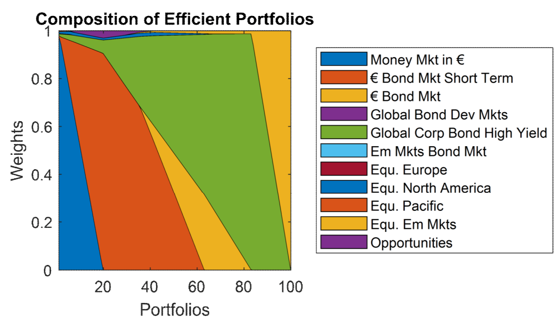
Absolute Constraints with Matlab:

```
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]);
```







A better way to set constraints

↳ from Absolute to Relative constraints....

⇓

INFRA - GROUP

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

Constraints:

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

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

$$w_i \geq 0$$

$$\frac{w_i}{\sum W_{SAME\ GROUP}} \geq H_i$$

$$\sum W_{\text{SAME GROUP}} \geq H_i$$

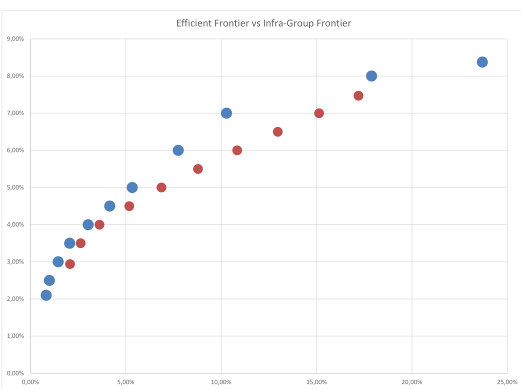
$$\frac{w_i}{\sum W_{\text{SAME GROUP}}} \leq K_i$$

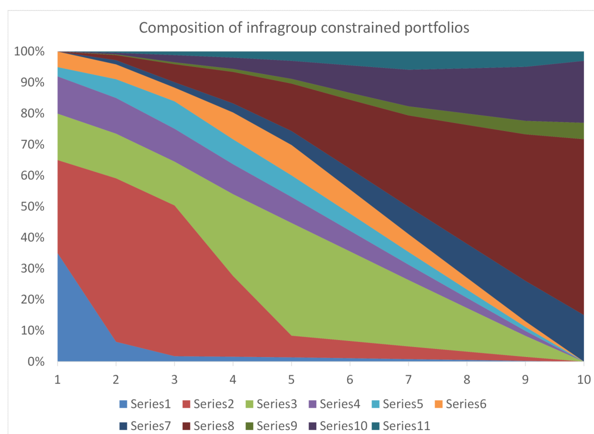
H_i [MKT NEUTR HBA 20%] K_i

EUROPEAN EQU. MKT

Asset Class	*min*	MKT NEUTR HBA	*MAX*
Money Mkt in €	2%	4,0%	35%
€ Bond Mkt Short Term	10%	20,0%	55%
€ Bond Mkt	15%	40,0%	65%
Global Bond Dev Mkts	12%	23,0%	28%
Global Corp Bond High Yield	3%	5,0%	10%
Em Mkts Bond Mkt	5%	8,0%	14%
Equ. Europe	15%	20,0%	32%
Equ. North America	35%	53,0%	60%
Equ. Pacific	5%	9,0%	15%
Equ. Em Mkts	6%	13,0%	20%
Opportunities	3%	5,0%	10%

Excel:






```
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');
```

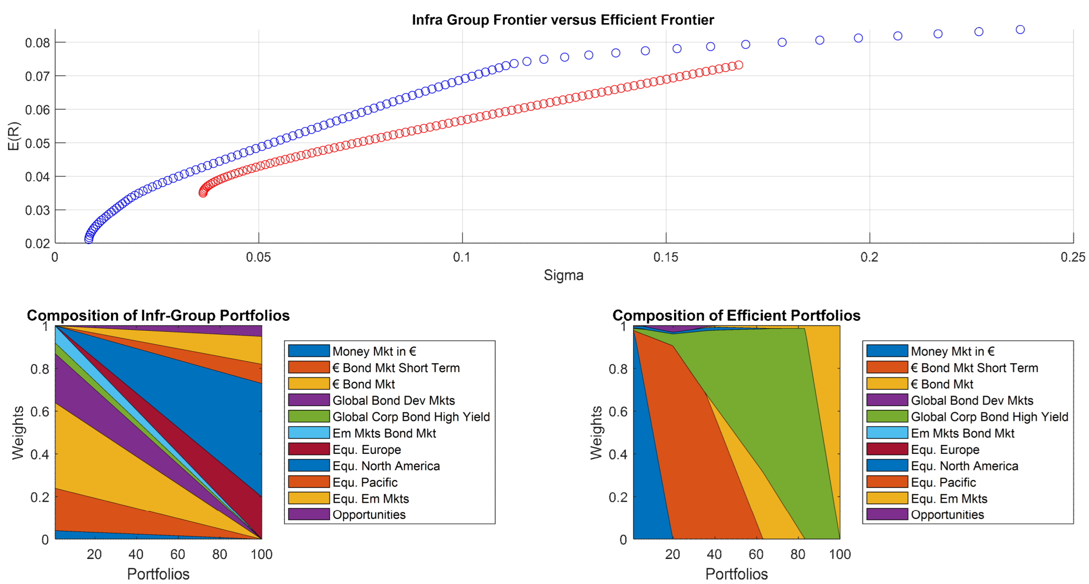
```
%setting P and the constraints for positive weights
P=Portfolio;
P=Portfolio('AssetMean',
EXP_RET,'AssetCovar',COV,'Assetlist',LABELS,'LowerBudget', 1,
'UpperBudget', 1);
LB=-zeros(1,length(EXP_RET));
b=-eye(length(EXP_RET));
P = setInequality(P,b,LB);

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:en
d,1))'];
end

EXP_RET_NAIVE=(EXP_RET'*NAIVE_PORTFOLIOS_COMPOSI
TION')'
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]);
```

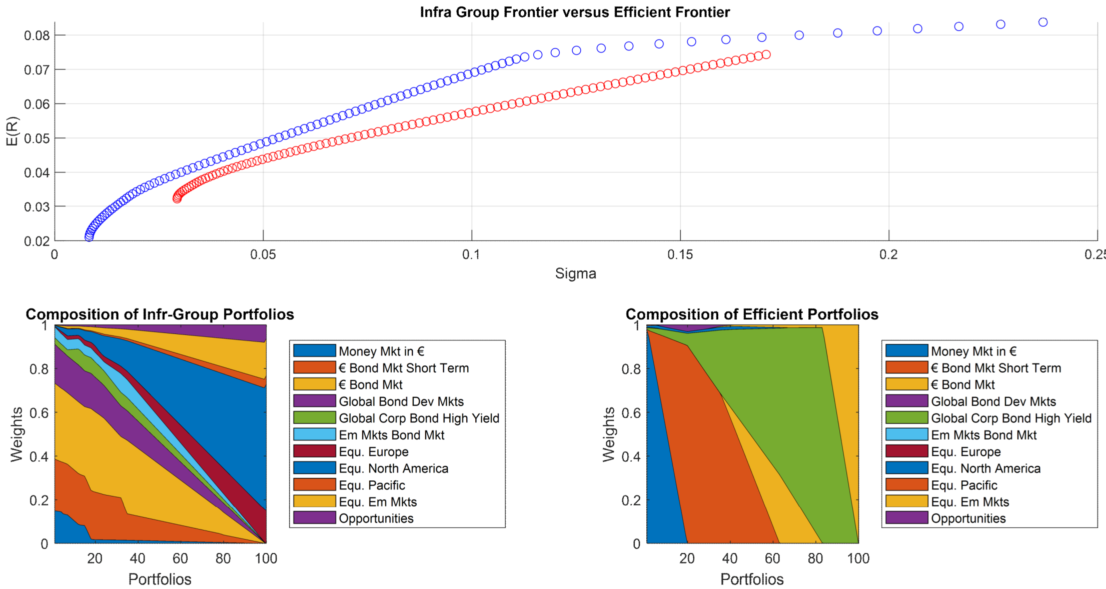
Confidence → ∅

Asset Class	*min*	MKT NEUTR HBA	*MAX*
Money Mkt in €	4%	4,0%	4%
€ Bond Mkt Short Term	20%	20,0%	20%
€ Bond Mkt	40%	40,0%	40%
Global Bond Dev Mkts	23%	23,0%	23%
Global Corp Bond High Yield	5%	5,0%	5%
Em Mkts Bond Mkt	8%	8,0%	8%
Equ. Europe	20%	20,0%	20%
Equ. North America	53%	53,0%	53%
Equ. Pacific	9%	9,0%	9%
Equ. Em Mkts	13%	13,0%	13%
Opportunities	5%	5,0%	5%



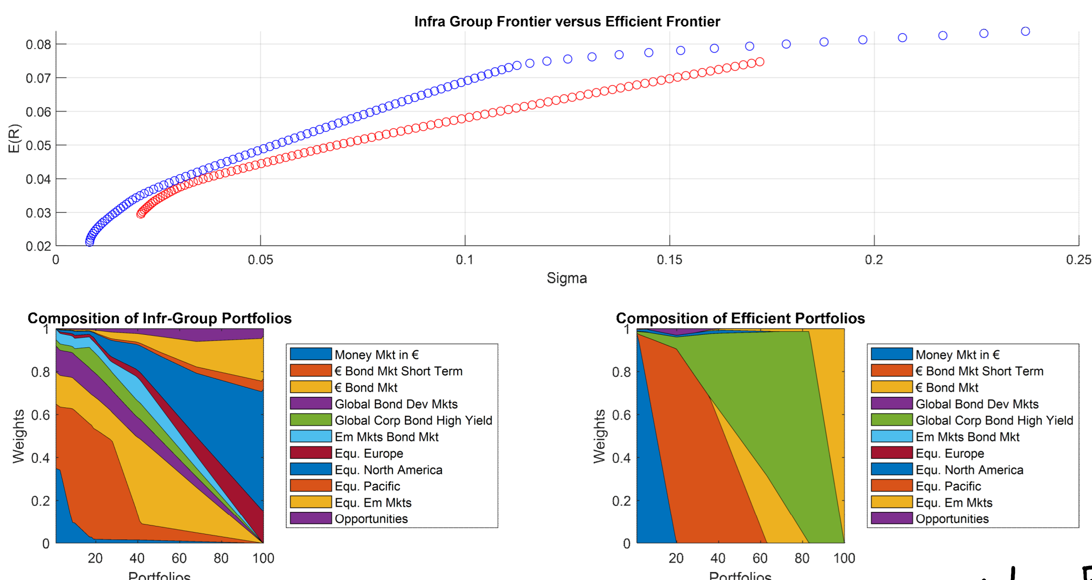
Confidence → SMALL

Asset Class	*min*	MKT NEUTR HBA	*MAX*
Money Mkt in €	2%	4,0%	15%
€ Bond Mkt Short Term	15%	20,0%	25%
€ Bond Mkt	35%	40,0%	45%
Global Bond Dev Mkts	18%	23,0%	29%
Global Corp Bond High Yield	3%	5,0%	8%
Em Mkts Bond Mkt	5%	8,0%	11%
Equ. Europe	15%	20,0%	25%
Equ. North America	47%	53,0%	58%
Equ. Pacific	4%	9,0%	13%
Equ. Em Mkts	9%	13,0%	17%
Opportunities	3%	5,0%	8%

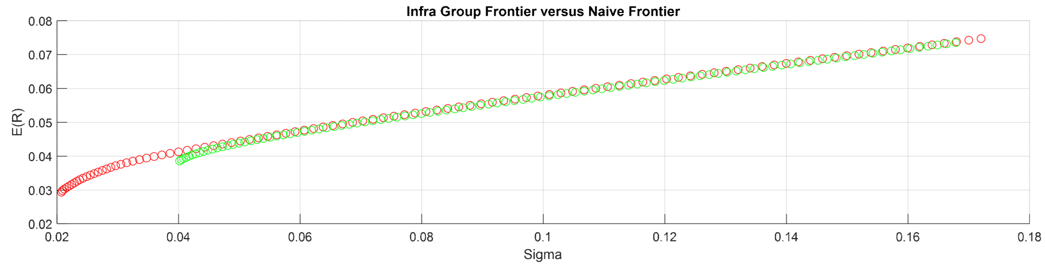


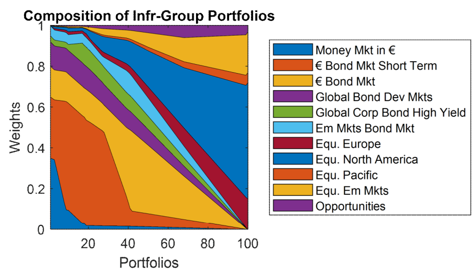
Confidence → Good

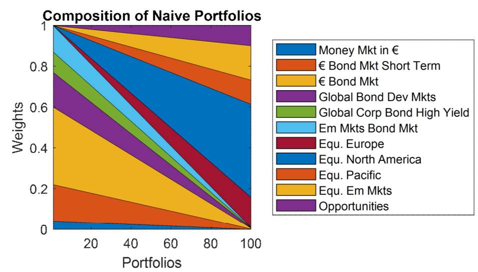
min	MKT NEUTR HBA	*MAX*
2%	4,0%	35%
10%	20,0%	55%
15%	40,0%	65%
12%	23,0%	28%
3%	5,0%	10%
5%	8,0%	14%
15%	20,0%	32%
35%	53,0%	60%
5%	9,0%	15%
6%	13,0%	20%
3%	5,0%	10%



A comparison between Infra Group Frontier and Above Frontier







Resampling TM (by Michaud) → Markowitz Optim + Monte Carlo Simulation

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

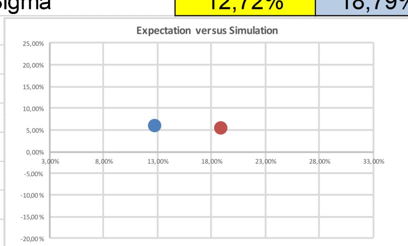
What do we need in order to simulate?

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

Simulation $= \alpha \cdot Exp + (1-\alpha)\, Rand$

Univariate MC Simulation → Excel

European Equ Mkt	Expectation	Simulation
Exp return	6,00%	5,62%
Sigma	12,72%	18,79%

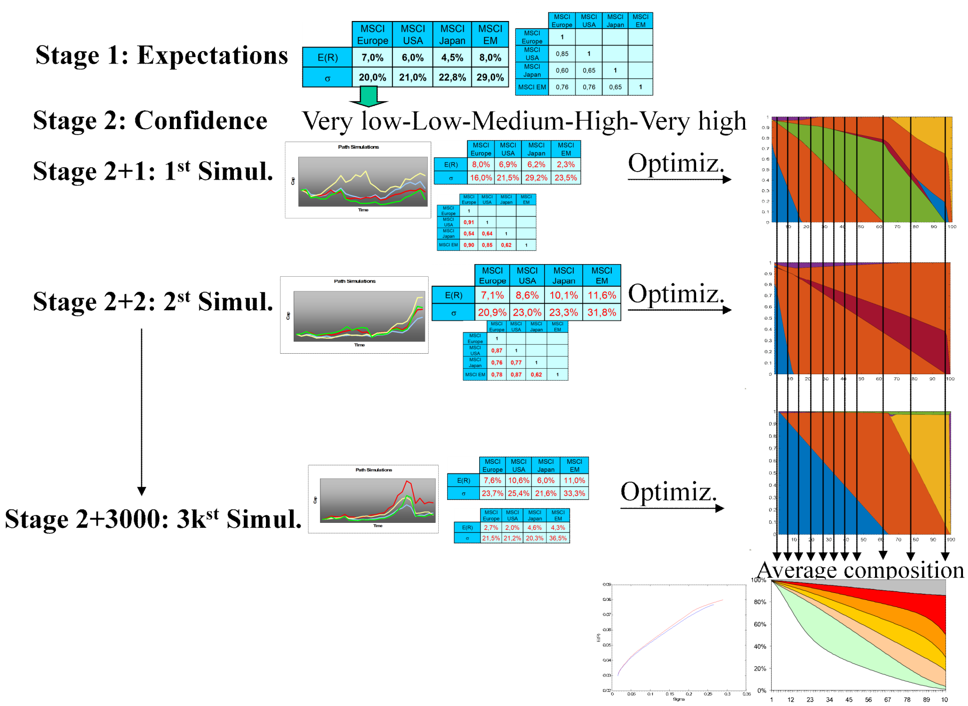


rand numb	simul returns		
0,4621242	4,79%		
0,9983643	43,41%	1000 numb	0,4896673
0,0116022	-22,87%	10 numb	0,4584377
0,4295233	3,74%		
0,3905747	2,47%		
0,3329822	0,51%		
0,5438641	7,40%		
0,3211239	0,09%		
0,0755519	-12,26%		
0,9644984	28,96%		
0,0848392	-11,47%		
0,2064946	-4,41%		
0,7762947	15,66%		

Parameter → Size (number of simulated returns from which I calculate $E(R)_{SIM}$ and σ_{SIM})

In Practice:

CONFIDENCE:	SIZE
LOW	12 - 15
MEDIUM	25 - 35
HIGH	40 - 50



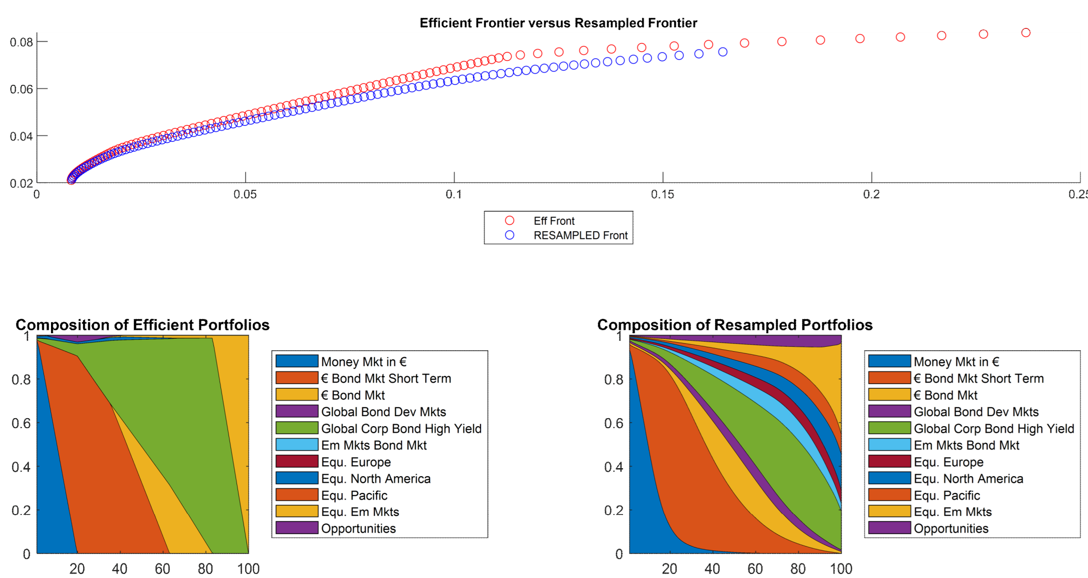
Resampling® on Matlab:

```
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;
```

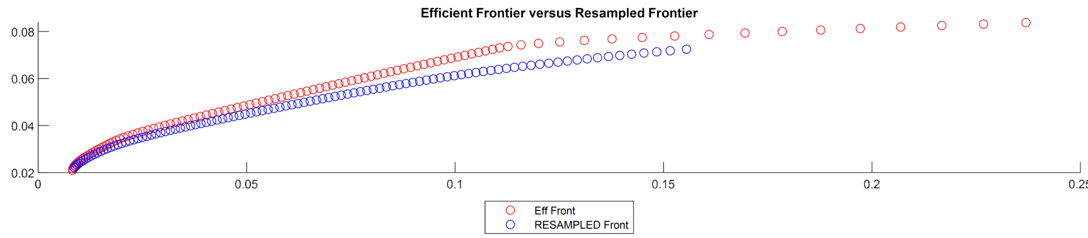
```
SIM= 1000;

% frontiera efficiente semplice
[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
```

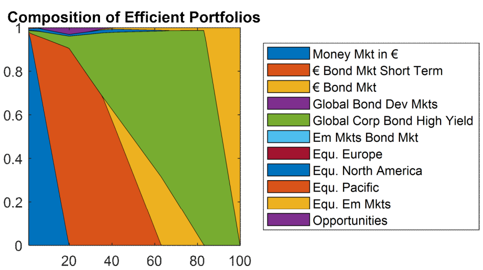
```
scatter (RISK_RESAMPL,EXP_RET_RESAMPL,'B')
hold off
title('Efficient Frontier versus Resampled Frontier')
legenda= legend({'Eff Front','RESAMPLED
Front'},'Location','SouthOutside')
subplot(2,2,3)
area(WTS2)
legenda= legend(LABELS,'Location','EastOutside')
title('Composition of Efficient Portfolios')
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]);
```

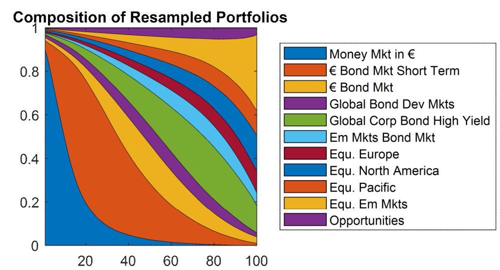
Size = 25 ⇓



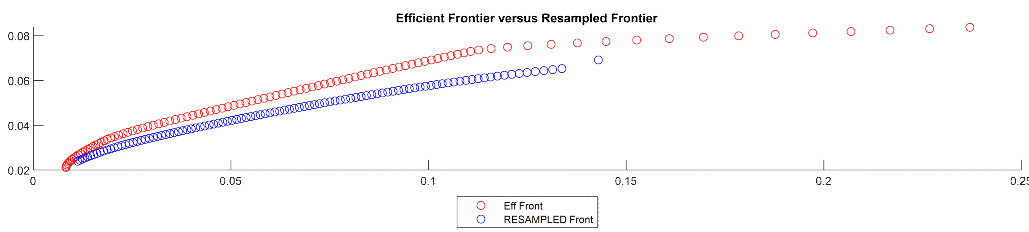
Size = 12

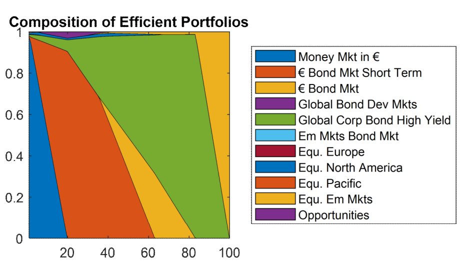


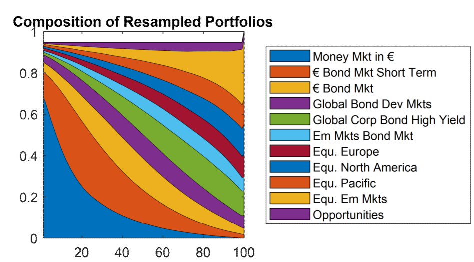




Size = 10,000







Bayesian Approaches

↳ Improving Markowitz Optimization

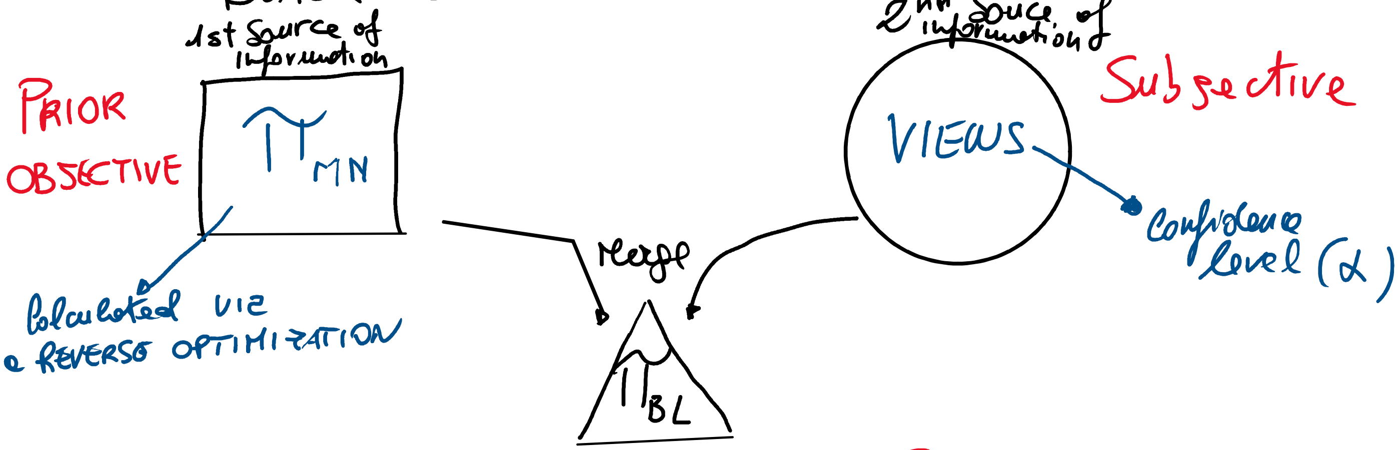
WORKING ON - EXPECTED RETURN ESTIMATION

↳ Improving Markowitz Optimization

working on ...... EXPECTED RETURNS ESTIMATION (2nd stage)

↓

BLACK- LITTERMAN Model



WRONG ⟶ $\Pi_{BL} = (1-\alpha)\cdot\Pi_{MN} + \alpha \cdot \text{Views}$

Analytics of the Black-Litterman Approach

Analytics of the Prior:

4 Ingredients

r_f = risk-free rate

W_{MN} = Column vector of M.N. portfolio composition

Σ = Variance-Covariance Matrix of <u>RETURN</u> of Asset Classes

λ = lambda
- risk-adversion coefficient
- coefficient of optimism about the future performance of the MARKET NEUTRAL PORTFOLIO

$$\lambda = \frac{E(R)_{MN} - r_f}{\sigma^2_{MN}}$$

$$\boxed{\text{INPUT: } r_f,\ W_{MN},\ \Sigma,\ \lambda}$$

Reverse Optimization:

$$\tilde{\Pi}_{MN} = r_f + \lambda \cdot \Sigma \cdot w_{MN}$$

Variance - Covariance Matrix of Asset Classes <u>EXPECTED</u> RETURN

Prior Information

$$\boxed{\text{Expected Returns} \sim N\left(\tilde{\Pi}_{MN}\ ;\ \tilde{\tau}\Sigma\right)}$$

Tau parameter has the role to transform a VaR-Cov MATRIX of Returns in a VaR-Cov. MATRIX of expected Returns

Property of the Sample Mean

$$r \longrightarrow \sigma_r^2 \Rightarrow \bar{r} \longrightarrow \underbrace{\left(\frac{1}{T}\right)}_{\tilde{\tau}} \cdot \sigma_r^2$$

$$\tilde{\tau} = \frac{1}{T}$$

Analytics of the 2nd source of information ⇒ VIEWS

└→ $P,\ Q,\ C,\ \Omega$

P = Matrix
- → n. of rows → n. of Views
- → n. of columns = n. of. ASSET CLASSES SELECTED

└→ P shows the asset classes involved in each view

	Money Mkt in €	€ Bond Mkt Short T	€ Bond Mk	Global Bon	Global Corp Bond	Em Mkts Bond Mk	Equ. Europe	Equ. North Americ	Equ. Pacific	Equ. Em Mkts	Opportunities	
P	0	0	0	-1	1	0	0	0	0	0	0	p1
	0	0	0	0	0	0	-1	1	0	0	0	p2

VIEWS
Corporate Global HY will overperforme Global Bond
Equity North America will overperforme Equity Europe

view
3,5%
1,5%

Q	3,50%
	1,50%

Q = Q-Domain ... n. of rows = numb. of Views

Equity North America will overperforme Equity Europe	1,5%

Q	3,50%
	1,50%

Q = Column Vector → n° of rows = numb. of. Views

↳ Q shows the VIEWS

C = Column Vector → numb. of rows = numb. of. VIEWS

↳ C shows the confidences of the single Views

confidence
30,000000000%
30,000000000%

C	30%	c1
	30%	c2

Theory — Practice

$$c_1, c_2, \ldots c_K \in \left]0\,;\,1\right[\Rightarrow c_1, c_2, \ldots, c_3 \in [15\%\,;\,40\%]$$

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

→ uncertainty of view)
↳ var-cov matrix of the views.

Ω → Matrix ⇒ numb. of rows = numb of column = numb. of. Views

↳ Ω is the variance-covariance matrix of Views

→ STRONG Assumption : Views are ∅ correlated

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

PRIOR

$$\boxed{\text{Exp Ret} \sim N(\Pi_{NN}\,;\,\tau\Sigma)}$$

Views

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

Merge!

$$\xcancel{\tilde{\Pi}_{BL} = \frac{(\tau\Sigma)^{-1} \cdot \tilde{\Pi}_{MN} + (\Omega)^{-1}\, Q}{\left[(\tau\Sigma)^{-1} + \Omega^{-1}\right]} = \left[(\tau\Sigma)^{-1} + \Omega^{-1}\right]^{-1} \cdot \left[(\tau\Sigma)^{-1} \cdot \tilde{\Pi}_{MN} + \Omega^{-1} \cdot Q\right]}$$

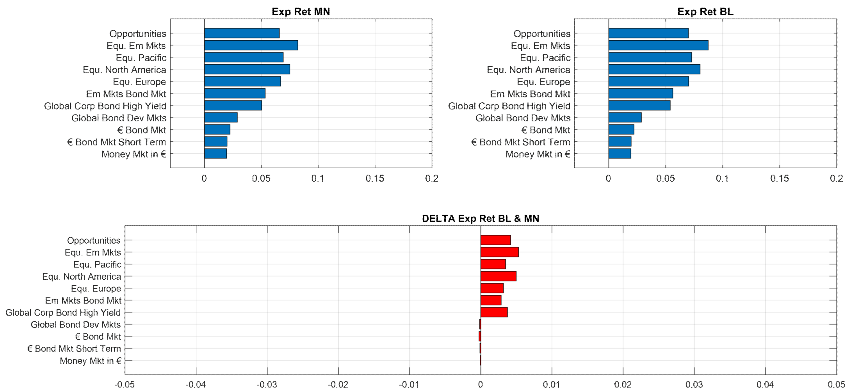
$$\Downarrow$$

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

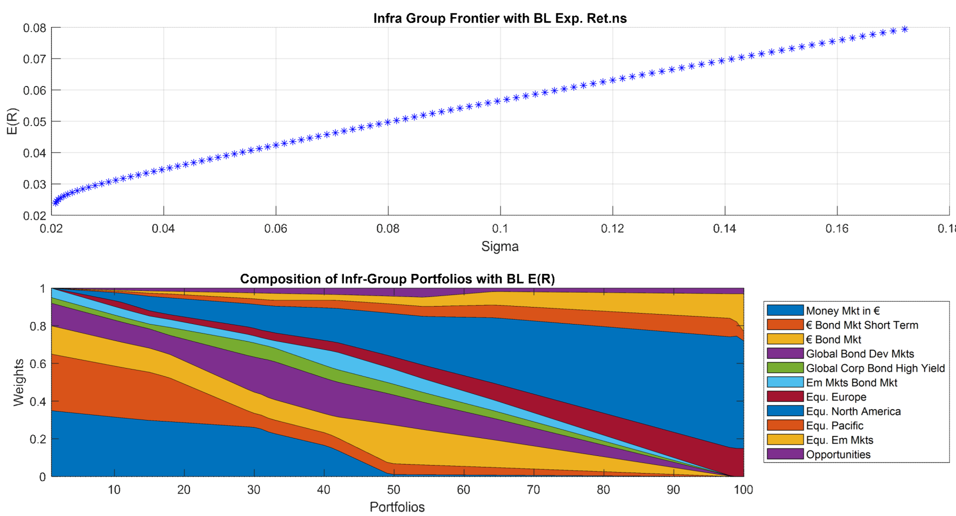
Black-Litterman on Matlab

```
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=4.5;
EXP_RET_MN=RISK_FREE+LAMBDA*SIGMA*W_MN
TAU=1/20
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;0.015]
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_
SIGMA)*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
```



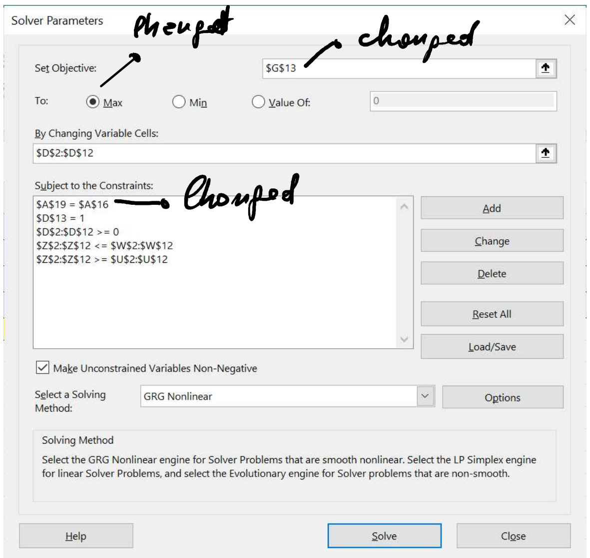
The best is to combine BL **&** infra-group constrained optimization



Portfolio selection

↳ Identify a subset of SAA that are compliant with the risk tolerance and investment horizon of each prototype of investor

VaR can be a useful tool in order to select SAAs.



ASSET CLASSES	E(r) BL	σ	Weights
Money Mkt in €	1,93%	0,87%	1,2%
€ Bond Mkt Short Term	1,98%	1,69%	5,9%
€ Bond Mkt	2,28%	4,17%	21,2%
Global Bond Dev Mkts	3,08%	6,92%	16,5%
Global Corp Bond High Yie	5,95%	11,07%	5,9%
Em Mkts Bond Mkt	6,27%	12,72%	8,2%
Equ. Europe	7,94%	17,53%	6,2%
Equ. North America	9,07%	17,80%	24,7%
Equ. Pacific	8,25%	18,56%	4,9%
Equ. Em Mkts	9,92%	23,69%	3,8%
Opportunities	7,87%	15,36%	1,6%
PORTFOLIO	**5,63%**	**8,29%**	**100,00%**

cov	ML Euro 0-1	ML Bond Euro	fa ML Obbl. E	ML Obbl. Glo
Money Mkt	**0,0001**	0,0001	0,0001	0,0001
€ Bond Mk	0,0001	**0,0003**	0,0005	0,0003
€ Bond Mk	0,0001	0,0005	**0,0017**	0,0012
Global Bon	0,0001	0,0003	0,0012	**0,0048**
Global Cor	-0,0002	-0,0000	0,0004	0,0024
Em Mkts B	-0,0001	0,0001	0,0008	0,0026
Equ. Europ	-0,0003	-0,0004	-0,0004	-0,0023
Equ. North	-0,0004	-0,0006	-0,0003	0,0009
Equ. Pacifi	-0,0003	-0,0003	-0,0002	0,0003
Equ. Em M	-0,0003	-0,0005	-0,0004	-0,0019
Opportuniti	-0,0003	-0,0005	-0,0007	-0,0006

	Equ porti
lambda=4.5	38,2%
lambda=5.5	41,1%

-8,00%
Tolerated Annual Loss

-8,00%
VaR 1yr (95%)

V. optimism or risk adversion ?

Higher Order Moments

Mean – σ – SK optimization

$$\max_{w} \left[\alpha \cdot E(R)_{PORT} + (1-\alpha)\, SK_{PORT} \right]$$

Constraints :

*

Constraints:

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

$w_i \geq 0$

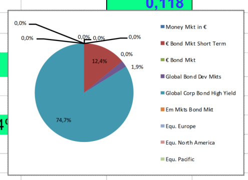
$\sum w_i = 1$

ASSET CLASSES	Π BL	σ	Skewn	Weights	Rend Port
Money Mkt in €	**1,94%**	0,87%	0,604	0,0%	-1,61%
€ Bond Mkt Short Term	**1,97%**	1,69%	- 0,303	12,4%	7,67%
€ Bond Mkt	**2,22%**	4,17%	- 1,766	0,0%	-13,51%
Global Bond Dev Mkts	**2,87%**	6,92%	0,177	1,9%	10,13%
Global Corp Bond High Yield	**5,40%**	11,07%	1,236	74,7%	5,54%
Em Mkts Bond Mkt	**5,63%**	12,72%	0,248	0,0%	19,08%
Equ. Europe	**7,02%**	17,53%	- 0,914	0,0%	3,31%
Equ. North America	**8,01%**	17,80%	- 0,691	0,0%	-1,99%
Equ. Pacific	**7,27%**	18,56%	- 0,255	0,0%	-22,35%
Equ. Em Mkts	**8,73%**	23,69%	0,211	10,9%	51,07%
Opportunities	**7,00%**	15,36%	- 0,455	0,0%	19,67%
PORTFOLIO	**5,29%**	**10,00%**	**Skew (Sk)**	100,0%	3,13%
			1,177		15,42%
			0,118		0,96%
					6,36%
					4,76%
					15,62%
					-0,26%
					-0,09%
					14,41%
					0,33%
					6,86%
					-7,82%

10,00%
Sigma Target

Preference for E(R) (**Alfa**) 90,0%

Objective Function 5,94



COV	*Bofa ML Euro 0-1 anni*
Money Mkt in €	**0,0001**
€ Bond Mkt Short Term	0,0001
€ Bond Mkt	0,0001
Global Bond Dev Mkts	0,0001
Global Corp Bond High Yie	- 0,0002
Em Mkts Bond Mkt	- 0,0001
Equ. Europe	- 0,0003
Equ. North America	- 0,0004
Equ. Pacific	- 0,0003
Equ. Em Mkts	- 0,0003
Opportunities	- 0,0003

	Alfa=100%	Alfa=90%	Alfa=0%
Bofa ML Euro 0-1 anni	0%	0%	0%
Bofa ML Bond Euro 1-3 Y	0%	12%	10%
Bofa ML Obbl. Euro	0%	0%	0%
Bofa ML Obbl. Globale	31%	2%	0%
ML Global HY	14%	75%	90%
Bofa ML Obbl Emergente	8%	0%	0%
MSCI Europe	5%	0%	0%
MSCI North America	24%	0%	0%

TACTICAL ASSET ALLOCATION (TAA)

TAA → $\boxed{\text{NO}}$

TAA → $\boxed{\text{yes}}$ → HOW?

(a) TAA via Flexible Funds

(b) TAA via a TACTICAL COMMITTEE

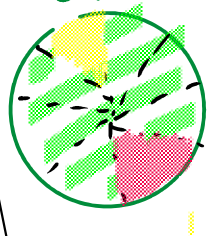
(a) TAA via Flexible Funds

S.A.A. → % of traditional Asset Classes

Portion of the portfolio invested in Flexible Fund

(b) TAA via a Tactical Committe

SAA



Quarter "Tactical Committee"

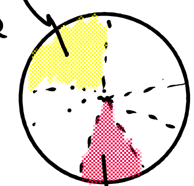
$\Rightarrow$

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

$\Rightarrow$ Optimize

+ View

TAA



- View

$\rightarrow$ "Tactical INPUTS" + Tactical Optimization

How to use the Black-Litterman Model for tactical purposes

Prior

$\boxed{\Pi_{SN}}$

Views TACTICAL $\rightarrow \alpha$

MERGE

$\Pi^{TACTICAL}_{BC}$

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

$\boxed{\text{Example}}$ of TACTICAL OPTIMIZATION

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

Constraints:

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

$$w_i^{TAA} \geq \emptyset \quad \forall i \in [1; K]$$

$$\sigma_{TAA} \leq \sigma^*$$

$$\sum w \geq h_i$$

$$\sigma_{TAA} = \sigma$$

$$\sum w_{RISKY} \geq h_i$$

$$\sum w_{RISKY} \leq k_i$$

$$\left.\begin{array}{l} w_i \geq LB_i \\ w_i \leq UB_i \end{array}\right\} \forall i \in [1;2;\dots,K]$$

$$ReVaR_{TAA} \geq ReVaR^*$$

Re-VaR = Measure the potential underperformance of the TAA versus SAA
The VaR of the position LONG in TAA and SHORT in SAA

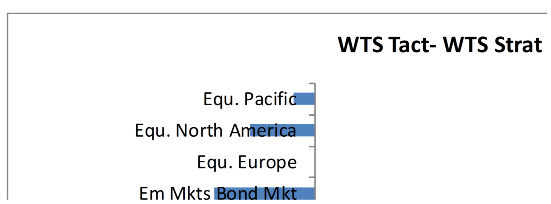
$$ReVaR = \left[E(R)_1^T \;\; E(R)_2^T \dots E(R)_K^T\right] \times \underbrace{\begin{bmatrix} w_1^T - w_1^S \\ w_2^T - w_2^S \\ \vdots \\ w_K^T - w_K^S \end{bmatrix}}_{\alpha} - K \cdot \sqrt{\alpha^T \times \begin{bmatrix} \text{Cov Matrix} \end{bmatrix} \times \alpha}$$

ASSET CLASSES	Rend att TATTICAL	σ Tact	SAA	TAA	Weights Tact- Weights Strat
Money Mkt in €	0,63%	0,87%	2%	2%	0,00%
€ Bond Mkt Short Term	1,00%	1,56%	22%	22%	0,00%
€ Bond Mkt	2,01%	3,58%	11%	14%	2,60%
Global Bond Dev Mkts	2,50%	7,13%	9%	25%	15,65%
Global Corp Bond High Yie	-2,50%	11,19%	5%	0%	-5,00%
Em Mkts Bond Mkt	-3,50%	10,01%	6%	2%	-4,00%
Equ. Europe	-3,00%	16,66%	8%	8%	0,00%
Equ. North America	-3,00%	16,37%	20%	17%	-2,60%
Equ. Pacific	-2,80%	17,16%	5%	4%	-0,88%
Equ. Em Mkts	-5,00%	21,90%	8%	6%	-1,77%
Opportunities	-4,00%	16,52%	4%	0%	-4,00%
PORTAFOGLIO	**-0,14%**	**6,49%**		**100,00%**	**0,00%**

cov	ML Euro 0-1
Bofa ML E	**0,0001**
Bofa ML B	0,0001
Bofa ML O	0,0001
Bofa ML O	0,0001
ML Global	-0,0002
Bofa ML O	-0,0001
MSCI Euro	-0,0003
MSCI Nort	-0,0004
MSCI Paci	-0,0003
MSCI Eme	-0,0003
Opportuniti	-0,0003

SIGMA Threshold	10,00%

RE-VAR (cl=95%)	-3,00%
ReVaR Threshold	-3,00%



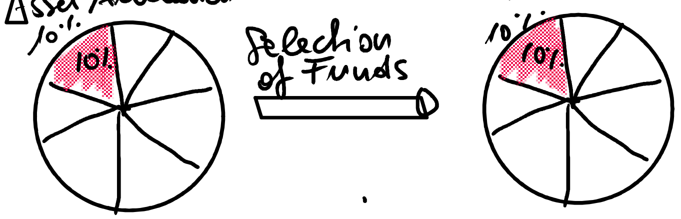
Fund / Asset Manager SELECTION

Asset Allocation

Selection

Product Allocation

Asset Allocation 10%   Product Allocation 10%

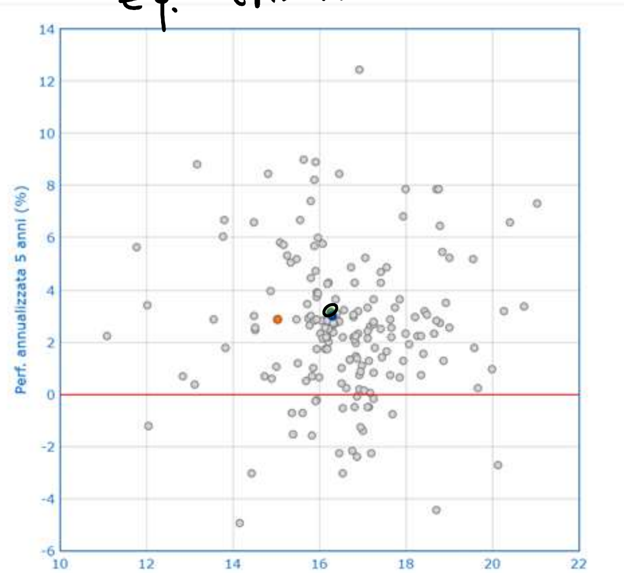


2) Active —— For Non Efficient MARKETS → Bond EM.MKT Equity

VS

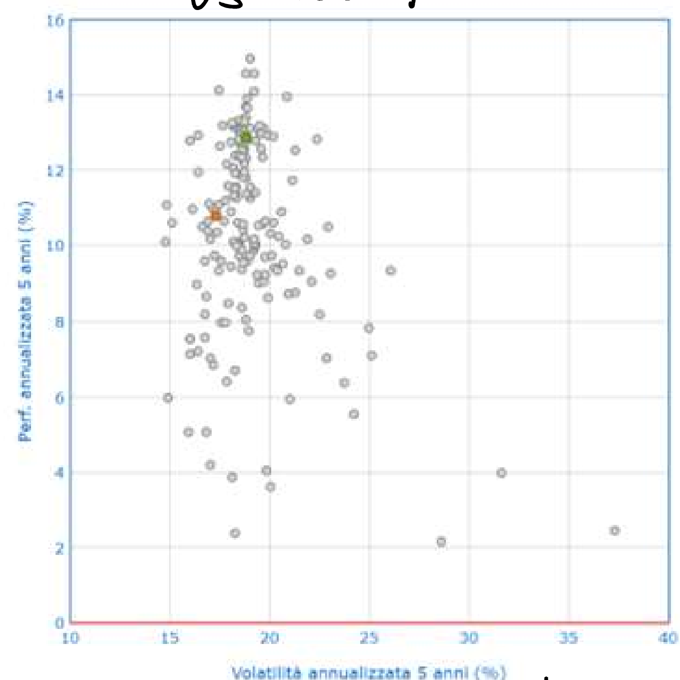
PASSIVE → Efficient Markets → Developed MKTS

Eq. EM. MKTS



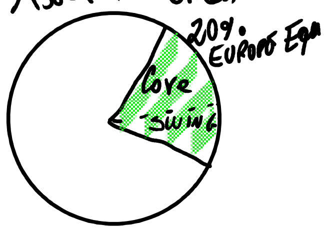
σ - 5y

US EQUITY



b) Core/Blend VS Swing/Satellite

Asset Allocation



Core/Blend Fund: Cover all the MARKet

Swing/Satellite Fund: focused on a "portion" of the Market

- Country
- Size
- Sector
- Style (G/V)

Cover all the market but are VERY VERY ACTIVE

Fund Valuation / Selection

Quantitative

Fund Valuation / selection

$\boxed{\text{Qualitative Analysis}}$ + $\boxed{\text{Quantitative Analysis}}$

- Reputation
- Quality of Asset Man
- Size Company
- Size of the Fund
- Quality of Risk management processes

QUANTITATIVE ANALYSIS

- Comparison of omogeneous funds:
  European Equity Funds Blend
- Time series: time window of **5 years**

	PICTET FUNDS LUX E	JANUS HENDERSON	FUND XXX	INVESCO SUST PAN E	MSCI EUROPA	RISK FREE

1) Return $\longrightarrow \overline{R}_F = \frac{\sum_{i=1}^{T} R_i}{T}$

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

$\longrightarrow \overline{TE}_F = \overline{R}_F - \overline{R}_B$

$\longrightarrow \text{Cumulative Return}_F = \prod_{i=1}^{T}(1+R_{F,i}) - 1 \Rightarrow 5y$

$\longrightarrow \text{Annualised Performance} = \sqrt[5]{(1+\text{Cumul Return}_F)} - 1$

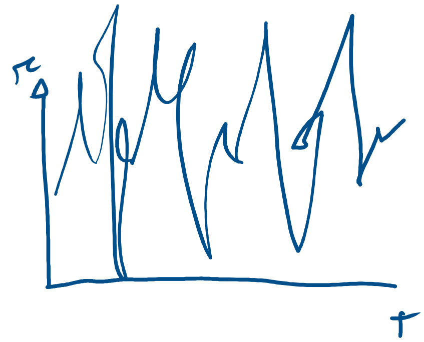
	PICTET FUNDS LUX E	JANUS HENDERSON	FUND XXX	INVESCO SUST PAN E	MSCI EUROPA	RISK FREE
Monthly Av. Return	0,71%	0,91%	1,07%	0,39%	0,79%	-0,01%
Monthly Risk Premium	0,72%	0,92%	1,08%	0,40%		
Average Tracking Error	-0,08%	0,12%	0,28%	-0,40%		
Cumulative Return	43,01%	60,91%	72,63%	19,31%	50,09%	
Annualised Return	7,42%	9,98%	11,54%	3,59%	8,46%	

2) Risk

- $\sigma_F = \sqrt{\frac{\sum_{i=1}^{T} (R_{F,i} - \bar{R})^2}{T}}$

DOWNSIDE RISK

- $DSR_F = \sqrt{\sum_{R_{F,i}<S} \frac{(R_{F,i} - S)^2}{T}}$



TRACKING ERROR VOLATILITY

- $TEV_F = \sqrt{\sum_{i=1}^{T} \frac{(TE_i - \overline{TE})^2}{T}}$

3) Risk Adjusted Performance Analysis

$$\text{Ratios} = \frac{\text{Return}}{\text{Risk}}$$

$$\text{Sharpe Ratio} = \frac{\bar{R}_F - r_f}{\sigma_F} = \frac{\overline{RP}_F}{\sigma_F}$$

$$\text{Sortino Ratio} = \frac{\bar{R}_F - r_f}{DSR_F} = \frac{\overline{RP}_F}{DSR_F}$$

$$\text{Information Ratio} = \frac{\bar{R}_F - \bar{R}_B}{TEV_F} = \frac{\overline{TE}_F}{TEV_F}$$

4) Rating $\Rightarrow$ 5 Classes

4) Rating ⇒ 5 Classes

	BLEND/CORE	BLEND/CORE	SATELLITE/SWING	BLEND/CORE
	PICTET FUNDS LUX EUROPE INDEX R - TOT RETURN IND	JANUS HENDERSON PAN EUROPEAN A2 EUR	**BSF EUROPN OPPTYS EXTSN A2 EUR - TOT RETURN IND**	INVESCO SUST PAN EUROPN STRUCT EQ E ACC EUR - TOT RETURN IND
ISIN	LU0130731713	LU0201075453	**LU0313923228**	LU0119753308
Quantalys	5*	5*	5*	2*

THE END