ECE 133B Project Proposal

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Our Project Proposal is using Singular Value Decomposition (SVD) and Kernel Density Estimation to optimizing portfolio allocation. Our goal will be to deliver a annualized sharpe ratio that is higher than the S&P500, and the optimal portfolio given by Markowitz's Mean-Variance Portfolio Optimization. We will use the S&P500 dataset over the past 10 years as the dataset.

Our approach will be the following, we will use SVD to identify individual sectors of the dataset that are correlated. Then we will use Kernel Density Estimation to estimate the multivariate probability density function of the returns of each sector and thus get a more accurate for the first and second moments of the distribution. Ie we have that the probability density function that the return for each sector $r_1, r_2, \ldots, r_n$ is given by

$$f(r_1, r_2, \ldots, r_n) = \frac{1}{m} \sum_{i=1}^{m} k(r_i')$$

where k is the kernel function and r_i' is the vector representing the return of the n sectors (so a vector of size n) for the ith observation in our trainset of m observations.

We use Kernel Density Estimation to estimate the probability density function of the returns of each sector because they will likely not be normally distributed as Markowitz's Mean-Variance Portfolio Optimization assumes. Specifically we will investigate using two kernels, a Gaussian Kernel and a Multivariate T Kernel, to estimate the probability density function of the returns of each sector. To optimize the parameters of the kernels we will use cross validation and gradient descent, for paremeters that are a matrices such as the Σ for a Gaussian Kerenel we will first decompose it with Cholesky Decomposition and then optimize the parameters of the decomposed matrix.