David Fan

Math 420 Project 2 Report

Task 1:

In general, values for my w^{mu} metrics are much larger than values for my w^{xi} metrics. This is always true for my nine assets, however, for my tangent portfolios occasionally w^{xi} will spike above w^{mu}. In general, my signal-to-noise metrics for tangent portfolios are a lot more sporadic, dropping and spiking much more often than my assets. It also seems as if the average value for my wmu metric is lower for my portfolios, while my w^{xi} metrics are higher. We are more certain in these estimators when their metrics are smaller. Since w^{xi} is generally lowest in our assets, we are most confident in it with our original 9 assets. On the other hand, we can see the lowest values of w^{mu} in our FST and FCT allocations for group ABC. We can also see somewhat low numbers for w^{mu} in our long tangent portfolio for group ABC, but not quite as much as for FST and FCT.

Task 2:

For the most part, it seems as if our metrics are on the smaller side. This means that any graphs with values that spike uncharacteristically high could inform us of possible issues in that period. VGSLX also seems to have an extremely high w^{m}, however it is also extremely consistently high, which could indicate that this is tied to some attribute of the stock, rather than market movements. The place that has the most spikes is in the FST and FCT graphs, for these allocations, w^{m} and w^{v} will spike extremely high even when compared to VGSLX. Upon closer inspection, spikes in FST and FCT seem to happen during times of recession, more specifically, they seem to line up with the housing crisis, the EU debt crisis, and the US, China trade war. This makes sense, as during these times the government is often actively influencing the market,

which could lead to large changes in variance and mean. The only metric I have yet to talk about, w^{KS}, is fairly consistent throughout all of the portfolios. It is also more representative of the asset/allocation as a whole when compared to w^m and w^v, so we should likely consider it when determining which asset/portfolio we are most certain of identical distribution. The three assets/portfolios that have the lowest value of w^{KS} are: VGSLX, FST group A, and FTL group A, therefore these are the portfolios we are most certain of the assumption of identical distribution.

Task 3:

W^{ar} and w^{ac} are fairly similar metrics, however, it seems as if w^{ac} is usually more informative. This is due to the fact that it can inform us on how well an IID model mimics data, as well as how close v00 and v11 are, and whether or not $(1 - \bar{w}, \bar{w}1)$ and (2v10, v00 + v11) are orthogonal.

For nearly every asset, our w^{ac} and W^{ar} are extremely close together. This is much less true for our portfolios, they begin to separate more, but still tend to spike and fall at around the same time. Our metrics are also much more volatile in the portfolios, with much higher spikes compared to the assets.

While w^{ac} seems to be more generally informative, the extra information might muddle the original intention to model which assets we are more certain of the assumption of independence for. Therefore, we should find the assets/portfolios that have the lowest W^{ar} values. These should be the assets/portfolios we are most certain about the assumption of independence. For us, these are the assets VGSTX, and GS.

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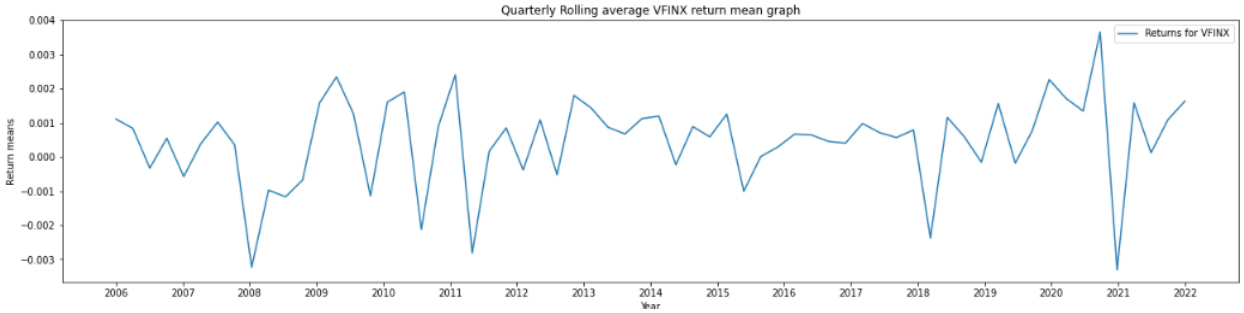
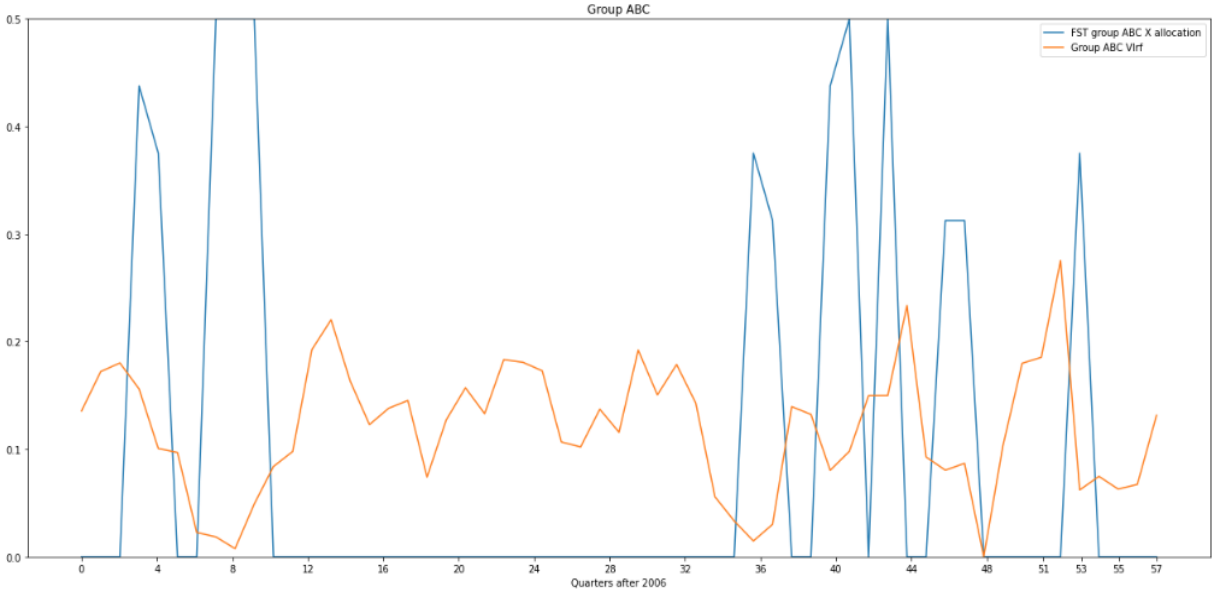
Task 5:

The four metrics I chose are:

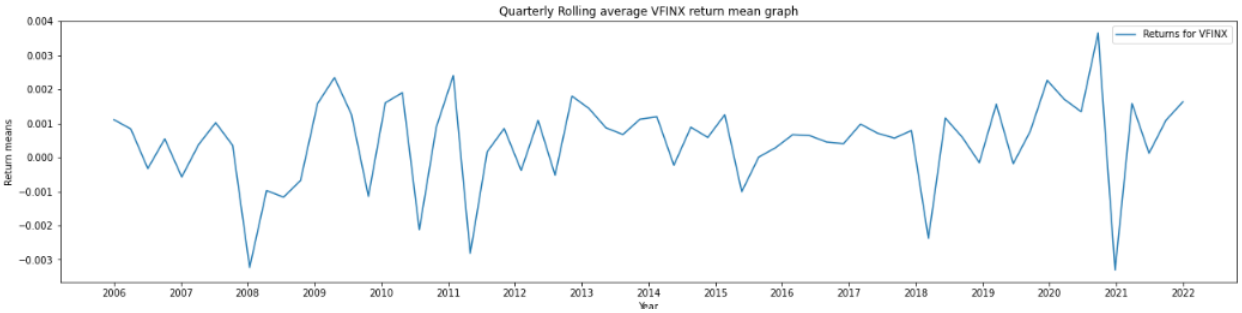
- Liquidity for the long tangent portfolio
- Efficiency for the equity index fund
- Proximity for the total bond index fund
- Stability for the tangency point metric

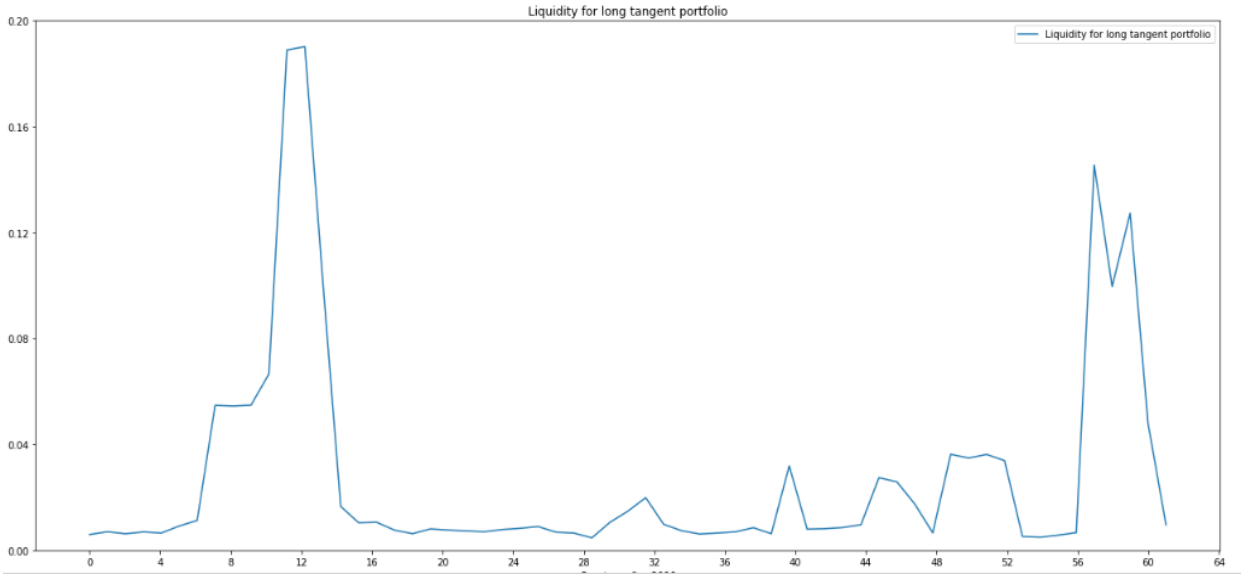
I chose most of these metrics primarily based on my project one results, as well as the general opinions of the rest of the class. The one metric included here that most groups found to be a poor indicator of economic downturn is Liquidity, whose inclusion in here I will explain later. First we should take a look at our χ plot relative to our returns.





As we can see here, χ spikes during times of economic downturns. For most of the past 16 years, χ has been at zero. This makes sense, as it is generally extremely dangerous to invest during downturns. With this in mind, our metrics from the first project where we attempted to find indicators for economic downturn will likely work well as factors for our caution coefficients. Three of these metrics that I have chosen, stability, proximity, and efficiency, are due to positive results from the first project. The last metric I have chosen is liquidity, which most of the class (myself included) agreed to be a bad indicator of economic downturn. To some extent, I still believe this to be true, however, when considering certain downturns, specifically the housing crisis, I believe liquidity is actually an extremely good indicator. The reason for this is because liquidity was actively involved in the 2008 downturn. Many companies that were giving out premium loans did not have enough liquidity to cover their short term losses, which caused them to go under. This is reflected within our graphs.





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In 2005 and 2006, the years leading up to the crisis, we can see that liquidity is extremely low. We then see it start to rise, which is likely due to companies realizing what was happening, and scrambling to liquidate assets, as well as the government beginning to take steps to prevent the crisis. Lastly, you can see that when the crash happens, liquidity spikes as the government attempts to stabilize the economy. Obviously, this relation does not always exist. In the other downturns that are less influenced by liquidity, we can't really see much of an indication, however, in situations where liquidity is involved, I believe it is the best indicator out of all of the metrics.

Out of the new metrics, W^{mu} for FLT, FST, and FCT seem to have a positive correlation.with χ, likely due to how common large market movements are during downturn, both before, and after. While both of these are certainly correlated, it's hard to call them great indicators. While they do show indication of the downturn while it is happening, there is not enough movement before the downturn occurs to efficiently inform our caution coefficient.

W^{m}, w^{v}, and w^{ks} metrics for FLT group ABC seems to be a very good leading indicator. We can see that it spikes a few quarters before several of the downturns, most notably, the housing crisis and the EU debt crisis. W^{ac} for the safe tangent group A seems to do the opposite, dropping extremely low before downturns. W^{ac} also moves similarly, however its movements are generally not large enough to gain any meaningful insight. Lastly, the sharpe ratio of the efficient long tangent portfolio has a negative correlation with χ. This makes sense, as volatile markets in a downturn tend to have higher risk for lower returns. While all of these metrics do a good job of indicating downturns, out of the five, I believe it would be best to just use w^{ks}, v_{lrf}, and w^{ac} to

inform our choice for caution coefficient, since w^m, w^v, and w^{ks} are very similar, using multiple of them might skew our coefficient.

In conclusion, I believe that efficiency for the equity index fund, proximity for the total bond index fund, stability for the tangency point metric, sharpe ratio of the efficient long tangent portfolio, the two distributions assessment for FLT group ABC, and the independence estimator w^{ac} for FST group A. If, when taking in the context of the situation, we find that liquidity could be a driving factor behind a theorized upcoming secession, we can also include liquidity for the efficient long tangent portfolio.

Task 1 graphs: