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Math 400 - Numerical Analysis
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MATH 400 - Forecasting ETH-USD Value Relations

Application Background

As the booming age of cryptocurrencies is on the rise, it's important for all investors (both active and prospective) to keep in mind any possible factors that would impact their assets and their values. However, because most people don't have the time to calculate such things, we can utilize Monte Carlo Simulation in order to calculate the potential future values. In this program, I did some research on how to utilize Monte Carlo Simulation to calculate projective values for several types of entities, including stocks, sales projections, and especially cryptocurrencies. As somebody who has a great interest and investments in crypto, I decided to conduct this research in hopes of being able to plan out the best possible time to sell or buy more. The results of this application, I hope, will project potential closing values for the cryptocurrency, Etherium, for the next 365-day period.

Numerical Analysis and Programming Explanation

Monte Carlo Simulation is incredibly useful when it comes to calculations based on previous data regressions. Understanding that I would have to translate this principle into Python, I decided to utilize specific libraries such as numpy, pandas, matplotlib, seaborn, and datetime in order to provide presentable calculations.

After importing the CSV file (which I obtained from Yahoo Finance's website), I then decided to begin my program by demonstrating the current historical closing prices of ETH throughout the last year or so. This allowed me the data I needed in order to begin the process of the Monte Carlo Simulation.

The next logical step was to calculate the percentage return value and apply a logarithm, which was evaluated as:

$$\text{Log Returns} = 1 + \log(\text{closingValue}(\%))$$

This code can be observed on line 23 of my program:

```
logReturns = np.log(1 + closingValue.pct_change()) #Percentage Return Value
```

After this, I needed to compute the drift, which would help the program to understand the previous returns that ETH brought on closing prices. Thus, I had to utilize both the mean and the variance in order to calculate drift. I was able to utilize a lot of prepared methods thanks to the numpy and pandas library, however, I had to calculate the drift by using the following formula:

$$\text{Drift} = \text{mean} - 1/2(\text{deviation})^2$$

This code can be observed on line 27 of my program:

```
D = u - (0.5*var) #Drift = mean - 1/2(deviation^2)
```

After this came calculating volatility, which came as the following formula:

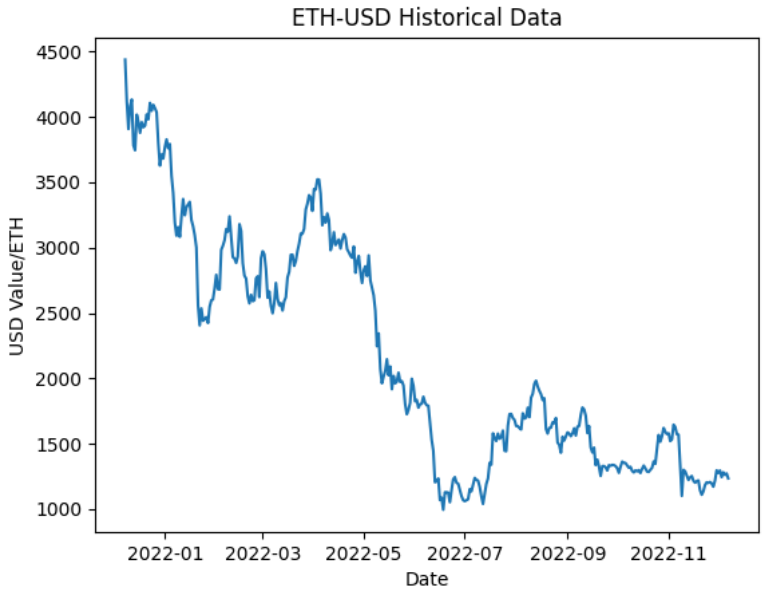
$$\text{Volatility} = \text{deviation} * Z$$

In this case, Z is a random variable, and this volatility is calculated assuming that this is done via standardized distribution. This can be seen on line 32:

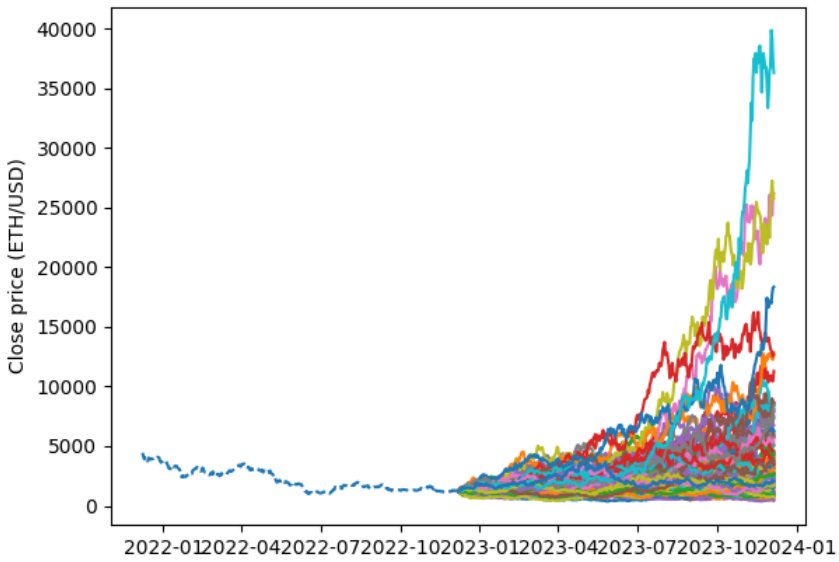
```
Z = norm.ppf(np.random.rand(days, iterations)) #Z is a randomized variable used
                                to help calculate volatility
```

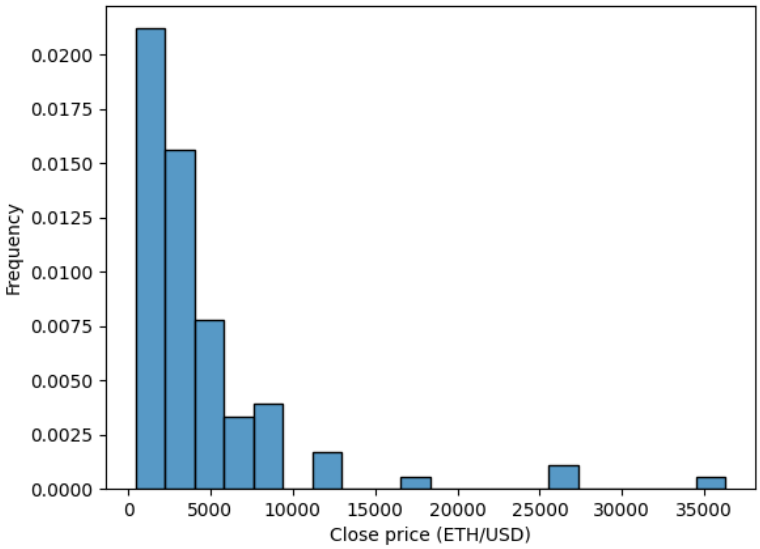
With all of this information, the program is able to compute the probabilities of the projected values of ETH.

Results



The graph above is simply the historical ETH-USD value based on the CSV file that I retrieved.





According to the two charts that my program produced, it seems the estimated value of ETH in the next year should range realistically to be about $3,500 per coin. Considering the variance frequency in the second chart, there seems to be a strong estimation that the value of each coin will rise by over 283.6%.

There are some outliers as well, saying that the value of each coin could rise so far as $25,000, or even so far as $38,500. While that would be incredibly ideal for anyone invested in this coin, it would be a fairly unlikely scenario.

In my calculations, the value of the drift came out to be about 0.00245%. This demonstrates that, while there certainly is still room for market volatility, the overall price of the coin will remain fairly steady, which shows the likelihood of it making a major financial jump in the next year is fairly low.

Conclusion

The results of this research and program demonstrate a few key notes:

1) If you want to invest in ETH, this is a good time to do so, as the market value is low and it's likely to go up
2) If you are currently invested in ETH, hold onto your coins, the value is likely to increase

While the overall volatility of ETH is fairly low, there is a high likelihood that uncalculable events that cannot be programmed into the simulation will impact the value of cryptocurrency values as a whole. This program also does not account for inflation rates in the value of the US Dollar, as that would require a lot more translation for reading the graphs and, frankly, isn't really worth doing when simply writing out a program to test out Monte Carlo simulations. Overall, this program is helpful, as it provides us with a potential year's worth of projections on the value of ETH. One way I would aim to improve this program in the future is to provide a CSV file with more history of the values of ETH, so that the program can provide more accurate results.

References

For full disclosure, I referenced an article called: "Bitcoin price forecasting with Monte Carlo simulations" by Leonardo Araujo quite a bit. When doing my research, I came across this article that seemed to be almost exactly what I was looking to do, just with a different cryptocurrency. Because I didn't want to directly copy the program, I decided to examine his approach both in mathematical terms and programming terms.

Full List of Referenced Articles:

- "Bitcoin price forecasting with Monte Carlo simulations" by Leonardo Araujo
- "Monte Carlo Simulations for Stock Price Predictions" by Elias Melul
- "Simulating future stock prices using Monte Carlo methods in Python"