

NEW YORK STOCK EXCHANGE

Final Presentation

Jamesville

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Data & Methods



**Results &
Discussion**



Conclusion

Data Pre-processing: Deal with weekends and Holidays

Problem: stock market only operates on weekdays, while cryptocurrencies are 24/7.

Solution: drop the values of weekends & holidays to better calculate and understand rolling averages in the upcoming steps

Time Interval: 2022/06/20 ~ 2022/11/18

	ABBV	ACN	AEP	AIZ	ALLE	AMAT	AMP	AMZN	AVB	AVY	AXP	BDX	BF-B
0	140.708679	280.480621	88.418961	170.033661	94.670303	94.696663	240.498566	108.680000	188.236267	154.721832	143.671829	235.735397	68.510963
1	140.708679	280.480621	88.418961	170.033661	94.670303	94.696663	240.498566	108.680000	188.236267	154.721832	143.671829	235.735397	68.510963
2	144.719955	284.121399	88.772827	169.558273	95.038704	93.472778	239.021484	108.949997	188.718170	155.070419	143.304611	236.472916	68.471062
3	146.573578	283.555939	90.837097	167.686386	96.392845	92.816063	237.484894	112.440002	193.242142	154.861267	140.585205	241.725189	69.318848
4	149.407959	296.988220	92.006828	171.202362	99.170822	96.875771	247.130615	116.459999	191.924286	164.681396	145.051376	250.077042	71.323608

Weekly Risk-Adjusted Return

1. Get **weekly return on daily basis** by calculating the percent change of stock price between current date and five days ago
2. Get **weekly adjusted return** by having previous weekly return divided by each stock's standard deviation
3. Calculate **rolling average of weekly adjusted return** using 5 days window
4. For each day, divide 110 assets' weekly returns into five quantiles to **get a rank**
5. Probability under each rank = total frequencies of each rank / total days

	ABBV	ACN	AEP	AIZ	ALLE
9	1.418226	-0.499210	1.600197	0.255988	0.504344
10	1.063957	-0.644175	1.192906	0.211540	0.445605
11	0.501553	-0.659025	0.822397	0.329564	0.399659
12	0.199687	-0.502777	0.390860	0.344832	0.424383
13	-0.034274	-0.449811	-0.150676	0.200259	0.263602

	ABBV	ACN	AEP	AIZ
9	5	1	5	3
10	5	1	5	4
11	4	1	5	4
12	4	1	4	4
13	3	1	2	4
14	2	2	1	3
15	2	2	1	4
16	2	2	1	3
17	4	2	2	2
18	4	2	3	1

	id	rank1	rank2	rank3	rank4	rank5
0	ABBV	0.255102	0.142857	0.153061	0.112245	0.336735
1	ACN	0.214286	0.214286	0.204082	0.234694	0.132653
2	AEP	0.183673	0.204082	0.173469	0.244898	0.193878
3	AIZ	0.346939	0.163265	0.153061	0.204082	0.132653
4	ALLE	0.224490	0.102041	0.173469	0.295918	0.204082

Momentum Calculation

1. Assign 1 to positive return and 0 to negative return
2. Calculating average value using 30 days window (30 days to generate proper ranking)
3. Get the distribution of the ranks

	id	rank1	rank2	rank3	rank4	rank5
0	ABBV	0.347222	0.055556	0.125000	0.041667	0.430556
1	ACN	0.291667	0.138889	0.263889	0.263889	0.041667
2	AEP	0.083333	0.291667	0.208333	0.194444	0.222222
3	AIZ	0.333333	0.347222	0.263889	0.055556	0.000000
4	ALLE	0.222222	0.194444	0.027778	0.541667	0.013889

Final ranking is generated by combine the two distribution with equal weights.

Decision Method

**Select Long Stocks and
Short Stock**

**Create Correlation
Matrix with Selected
Stocks**

**Use Gurobi to Optimize
Decision Weights**

Select Long Stocks and Short Stocks

Long : pick up 20 most profitable assets that have the highest probability of rank 4 and rank 5 summed up.

Short : pick up 20 least profitable assets that have the highest probability of rank 1 and rank 2 summed up.

```
df["most_profitable"] = df['rank5'].rank(method='min', ascending=False)
df["least_profitable"] = df['rank1'].rank(method='min', ascending=False)
df["rank4&rank5"] = df['rank4'] + df['rank5']
df["rank1&rank2"] = df['rank1'] + df['rank2']
```

```
select_longindex = df.sort_values(by = "most_profitable").index[:20]
select_longindex
```

```
Int64Index([31, 21, 92, 41, 49, 13, 64, 102, 0, 32, 60, 43, 24, 6, 45, 104, 34,
            87, 33, 27],
           dtype='int64')
```

```
select_shortindex = df.sort_values(by = "least_profitable").index[:20]
select_shortindex
```

```
Int64Index([ 69,  70,  63,  99,  59,  71, 108,  67,  28,  73,  58,  36, 109,
            76,  18,  25, 103,  14,  72,  12],
           dtype='int64')
```

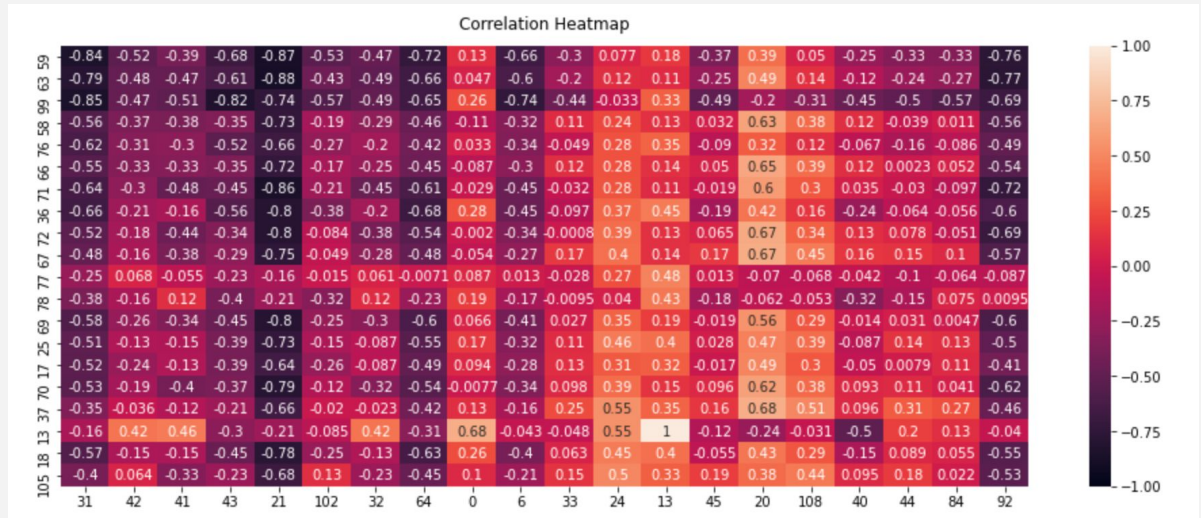
Using Correlation to minimize risk

The more the two assets are negatively correlated, the risk is lower.

Basing on the correlation between assets-to-long and assets-to-short to select the most negative correlations and minimize risk.

Initially: manually picked up 10 pairs of assets with the most negative correlation.

Now: improve code and utilize the algorithm to select.



X axis : asset-to-long

y axis: asset-to-short

Optimization to Assign weights

With the portfolio, we used Gurobi to construct two optimization models, one for long and one for short, to find out the weights for each asset.

Objective function: $\min \text{portfolio_risk} = x @ \text{sigma} @ x$ (covariance matrix)

Constraints: the sum of the weights = assigned weight

the absolute value of each weight is between 0 and 0.3

Looped to find out the weight for long and weight for short, from long weight = 0.0, short weight = 1.0 to long weight = 0.9, short weight = 0.1. Calculated the volatility (the square root of objective function) and expected return (delta = mean price change). Selected the pair that minimizes volatility.

	0.0	0.1	0.2	0.30000000000000004	0.4	0.5	0.6000000000000001	0.7000000000000001	0.8	0.9
COP	0.0	0.000000	0.000000	0.000000	0.050000	0.066239	0.125191	0.172331	0.219471	0.266611
GPC	0.0	0.000000	0.050000	0.050000	0.054440	0.083761	0.111274	0.138280	0.165286	0.192293
ROST	0.0	0.100000	0.150000	0.250000	0.295560	0.300000	0.300000	0.300000	0.300000	0.300000
AMP	0.0	0.000000	0.000000	0.000000	0.000000	0.050000	0.063535	0.089389	0.115242	0.141096
XRP-USD	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Volatility	0.0	0.001510	0.002938	0.004360	0.005788	0.007294	0.008893	0.010549	0.012235	0.013941
Expected Return	0.0	0.000135	0.000337	0.000472	0.000615	0.000736	0.000896	0.001041	0.001186	0.001331

Strength and Limitations

week1	week2	week3	week4	week5	week6	week7	week8	week9	week10
3.5	7.5	12	12	2	4	4	8	5	6.5

Strength:

Forecasting: included risk-adjusted return, rolling average, and momentum to capture the long-term trend and eliminate occasional fluctuations.

Decisions: used correlation to construct the portfolio and minimized risk to find the optimal weights.

Limitations and future improvements:

Forecasting: include more related data, like sentiment indices.

Decisions: construct optimization model to maximize returns.

Conclusion

What we have learned

- Market intuitions
- Hedging your positions
- Quantitative modelling methods
- Computer decisions vs. human intuitions



Questions?