Quantitative Finance Analysis Project

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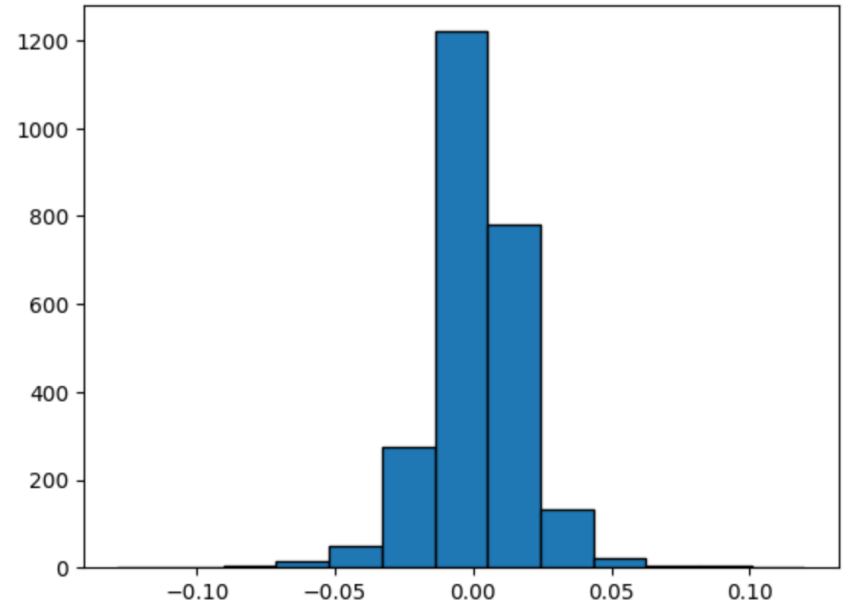
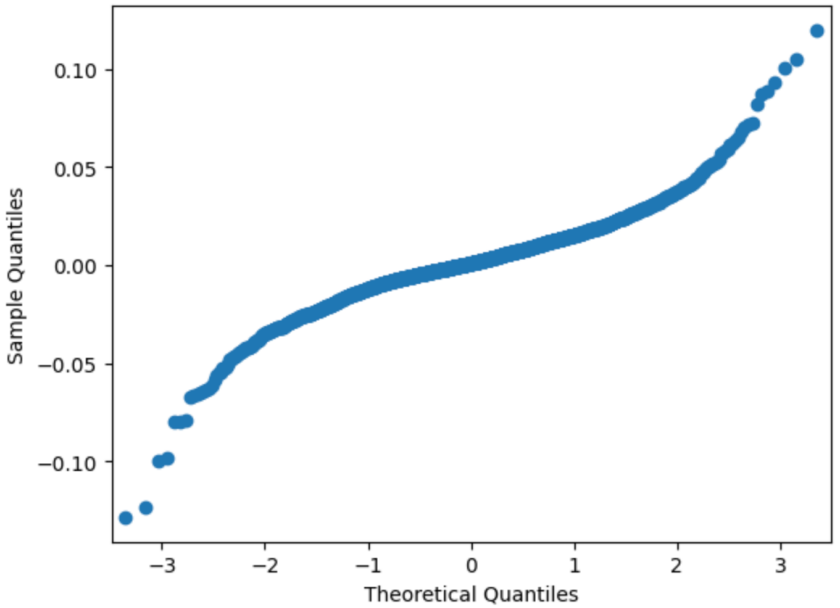
Checking for Normal Distribution – Visual Test

- The histogram plotted over 13 bins shows that the daily returns of the AAPL stock do not seem to be normally distributed as a symmetrical bell curve is not seen.

- This is further endorsed by the QQ plot as we can see an absence of a straight line that would have indicated normal distribution



Histogram



QQ Plot

Checking for Normal Distribution – Further Statistical Scrutiny

- Shapiro test results:

ShapiroResult(
statistic=0.930935800075531,
pvalue=1.315208172699652e-32)

- We can see here the p-value is less than 0.05; therefore, we can confirm that the null hypothesis of the returns being normally distributed can be rejected.

OLS on AAPL

- The OLS is a good choice in this matter because we want to predict a continuous variable, there is only one independent variable and no significant outliers exist which could skew the coefficients.
- Another option could have been LASSO regression but as can be seen the OLS regression performs great with a high R^2 value and a high F-statistic along with low P>|t| value for the coefficient. (Note: However, the results for the constant is not significant)

OLS Regression Results

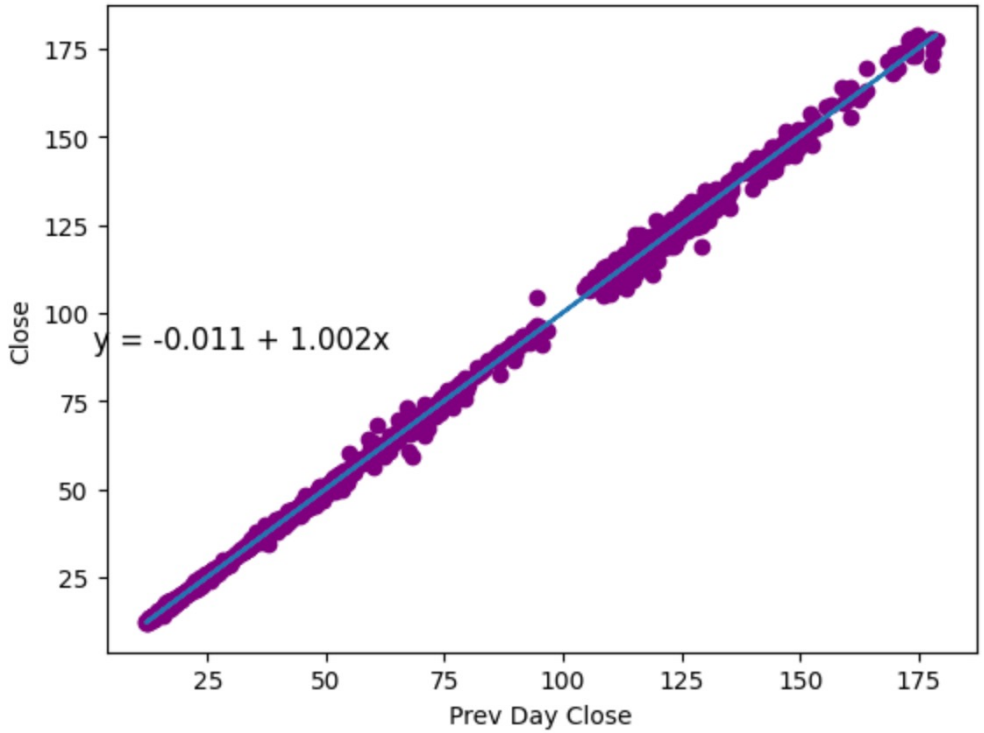
Dep. Variable:	Close	R-squared:	0.999
Model:	OLS	Adj. R-squared:	0.999
Method:	Least Squares	F-statistic:	2.856e+06
Date:	Thu, 22 Jun 2023	Prob (F-statistic):	0.00
Time:	01:25:43	Log-Likelihood:	-3930.5
No. Observations:	2515	AIC:	7865.
Df Residuals:	2513	BIC:	7877.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-0.0106	0.036	-0.293	0.770	-0.081	0.060
Close	1.0016	0.001	1689.967	0.000	1.000	1.003

Omnibus:	590.598	Durbin-Watson:	2.188
Prob(Omnibus):	0.000	Jarque-Bera (JB):	22515.647
Skew:	-0.329	Prob(JB):	0.00
Kurtosis:	17.643	Cond. No.	95.2

OLS Visually

- As seen on the scatterplot, the OLS does a good job of calculating the a and b coefficients and produces a solid line-of-fit.

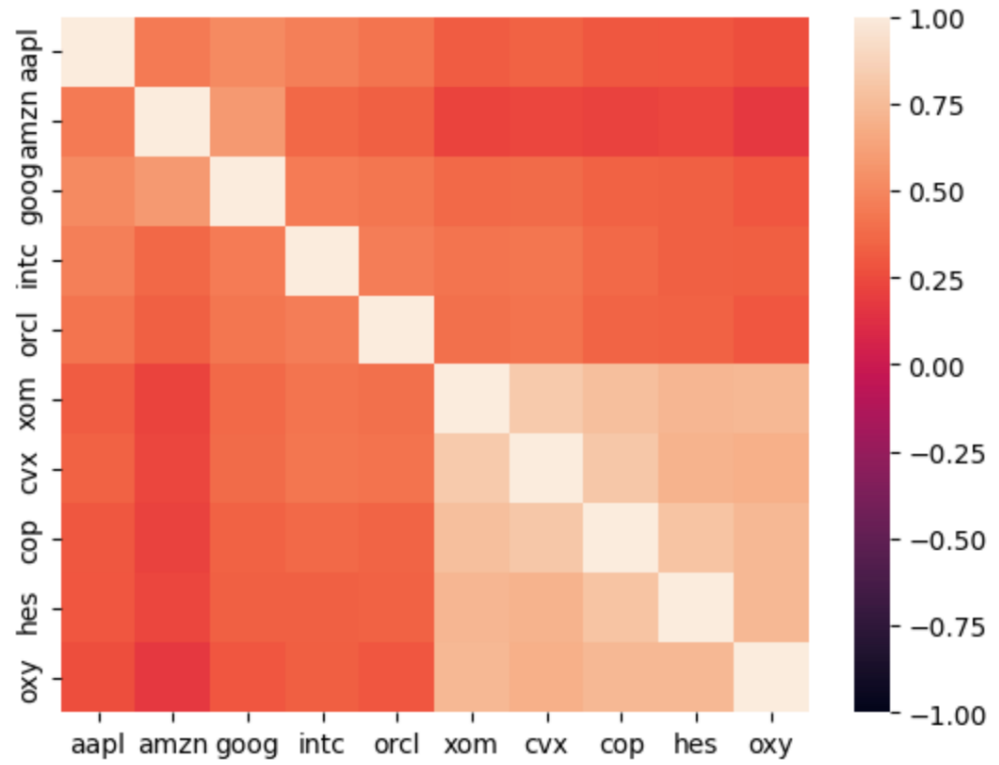


Correlation between 10 stocks

	aapl	amzn	goog	intc	orcl	xom	cvx	cop	hes	oxy
aapl	1.000000	0.442801	0.513427	0.462041	0.419937	0.315857	0.340085	0.298697	0.293333	0.258330
amzn	0.442801	1.000000	0.578545	0.366642	0.331886	0.226177	0.227381	0.211909	0.229652	0.173110
goog	0.513427	0.578545	1.000000	0.450994	0.422743	0.373371	0.376989	0.339404	0.328610	0.294559
intc	0.462041	0.366642	0.450994	1.000000	0.454165	0.416100	0.424467	0.369746	0.334206	0.323938
orcl	0.419937	0.331886	0.422743	0.454165	1.000000	0.396569	0.408759	0.349623	0.341594	0.291447
xom	0.315857	0.226177	0.373371	0.416100	0.396569	1.000000	0.827382	0.771688	0.720744	0.731325
cvx	0.340085	0.227381	0.376989	0.424467	0.408759	0.827382	1.000000	0.809125	0.707055	0.689207
cop	0.298697	0.211909	0.339404	0.369746	0.349623	0.771688	0.809125	1.000000	0.796259	0.728507
hes	0.293333	0.229652	0.328610	0.334206	0.341594	0.720744	0.707055	0.796259	1.000000	0.733748
oxy	0.258330	0.173110	0.294559	0.323938	0.291447	0.731325	0.689207	0.728507	0.733748	1.000000

Findings:

- None of the stocks are negatively correlated with each other. Showing that they are affected by the market and other economic factors in a similar way.
- XOM, CVK COP, HES and OXY (energy stocks) are highly positively correlated to each other while the ORCL INTC GOOG AMZN and AAPL (tech stocks) show low rates of positive correlation within that group.
- The two groups of stocks are lowly positively correlated with the stocks in the other group.
- Energy stocks tend to all do well and poor together more than the tech stocks.



Kmeans Clustering on the 10 Stocks

Findings

- All the tech stocks performed similarly and the energy stocks performed similarly as shown by the two clusters formed.
- This supports the correlations found in question 3.

	Stock	Cluster Number
0	AAPL	0
1	AMZN	0
2	COP	1
3	CVX	1
4	GOOG	0
5	HES	1
6	INTC	0
7	ORCL	0
8	OXY	1
9	XOM	1

Optimal Portfolio based on Minimum Variance

```
# variance of minimum variance portfolio
min_var_port_var = portfolio_var(min_var_results["x"])
round(min_var_port_var, 4)
```

```
0.0013
```

Optimal Portfolio weights:

- Comprised of mainly tech stocks except GOOG and has the highest weight for the AAPL stock.

Potential Issues:

- Does not account for the expected returns. Using something like the Sharpe ratio might result in a better investment portfolio.
- Should usually result in a diversified portfolio but does not necessarily in this case as all investments are in tech stocks.

	Stock	Weight
0	AAPL	0.3077
1	AMZN	0.1520
2	COP	0.2400
3	CVX	0.0000
4	GOOG	0.0000
5	HES	0.0000
6	INTC	0.0952
7	ORCL	0.2050
8	OXY	0.0000
9	XOM	0.0000