Submission Number: Group Work Project 3

Group Number: 06

Group Members:

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Statement of integrity: By typing the names of all group members in the text box below, you confirm that the assignment submitted is original work produced by the group (*excluding any non-contributing members identified with an "X" above*).

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Use the box below to explain any attempts to reach out to a non-contributing member. Type (N/A) if all members contributed.

N/A

** Note, you may be required to provide proof of your outreach to non-contributing members upon request.*

8.1 Trading Manager's Perspective:

The entities in question are Gold, Equity, and Bitcoin. We characterize each vertical by considering GLD, SPEU, and BTC-USD adjusted close prices. We first characterize the behavior essentially using the statistics shown by their time series. The adjusted close prices already take into account any splits or changes in the composition.

We firstly see that none of the series are mean reverting and follow an overall bullish trendline. This means that on average, the value of each series will keep increasing over time. However, we also see that the kurtosis for Gold (-0.90) and Equity (-0.46) are negative and small in magnitude, while that of Bitcoin (2.24) is much higher. Further, Bitcoin shows much higher volatility and a daily change than the other two. This can actually be worked to our advantage too!

If we were to trade only one entity among the three with a simple model, we would use Bitcoin for this reason. For a simple ARMA-based model (ARIMA), Bitcoin can vaguely estimate the trendline (moving averages) quite accurately if not the actual rise and fall. If we have a value better than the model's value, we can sell; if not we will short. We can only do this under the assumption that the overall trendline of the mean is increasing in nature. Variance-based methods will not suit such a trading pattern since they rely on making many, but small profits based on each conditional variance and hence we will choose ARIMA. Calculations from the quant team expect 132.55% on such a trade strategy!

Next, to understand the data from just the pure variations, we can plot the adjusted closing data for all three. If the time series shows bounded variability, then we can understand that this is an ARCH/GARCH driven process. In our time of consideration, we find that GLD and BTC are suitable for such a strategy. Thus if we were to trade in two, we would most likely choose the two. A suitable strategy will be to use Gold and Bitcoin such that moving averages are accounted and the variance is also considered. VARMA fits this better. Since we do not observe the rises and falls in the two at similar periods, we can infer lesser or correlation and hence choose to optimize weights with a variance model.

If we want to trade in three classes, we will want to know if they are collectively forming a set of weights that can give the highest values. Plotting them together does not give clear indications of such a possibility. We choose to go for a VARMA model.

This will be collectively the best strategy to diversify all assets and balance their weights to gain maximum profit and use the volatility as well as the moving average in an optimal way.

8.2 Quant Team Manager's Perspective:

The data for the given time period is highly volatile. If we can model the volatility well, we can get high returns from the market. That is exactly the goal to understand the quantitative data and make strategies. We start with the assumption that we have only knowledge from the beginning of Q2 2020. Then we formulate a plan to maximize return % over quarters Q3 and Q4 combined. We ideally want to keep the models as simple as possible, yet we expect to get the best model prediction. The adjusted closing prices will give us adjusted data in hand, and we need not worry about any action within the entity but only the value of the time-series.

An ARIMA focuses on the moving average while the GARCH models the volatility. If we are only focused on trading one asset class, then we can make a randomized walk, such that the value predicted is the mean MA, and we sell if it's high and short if low. This will be a very effective strategy since the margins are as high as the volatility in the series. In fact, a series with a high number of outliers in copulas works better in such an approach. Hence, we take Bitcoin that gives us an overall 132.55% return.

Should we aim to trade in two classes, we want the model to supplement one primary entity and collectively create a strategy. With the VARMA model, we use the Gold returns to enhance the prediction for the bitcoin returns. for Q3, the return is 42.5%, while for Q4, it's 40.8%. Return for the 2 quarters is 100.7%. Due to such a high return, we choose VARMA. The cointegration in this situation does not work well since the $p>0.01$ in these combinations, and hence we choose VARMA.

If we want to get the best returns, we need to understand the cointegration between the series to formulate the correct strategies. We get the correlation for each signal with the others. In the trials, we find out that the $p<0.01$ in all three cases. This means that they are all cointegrated! Hence we can formulate a strong strategy with the help of the correlation between the three. In such a case, a VECM model can give us optimized coefficients for trading all three. We allocate our capital to 3 assets based on the predicted return; with a negative return means that we'll short the asset, and the sum of the 3 assets is always 1. Q3's return is 7%, Q4's return is 46.3%, total return is 56.5% If the values in the model are negative, it means that we short it, if not we sell it. However, with the VARMA model, we use both the equity and gold returns as to enhance the prediction for the bitcoin returns. For Q3, the return is 56.6% while for Q4, it's 61.59%. Return for 2 quarters is 153% combined.

Since this has the highest return percentage, as an overall strategy for all three, the VARMA is preferred across all three classes as best strategy.

8.3 Distribution:

The work was organized in the following structure:

1. Code part
    a. Saverio did the code from 0 to 5
    b. Harshil did the main version of the code from 0 to 7
    c. Comments were written after discussion in wqu forum and zoom call
2. Writing reports part was made
    a. Manas wrote the reports
    b. Saverio did a revision of the reports
    c. Harshil did a second revision of the reports
3. Distribution of the workload part
    a. Manas wrote this section about distribution
    b. Harshil and Saverio were in verification
4. Folder for submission preparation and submission
    a. Saverio prepared the submission
    b. Harshil and Manas were in verification after parts were written