Presentazione Progetto BISF

Tommaso Cammelli – 851593

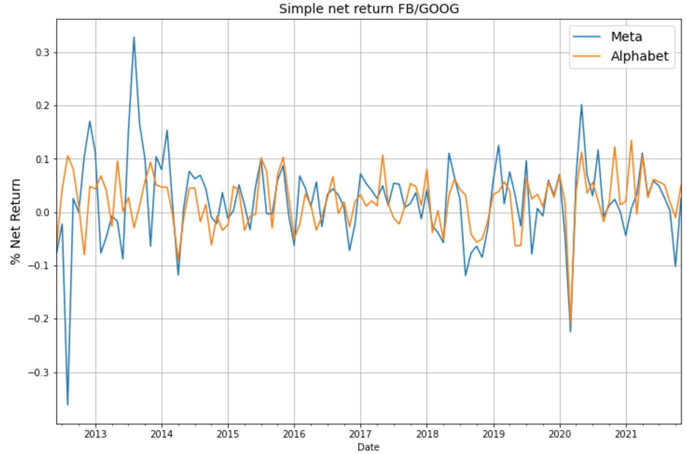
Titoli utilizzati

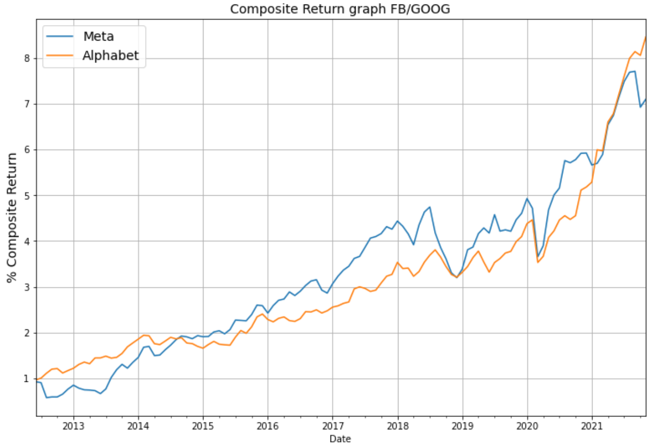
settore tecnologico	settore militare	settore bancario
Meta	Raytheon	BANK OF AMERICA
Alphabet	LOCKHEED MARTIN	JPMORGAN CHASE & CO.

Statistiche descrittive

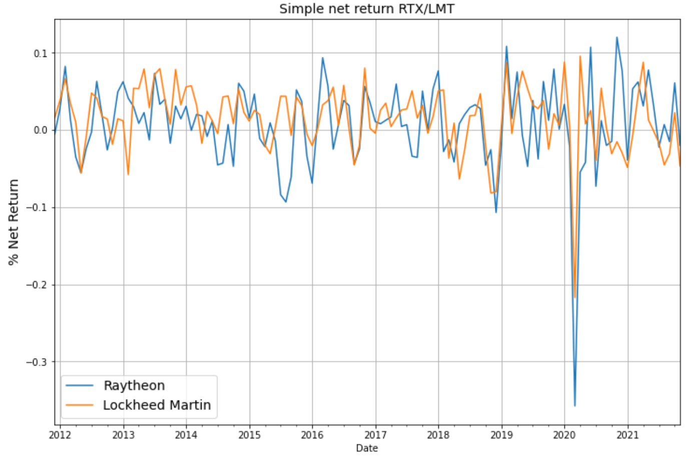
Rendimenti semplici e composti

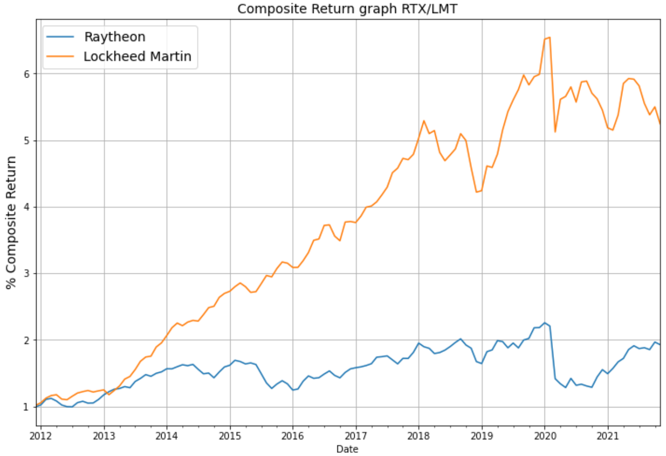
titoli tecnologici



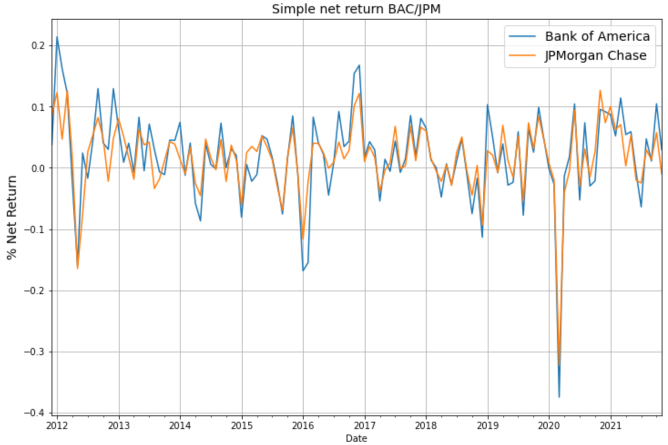


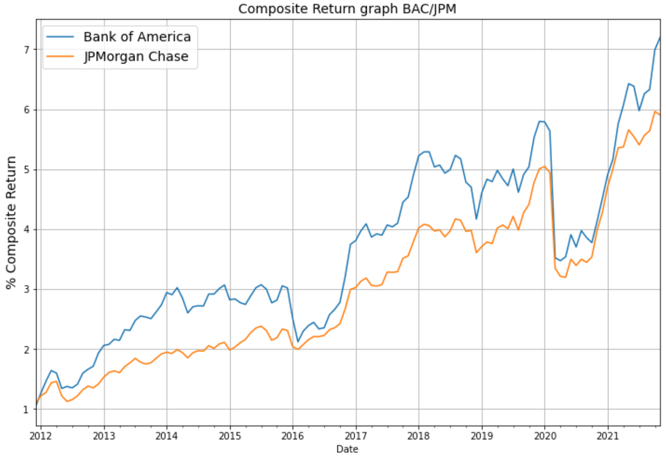
titoli militari





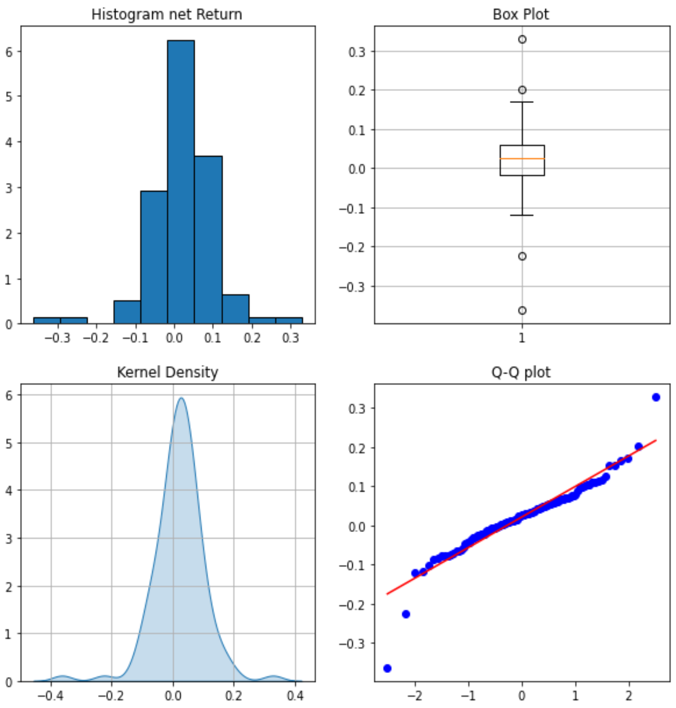
titoli bancari





Grafici diagnostici e statistiche – FB/GOOG

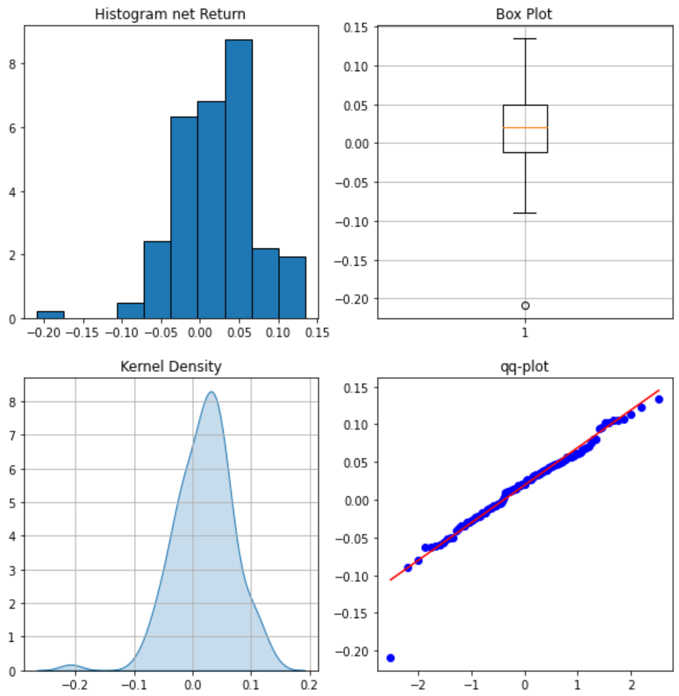
Meta (FB)



	Media	Varianza	Deviazione Standard	Asimmetria	Curtosi
Adj Close	0.0207	0.0065	0.0807	-0.5917	5.5871

Volatilità: 36,44%

Alphabet (GOOG)

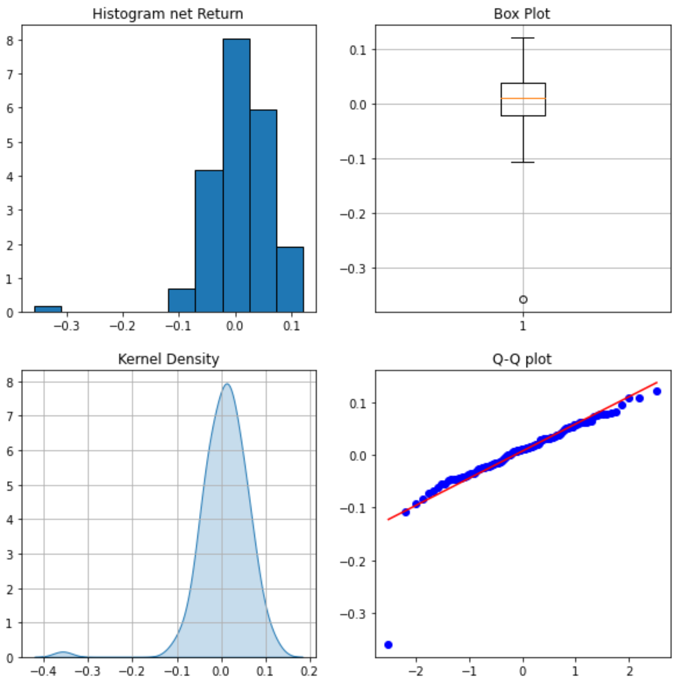


	Media	Varianza	Deviazione Standard	Asimmetria	Curtosi
Adj Close	0.0192	0.0025	0.0501	-0.6988	2.6747

Volatilità: 25,11%

Grafici diagnostici e statistiche – RTX/LMT

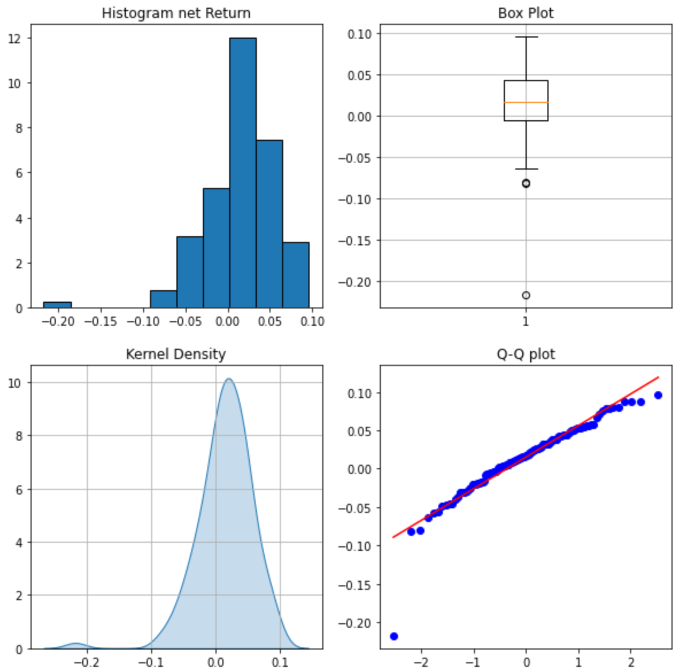
Raytheon (RTX)



	Media	Varianza	Deviazione Standard	Asimmetria	Curtosi
Adj Close	0.0072	0.0031	0.0554	-2.3533	14.7837

Volatilità: 25,49%

Lockheed Martin (LMT)

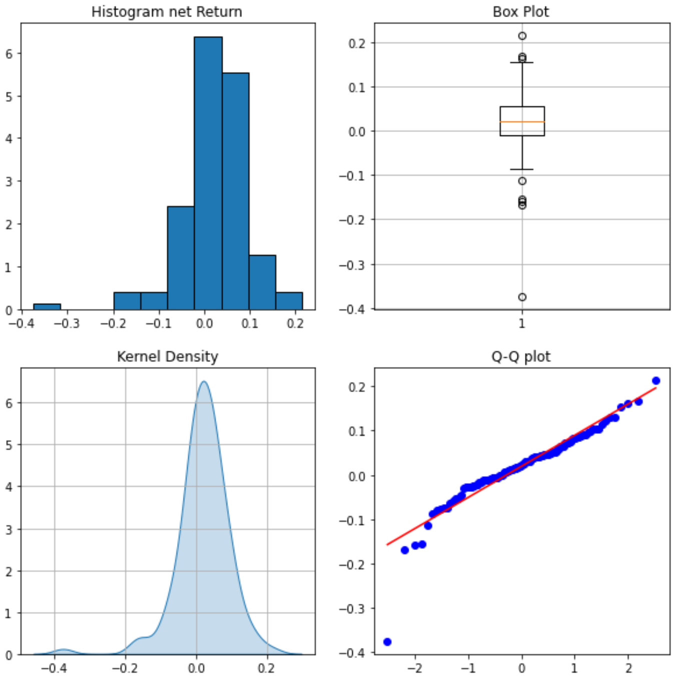


	Media	Varianza	Deviazione Standard	Asimmetria	Curtosi
Adj Close	0.0148	0.0018	0.0427	-1.4478	6.3315

Volatilità: 21,1%

Grafici diagnostici e statistiche – BAC/JPM

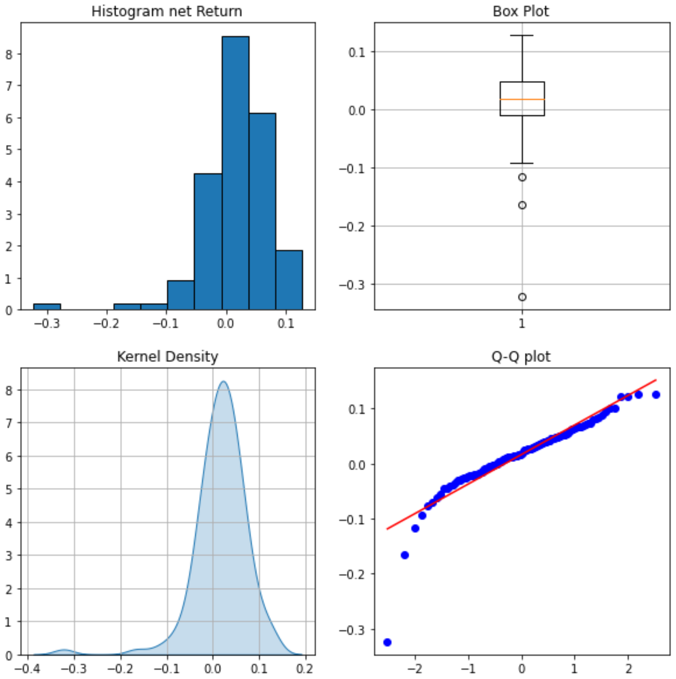
Bank of America (BAC)



	Media	Varianza	Deviazione Standard	Asimmetria	Curtosi
Adj Close	0.0194	0.0053	0.0729	-1.3789	6.9176

Volatilità: 31,74%

JPMorgan Chase (JPM)

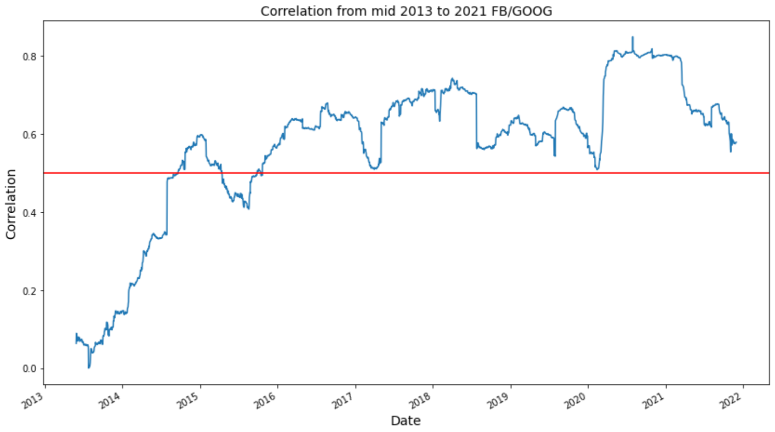


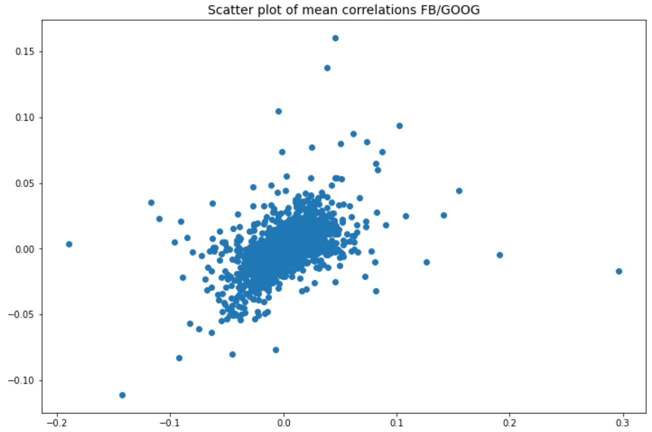
	Media	Varianza	Deviazione Standard	Asimmetria	Curtosi
Adj Close	0.0166	0.0032	0.0569	-1.9897	10.3171

Volatilità: 27,04%

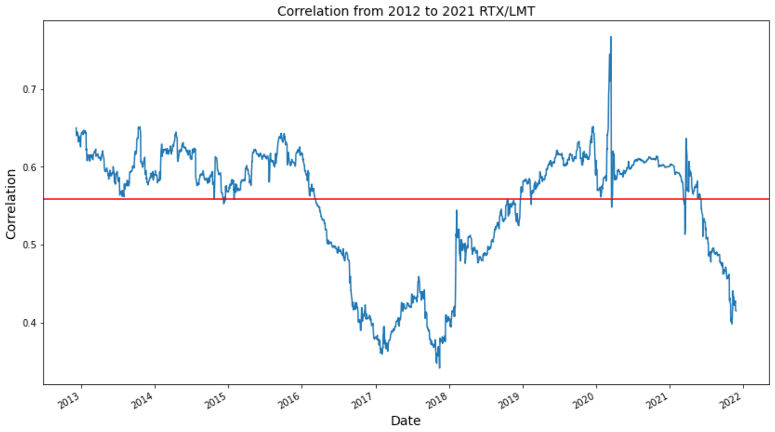
Correlazione e dispersione

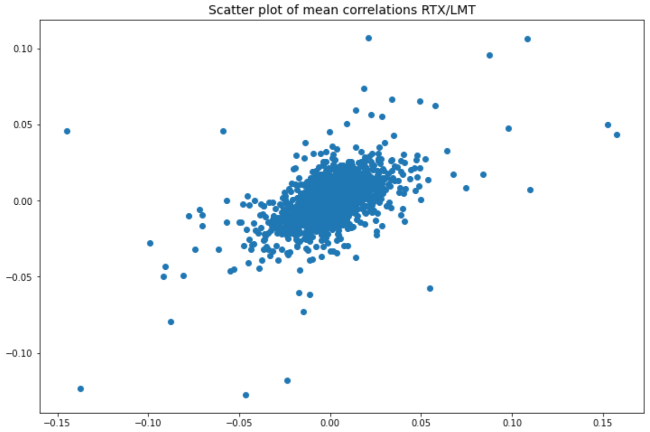
titoli tecnologici



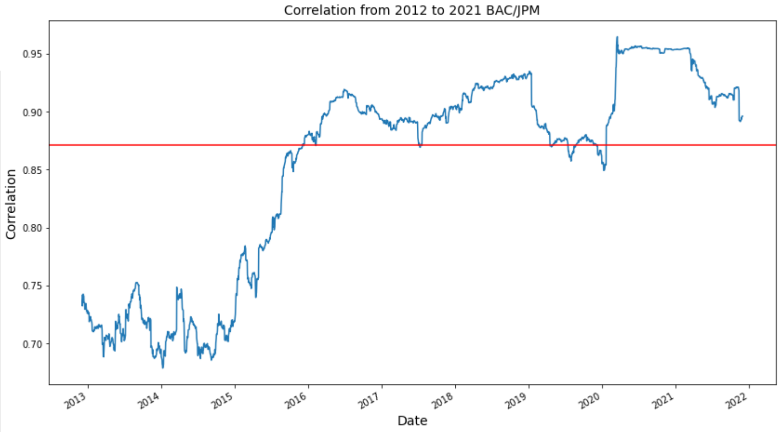


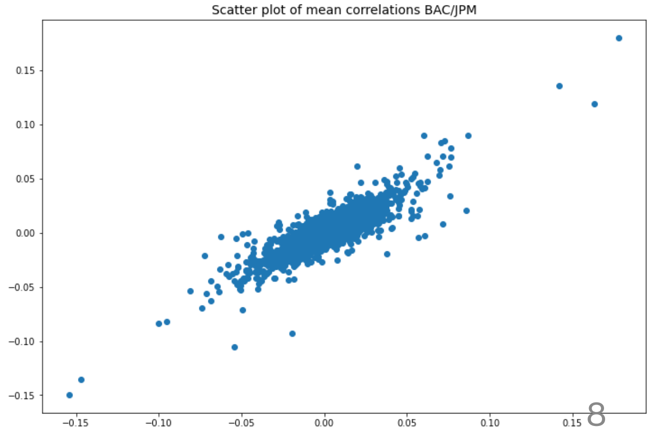
titoli militari





titoli bancari





Modelli di Previsione

Mediante modello ARIMA

Il modello di previsione ARIMA

ARIMA (AutoRegressive Integrated Moving Averages) è un modello statistico autoregressivo integrato a media mobile che ci permette di effettuare predizioni sui trend futuri in una serie storica (utilizzando dati passati).

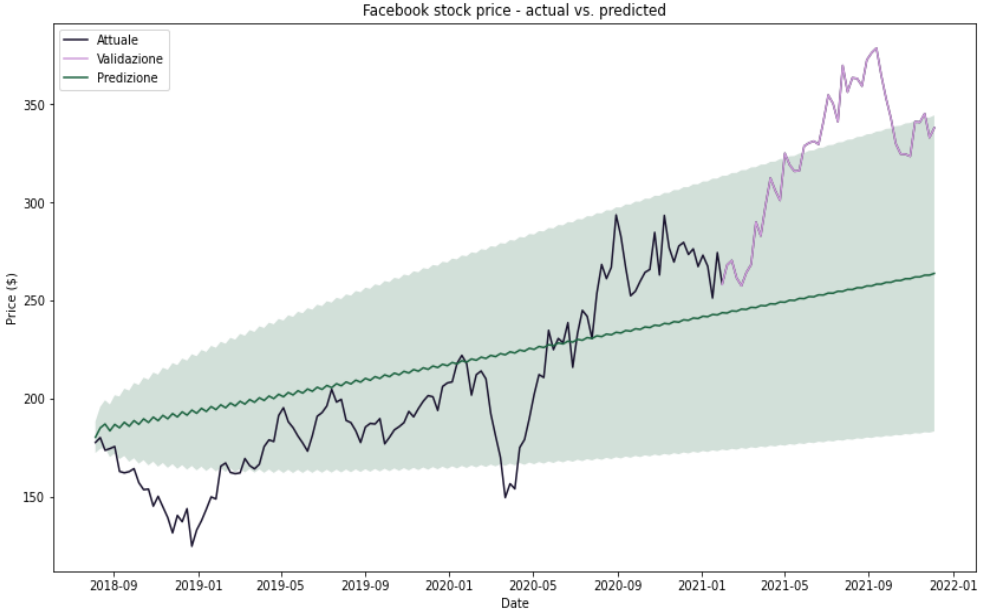
Questo modello essendo composto da 3 parti (definite dal nome), necessità in input tre variabili:

- p = *lag order*
- d = *grado di differenziazione*
- q = *ordine della media mobile*

La scelta accurata di queste tre variabili è fondamentale per ottenere risultati con margine di errore inferiore.

Predizioni con ARIMA – FB/GOOG

predizione per Meta (FB)

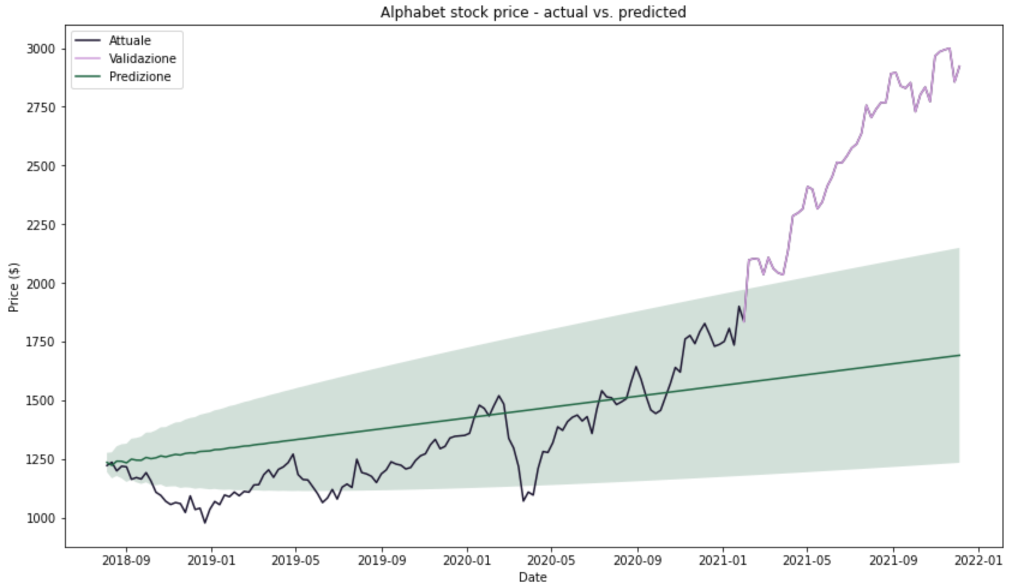


parametri stimati (p, d, q)

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	324
Model:	SARIMAX(3, 1, 1)	**Log Likelihood**	-912.383
Date:	Tue, 24 May 2022	**AIC**	1836.767
Time:	16:34:12	**BIC**	1859.433
Sample:	0	**HQIC**	1845.815
	- 324		
Covariance Type:	opg		

predizione per Alphabet (GOOG)



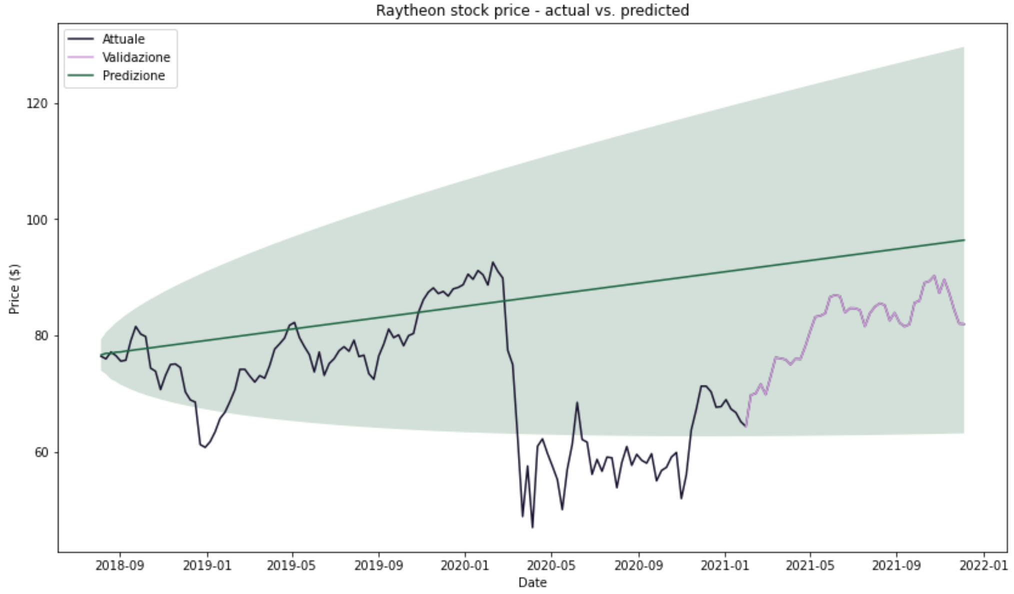
parametri stimati (p, d, q)

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	348
Model:	SARIMAX(3, 1, 2)	**Log Likelihood**	-1546.650
Date:	Tue, 24 May 2022	**AIC**	3107.301
Time:	16:39:05	**BIC**	3134.246
Sample:	0	**HQIC**	3118.029
	- 348		
Covariance Type:	opg		

Predizioni con ARIMA – RTX/LMT

predizione per Raytheon (RTX)

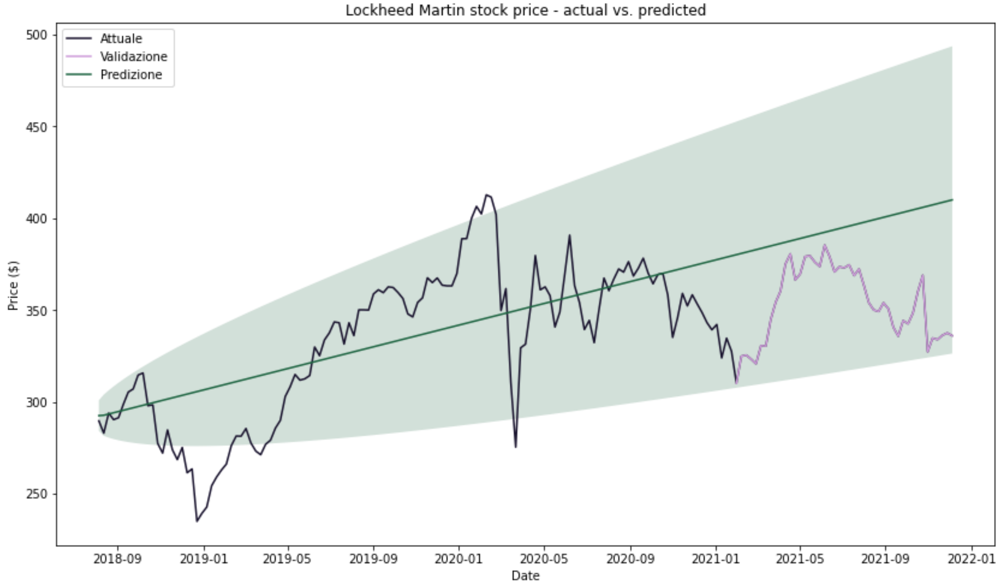


parametri stimati (p, d, q)

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	348
Model:	SARIMAX(1, 1, 1)	**Log Likelihood**	-596.913
Date:	Tue, 24 May 2022	**AIC**	1201.826
Time:	16:49:36	**BIC**	1217.224
Sample:	0	**HQIC**	1207.957
	- 348		
Covariance Type:	opg		

predizione per Lockheed Martin (LMT)



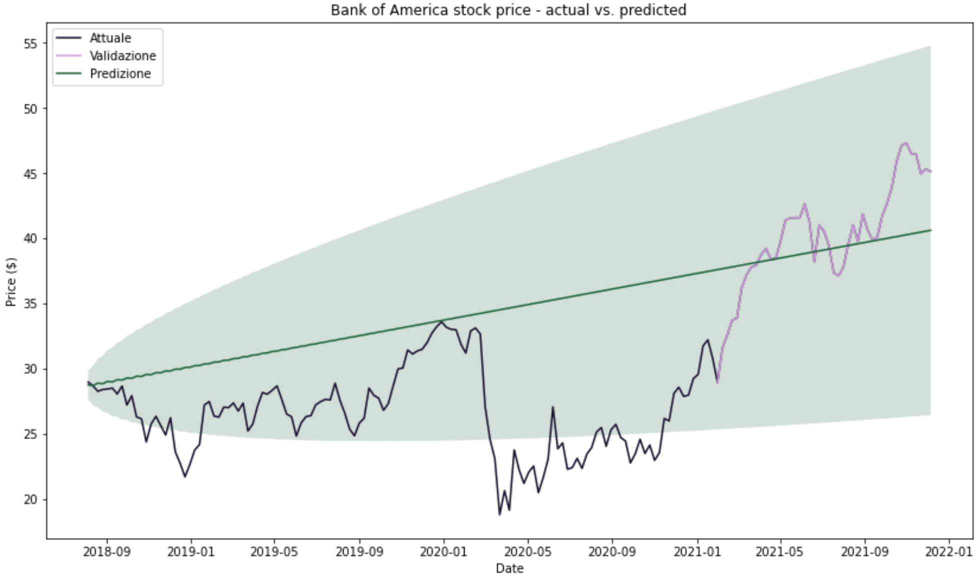
parametri stimati (p, d, q)

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	348
Model:	SARIMAX(0, 1, 2)	**Log Likelihood**	-994.125
Date:	Tue, 24 May 2022	**AIC**	1996.251
Time:	16:57:17	**BIC**	2011.648
Sample:	0	**HQIC**	2002.381
	- 348		
Covariance Type:	opg		

Predizioni con ARIMA – BAC/JPM

predizione per Bank of America (BAC)

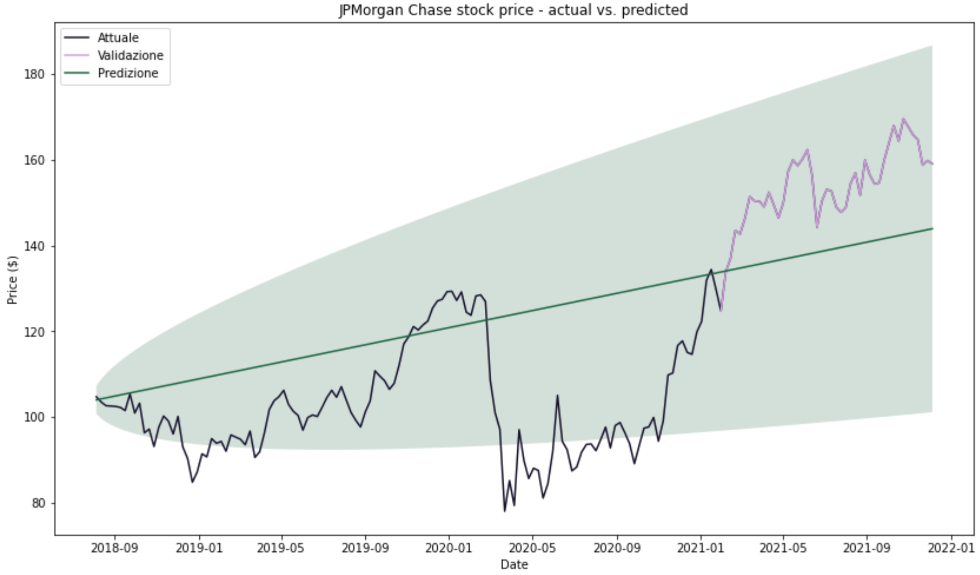


parametri stimati (p, d, q)

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	348
Model:	SARIMAX(1, 1, 1)	**Log Likelihood**	-288.497
Date:	Tue, 24 May 2022	**AIC**	584.994
Time:	17:14:17	**BIC**	600.392
Sample:	0	**HQIC**	591.125
	- 348		
Covariance Type:	opg		

predizione per JPMorgan Chase (JPM)



parametri stimati (p, d, q)

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	348
Model:	SARIMAX(0, 1, 0)	**Log Likelihood**	-666.058
Date:	Tue, 24 May 2022	**AIC**	1336.117
Time:	17:27:36	**BIC**	1343.815
Sample:	0	**HQIC**	1339.182
	- 348		
Covariance Type:	opg		

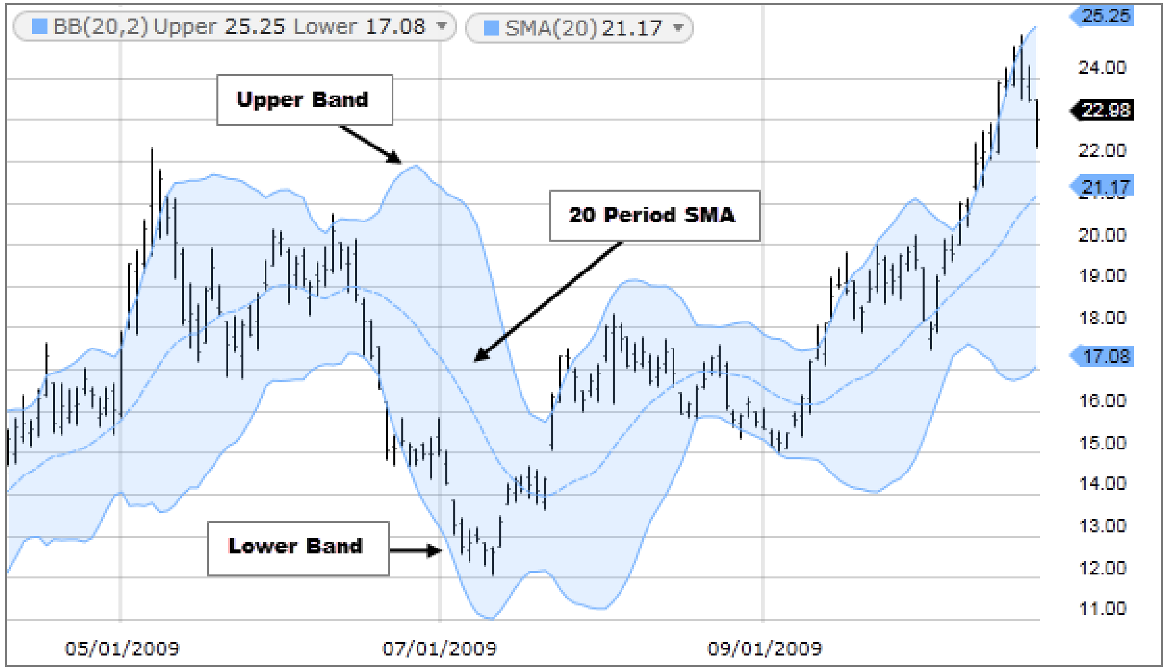
Strategie di trading

Mediante Bollinger’s Bands

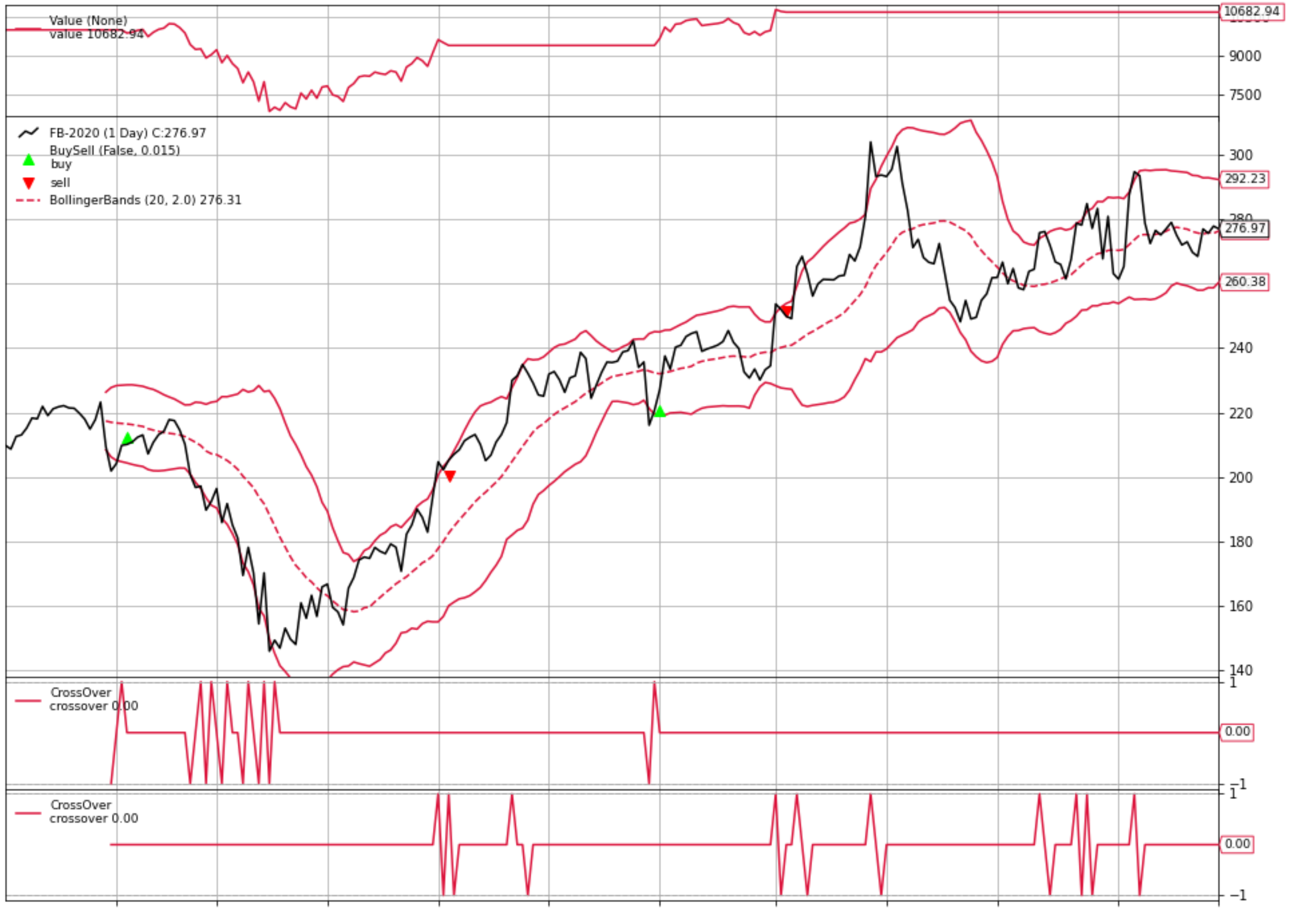
Strategia con Bollinger's Band (BB)

La Bollinger's Band è uno strumento analitico costituito da un insieme di linee che si trovano rispettivamente due deviazioni standard sopra e sotto (positivamente e negativamente) la media mobile semplice (SMA) relativa ad il prezzo di un titolo.

La strategia con le BB prevede che in caso di 'breakout' cioè superamento della linea superiore o inferiore, venga generato un trading signal. (senza short selling)

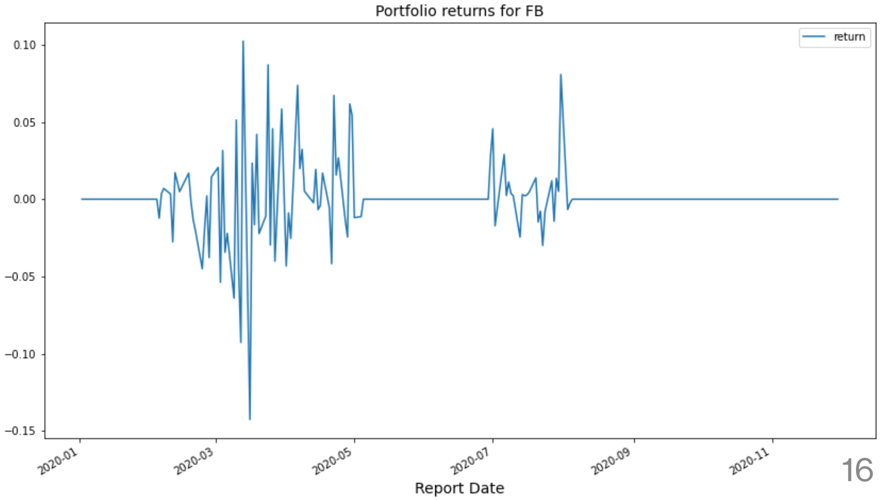


Backtest strategia BB su FB



```
Starting Portfolio Value: 10000.00
2020-02-05, BUY CREATED --- Size: 47, Cash: 10000.00, Open: 212.51, Close: 210.11
2020-02-05, BUY EXECUTED --- Price: 212.51, Cost: 9987.97, Commission: 9.99
2020-05-04, SELL CREATED --- Size: 47
2020-05-04, SELL EXECUTED --- Price: 200.20, Cost: 9987.97, Commission: 9.41
2020-05-04, OPERATION RESULT --- Gross: -578.57, Net: -597.97
2020-06-30, BUY CREATED --- Size: 42, Cash: 9402.03, Open: 220.59, Close: 227.07
2020-06-30, BUY EXECUTED --- Price: 220.59, Cost: 9264.78, Commission: 9.26
2020-08-04, SELL CREATED --- Size: 42
2020-08-04, SELL EXECUTED --- Price: 251.56, Cost: 9264.78, Commission: 10.57
2020-08-04, OPERATION RESULT --- Gross: 1300.74, Net: 1280.91
Final Portfolio Value: 10682.94
```

Rendimento annuale (periodo 2020): +7.4%



CAPM

Capital Asset Pricing Model

Il CAPM ed il modello Fama-French

- Il CAPM (Capital Asset Pricing Model) descrive la relazione tra il rischio sistematico (o di mercato) e i rendimenti aspettati di una *security. Interpretando i valori dell'indice* β *si può avere una idea del livello di* sensitività dell'indice rispetto al mercato.
- Il modello Fama-French a 3 fattori estende il CAPM aggiungendo altri due indici beta (o fattori) utili per spiegare l'eccesso di ritorno di un asset o portfolio.

$$E(r_i) - r_f = \alpha + \beta_{mkt} MKT + \beta_{smb} SMB + \beta_{hml} HML$$

Esposizione con Fama-Frech – FB/GOOG

Esposizione per FB

```
                            OLS Regression Results
==============================================================================
Dep. Variable:             excess_rtn   R-squared:                       0.194
Model:                            OLS   Adj. R-squared:                  0.172
Method:                 Least Squares   F-statistic:                     8.851
Date:                Thu, 26 May 2022   Prob (F-statistic):           2.63e-05
Time:                        15:09:13   Log-Likelihood:                 112.20
No. Observations:                 114   AIC:                            -216.4
Df Residuals:                     110   BIC:                            -205.5
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      0.0100      0.009      1.089      0.278      -0.008       0.028
mkt            1.1343      0.231      4.910      0.000       0.676       1.592
smb           -0.0631      0.366     -0.172      0.863      -0.789       0.662
hml           -0.4505      0.286     -1.578      0.117      -1.016       0.115
==============================================================================
Omnibus:                       27.694   Durbin-Watson:                   1.867
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              104.260
Skew:                           0.716   Prob(JB):                     2.29e-23
Kurtosis:                       7.461   Cond. No.                         43.8
==============================================================================
```

Esposizione per GOOG

```
                            OLS Regression Results
==============================================================================
Dep. Variable:             excess_rtn   R-squared:                       0.392
Model:                            OLS   Adj. R-squared:                  0.376
Method:                 Least Squares   F-statistic:                     24.92
Date:                Thu, 26 May 2022   Prob (F-statistic):           1.63e-12
Time:                        15:23:11   Log-Likelihood:                 191.82
No. Observations:                 120   AIC:                            -375.6
Df Residuals:                     116   BIC:                            -364.5
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      0.0068      0.005      1.400      0.164      -0.003       0.016
mkt            1.0504      0.122      8.637      0.000       0.810       1.291
smb           -0.5393      0.196     -2.752      0.007      -0.927      -0.151
hml           -0.1268      0.154     -0.825      0.411      -0.431       0.178
==============================================================================
Omnibus:                        6.136   Durbin-Watson:                   2.133
Prob(Omnibus):                  0.047   Jarque-Bera (JB):                7.037
Skew:                           0.309   Prob(JB):                       0.0296
Kurtosis:                       4.012   Cond. No.                         44.4
==============================================================================
```

Dove:
- **mkt**: Market factor
- **smb**: Size factor
- **hml**: Value factor

Esposizione con Fama-Frech – RTX/LMT

Esposizione per RTX

```
                            OLS Regression Results
==============================================================================
Dep. Variable:             excess_rtn   R-squared:                       0.606
Model:                            OLS   Adj. R-squared:                  0.595
Method:                 Least Squares   F-statistic:                     59.36
Date:                Thu, 26 May 2022   Prob (F-statistic):           2.50e-23
Time:                        15:28:18   Log-Likelihood:                 210.65
No. Observations:                 120   AIC:                            -413.3
Df Residuals:                     116   BIC:                            -402.1
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     -0.0067      0.004     -1.612      0.110      -0.015       0.002
mkt            1.2293      0.104     11.824      0.000       1.023       1.435
smb           -0.0075      0.168     -0.045      0.964      -0.339       0.324
hml            0.4470      0.131      3.401      0.001       0.187       0.707
==============================================================================
Omnibus:                       12.722   Durbin-Watson:                   2.189
Prob(Omnibus):                  0.002   Jarque-Bera (JB):               26.871
Skew:                           0.361   Prob(JB):                     1.46e-06
Kurtosis:                       5.203   Cond. No.                         44.4
==============================================================================
```

Esposizione per LMT

```
                            OLS Regression Results
==============================================================================
Dep. Variable:             excess_rtn   R-squared:                       0.383
Model:                            OLS   Adj. R-squared:                  0.367
Method:                 Least Squares   F-statistic:                     24.01
Date:                Thu, 26 May 2022   Prob (F-statistic):           3.70e-12
Time:                        15:34:07   Log-Likelihood:                 210.71
No. Observations:                 120   AIC:                            -413.4
Df Residuals:                     116   BIC:                            -402.3
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      0.0046      0.004      1.103      0.272      -0.004       0.013
mkt            0.8730      0.104      8.402      0.000       0.667       1.079
smb           -0.5501      0.167     -3.285      0.001      -0.882      -0.218
hml           -0.0070      0.131     -0.053      0.958      -0.267       0.253
==============================================================================
Omnibus:                        4.739   Durbin-Watson:                   2.122
Prob(Omnibus):                  0.094   Jarque-Bera (JB):                4.429
Skew:                          -0.469   Prob(JB):                        0.109
Kurtosis:                       3.085   Cond. No.                         44.4
==============================================================================
```

Dove:

- **mkt**: Market factor
- **smb**: Size factor
- **hml**: Value factor

Esposizione con Fama-Frech – BAC/JPM

Esposizione per BAC

```
                            OLS Regression Results
==============================================================================
Dep. Variable:             excess_rtn   R-squared:                       0.604
Model:                            OLS   Adj. R-squared:                  0.593
Method:                 Least Squares   F-statistic:                     58.87
Date:                Thu, 26 May 2022   Prob (F-statistic):           3.34e-23
Time:                        15:37:12   Log-Likelihood:                 178.26
No. Observations:                 120   AIC:                            -348.5
Df Residuals:                     116   BIC:                            -337.4
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      0.0073      0.005      1.356      0.178      -0.003       0.018
mkt            1.3409      0.136      9.847      0.000       1.071       1.611
smb            0.2108      0.219      0.961      0.339      -0.224       0.645
hml            1.0896      0.172      6.330      0.000       0.749       1.431
==============================================================================
Omnibus:                       10.439   Durbin-Watson:                   2.198
Prob(Omnibus):                  0.005   Jarque-Bera (JB):               17.075
Skew:                           0.375   Prob(JB):                     0.000196
Kurtosis:                       4.689   Cond. No.                         44.4
==============================================================================
```

Esposizione per JPM

```
                            OLS Regression Results
==============================================================================
Dep. Variable:             excess_rtn   R-squared:                       0.691
Model:                            OLS   Adj. R-squared:                  0.683
Method:                 Least Squares   F-statistic:                     86.28
Date:                Thu, 26 May 2022   Prob (F-statistic):           2.06e-29
Time:                        15:44:25   Log-Likelihood:                 221.60
No. Observations:                 120   AIC:                            -435.2
Df Residuals:                     116   BIC:                            -424.1
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      0.0058      0.004      1.541      0.126      -0.002       0.013
mkt            1.1199      0.095     11.802      0.000       0.932       1.308
smb            0.0163      0.153      0.107      0.915      -0.287       0.319
hml            1.0124      0.120      8.440      0.000       0.775       1.250
==============================================================================
Omnibus:                       10.230   Durbin-Watson:                   2.123
Prob(Omnibus):                  0.006   Jarque-Bera (JB):               20.512
Skew:                          -0.256   Prob(JB):                     3.51e-05
Kurtosis:                       4.959   Cond. No.                         44.4
==============================================================================
```

Dove:

- **mkt**: Market factor
- **smb**: Size factor
- **hml**: Value factor

Portfolio Optimization

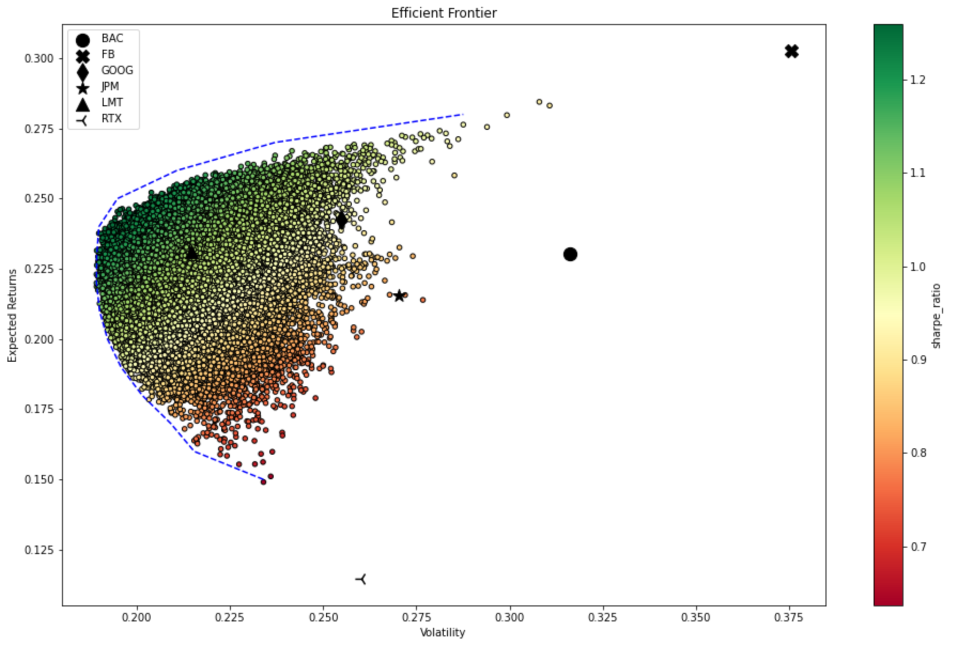
Costruzione di portafoglio

Portfolio optimization e Monte Carlo

- La Modern Portfolio Theory **MPT** è il principio fondamentale che sta dietro alla allocazione degli asset in un portfolio, tale principio si basa sulla *diversificazione* dei titoli per cercare di aumentare il profitto e di ridurre il rischio.
- Le simulazioni di Monte Carlo ci permettono di ottenere un set di portafogli ottimali grazie alla generazione in maniera random di un elevato numero di portafogli, tale metodo lo si può utilizzare sia con dati passati ma anche con dati di previsione.

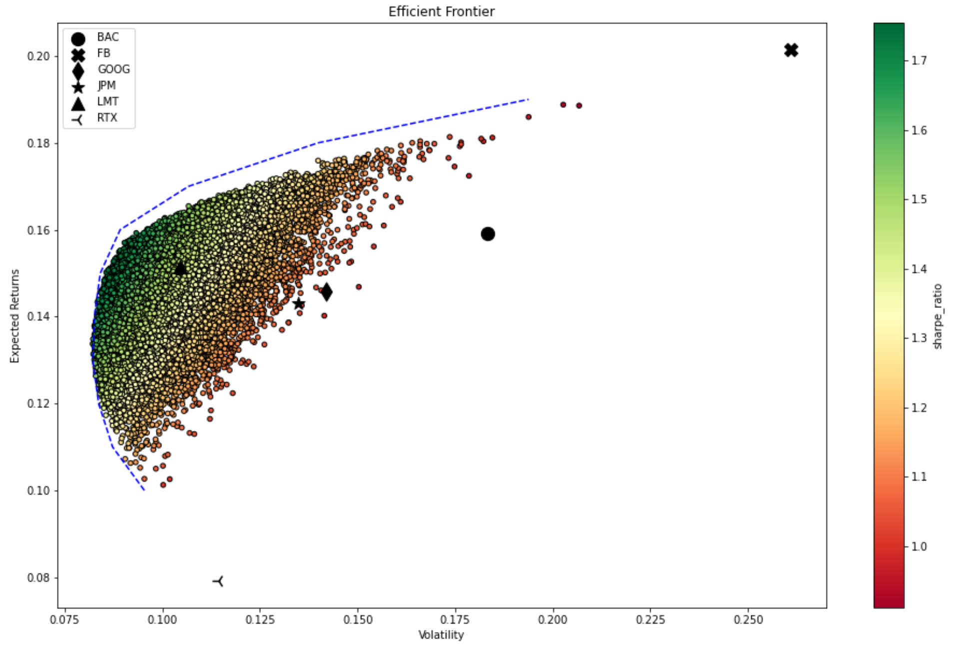
Portafoglio ottimale con monte carlo

Portfolio con dati storici




```
Maximum Sharpe ratio portfolio ----
Performance
returns: 24.54% volatility: 19.48% sharpe_ratio: 125.94%
Weights
BAC: 1.55% FB: 15.66% GOOG: 31.05% JPM: 0.10% LMT: 51.17% RTX: 0.48%
```

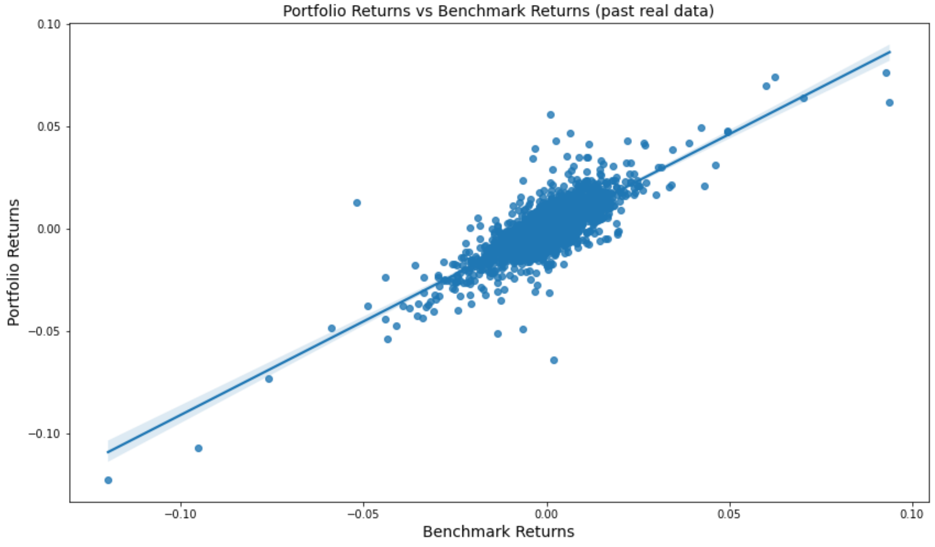
Portfolio con dati di previsione (ARIMA)




```
Maximum Sharpe ratio portfolio ----
Performance
returns: 15.02% volatility: 8.56% sharpe_ratio: 175.42%
Weights
BAC: 0.50% FB: 10.80% GOOG: 17.47% JPM: 28.70% LMT: 38.01% RTX: 4.52%
```

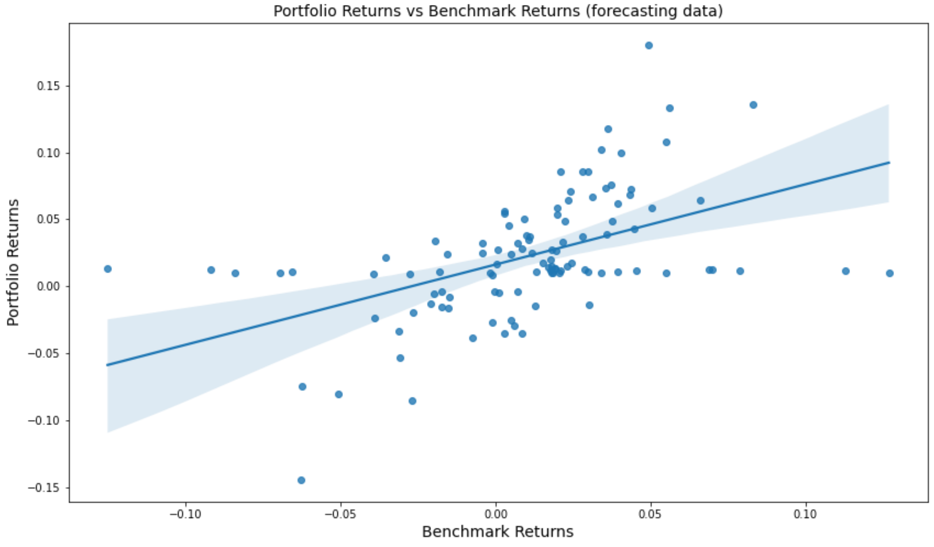
Beta dei portafogli ottimali

Portfolio con dati passati



$\beta = 0.9145$

Portfolio con dati di previsione (ARIMA)



$\beta = 0.5996$