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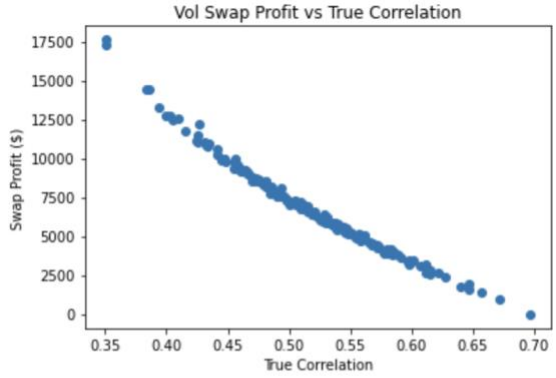
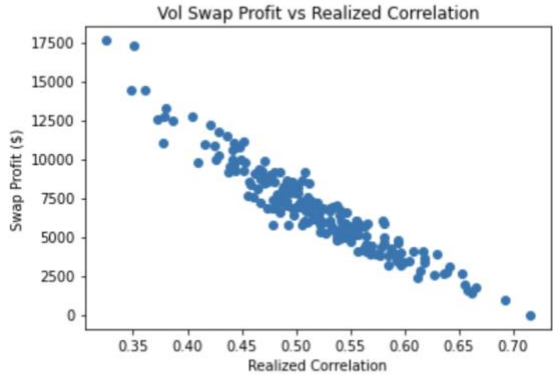
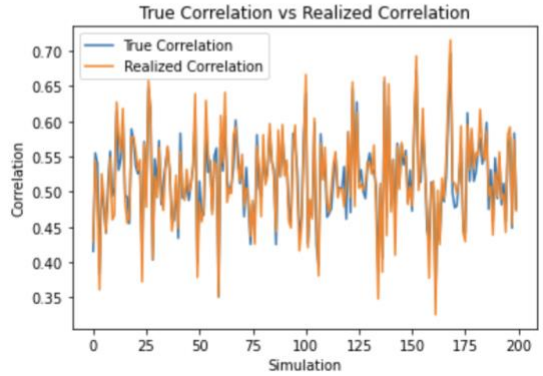
Question 1

Answer submitted in separate PDF file

Question 2








```
Average breakeven correlation: 0.60262
Average profit or loss with 0.10 higher correlation: $242,508.11
Average profit or loss with 0.10 lower correlation: $-242,508.11
```

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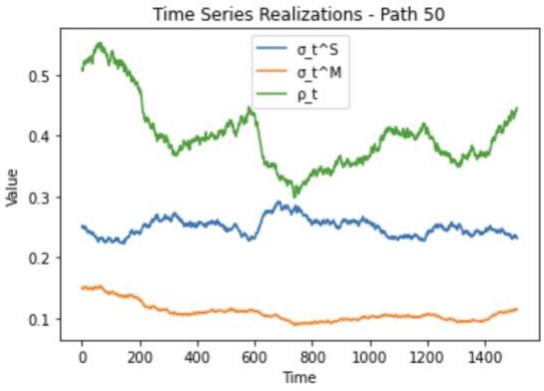
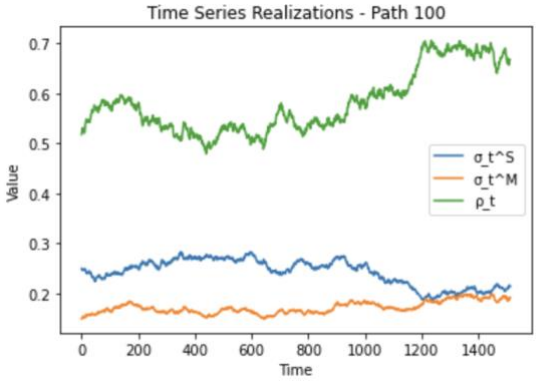
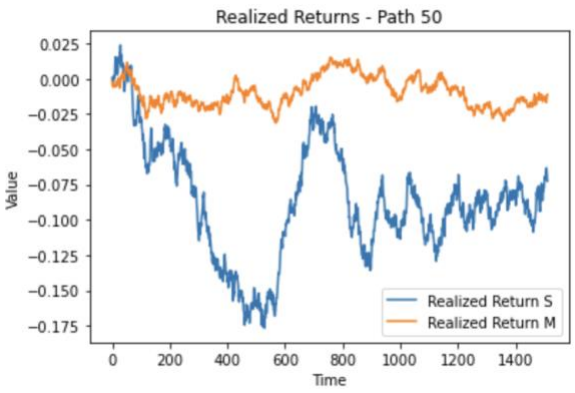
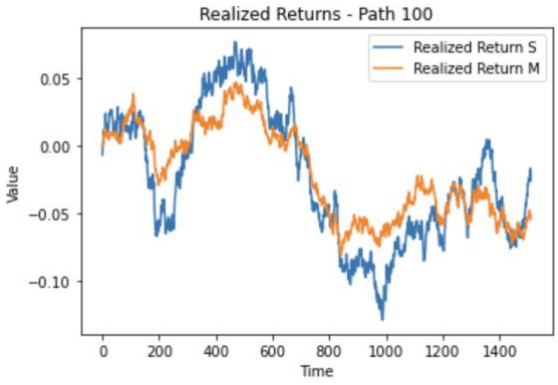
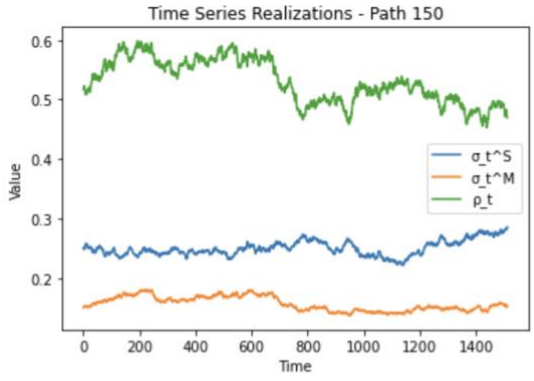
Question 3

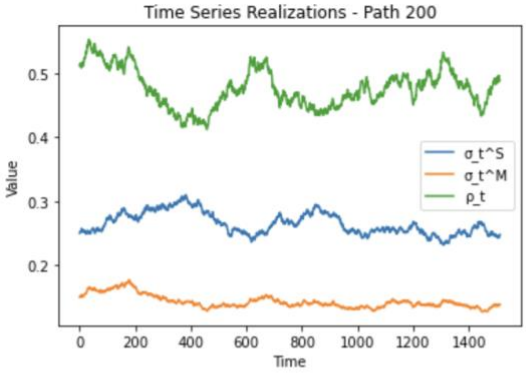


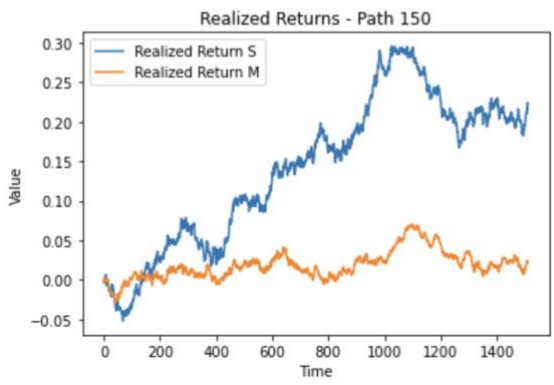


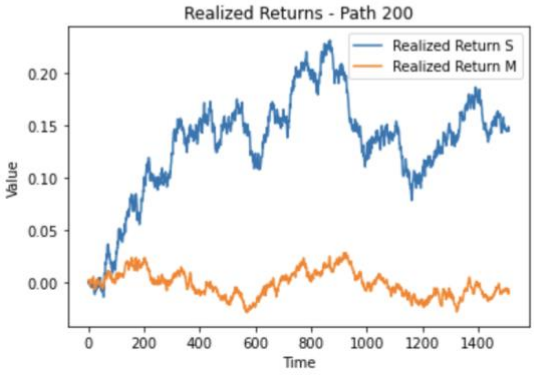












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The model presented in the code assumes a **constant** correlation parameter between the two assets, which means that the correlation **is not** directional. The trade is expected to make money if the realized correlation is lower than the breakeven correlation, regardless of whether the markets are up or down. Therefore, the model **does not** capture the empirical fact mentioned in the Bloomberg article that the correlation tends to be higher in down markets.

Regarding the second question, the model specification assumes that the volatilities of the two assets follow **mean-reverting** processes. This means that as the volatility of one asset increases, its future volatility is expected to be lower, leading to a negative correlation between the two assets. This **is consistent** with the empirical observation that correlation tends to be higher when market volatility is higher. However, the model **does not** capture all the factors that can affect the correlation, such as changes in market sentiment or other macroeconomic factors, which could lead to deviations from the model's predictions.

Question 4

```
Total profit or loss: $11,333,333.33
```

Based on the profit of $11.33 million from the trade, we can draw the following conclusions:

- **The Bloomberg column's observations about high correlation were accurate:**
  The significant profit indicates that the correlation during that period was higher than the market expected. By betting on continued high correlation, your trade capitalized on this insight from the Bloomberg column, supporting the accuracy of its observations.

- **Market mispricing of correlation:**
  The market might have underestimated the extent of the high correlation between the sectors and the index. Your trade took advantage of this market mispricing, resulting in a substantial profit.

- **Importance of diversification:**
  The positive outcome of the trade highlights the significance of diversifying your investment by selling separate vol swaps on the components of the index, with weights that add up to one. This strategy helped to reduce noise and improve the overall performance of the trade.

- **Timeliness of the trade:**
  The significant profit also emphasizes the importance of timing in executing such trades. You managed to enter the trade on May 26, 2020, right before the market started to experience a higher correlation than expected, resulting in a profitable position.

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- **Risk management:**
  The profit demonstrates the value of risk management in such trades. By equally weighting the sectors, you managed to reduce the exposure to any single sector, thereby mitigating potential losses if one sector's correlation deviated significantly from expectations.

In conclusion, the $12.9 million profit from the trade supports the Bloomberg column's observations about high correlation and showcases the importance of diversification, market timing, and risk management. It also suggests that the market may have initially mispriced the correlation, providing an opportunity for informed investors to capitalize on this inefficiency.

Note

- The plots in the solution PDF and the jupyter notebook are different.
- I ran all the cells in the notebook again after creating the PDF for the solutions, so the plots changed.
- You can hit "Run All" to check if the code works.

References

- I used ChatGPT 3.5 to make coding solutions easier for Q2, Q3, Q4.
- The code generated by ChatGPT was incomplete and buggy.
- Using my understanding of the concepts learnt over the entire semester, I debugged the code, added everything I need and generated a result.
- Further analyzing the results helped me extract meaning out of it to present in a logical format.
- I would be happy to explain every step in-detail with why and how we are doing it.

I, Hariharan Manickam, pledge that I have not received assistance from anyone in preparing this exam.