SUMMER INTERNSHIP PROJECT-2020

TOPIC-Portfolio Optimization through deep learning

Well it’s a trending topic in field of finance,as many classical techniques were devised for optimization of portfolio on the basis of Markowitz theory and all.

In this project we did portfolio optimization through deep learning,as we trained autoencoder and we also used reinforcement learning.And finally we compared results of 3 models.

1.Classical optimization methods

2.Autoencoders(Artificial Neural Network)

3.Reinforcement Learning(Deep Q Learning)

We will explain it in brief here.

While doing this project what we found is that training model so as to learn the market structure is most tedious task.Dataset we used in our project was nifty50 companies last 5 yrs stock prices and volumes,returns.

As we can see that 3 files were made in our project,stock prices file,volumes file,returns file.So our main concern was to maximize return while minimizing the risk,and basically increasing sharpe ratio.So we trained our model in such a way that it should assign weights to stocks on basis of sharpe ratio and returns.

And we compared our model portfolio with market benchmark portfolio.We took equal allocation as benchmark portfolio.We used 300 trading days for making decision (fitting autoencoder etc) and for next 300 trading days we are holding assets with respect to weights found by algorithm.After this holding period re-weighting procedure starts again.In our code this window-fit and window-hold meant trading days.

Classical methods used for optimization are-

1.MaxSharpe Agent-In maximizing sharpe ratio.

2.Min Variance Agent-No investor invest below this portfolio.The min variance optimization function determines the lower bond of efficient frontier.

3.MaxDeccorelation Agent-It applies to cases where investor believes all assets have similar returns.It is min variance optimization that is performed on correlation matrix rather than covariance matrix.

4.MaxReturns Agent-It believes in maximizing returns from assets.

Now,neural network which we used was Autoencoder.Our main purpose was a to use autoencoder, as classical methods which we used above was just for comparison purpose.

Autoencoder(Artificial Neural Network)-They squeeze input data into some low dimensional vector and after restore input from this representation.In this model for training purpose returns was given as input and returns was taken as as output also.Among all the models tried this was the best performer.Also why we preferred this because as stock market dataset is high dimensional data so for training other neural networks would not have been easily possible,as autoencoder reduces the dimension of dataset,that’s why we preferred it.

Finally we tried portfolio optimization using Reinforcement Learning(RL)

RL-:They don’t learn structure of market nor do predictions,they directly learn policy of changing weights dynamically in continuously changing market.

Deep Q-Learning-We describe market with some state s\_t and doing some action on this market and then going to state s\_{t+1} we get a reward (means changed value of portfolio based on weights we applied).This Q(S,a) function means here S is market and a is allocated weight.This Q(S,a) function is approximated with deep neural network and we train a model to optimize for sharpe ratio or other criteria.

Now lets discuss finally about results of models and answer to questions which were mentioned in problem statement.

1..Autoencoder was the best performer as we can see from plots also that in autoencoder one autoencoder portfolio was very much close to benchmark portfolio ,but in real markets deep Q learning will perform nicely.

2.Now we saw that deep portfolios were better performers than traditional optimization methods.

3.We can formulate profitable trading strategies based on deep portfolio.

4.We can see that in bar graph each company were plotted on the basis of weight allocated by the algorithm.Here weight refers to like how much money should we invest in particular company.So,on the basis of returns and risk weights were allocated.

5.We can see results like sharpe ratio,returns etc…founded by different models are given in source code file.

Well now our model is ready,investor can just change dataset as per his/her needs and get allocated weights for each stocks.

So,finally we would like to thank Prof. Abhijeet Chandra Sir,for giving such a nice project which helped us a lot in learning concepts of core finance and many other things.

Reference-From research papers and from articles of Bloomberg,medium etc.

From

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