20598 – Finance with Big Data
PC Lab #1: Applied Portfolio Theory (Week 2)

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PC Lab Groups

PC Labs Groups

Last Name	First Name	PC Lab Group
MOGER	PETTER	
MUELLER	JOHANNES	1
KRAFFT	OKSAR	
SALA	EMANUELE	
SOLERI	LUCA	2
STEFANA	FABIO GIOVANNI	
LIU	HAO	
YANG	XIAOHAN	3
ZHANG	ZHERUI	
D'AMBROSIO	LUCA FLAVIO ROBERT	
DE MIN	FILIPPO	4
JUREN	FILIP	
ANGIUS	MATTIA	
MARINOZZI	FEDERICO	5
POLVERARI	LEONARDO	
CETIN	BUMIN KAGAN	
FILIPPINI	AMEDEO	6
MITOIU	DANIEL	

PC Labs Groups

NAHORNY	JAKUB	
RONK	IAN CONSTANTIJN	**7**
SALOCCHI	GIANFRANCO	
OSMAN ALSAN	BERKANT	
GUNTHER	BENEDIKT	**8**
ZHANG	BUBU ZHANG	
BRIVIO	VALENTINA	
CARBONIERO	GIOVANNI	**9**
MANCINELLI	PIERLUIGI	
ZOTTOLI	ARIANNA	
BISETTI	BRYAN	
BUKHARI	SYED TAHIR ABBAS	**10**
DUICO	ANDREA	
COGNIGNI	RICCARDO	
PRENCE	ERA	**11**
STEFANI	GIOVANNI	

PC Labs Groups

Non-attending:

ANNONI	FEDERICO
BELLODI	GIACOMO
CIPOLLA CIPOLLA	ENRICO
HU	ZHUOHAO
RUZZI	CATERINA
UNGARELLI	FEDERICO

PC Labs Groups

Still waiting for an answer:
Mark LEVIN → Need to find a group !
Beatrice LAINI ?
Ossama TCHINA ?

PC Labs Grading

- PC Labs solutions are submitted as Jupyter Notebooks, via email to me and Andrea (TA): andrea.andolfatto@phd.unibocconi.it

    - Email title : PCLab#1 - Group X - Name1 Name2 Name3

    - Your Jupyter Notebook starts in the same way

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- PC Labs grade will depend on :

    - Your ability to submit it before the deadline **(Friday, 12pm midnight)**

    - The quality of your code (comments, readability, use of functions, etc.)

    - The structure of the Jupyter Notebook : well organized, explain what you are doing and why

    - Your ability to complete the tasks

Applied Portfolio Theory

Goals

- Manipulate and visualize stock market data (S&P 500)

- Create portfolios and compute basics statistics

- Draw the efficient frontier and find the *best* (i.e., tangency) portfolio

- Test the Markowitz mean-variance theory in practice: can you beat the market ?

Big picture context

- You've just been hired by a large *old-school* Asset Management Company

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- The fund manager asks you to figure out the optimal weights to create a tangency portfolio with some stocks, for which your broker offers no transaction fees.

- The data is on Bboard or on my website

Task #1 :Import the data and describe the sample

- Sort the stock data by date and print the number of stocks

- Check if data contains any null values

- What is the average market value of the S&P500 ?

- Which stock or index has the minimum dispersion in dollar value ?

- What is the maximum price for Amazon stock over the specified time period ?

Task #2 : Plot the data

- Define a function to plot the entire dataframe
    - The function takes in a dataframe as an input argument and does not return anything back

RAW STOCK PRICES (WITHOUT NORMALIZATION)
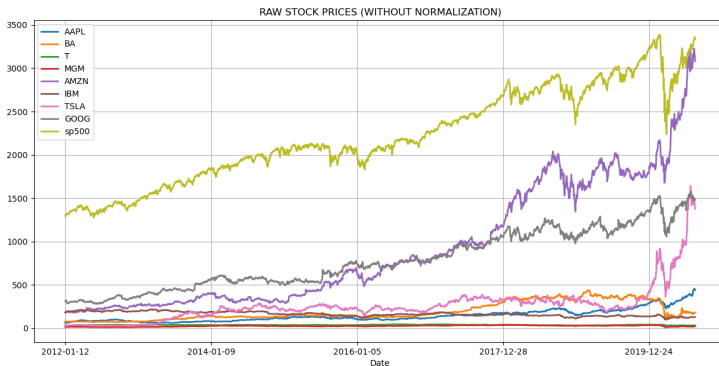
Task #3 : Print out normalized (scaled) stock prices

- Define a function to normalize the prices based on the initial price
  - The function simply divides every stock by it's price at the start date (i.e. : Date = 2012-01-12)

- Plot normalized data

- **Optional** : Define a function to perform an interactive data plotting using `plotly express`

Task #5 : Calculate stock returns (1)

- Define a function to calculate stocks daily returns (for all stocks)
  - Loop through each stock
  - Loop through each row belonging to the stock

- Plot it !
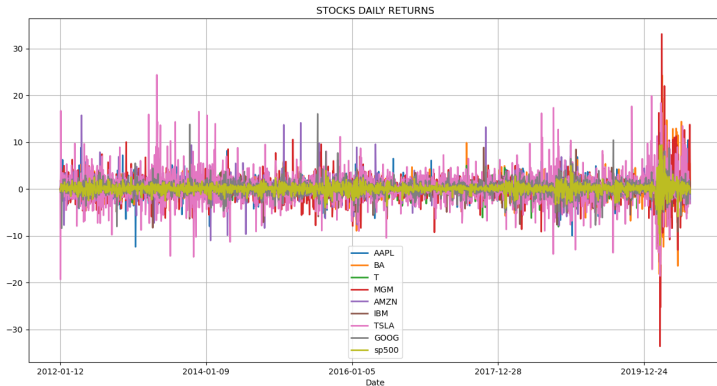
Task #5 : Calculate stock returns (2)

- Calculate the correlations between daily returns

- Plot the correlation table as in heat-map

- What are the top 2 stocks that are positively correlated with the S&P500 ?

- What is the correlation between Amazon and Boeing ? Comment on your answer

- What is the correlation between MGM and Boeing ? Comment on your answer

Task #5 : Calculate stock returns (3)

- Plot the histograms of daily returns and comment

- **Optional** : Define a function to perform an interactive and fancy histograms plots using `Plotly`
  - Plotly's Python API contains a super powerful module known as figure factory module
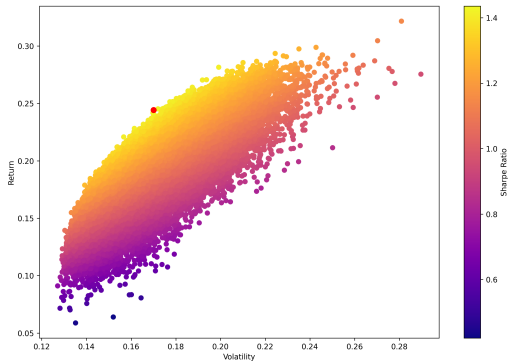
Task #6 : Portfolio weights
Simulation exercise

- Write a function that will :
  - Simulate 1000 portfolios with random weights
  - Compute the return, the variance and the Sharpe ratio of each portfolio
  - Return the maximum Sharpe ratio and its weights

- What are the weights of your tangency portfolio ? What would have been the performance of this portfolio over the sample period ? Plot it !

Task #6 : Portfolio weights
Simulation exercise

- What are the weights of your tangency portfolio ? What would have been the performance of this portfolio over the sample period ? Plot it !
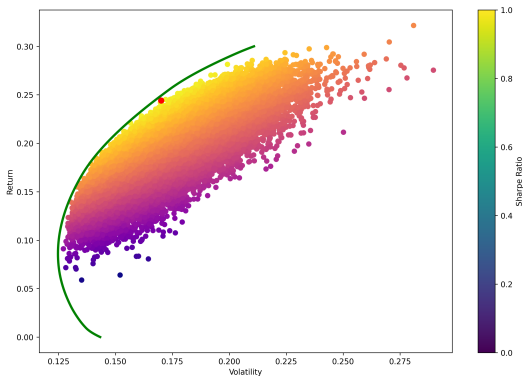
Task #6 : Portfolio weights
Simulation exercise

- **Optional** : Define a function that finds the weights that minimize the variance for all possible level or return (i.e., that draw the efficient frontier). Plot it against the previous scatter plot

Task #7 : Testing Portfolio Theory - **Optional**

- Re-run Task #6 but only on the first part of the sample (2012-2016)

- Find out what are the optimal weights for this period

- Simulate your optimal portfolio on the second part of the sample (2016-end)
    - How does it perform ?
    - Plot the expected (measured over the 1st period) vs. the realized return and volatility (over the second).

- **Super optional :** Let's go a step further. Every year, you re-balance your portfolio based on last year data. What is your performance overall ?