

# Report on Statistical Methods in Asset Management

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## 1. Summary

In the report, we built investment portfolios of 15 stocks in the US market. Monthly Stock price from 2013-02-01 to 2019-11-01 sourced from Yahoo. We explored the individual features and joint distribution of the assets. The 15 assets are either normally, t, or skewed-t distributed. Correlation matrix, PCA, and Copulas suggest that they are only slightly correlated, so it is easy to diversify non-systemic risk. Taking both risk and return into account, we constructed efficient frontier, MVP (Minimum Variance Portfolio) and tangency portfolio of the 15 assets. The tangency portfolio, either short allowed or not allowed, has higher Sharpe ratio and lower Value-at-Risk and Expected Shortfall than any individual asset.

## 2. Descriptive Statistics

In our report, we pick 15 stocks. They are summarized in the table below:

**Table 1 : Stock name and the related company name**

Stock	Company	Stock	Company
AAPL	Apple	M	Macy's
AAL	American Airlines Group	MSFT	Microsoft
AEP	American Electric Power	MU	Micron Technology
F	Ford Motor	NKE	Nike
FB	Facebook	SPG	Simon Property Group
JPM	JP Morgan Chase & Co	T	AT&T
KO	Coca-Cola	TIF	Tiffany & Co
LMT	Lockheed Martin		

Our data is from 2013-02-01 to 2019-11-01. The following table contains the summary statistics of monthly return of each stock.

**Table 2 : Descriptive Statistics**

Stock	Mean	Sd	Skewness	Kurtosis	Beta	Distribution
AAPL	2.00%	7.30%	-0.36	-0.10	1.27	normal
AAL	1.45%	11.13%	0.32	-0.22	1.77	normal
AEP	0.96%	4.42%	-0.43	-0.13	0.16	skewed t
F	-0.23%	6.41%	0.10	1.17	1.10	t
FB	2.69%	9.19%	1.58	5.77	1.01	t
JPM	1.43%	5.78%	-0.07	0.04	1.17	normal
KO	0.51%	3.76%	-0.46	-0.34	0.51	skewed t
LMT	1.97%	4.95%	-0.58	1.19	0.92	t
M	-0.66%	9.66%	-0.53	1.39	0.71	skewed t
MSFT	2.27%	5.82%	0.24	0.99	1.03	t
MU	2.99%	12.11%	-0.20	-0.08	1.78	normal
NKE	1.68%	5.70%	-0.03	-0.23	0.81	normal
SPG	0.13%	5.02%	0.13	-0.54	0.57	normal
T	0.19%	4.58%	-0.22	0.33	0.52	normal
TIF	1.28%	9.20%	0.38	1.50	1.74	t

From the summary statistics table above, it can be seen that except for stock F, M, all other stocks in the 15 stocks chosen have positive average return. Meanwhile, the stocks with average return above or around 1.5% are AAPL, AAL, FB, JPM, LMT, MSFT, MU, NKE. Compared with the rest of the 15 stocks, these are the ones with relatively higher average return. In general, if one hold any of this stock starting from 2013-02-01 to 2019-11-01, he or she are supposed to get an average of around 1.5% or above return per month.

As for standard deviation, stock AAL, FB, M, MU, TIF have relatively higher sd values which are around 10% comparing with the rest of the 15 stocks. For stocks that have mean return above 2%, their sd are mostly close to 10%.

We have also tried fitting different distributions (normal, Cauchy, t, skewed t) to the monthly return of these 15 assets, the results show that normal distribution fits better for AAPL, AAL, JPM, MU, NKE, SPG, T. Meanwhile, t distribution fits better for F, FB, LMT, MSFT, TIF and skewed t distribution fits better for AEP, KO, M.

From stock price plots and equity curves, we can observe that the stocks that generally have upward trends are AAPL, AEP, FB, JPM, KO, LMT, MSFT, NKE. The stock that generally has a downward trend is F. The stocks that generally bounce in shapes of "M" or "W" are AAL, M, MU, SPG, T, TIF.

From equity curves, the red lines correspond to S&P500. As can be seen, stocks AAPL, AAL, FB, JPM, LMT, MSFT, MU, NKE generally have values larger than that of S&P500. So these stocks outperform S&P500 while the

others are not. This is consistent with the results we observe from the beta values in the summary statistics table since for those stocks that outperform S&P500, they also have beta values around or larger than 1. And we can also notice that these stocks that outperform S&P500 also have high average return rate.

**Table 3 : Sharpe Ratio**

Stock	Sharpe Ratio
AAPL	0.2655
AAL	0.1249
AEP	0.2020
F	-0.0460
FB	0.2856
JPM	0.2359
KO	0.1191
LMT	0.3856
M	-0.0747
MSFT	0.3787
MU	0.2421
NKE	0.2842
SPG	0.0130
T	0.0281
TIF	0.1322

**Table 4 : Annual Return and Standard Deviation**

Stock	Annual Return	Annual <u>Sd</u>
AAPL	0.2403	0.2530
AAL	0.1744	0.3856
AEP	0.1148	0.1532
F	-0.0277	0.2219
FB	0.3227	0.3185
JPM	0.1713	0.2004
KO	0.0613	0.1301
LMT	0.2368	0.1716
M	-0.0790	0.3347
MSFT	0.2720	0.2016
MU	0.3594	0.4195
NKE	0.2020	0.1975
SPG	0.0154	0.1740
T	0.0231	0.1588
TIF	0.1536	0.3187

From the table of Sharpe's Slope, we can see that LMT has highest Sharpe's Slope 0.3856 , followed by MSFT (0.3787), FB (0.2856) and NKE (0.2842) etc. So these stocks are the best ones with higher risk-adjusted returns.

From Table of annual mean return and sd, the stocks that have highest year return from high to low are MU, FB, AAPL, LMT etc. In terms of risk-adjusted return, we can see the results are consistent with what we observe from table of Sharpe's Slope.

The results from ACF plots show that most of the stocks are stationary except for few stocks such as KO, MSFT where their ACF value for some lags are outside of the bounds which shows a bit non-stationarity.

By checking the correlation plot, pairwise scatter plot, correlation matrix and covariance matrix, we can summarize that most of the 15 stocks are positively but weakly related. The correlation coefficients between these stocks are not larger than 0.5. A few stocks are negatively related and they are JPM-AEP, M-AEP, TIF-AEP, MU-SPG etc. Stock TIF is the one that is mostly correlated to the other stocks. In general, these 15 stocks are not that highly correlated with one and another.

### 3. Portfolio Theory

According to the stocks we choose for the portfolio, we adjust the weight of each asset to combine them to different types of portfolios. We find the efficient frontier, minimum variance portfolio and tangency portfolio with short selling and without short selling. Sharpe ratios of these portfolios and assets are also calculated to give better comparison among portfolios.

We consider the two cases of minimum variance portfolio when short selling is allowed and short selling is not allowed. The information of MVP with short and without short are shown in the following:

**Table 5 : Weights of MVP with and without Short**

Stock	MVP with short	MVP without short	Tangency with short	Tangency without short
AAPL	0.019	0.0071	0.1128	0.024
AAL	-0.0676	0	-0.0989	0
AEP	0.2963	0.2795	0.5369	0.2388
F	0.0118	0	-0.3325	0
FB	0.0604	0.0447	0.1539	0.0948
JPM	0.1517	0.1309	0.2595	0.0143
KO	0.1491	0.19	-0.299	0
LMT	0.1007	0.0709	0.3776	0.2508
M	0.07	0.0402	-0.0108	0
MSFT	0.0186	0.0156	0.2618	0.2261
MU	0.0197	0.0012	0.0957	0.0402
NKE	0.0649	0.0572	0.2205	0.1111
SPG	0.0149	0.0054	-0.1186	0
T	0.137	0.1572	-0.0874	0
TIF	-0.0466	0	-0.0716	0

When the short is allowed, we would short -0.0676 for AAL and short -0.0466 for TIF. When the short is not allowed, we would not be held any AAL, F, and TIF.

**Table 6 : Annual Mean and Risk of MVP**

	Annual mean	Annual Risk
MVP_short	0.1209	0.08478
MVP_not_short	0.1158	0.08803

The annual mean and risk for MVP(short allowed) are 0.1209 and 0.08478. For the MVP(short not allowed), the annual mean and risk are 0.11580 and 0.08803.

Assume that we have \$100,000 to invest, Value-at-risk of the MVP with short

and without short would be 3386.822 and 3727.989. The comparison of VaR of MVP and individual assets are shown in the following chart:

**Table 7 : Comparison of VaR of MVP and Individual Asset**

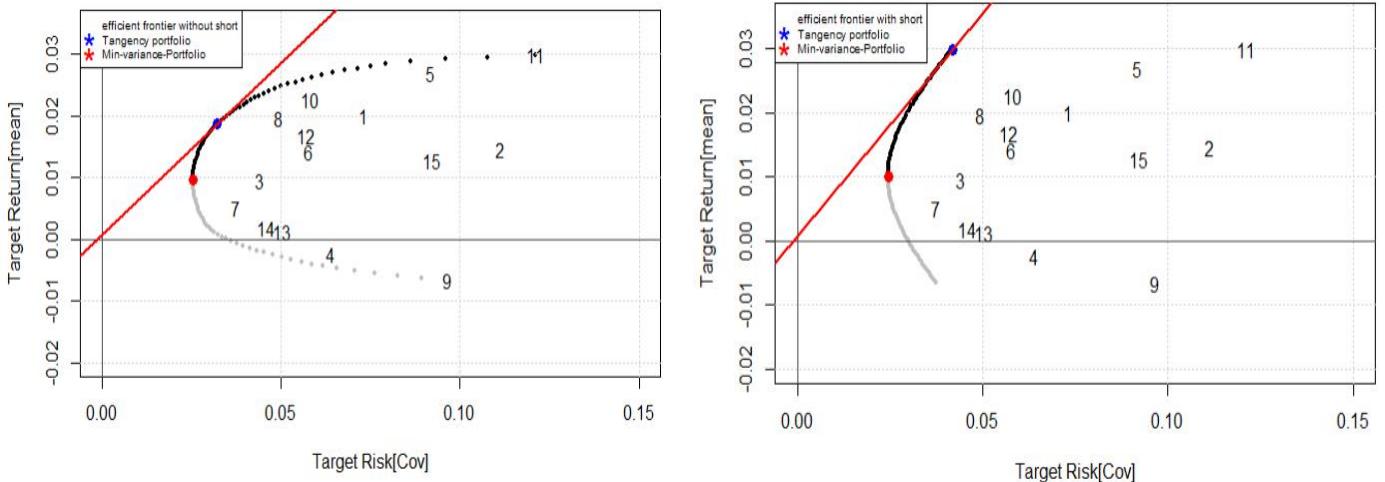
Stock	Sharpe Ratio	VaR	ES
AAPL	0.2655	0.1164	0.1373
AAL	0.1249	0.1540	0.1793
AEP	0.202	0.0682	0.0853
F	-0.046	0.0964	0.1417
FB	0.2856	0.1035	0.1159
JPM	0.2359	0.0865	0.1064
KO	0.1191	0.0604	0.0746
LMT	0.3856	0.0574	0.0956
M	-0.0747	0.1607	0.2232
MSFT	0.3787	0.0762	0.0932
MU	0.2421	0.1659	0.2229
NKE	0.2842	0.0731	0.1004
SPG	0.013	0.0754	0.0889
T	0.0281	0.0819	0.0981
TIF	0.1322	0.1404	0.1698
MVP	0.4114	0.0339	0.0468
MVP_no short	0.3758	0.0373	0.0491
TP	0.5879	0.0423	0.0647
TP_no short	0.506	0.0440	0.0650

Based on the information of this chart, we can know the VaR of MVP with short and without short are smaller than almost all of the individual assets, and expected shortfall as well.

**Table 8 : Return, Variance and Standard deviation of Tangency Portfolio with Short and without Short**

	Expected return	Variance	Standard Deviation
Tangency_short	0.0318	0.0020	0.0445
Tangency_Not_short	0.0187	0.0010	0.0322

We also use the estimated means, variances and covariances to compute the efficient portfolio frontier, with and without short sales allowed, for the risky assets via the Markowitz approach.



**Figure 1 : Efficient portfolio frontier, with and without short sales allowed.**

The Sharpe ratio of each assets and tangency portfolio are showed in previous chart. The chart shows us that the tangency portfolio with short allowed has the highest Sharpe ratio, which is 0.5879. The Sharpe ratio of tangency portfolio without short is 0.5060. Whether the short allowed or not allowed, the Sharpe ratio of tangency portfolio is higher than individual assets.

#### 4. Asset Allocation

We calculate the efficient portfolio with target expected return of 6% per year(0.5% per month) with short not allowed. The weight of each assets and VaR are showed as the following:

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Portfolio Weights:
AAPL    AAL    AEP      F     FB     JPM      KO     LMT      M     MSFT      MU
0.0000  0.0000  0.2070  0.0768  0.0183  0.0790  0.2803  0.0000  0.0665  0.0000  0.0000
NKE     SPG      T     TIF
0.0065  0.0567  0.2089  0.0000

Covariance Risk Budgets:
AAPL    AAL    AEP      F     FB     JPM      KO     LMT      M     MSFT      MU
0.0000  0.0000  0.1846  0.0900  0.0088  0.0617  0.2795  0.0000  0.0848  0.0000  0.0000
NKE     SPG      T     TIF
0.0047  0.0617  0.2242  0.0000

Target Returns and Risks:
mean   Cov   CVaR   VaR
0.0050  0.0269  0.0564  0.0324

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According to this efficient portfolio with short not allowed and target expected

return constraints. We decided to not invest AAPL,AAL,LMT,MSFT,MU and TIF, and we would invest 20.6973% for AEP, 7.6768% for F, 1.8301% for FB, 7.9025% for JPM, 28.0255% for KO, 6.6547% for M, 0.6506% for NKE, 5.6684% for SPG and 20.8941%for T. With the result of the previous chart, the monthly 5% value-at-risk and expected shortfall are 3240 and 5640 based on an initial \$100,000 investment.

We also combine the T-Bills and the tangency portfolio to a new efficient portfolio with target expected return of 0.5% per month. The following chart is showed the new efficient portfolio:

**Portfolio Weights:**

AAPL	AAL	AEP	F	FB	JPM	KO	LMT
0.0000	0.0000	0.0000	0.0907	0.0000	0.0000	0.0344	0.0000
M	MSFT	MU	NKE	SPG	T	TIF	riskfree
0.0586	0.0000	0.0000	0.0000	0.0553	0.0878	0.0000	0.6732

**Covariance Risk Budgets:**

AAPL	AAL	AEP	F	FB	JPM	KO	LMT
0.0000	0.0000	0.0000	0.2771	0.0000	0.0000	0.0334	0.0000
M	MSFT	MU	NKE	SPG	T	TIF	riskfree
0.2493	0.0000	0.0000	0.0000	0.1130	0.1637	0.0000	0.1635

**Target Returns and Risks:**

mean	Cov	CVaR	VaR
0.0050	0.0130	0.0206	0.0177

From the chart we can get the result that we would not invest AAPL, AAL, AEP, FB, JPM, LMT, MSFT, MU ,NIKE and TIP. The new efficient portfolio is consisted of 67.3228% risk free asset, 9.0736% F stock, 3.4396% KO stock, 5.8590% M stock, 5.5266% SPG stock and 8.7783% T stock. With the result of the previous chart, the risk of this portfolio, the monthly 5% value-at-risk and expected shortfall are 0.013, 1770 and 2060 based on an initial \$100,000 investment.

To sum up, the new efficient portfolio based on T-Bills and the tangency portfolio has lower risk, VaR and expected shortfall than the efficient portfolio based on 15 risky assets.

## 5. Principle Component Analysis

As can be seen from the table of Importance of components, the first 11 stocks explain 90% of the total variation. The first 3 components explain only 48.55% of the total variation. Therefore for our data, it seems like PCA is not so helpful in reducing number of dimensions. We cannot expect to use the first few principal components to explain most of the variation. This may be partly (if not mostly) due to that these 15 stocks are not so highly correlated with one and another. Recall of what we have seen in the correlation matrix and plots, correlation between stocks are mostly weak which are no larger than 0.5.

**Table 9 : Principle Components of the 15 Assets**

PC	Standard deviation	Proportion of Variance	Cumulative Proportion
Comp. 1	2.0103	0.2694	0.2694
Comp. 2	1.3589	0.1231	0.3925
Comp. 3	1.1812	0.0930	0.4855
Comp. 4	1.1156	0.0830	0.5685
Comp. 5	1.0196	0.0693	0.6378
Comp. 6	0.9607	0.0615	0.6994
Comp. 7	0.8652	0.0499	0.7493
Comp. 8	0.8463	0.0477	0.7970
Comp. 9	0.8087	0.0436	0.8406
Comp. 10	0.7635	0.0389	0.8795
Comp. 11	0.6751	0.0304	0.9099
Comp. 12	0.6475	0.0279	0.9378
Comp. 13	0.6227	0.0258	0.9637
Comp. 14	0.5443	0.0197	0.9834
Comp. 15	0.4990	0.0166	1.0000

## 6. Risk Management

We calculate Value-at-Risk and Expected Shortfall to evaluate the risk of each asset and portfolio.

Assume we have \$100,000, Value-at-Risks of the 15 assets calculated with non-parametric and normal distribution and are showed in the following chart.

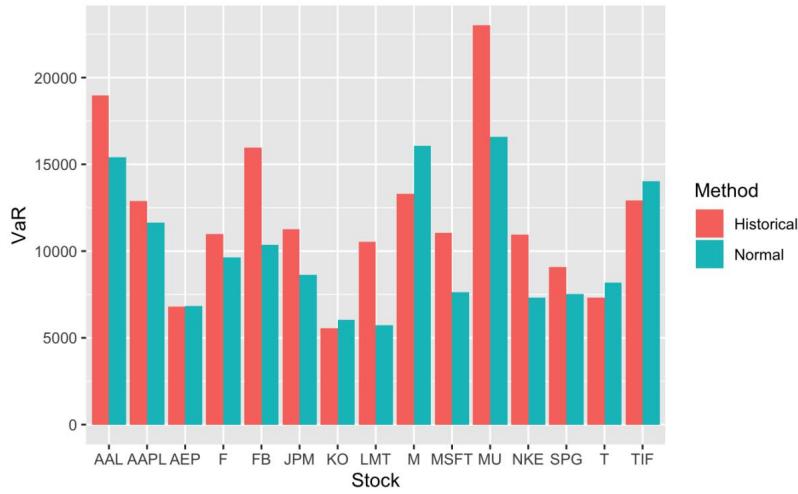


Figure 2 : Value-at-Risk based on historical data and normal distribution

MU has the largest VaR in both non-parametric and parametric calculation, which are \$16593.59 and \$23004.93. KO has the lowest VaR, \$5555.88, in non-parametric calculation and LMT has the lowest VaR which is \$5736.18 in parametric calculation. Overall, VaRs in non-parametric calculation are generally higher than those calculated with normal simulation.

For Expected Shortfall, M has the largest ES in non-parametric calculation, which is \$ 22321.23. MU has the largest ES in parametric calculation, which is \$21982.66. KO has the lowest ES in both non-parametric calculation and parametric calculation, which are \$7456.19 and \$7236.68 separately. Overall, ESs in the two methods usually have difference around \$5000. The confidence intervals of VaRs and ESs of all the assets contain the related estimates, which could be found in our R file.

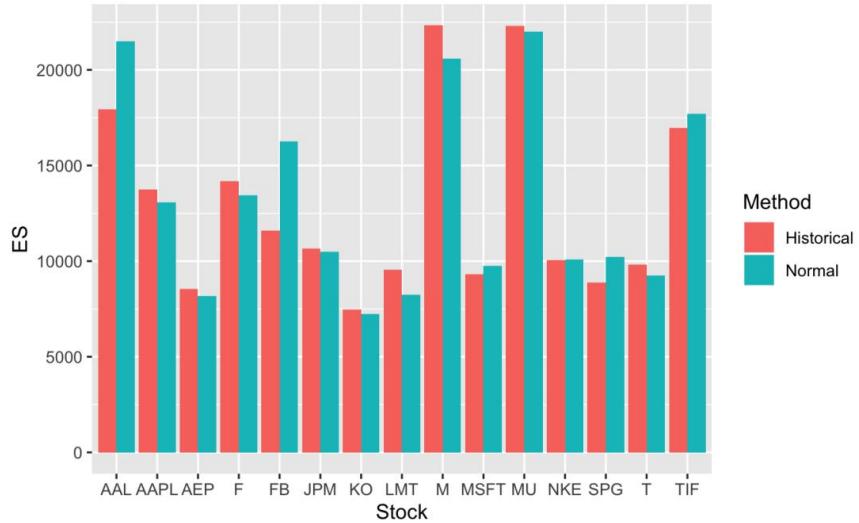


Figure 3 : Expected Shortfall based on historical data and normal distribution

In Descriptive Statistics Part, we find that some stocks follow not normal but t distribution. Thus, non-parametric method is more persuasive for them. Combined both two calculations, we can imply that MU and M are most risky. Their have large VaR and ES, which means that under same probability, 95%, MU and M experience large loss, and above VaR, although the probability is only 5%, the amount of their loss is large. In the opposite way, KO and LMT are less riskier than other assets in both VaR and ES measures.

## 7. Copulas

We fit copulas to model the joint distribution of the returns. We first transform the return data in to pseudo-observations. Then we fit gaussian copula, t-copula, clayton copula and gumbel copula and check AIC value.

Table 10 : AIC values of Copulas

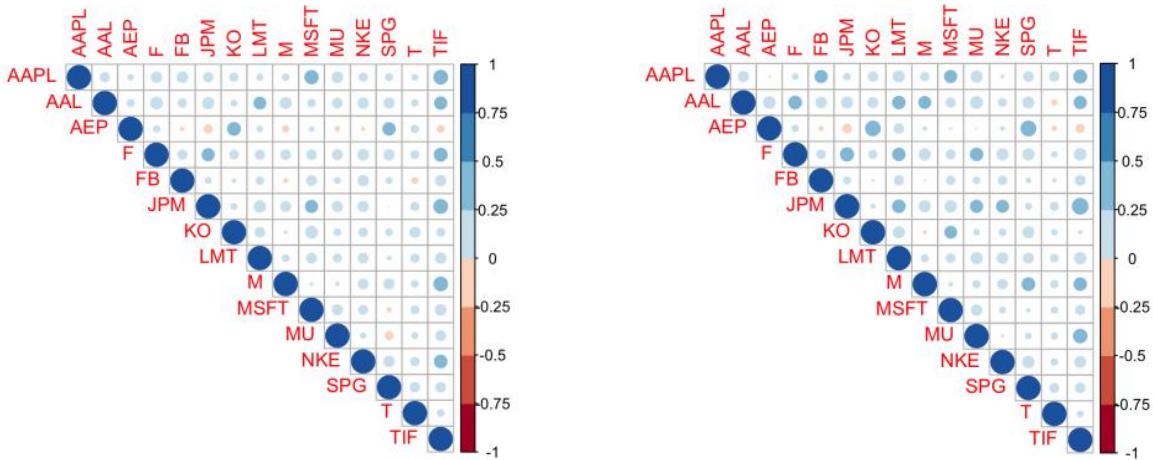
Copulas	Gaussian	t	Clayton	Gumbel
AIC	-139.3852	-141.1051	-136.7047	-110.3141

T-Copula has the lowest AIC value suggesting that t-copula fits the data better than the test three copula model.

Parameters of gaussian copula and t-copula models are the correlations of the assets, absolute value of which are around 0.2-0.5. Parameters of clayton copula and gumbel copula are 0.2623 and 1.1634. All the four models show

that the 15 assets are only slightly correlated. The fact that T-copula fits best implies that the joint distribution of these assets is joint fat-tailed. Joint happening of extreme events, such as extremely large returns and extremely large losses, is under a relatively high probability. The probabilities of the two opposite extreme events are relatively symmetric.

We also generate simulation data from the t-copula model we fitted before. The correlation, Kendall's tau, is similar to the original data, meaning the model fits well.



**Figure 4 : Correlation plots of original data and data generated by fitted t copula**

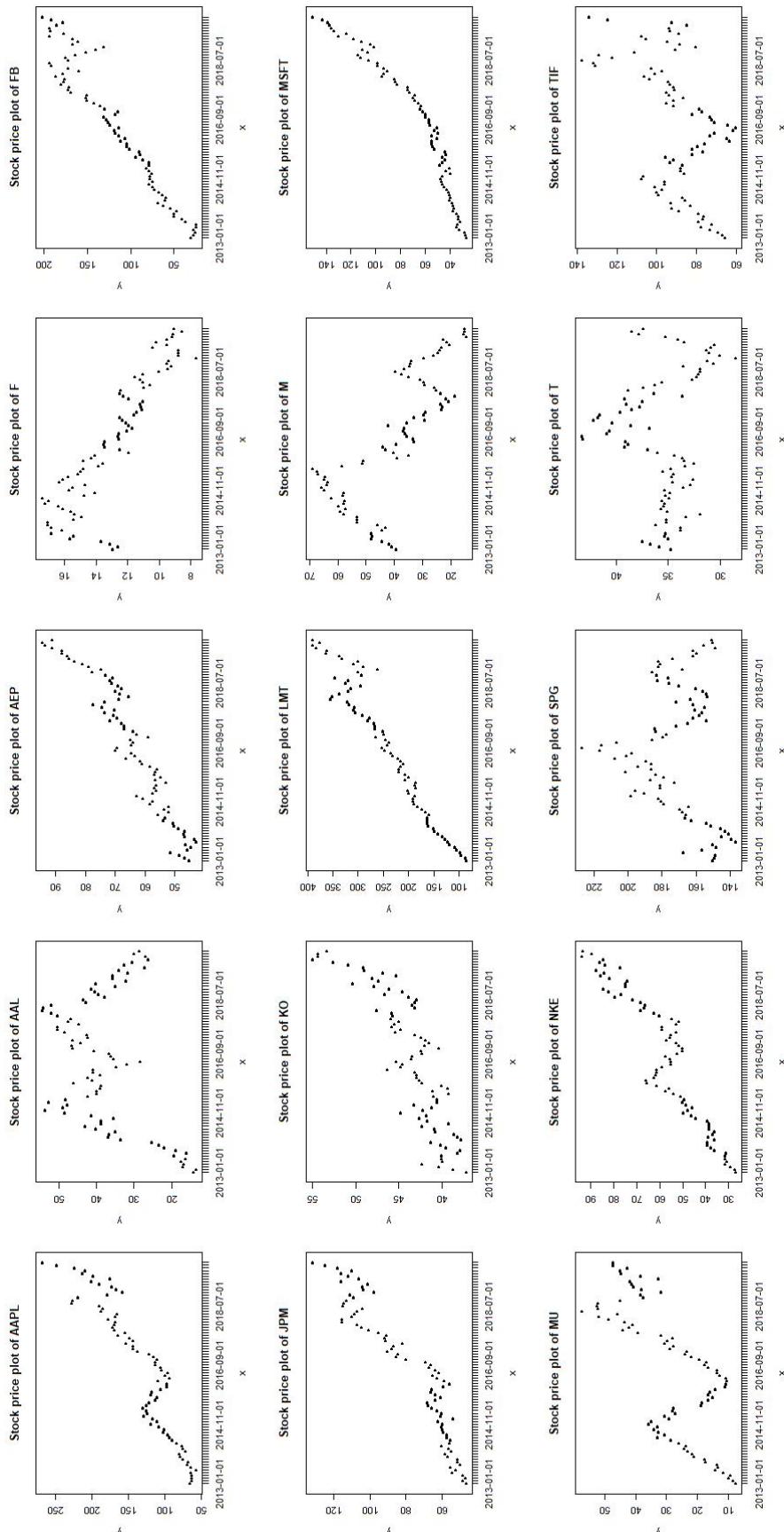
## 8. Conclusion

In the report, we analyzed the individual performance of 15 stocks. The stock returns are mostly t or normally distributed and a few of them are skewed-t distributed. Values of Beta and equity curve show the similar result that 8 out of 15 stocks perform better than S&P 500 index.

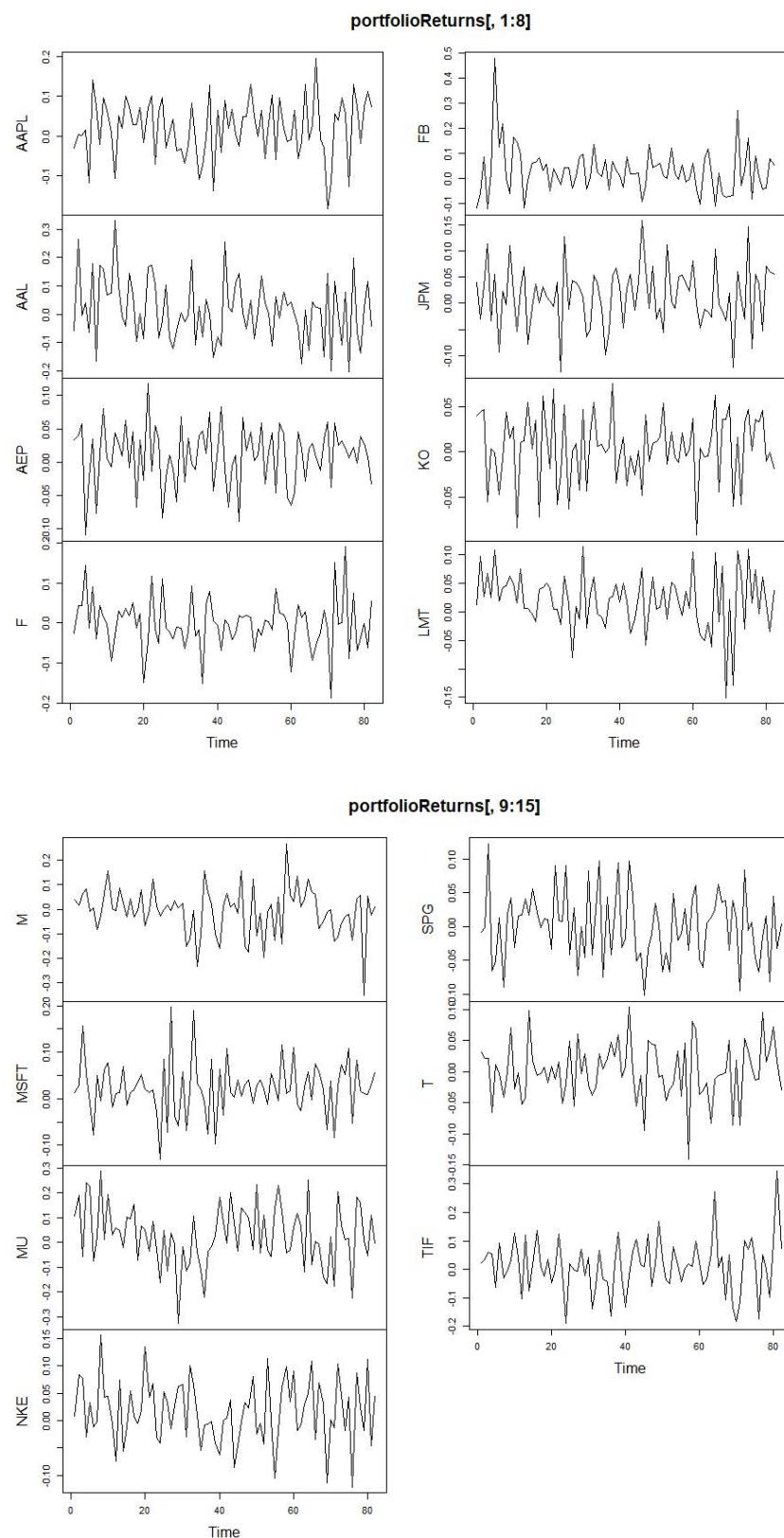
Among all the assets, LMT performs the best based on Sharpe's Ratio and it has the lowest Value-at-Risk and Expected Shortfall. While M suffers the lowest Sharpe's Ratio and highest Value-at-Risk and Expected Shortfall.

The 15 stocks are proved to be slightly correlated with correlations among -0.17 and 0.49. Joint distribution of them are fitted by t-copula, which shows similar slight correlations. These are also consistent with what we found in PCA, where the first three principal components can only explain less than 50% of the overall variation. Thus, we can easily diversify the non-systemic risk. Then we calculated efficient frontier and built MVP and tangency portfolio. The tangency portfolio earns more return and is less riskier than any individual asset.

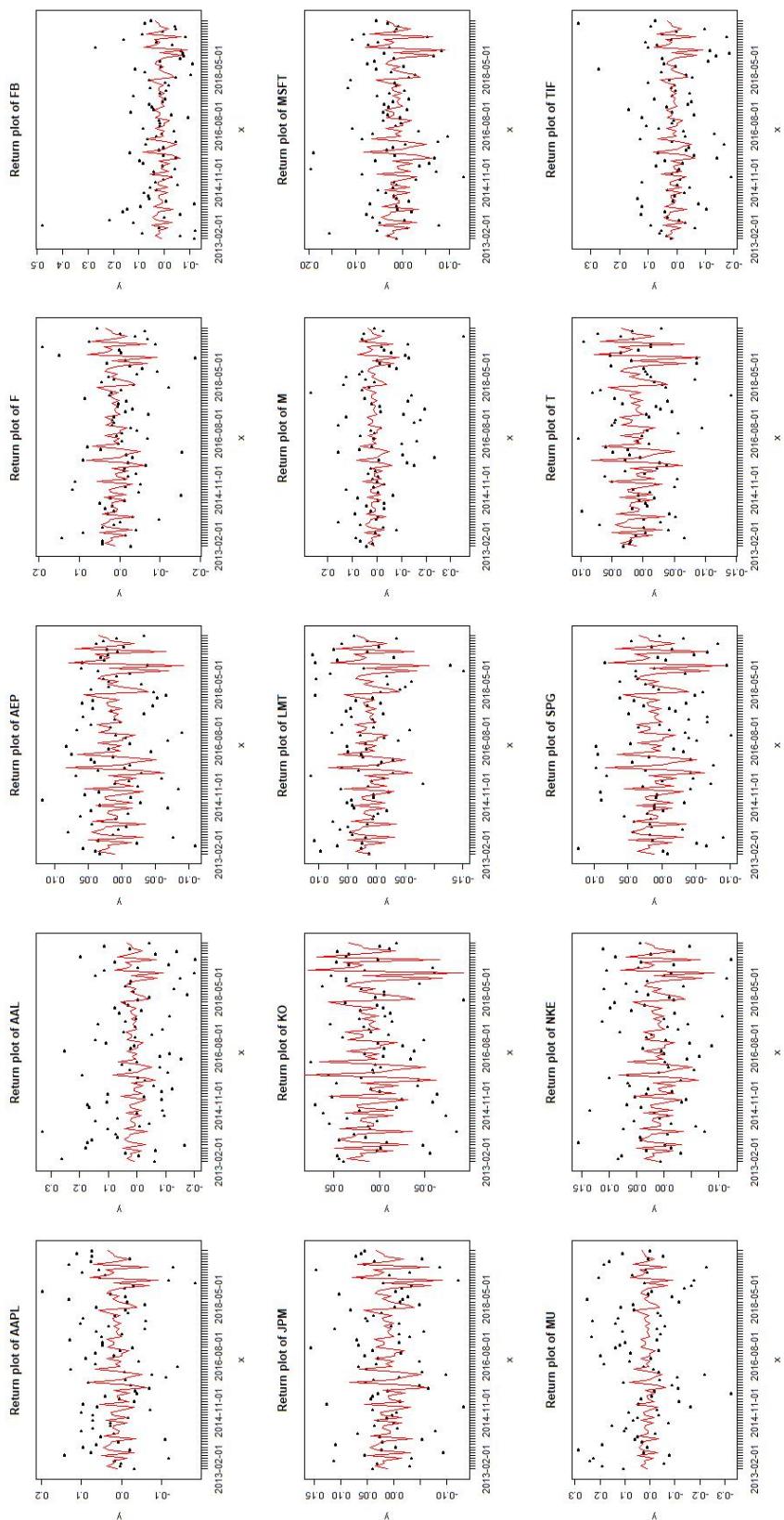
## Appendix



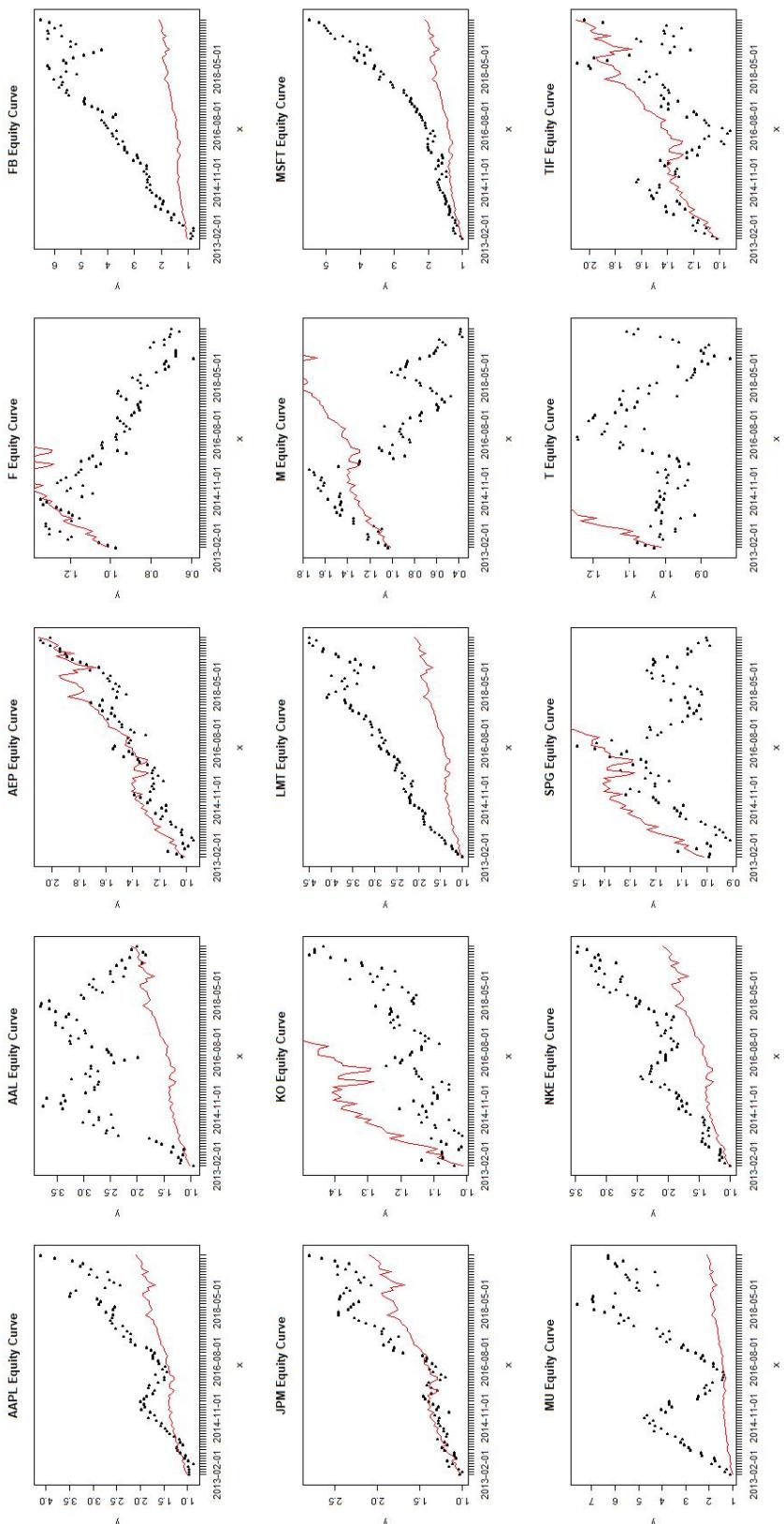
**Figure 6 : Monthly Return Plot (Line)**



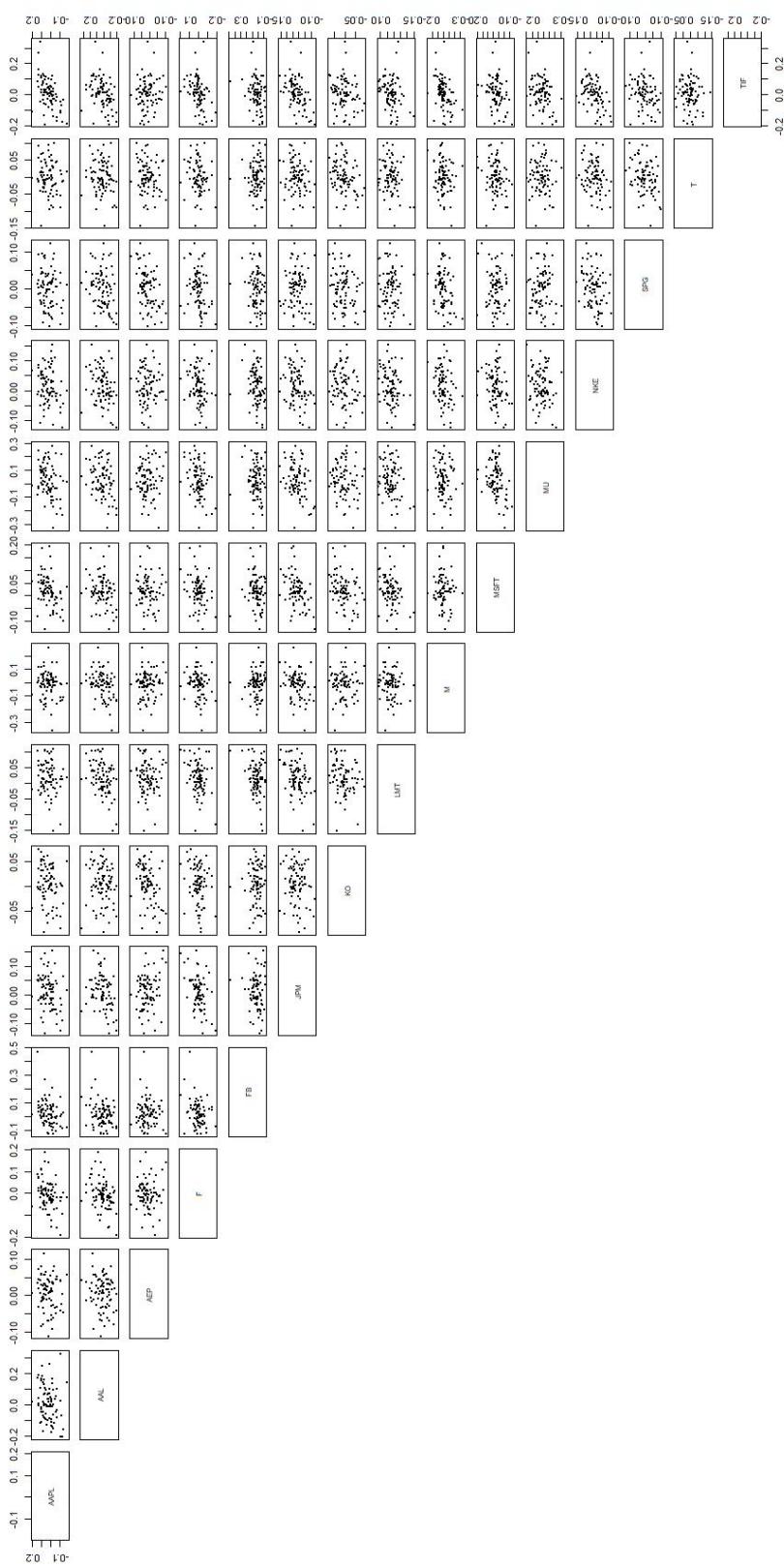
**Figure 7 : Monthly Return plot (dots; red line represents S&P500)**



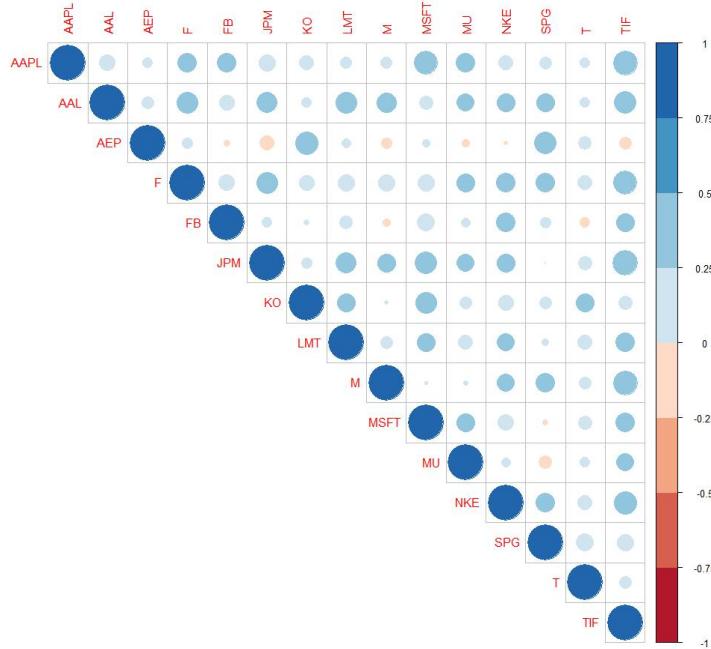
**Figure 8 : Equity Curve (red line represents S&P500)**



**Figure 9 : Pairwise Scatter Plot**



**Figure 10 : Correlation plot**



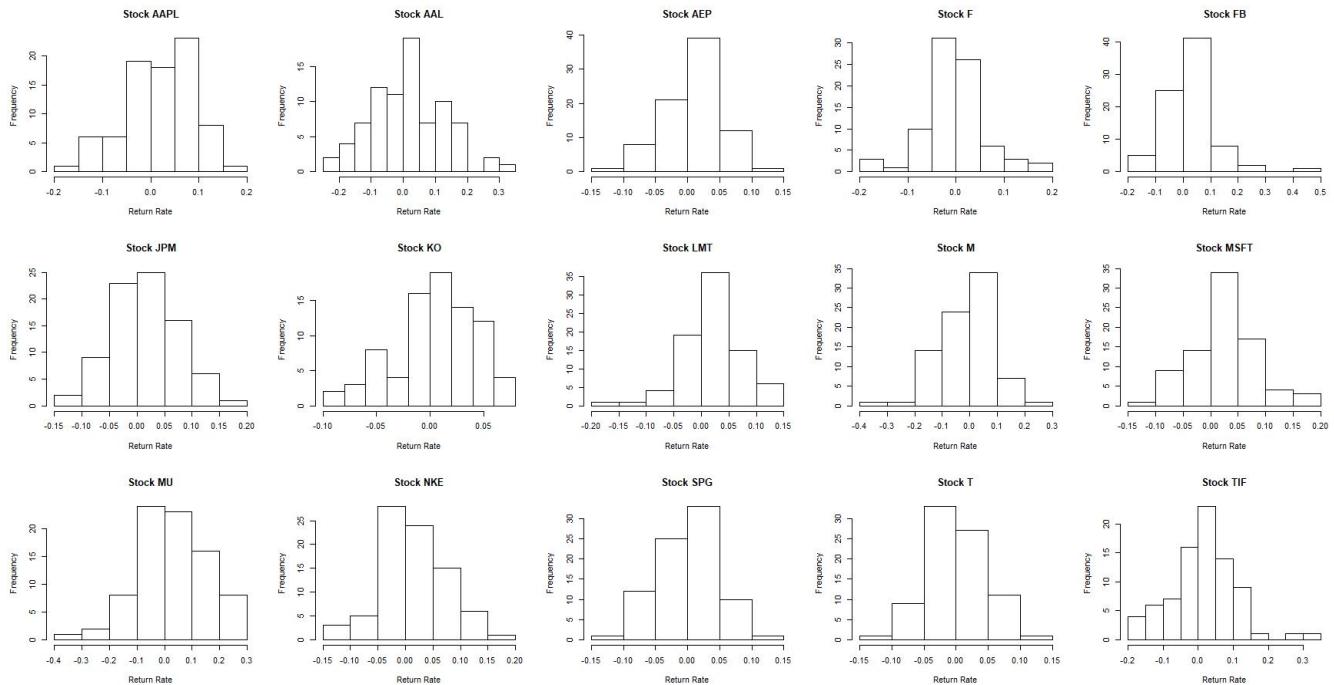
**Table 11 : Covariance Matrix**

	AAPL	AAL	AEP	F	FB	JPM	KO	LMT	M	MSFT	MU	NKE	SPG	T	TIF	
<b>AAPL</b>	0.0053325938	0.0015998005	3.197757e-04	1.497810e-03	2.037404e-03	9.275245e-04	5.172721e-04	6.033029e-04	0.0008951602	0.0015933282	0.0025257291	8.079662e-04	6.029676e-04	0.0003268894	0.0033602947	
<b>AAL</b>	0.0015998005	0.0123911957	7.856212e-04	2.693434e-03	2.782918e-03	2.050796e-03	2.166696e-04	2.314205e-03	0.0035151686	0.0014248385	0.0041750851	1.632676e-03	1.431169e-03	0.0005490205	0.0034353703	
<b>AEP</b>	0.0003197757	0.0007856212	1.954942e-03	5.786638e-05	1.855988e-04	-5.868461e-04	7.011016e-04	6.996809e-05	-0.0005060766	0.0001437290	-0.0003976941	-4.713743e-05	1.024034e-03	0.0002748468	-0.0004964617	
<b>F</b>	0.0014978102	0.0026934339	5.786638e-05	4.102706e-03	1.620424e-03	1.680473e-03	5.164379e-04	9.310180e-04	0.0010864286	0.0009757020	0.0025590521	7.238270e-04	8.309439e-04	0.0004241903	0.0021176072	
<b>FB</b>	0.0020374035	0.0027829183	1.855988e-04	1.620424e-03	8.453763e-03	4.493379e-04	5.249013e-03	1.278171e-03	-0.0004019921	0.0004604488	0.0007780560	1.349736e-03	7.017275e-04	-0.0001982997	0.0023158331	
<b>JPM</b>	0.0008927545	0.0020507964	-5.868461e-04	1.680473e-03	4.493379e-04	3.346310e-03	3.089969e-04	1.143657e-03	0.0016026439	0.0014565858	0.0022323975	9.424292e-04	4.658825e-05	0.0003890975	0.0023876348	
<b>KO</b>	0.0005172721	0.002166969	7.011016e-04	5.164379e-04	5.249013e-03	3.089896e-04	4.1410711e-03	4.035478e-04	2.453638e-03	0.0004893376	0.0007188941	0.0015180368	7.967737e-04	2.582470e-04	0.0005393102	0.0011335507
<b>LMT</b>	0.0006033029	0.0023142051	6.996809e-05	9.310180e-04	1.278171e-03	1.143657e-03	4.035478e-04	2.453638e-03	0.0004893376	0.0007188941	0.0015180368	7.967737e-04	2.582470e-04	0.0005393102	0.0011335507	
<b>M</b>	0.0008951602	0.0035151686	-5.060766e-04	1.086429e-03	-4.019921e-04	1.602644e-03	-1.165401e-04	4.893376e-04	0.0093360472	0.0003540263	0.0003943765	1.370315e-03	1.406892e-03	0.0006920709	0.0035747799	
<b>MSFT</b>	0.0015893282	0.0014248385	1.437290e-04	9.575020e-04	4.604480e-04	1.456586e-03	7.656972e-04	7.188941e-04	0.0003540263	0.0033862348	0.0023371324	7.910340e-04	1.162031e-04	0.0004501490	0.0015651803	
<b>MU</b>	0.0025257291	0.0041750851	-3.976941e-04	2.595052e-03	7.780506e-04	2.232398e-03	6.099310e-04	1.518037e-03	0.0003943765	0.0023371324	0.0146626644	1.009241e-03	-3.818243e-04	0.0004009195	0.0003960900	
<b>NKE</b>	0.0008079662	0.0016326777	-4.713743e-05	7.238270e-04	1.349736e-03	9.424292e-04	4.040693e-04	7.967737e-04	0.0013703146	0.0007910340	0.0010092412	3.250546e-03	8.217469e-04	0.0004914256	0.0018630890	
<b>SPG</b>	0.0006029676	0.0014311694	1.024034e-03	8.309439e-04	7.017275e-04	4.658825e-05	3.889588e-04	2.582470e-04	0.0014068918	0.0001162031	0.0003818243	8.217469e-04	2.523746e-03	0.0006840333	0.0008530080	
<b>T</b>	0.0003268894	0.0005490205	2.748468e-04	4.241903e-04	-1.982997e-04	3.890975e-04	4.678858e-04	5.393102e-04	0.0006920709	0.0004501490	0.0004009195	4.914256e-04	6.804633e-04	0.002103573	0.0004800197	
<b>TIF</b>	0.0033602947	0.0034353703	-4.964617e-04	2.117607e-03	2.315833e-03	2.587635e-03	5.423198e-03	1.133551e-03	0.0035747799	0.0015651803	0.0039360900	1.863089e-03	8.530080e-04	0.0004801917	0.0084662180	

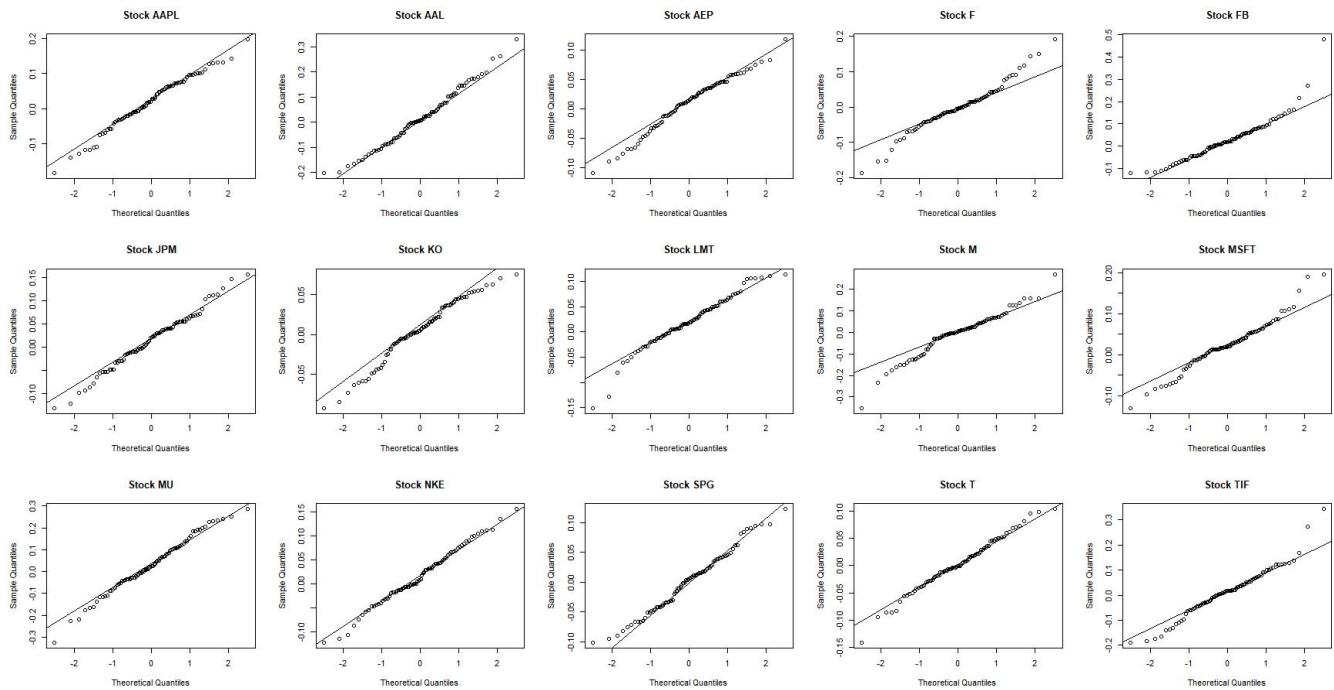
**Table 12 : Correlation Matrix**

	AAPL	AAL	AEP	F	FB	JPM	KO	LMT	M	MSFT	MU	NKE	SPG	T	TIF
<b>AAPL</b>	1.00000000	0.21054407	0.08098519	0.29032118	0.30146603	0.2287850389	0.17726189	0.10834667	0.10967447	0.44693926	0.30007292	0.16557286	0.1284161034	0.08562162	0.4743200
<b>AAL</b>	0.21054407	1.00000000	0.13128939	0.36628900	0.18276902	0.3363372188	0.08847313	0.36946703	0.32140486	0.15235426	0.25377390	0.26073943	0.2673131551	0.08433735	0.3978080
<b>AEP</b>	0.08098519	0.13128939	1.00000000	0.09870376	-0.03292302	-0.1687291170	0.41637553	0.07103754	-0.10064858	0.05179526	-0.05464677	-0.01507385	0.3987440276	0.14206549	-0.1238885
<b>F</b>	0.29032118	0.36628900	0.09870376	1.00000000	0.21108826	0.3685310347	0.19896388	0.22158009	0.23622947	0.22889390	0.26598535	0.29443519	0.284810530	0.17447568	0.4488741
<b>FB</b>	0.30146603	0.18276902	0.09870376	0.21108826	1.00000000	0.081834115	0.02872193	0.14670062	-0.04922672	0.24663423	0.07523862	0.293933283	0.1041891142	-0.07965738	0.2733427
<b>JPM</b>	0.22878506	0.33633722	-0.1687291170	0.36853103	0.08183411	1.0000000000	0.09911734	0.33113484	0.26393923	0.38045951	0.25671249	0.26944635	-0.0006639022	0.16000044	0.4885341
<b>KO</b>	0.17726189	0.08847313	0.41637553	0.19896388	0.02872193	0.0991173366	1.00000000	0.26892393	0.01729411	0.36193555	0.13020102	0.20044405	0.1288514492	0.2780226	0.1643321
<b>LMT</b>	0.10834667	0.36946703	0.07103754	0.22158009	0.14670062	0.3311348375	0.26892393	1.00000000	0.13035339	0.26082650	0.16740131	0.25046528	0.0468758503	0.16942557	0.2840304
<b>M</b>	0.10967447	0.32140486	-0.10068458	0.23622947	-0.04922672	0.2639392527	0.01729411	0.13035339	1.00000000	0.01193936	0.02258356	0.25068295	0.2828767645	0.12613054	0.4716644
<b>MSFT</b>	0.44639262	0.15253426	0.05179526	0.22889390	0.24663423	0.3804595074	0.36193555	0.26082650	0.01193936	1.00000000	0.28030822	0.21204602	-0.0293967197	0.16041401	0.2850753
<b>MU</b>	0.30007292	0.25377390	-0.05464677	0.26598535	0.07523862	0.2567124868	0.13020102	0.16740131	0.02258356	0.28030822	1.00000000	0.07621815	-0.1408234564	0.07994036	0.2556677
<b>NKE</b>	0.16557286	0.26073943	-0.01507385	0.29443519	0.29933283	0.2694463491	0.20044405	0.25046528	0.25068295	0.21204602	0.07621815	1.00000000	0.2945004952	0.17780608	0.4124139
<b>SPG</b>	0.12841610	0.26731316	0.39874403	0.28481405	0.10418911	-0.0006639022	0.12885154	0.04687585	0.28287676	-0.02939672	-0.14082346	0.29450050	1.0000000000	0.24691721	0.2381015
<b>T</b>	0.08562162	0.08433735	0.14306549	0.17447568	-0.07965738	0.1600004353	0.27802266	0.16942567	0.12613054	0.16041401	0.07994036	0.17780608	0.2469172081	1.0000000000	0.1211676
<b>TIF</b>	0.47432004	0.39780803	-0.12388851	0.44887409	0.27334269	0.4885340821	0.16433213	0.28403043	0.47166444	0.28507526	0.25566766	0.41241388	0.2381014573	0.12116760	1.0000000000

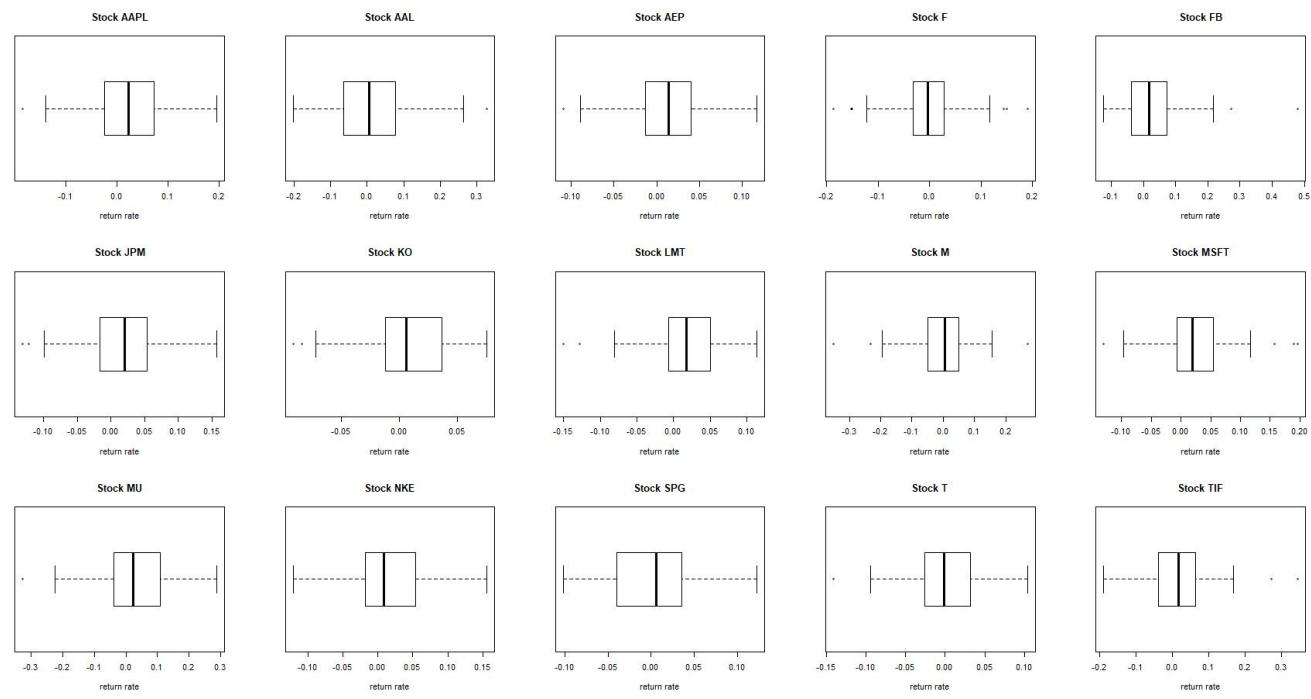
**Figure 11 : Histogram**



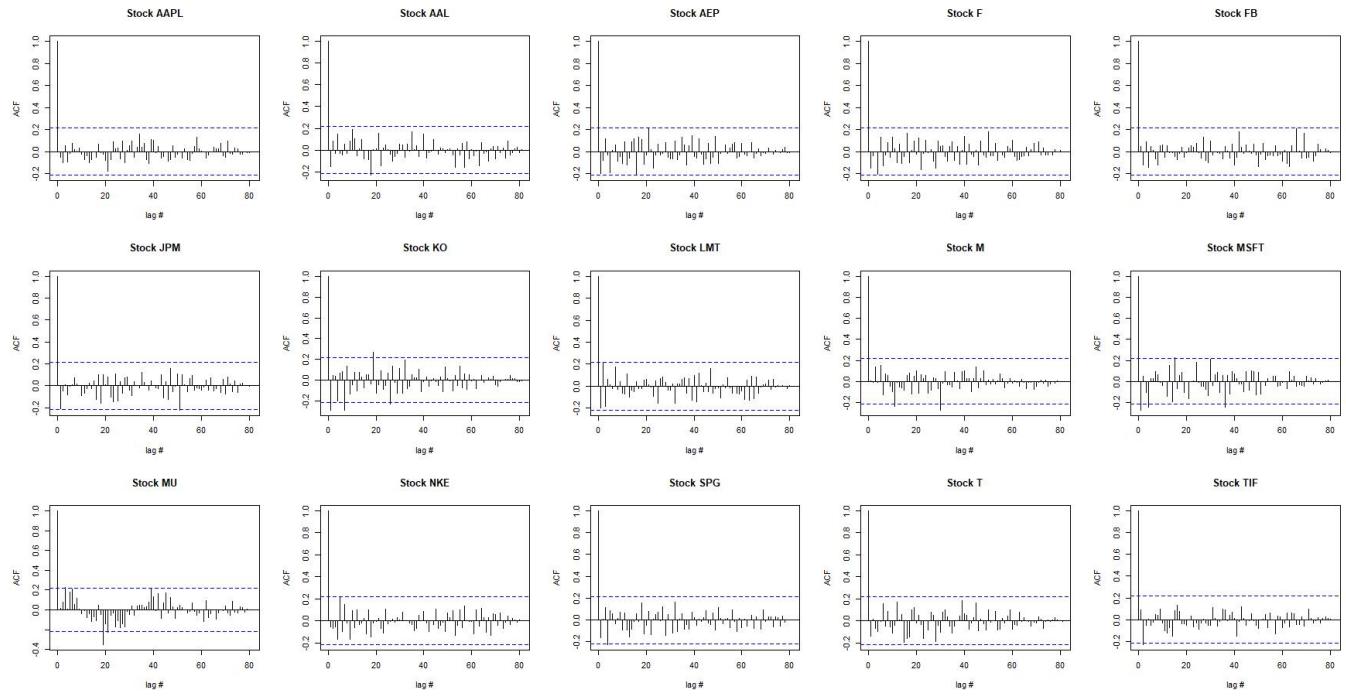
**Figure 12 : QQ plot**



**Figure 13 : Boxplot**



**Figure 14 : ACF Plot**



**Figure 15 : Empirical Density Distribution**

