

## 1 Introduction

From the previous report of exploring different methods to simulate VaR and ES, the best calculation model for their certain portfolio is the combination of constant correlation conditional Garch (CCC Garch) model with Var-Cov(6) and VaR-Cov(based on student-t with freedom 6).

To validate this conclusion, the CCC Garch model with Var-Cov(6) and Var-Cov method (with freedom 6, which is approved to match the distribution of historical data best) are simulated to verify the document result. Then, sum up the violations of the prediction compared with empirical data and do Bernoulli Test. If the two-sided P-value is significant at 10% level, this conclusion is convincing.

The result shows that, both CCC-Garch and VaR-Cov(t-6) model are not valid for 97.5% VaR; and only CCC Garch is valid for 99% VaR, which is the same as the previous conclusion.

## 2 Documentation

In this validation report, the portfolio from document is made up with four indexes and one bonds:

- AEX (EUR) 30%
- FTSE (GBP) 20%
- NASDAQ (USD) 20%
- GREEN (GBP) 15%
- Bond (EUR) 15%

The documnet has two preferred models for this portfolio is GARCH Constant Conditional Correlation (CCC) with Var-Cov(6) and Var-Cov(6) method. And the historcial data is range from 01/04/2010 to 30/03/2020. For backtest, the last 252 \* 5 days were used.

## 3 Theoretical Assessment

Firstly, we used corresponding historical data to linearize loss operator derivations. And the daily portfolio loss (figure 1) shows during 2011, 2015 – 2016, 2020 there are significant loss. Especially at 2020 due to the coronavirus the daily loss can be bigger than 0.1%. The distribution also shows there are many extreme value since to these stress period.

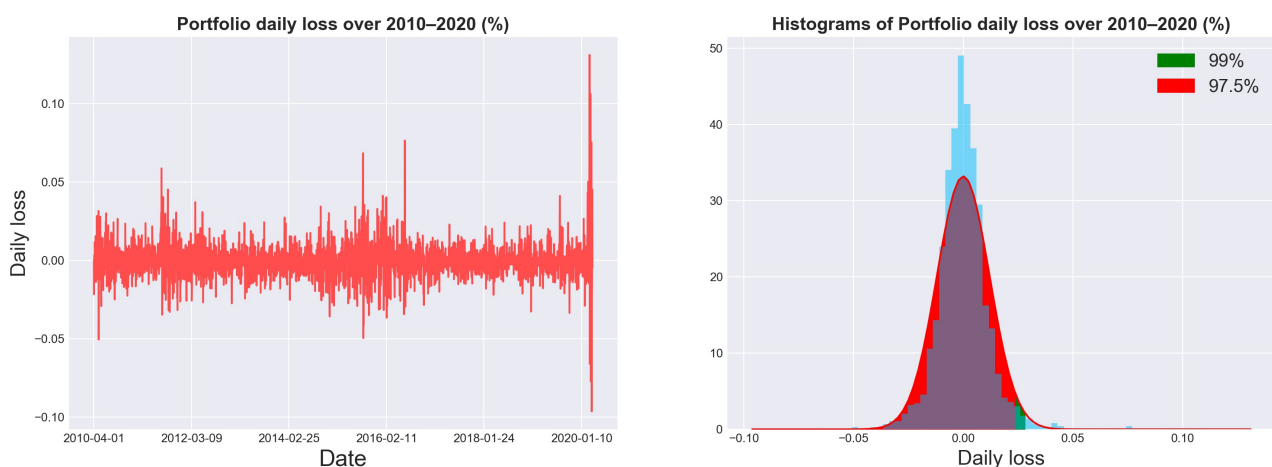


Figure 1: Daily loss of portfolio and corresponding distribution.

Then, we check out the normal and student t test. Figure 2 shows that the normal assumption is not correct since there is a extremely heavy tail because of stress period. Then we check out student t test with degree 3 and 6. Student t with degree 6 is better than normal assumption but still have a heavy tail. While Student t with degree 3 is the best at the beginning of theoretical quantiles. But for big quantiles the values are deviated from straight line. Thus, we think student t test with degree 6 is the best assumption which is the same as the document.

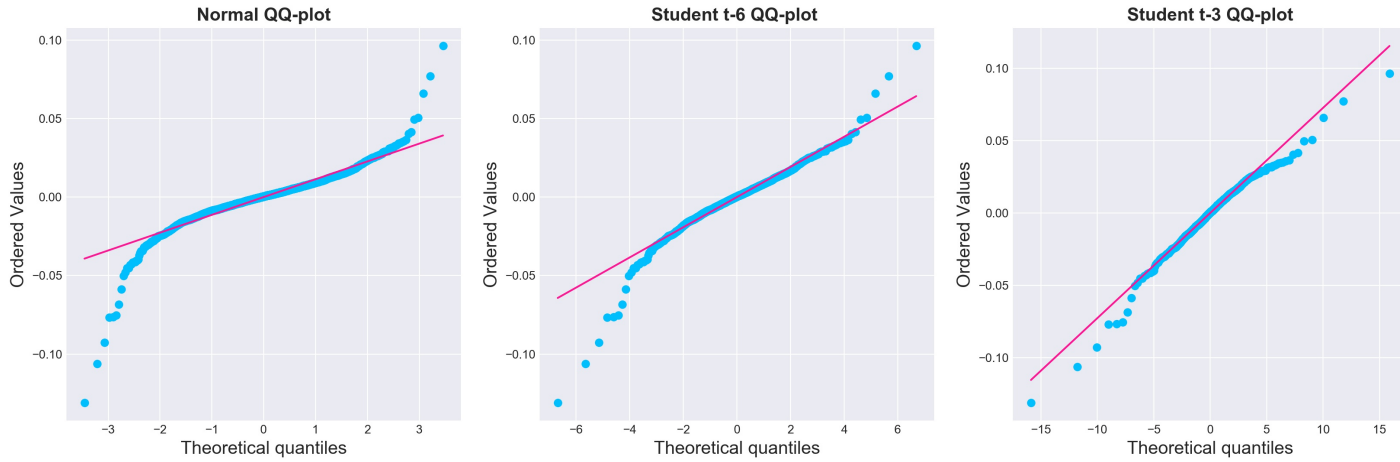


Figure 2: Check assumption of portfolio loss with normal and student t test

## 4 Quantitative Assessment

In this part we perform the most important backtest using preferred model : GARCH CCC with Var-Cov(6). And according to the document, last  $252 \times 5$  days are in test.

Figure 3 shows that CCC with Var-Cov(6) has great performance to evaluate the portfolio loss. And the clusters happen during 2015 and 2020, which are corresponding stress period. But Var-Cov(6) has bad performance.

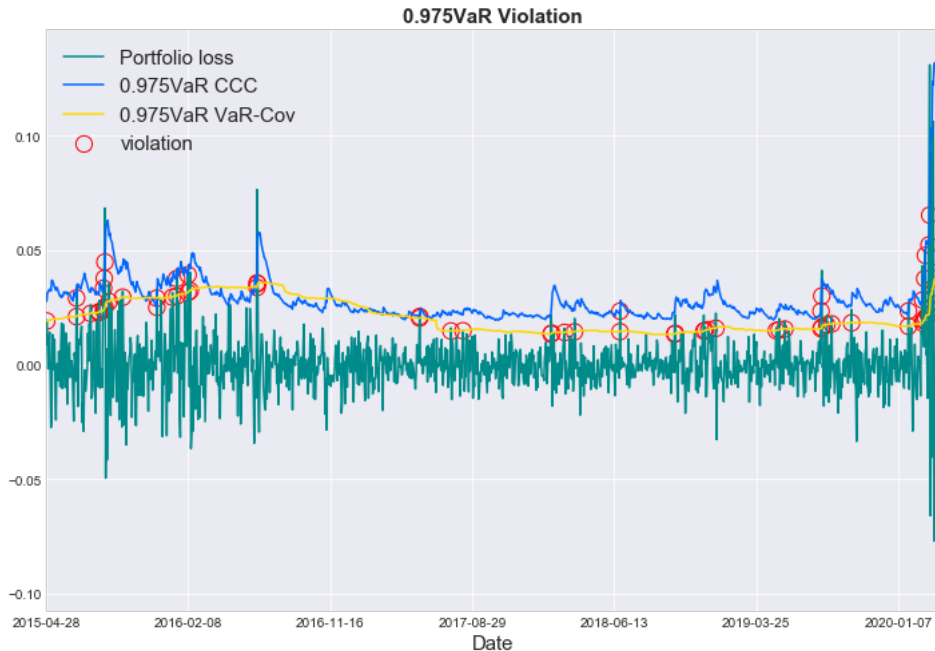


Figure 3: Caption

Then we check the assumption of VaR according to the table 1. The results shows for both 0.975VaR and 0.99VaR the violations are smaller than expected number. Even though the p-value of 0.975VaR from our result is smaller than 0.05, p-value of 0.99VaR from our result is 0.254. It means for 0.975VaR the model overestimates the portfolio. But for 0.99VaR it shows statistically significance. Furthermore, when

compared with result of document the mainly difference is the number of violations of 0.975VaR. The possible explanation is because of data processing. For example, the frequency of recalculate correlation matrix. In short, GARCH CCC with Var-Cov(6) and Var-Cov(t-6) are not sufficient to evaluate VaR of this portfolio.

Table 1: Numbers of violations of the 97.5% and 99% VaR estimate calculated for all four models							
Year	Five years	Four years	Three years	Two years	One year	ALL	P-value
Trading days	252	252	252	252	252	1260	-
Var-0.975							
Expected number	6.3	6.3	6.3	6.3	6.3	31.5	-
CCC Garch	7	1	1	1	8	18	0.011
Var-Cov (t-6)	13	2	6	7	19	47	0.009
Document result	10	2	0	0	10	22	0.092
Var-0.99							
Expected number	2.5	2.5	2.5	2.5	2.5	12.6	-
CCC Garch	2	1	1	0	5	8	0.254
VaR-Cov (t-6)	7	1	2	5	13	28	0.000
Document result	3	1	0	0	7	11	0.360

## 5 Limitations

The main limitations is the assumption of portfolio obeys student t with degree 6. Because as figure 2 shows student t with degree 6 still has many quantile deviate from the straight line which means this assumption is not ideal. Thus, in this way some improvement should be done.

## 6 Final validation result

For Var-Cov(6), we think the model is red. Because p-value of 0.975VaR and 0.99VaR are smaller than 0.05. We think it is because the Varicance-Covariance method does not have dynamic VaR. For Garch CCC with Var-Cov(6), we think it is yellow. It is effective for 0.99VaR but for 0.975VaR it is still not valid.

## References