AI in Finance Assignment 7

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Insights

- Cybersecurity Risk Measurement Justification
  - Selected Measurement: **Ratio**
  - Justifications: Ratio provides a normalized measure of cybersecurity risk. By calculating the ratio of relevant sentences to total sentences, variations in the overall length of the Item 1A section across different filings are considered. This allows for more meaningful comparisons between companies and across time periods.
- Mean & Std.Dev Cyber Risk Observations
  - All Industries have a positive skewness of around 3, indicating that there are a few companies with really high cybersecurity risk compared with other companies in each industries. This suggests that extreme cases of cybersecurity exposure exist, possibly due to inadequate security measures or higher-profile attacks on certain firms.
  - All Industries have kurtosis greater than 3, indicating a distribution with heavier tails and a sharper peak than the normal distribution, which shows that though lots data points are centered together, there are also plenty of data points located else where, creating heavy tails.
  - The means for cyberrisk ratio increase dramatically for all industries after 2010. This could indicate a growing awareness and recognition of cybersecurity risks within organizations, likely influenced by high-profile cyber incidents and regulatory changes that prompted firms to assess and report their cybersecurity vulnerabilities more accurately. The rise in average risk may also reflect the increasing sophistication of cyber-threats targeting various industries.
  - The standard deivations for cyberrisk ratio also has a obvious increasing pattern for most industries from 1996 to 2023, except for Agriculture, which has a decreasing pattern in standard deviation after 2012, and Public, which decrease dramatically at 2020. This suggests that the disparity in cybersecurity risk among companies is widening, with some firms becoming significantly more exposed to risks than others. The increase in variability indicates that while some companies have strengthened their defenses, others may be lagging behind, leading to greater overall differences in risk profiles.
    - The Agriculture industry stands out with a decreasing pattern in standard deviation after 2012, which could imply that firms in this industry are experiencing more uniform levels of cybersecurity risk over time. This might be due to a lack of significant cybersecurity events or initiatives to improve security measures across the industry.
    - The Public Administration industry's dramatic decrease in standard deviation at 2020 might be due to regulatory changes, standardized security practices, or increased focus on cybersecurity within the public sector, making risk levels more uniform across firms. However, it could also be attribute to random sampling.
- Portfolio Analysis
  - Equal Weighted Portfolio with High Cybersecurity Risk Portfolio Return
    - 16.3%
    - After 2005: 20.9%
  - Equal Weighted Portfolio with Low Cybersecurity Risk Portfolio Return
    - 12.5%

    - After 2005: 17.1%
- Value Weighted Portfolio with High Cybersecurity Risk Portfolio Return
    - 26.7%
    - After 2005: 40.7%
- Value Weighted Portfolio with Low Cybersecurity Risk Portfolio Return
    - 17.6%
    - After 2005: 30%
- The return for high cyberrisk portfolio is higher than the return for low cyberrisk portfolio, such differnence is mainly due to the overall better performance of high cybersecurity risk portfolio after 2005. Moreover, difference in distribution between these two portfolios are mainly shown before 2005, which might due to lack of data points, where most listed companies had cyberrisk as 0, and lack of awareness of cybersecurity issue leading to lack of effective data points. Starting from 2006, these two profiles seems to have similar shape portfolio returns, with a consistent slightly higher return in portfolio with higher cybersecurity risk. This observation is consistent with both equal weighted portfolio and value weighted portfolio.
    - This suggests that firms with greater exposure to cybersecurity risks were delivering better returns during this period, potentially due to the market not yet fully recognizing the risks associated with cybersecurity or firms benefiting from rapid technological adoption, despite their vulnerabilities, which is a consistent result with the paper provided.
    - Earlier in the data period, there was less awareness of cybersecurity issues, leading to less emphasis on risk management in corporate strategies. The lack of robust data during this period may have influenced the performance metrics of the portfolios.
    - Similer return pattern in return for stocks with different cyber risk could suggest that investors have begun to factor cybersecurity risk into their valuations or that companies have implemented better risk management practices, reducing the performance gap.
    - Only measuring portfolio return after 2005, there is a increase in all portfolios, but the gap between portfolio with higher cyberrisk and portfolio with lower cyberrisk remains the same, showing that cyberrisk can still distinguished portfolio with potential higher return even awareness toward cyberrisk increase.
- The return for value weighted portfolio is higher than the return for equal weighted portfolio.
    - This suggests that larger companies may have advantages in navigating cybersecurity risks, which ultimately impacts their stock performance.

Constructing Measure of Cybersecurity Risk

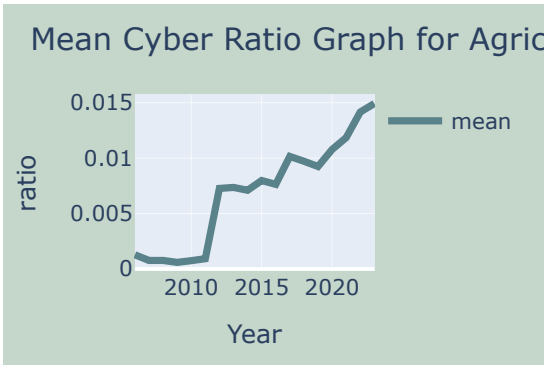
- If filing date is before July, then we consider the risk measurement could be applied for current year; else, it will be applied to the future year

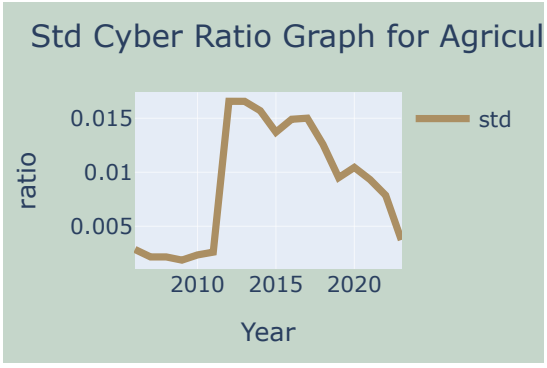
Mean & Std.Dev Analysis

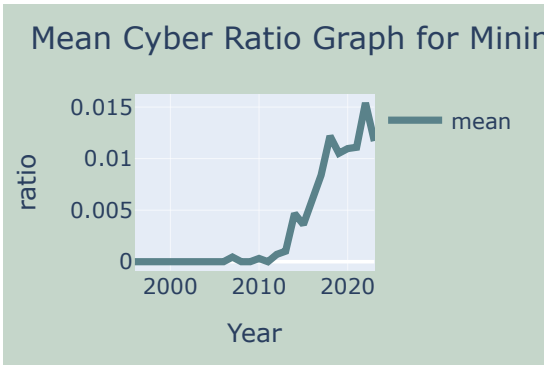
```
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Agriculture
count       138.000000
mean          0.006513
std           0.010808
min           0.000000
max           0.044444
skew          2.076317
kurtosis      4.034872
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.000000
75%           0.007850
95%           0.031498
99%           0.044444
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Mining
count       188.000000
mean          0.004992
std           0.008027
min           0.000000
max           0.053763
skew          2.313061
kurtosis      7.913731
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.000000
75%           0.008478
95%           0.019998
99%           0.031838
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Construction
count       178.000000
mean          0.005413
std           0.008362
min           0.000000
max           0.041958
skew          1.951254
kurtosis      3.862335
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.000000
75%           0.007477
95%           0.021756
99%           0.032455
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Manufacturing
count       278.000000
mean          0.004684
std           0.011015
min           0.000000
max           0.117117
skew          5.203366
kurtosis     42.011789
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.000000
75%           0.004838
95%           0.024090
```

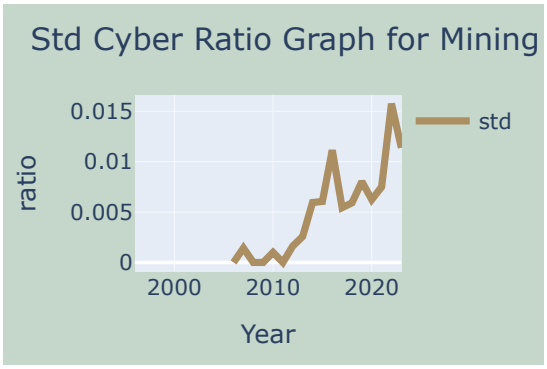
```
99%           0.038625
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Transportation
count       198.000000
mean          0.007402
std           0.009832
min           0.000000
max           0.054237
skew          1.530520
kurtosis      2.490333
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.003046
75%           0.013223
95%           0.026929
99%           0.034937
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Wholesale
count       195.000000
mean          0.008441
std           0.013974
min           0.000000
max           0.097345
skew          2.939837
kurtosis     11.726853
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.002364
75%           0.012048
95%           0.034335
99%           0.057746
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Retail
count       213.000000
mean          0.006936
std           0.008952
min           0.000000
max           0.051095
skew          1.647674
kurtosis      3.223421
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.004237
75%           0.011070
95%           0.024997
99%           0.033175
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Finance
count       201.000000
mean          0.009461
std           0.012723
min           0.000000
max           0.069686
skew          1.502620
kurtosis      2.275229
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.003289
75%           0.016194
```

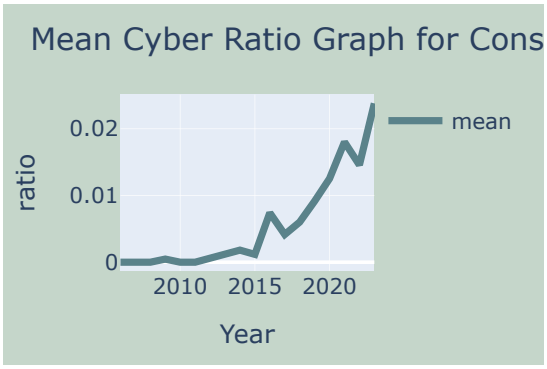
```
95%           0.034591
99%           0.041667
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Service
count       239.000000
mean          0.007462
std           0.011234
min           0.000000
max           0.056872
skew          2.118013
kurtosis      4.868462
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.002469
75%           0.012511
95%           0.032492
99%           0.049574
Name: ratio_cyber, dtype: float64
--------------------------------------------------
This is the Statistics of ratio of cyber for industry Public
count       160.000000
mean          0.005635
std           0.008702
min           0.000000
max           0.067901
skew          3.457380
kurtosis     17.819636
1%            0.000000
5%            0.000000
25%           0.000000
50%           0.002845
75%           0.007481
95%           0.021175
99%           0.037676
Name: ratio_cyber, dtype: float64
```

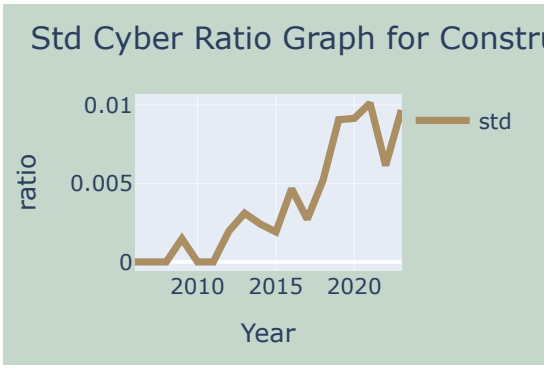


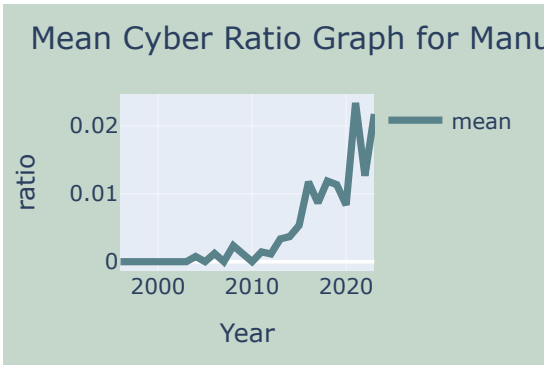


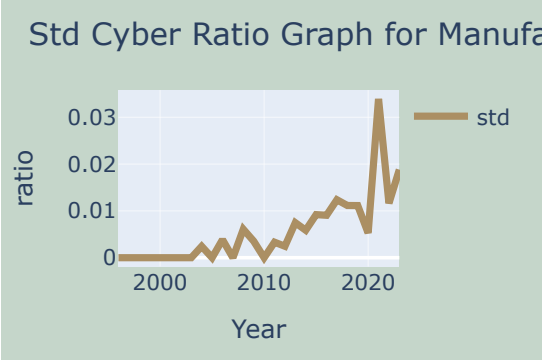

Mean Cyber Ratio Graph for Minir
ratio
0.015
0.01
0.005
0
2000
2010
2020
Year
mean

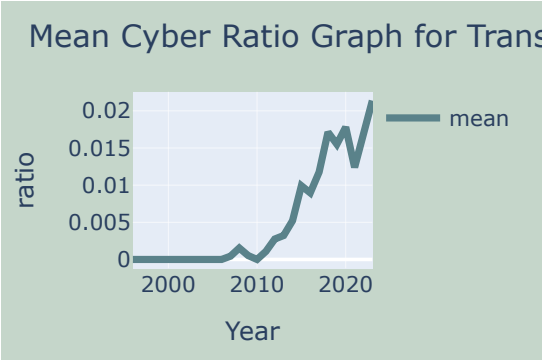

Std Cyber Ratio Graph for Mining
ratio
0.015
0.01
0.005
0
2000
2010
2020
Year
std

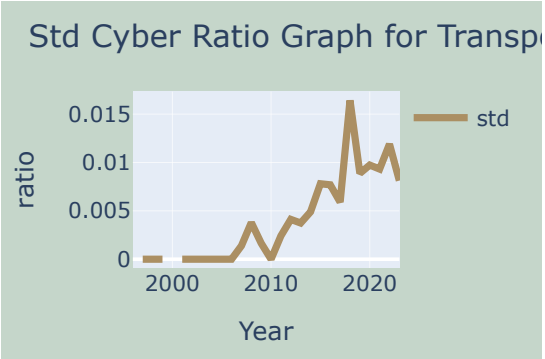

Mean Cyber Ratio Graph for Cons
ratio
0.02
0.01
0
2010
2015
2020
Year
mean

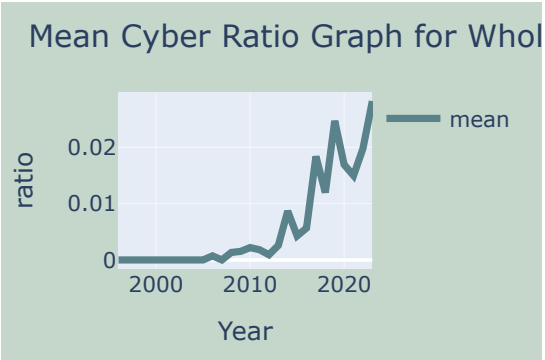

Std Cyber Ratio Graph for Constr
ratio
0.01
0.005
0
2010
2015
2020
Year
std

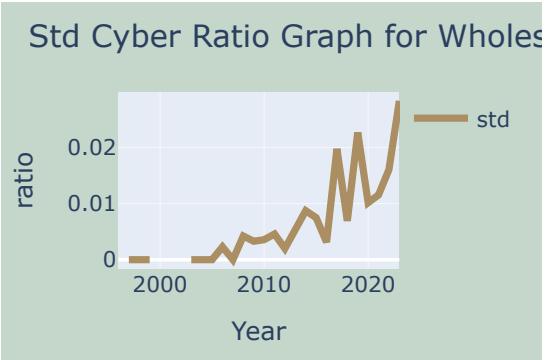

Mean Cyber Ratio Graph for Manu
ratio
0.02
0.01
0
2000
2010
2020
Year
mean


Std Cyber Ratio Graph for Manufa
ratio
0.03
0.02
0.01
0
2000
2010
2020
Year
std


Mean Cyber Ratio Graph for Trans
ratio
0.02
0.015
0.01
0.005
0
2000
2010
2020
Year
mean


Std Cyber Ratio Graph for Transp
ratio
0.015
0.01
0.005
0
2000
2010
2020
Year
std


Mean Cyber Ratio Graph for Whol
ratio
0.02
0.01
0
2000
2010
2020
Year
mean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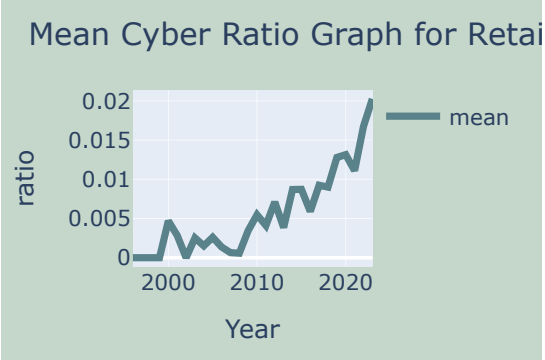
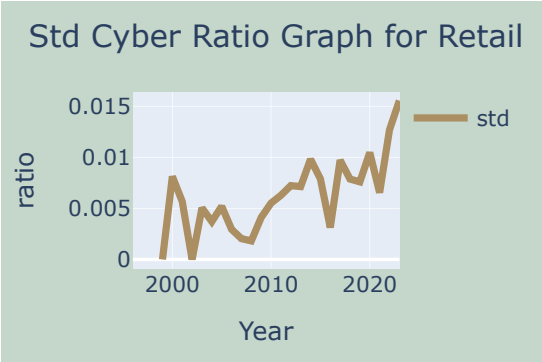
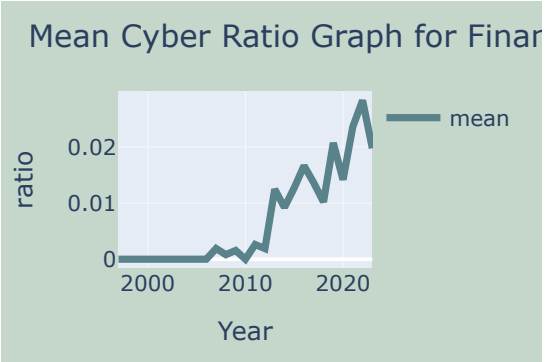
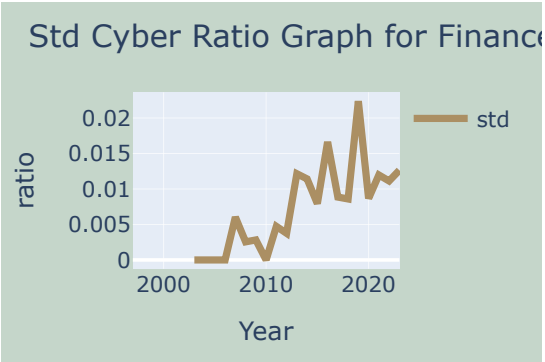
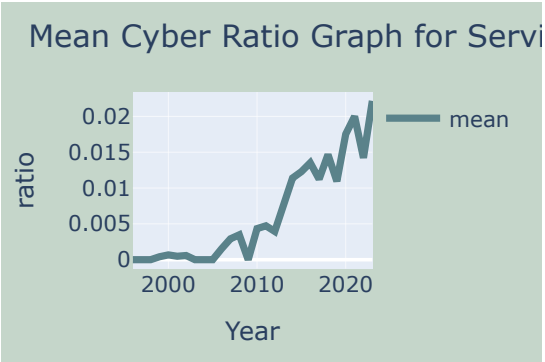
ratio
0.02
0.01
0
2000
2010
2020
Year
std

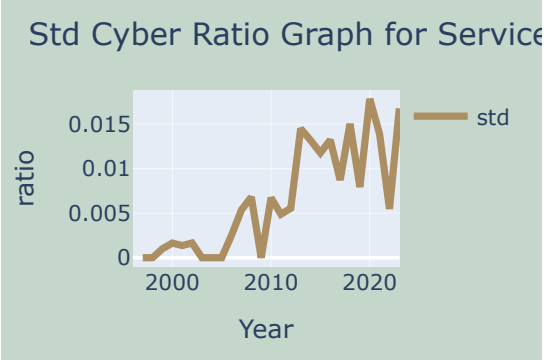

Mean Cyber Ratio Graph for Retai
ratio
0.02
0.015
0.01
0.005
0
2000
2010
2020
Year
mean

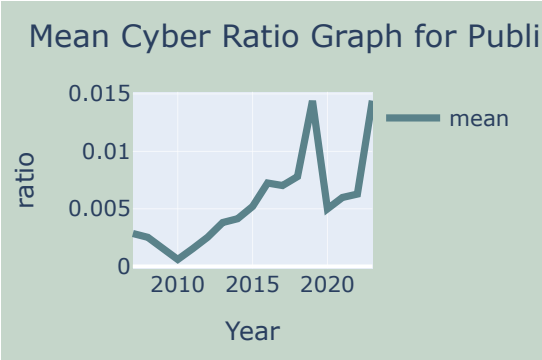

Std Cyber Ratio Graph for Retail
ratio
0.015
0.01
0.005
0
2000
2010
2020
Year
std

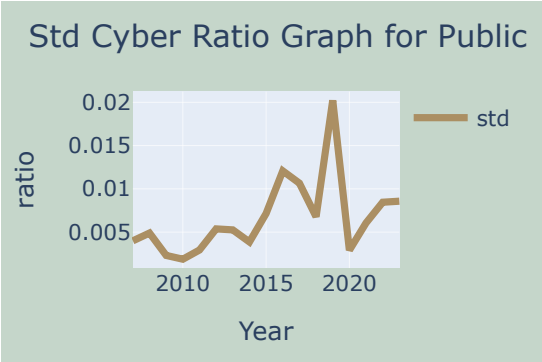

Mean Cyber Ratio Graph for Finar
ratio
0.02
0.01
0
2000
2010
2020
Year
mean


Std Cyber Ratio Graph for Finance
ratio
0.02
0.015
0.01
0.005
0
2000
2010
2020
Year
std


Mean Cyber Ratio Graph for Servi
ratio
0.02
0.015
0.01
0.005
0
2000
2010
2020
Year
mean

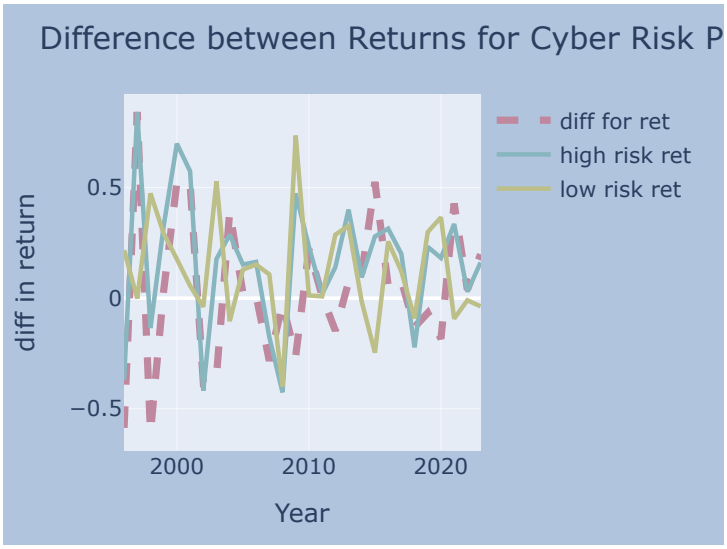






Portfolio Analysis

```
Average return rate for high cyber risk equal portfolio constructed by cyber_risk is 0.16306
294392775447
Average return rate for low cyber risk equal portfolio constructed by cyber_risk is 0.125242
8433950231
Average return rate for high cyber risk equal portfolio constructed by cyber_risk After 2005
is 0.20886918258492135
Average return rate for low cyber risk equal portfolio constructed by cyber_risk After 2005
is 0.17088637611340227
```




```
Average return rate for high cyber risk weighted portfolio constructed is 0.2666593194230562
6
Average return rate for low cyber risk weighted portfolio constructed is 0.17644355970107567
Average return rate for high cyber risk equal portfolio constructed by cyber_risk After 2005
is 0.4065063497629581
Average return rate for low cyber risk equal portfolio constructed by cyber_risk After 2005
is 0.300063665749655
```