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Topic: Weekly report (6/10-6/16) – wrap up "Rglpk" optimization

Last week, I implemented the "Rglpk" method. This is a linear programming problem solver, I used it to solve the excepted shortfall optimization.

The excepted shortfall is the mean of loss greater than certain threshold, usually 5% quantile of historical return. Even though it seems like a statistic of historical data, we can transform it into a linear equation form which combined VaR and upper limitation of VaR:

In above equation, is number of observations, aka the length of historical data; is the weight vector; and is the historical data matrix. Since we introduced new variables to optimization equation, we need to set constraints to this new variable. Assume vector . Then we know and . The constraints of weight vector are determined by portfolio constraints. Then in the general linear equation, we have which , and constraint matrix A according to portfolio constraints.

After implemented algorithm, I ran several tests on the new optimization. The test dataset, dim , comes from real stock return (with pmm method datapoint imputation to replace NA value). I compared mean return, ES, ES ratio and running time for five method and got the results as following.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| method | time (s) | mean | ES | Ratio |
| DEoptim | 27.53 | 0 | 0.07 | 0.02 |
| random | 85.91 | 0 | 0.15 | 0.01 |
| pso | 52.69 | 0.01 | 0.99 | 0.01 |
| GenSA | 136.78 | 0 | 1.11 | 0 |
| Rglpk | 6.86 | 0 | 0.1 | 0.02 |

We can see that the Rglpk and DEoptim gave same highest ratio with similar ES and mean. However, DEoptim spent half minute to find the optimized weight while Rglpk only needs 7 seconds. Beside this sample test, I did several test, and found: the Rglpk always gives highest ES Ratio with or without other method; the mean running time for optimization of 10 years historical data on 20 stocks is around 5 seconds; Rglpk needs 5 minutes to optimize 10 years historical data on 1500 stocks while other methods can not process such big dataset. Also, Rglpk also provides same weight and result under same objective and constraints.

In this week, I will revise osqp method, and use osqp to solve ES optimization. Beside review the osqp, I will implement mco method, which will provide customized constraints and objectives. After finished osqp and Rglpk method, they can replace ROI method.