

# **Simulation of Net Profits Using Bitcoin Miners**

## **Contents**

- 1 Introduction**
- 2 Methodology**
  - 2.1 Problem Definition**
  - 2.2 Simulations**
- 3 Findings**
- 4 Applications of Findings and Sensitivity Analysis**
- 5 Limitations**
- 6 Conclusion**

## **1 Introduction**

Bitcoin was the first cryptocurrency ever created by the anonymous Satoshi Nakamoto. Although the normal online ecommerce system relies on financial institutions as trusted third parties for payments, it suffers from the weaknesses of the trust based model, such as transactional irreversibility as financial institutions cannot resolve disputes [1]. Thus, the concept of cryptocurrency was created to allow electronic payments to be made securely and directly without the need of a third party by the utilisation of blockchain technology. As one of the earliest forms of cryptocurrency, Bitcoin relies on the older Proof-of-Work model to verify the validity of all of its transactions and newly mined tokens. The Proof-of-Work model is a decentralized consensus mechanism that requires all members of the blockchain to solve massive and complex mathematical problems. By successfully solving these problems, miners are rewarded with blocks which are also small amounts of Bitcoin. In the current year, the difficulty of mining Bitcoin has increased to the point where a large number of advanced mining equipment is needed [2]. However, these mining machines require a huge amount of energy to operate and incur huge electricity costs that can incur profit losses Bitcoin miners. Thus, in this report, by simulating with the use of a Monte-Carlo simulation, we will explain the usefulness of our model in aiding the decision making process of using the best Bitcoin mining machine to generate the most profit from mining.

## **2 Methodology**

In this report we will use Monte-Carlo simulation to simulate the average profit of each of the nine different Bitcoin miners.

### **2.1 Problem Definition**

Bitcoin mining is a resource intensive process that requires a lot of electricity to operate. This is because the mining machine has to solve complex mathematical problems quickly in order to earn Bitcoin. The difficulty of mining Bitcoin has exponentially worsened these years due to the increasing number of miners and decreasing Bitcoin halving rate. To successfully mine a chunk of Bitcoin in 2021, hundreds of mining machines are required as the rewards get more scarce. Different mining machines will be more profitable in different regions due to differing electricity costs. For simplicity, we assume that the rate of Bitcoin mined for each machine is uniformly distributed and there are no faulty machines.

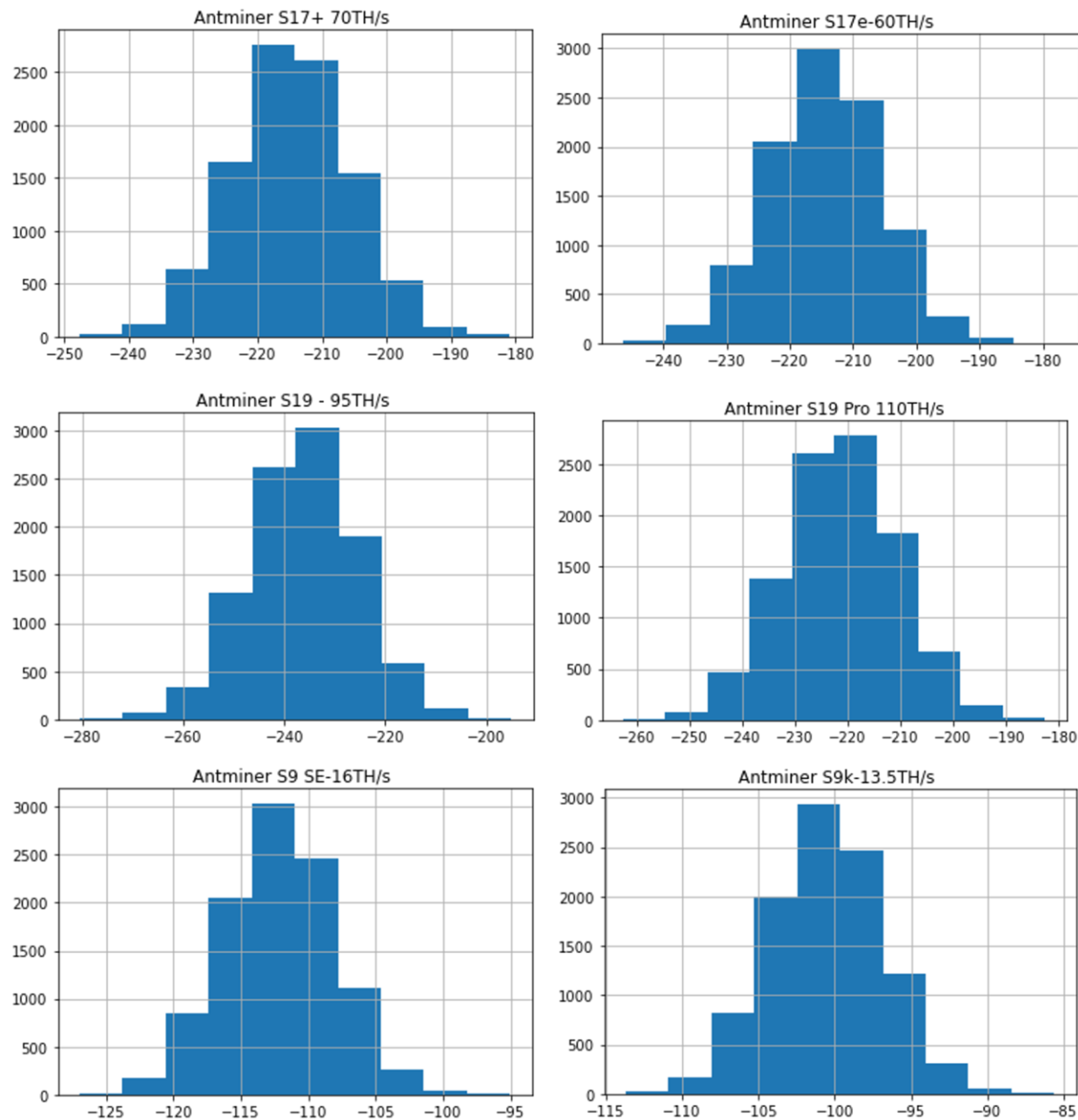
### **2.2 Simulations**

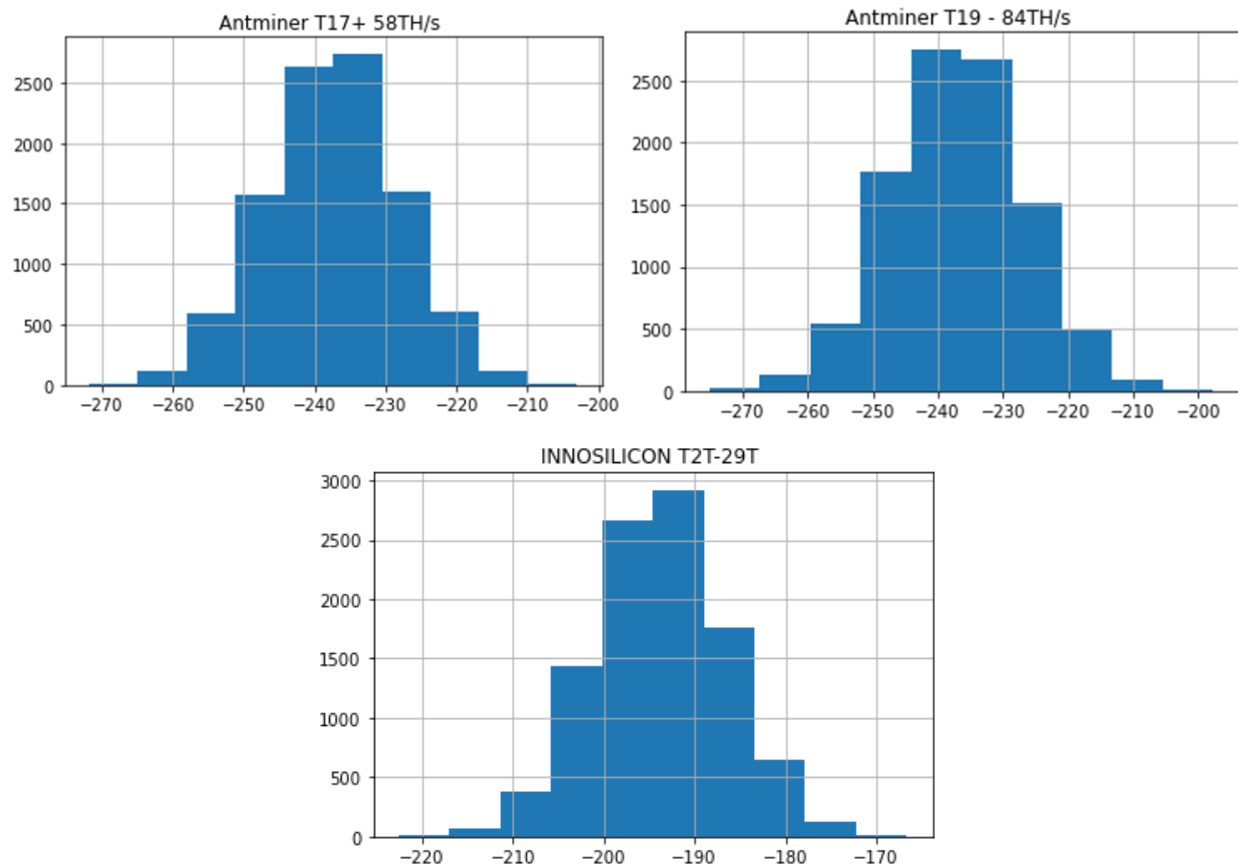
As mentioned earlier, we used the Monte Carlo method to conduct the simulations of net profit. The simulation model comprises two independent variables, namely “USD Profit” and “M.B.C Cost” (energy cost in USD), with the objective of estimating the “Net Profit” of each Bitcoin miner. After examining the data, “BTC Profit”, and hence the derived quantity “USD Profit”, is assumed to follow a uniform distribution, while “M.B.C. Cost” is modelled as a normal distribution. The specifications for our simulation include 10,000 simulations with a representative sample size of

500 for each of our model simulations, and after which iterating through the nine different Bitcoin miners.

### 3 Findings

In this section, we will present our findings from the simulation, using historical Bitcoin mining data from the excel file “country\_model\_dataset”. For contextual purposes, we fix a mean exchange rate of 1 Bitcoin = 9,171.35 USD, based on that of the existing dataset. Figure 1 below presents the frequency distribution of net profit in USD across the nine different Bitcoin miners, as obtained from the 10,000 iterations of Monte Carlo sampling.





**Figure 1 : Histograms of Net Profit Across Different Bitcoin Miners**

The following table summarises certain key statistics from the above data to allow for a clearer comparison, and all net profit figures are stated in USD.

Bitcoin Miner	Mean Net Profit	SD of Net Profit	Min. Net Profit	Max. Net Profit
Antminer S17+ 70TH/s	-214.80	10.06	-254.41	-178.42
Antminer S17e-60TH/s	-214.60	9.58	-252.50	-179.96
Antminer S19 - 95TH/s	-236.27	11.89	-282.78	-193.24
Antminer S19 Pro 110TH/s	-221.56	12.13	-269.21	-177.64
Antminer S9 SE-16TH/s	-112.20	4.37	-129.70	-96.40
Antminer S9k-13.5TH/s	-100.49	3.92	-116.18	-86.33
Antminer T17+ 58TH/s	-237.37	10.19	-277.83	-200.56
Antminer T19 - 84TH/s	-237.27	11.39	-282.02	-196.05
INNOSILICON T2T-29T	-193.92	7.52	-224.03	-166.75

**Table 1 : Summary Statistics of Net Profit Across Different Bitcoin Miners**

From Table 1, we can observe that all nine Bitcoin miners produce negative net profits on average, with the Bitcoin miner Antminer S9k-13.5TH/s obtaining the smallest loss of -86.33 USD. On the other hand, the miner Antminer T19 - 84TH/s obtains the greatest mean loss in profits of -196.05 USD.

#### **4 Applications of Findings and Sensitivity Analysis**

From the simulations, at the aforementioned exchange rate of 1 Bitcoin = 9,171.35 USD, the best miner for maximising profits, or minimising loss in this context, would be the Antminer S9k-13.5TH/s.

To perform sensitivity analysis, we first investigate the effect of changing the monthly electricity bill on the mean profitability of Bitcoin mining. With this in mind, we vary the monthly electricity bill by +1% and -1% to obtain their respective effects on net profits in USD, then compare the average percentage change in net profits in USD across all nine Bitcoin miners. Based on the simulations, we can conclude that the INNOSILICON T2T-29T produces the greatest increase of  $7.22 \times 10^{-15}$  % in net profits per percentage change in the monthly electricity bill. However, since the order of magnitude of change in net profits is very small, it can be said that the monthly electricity bill has a rather negligible effect on net profits.

In addition, we study the effect of changing the profits in USD on the mean profitability of Bitcoin mining. Similarly, we vary the profits by +1% and -1% to obtain their respective effects on net profits in USD, then compare the average percentage change in net profits in USD across all nine

Bitcoin miners. From this, we found Antminer S19 - 95TH/s to be the miner that produces the greatest increase of 0.00211% (3 s.f.) in net profits per percentage change in profits in USD. In general, it can be observed that varying the profits in USD has a more significant impact on the profitability of Bitcoin mining than varying the monthly electricity bill.

Furthermore, we can also determine the effect of the Bitcoin exchange rate on the mean profitability of Bitcoin mining. The exchange rate of Bitcoin is highly-volatile, and thus any changes would have a significant impact on the USD profit per mining attempt. For example, by using the current Bitcoin price of 60,833.36 USD, the closing price on 6th Nov 2021, the profitability of mining Bitcoin would be extremely profitable at present across all the different miners, regardless of their individual performances [4].

## **5 Limitations**

The profitability of Bitcoin mining in the long run is also affected by the volatility of Bitcoin itself. Given the fluctuating exchange rate of Bitcoin in USD, mining may be extremely profitable in certain periods of time. In the long run, it may be better for miners to hold onto mined Bitcoin as its price grows. To prevent losses from Bitcoin price correction in other time periods, advanced technical analysis can also be used to judge the timing of when to sell mined Bitcoin.

Moreover, the Bitcoin profit rate of each machine does not take account of the hash rate failure. Hence, the actual realised profit might be lower. Other factors such as land rental, machine cost and the fluctuation of the difficulty of mining a block are also not reflected in the data but may affect the decision of the best mining machine if included. Also, due to the recent rapid advancements in the blockchain space, there are newer methods to earn cryptocurrency such as the use of staking and lending in centralised exchanges such as Binance and decentralised platforms such as Aave [3]. These newer methods do not incur huge electricity costs on the user and may be a better alternative to Bitcoin mining if large initial amounts of Bitcoin are staked or lent. In addition, there are many new cryptocurrencies that are cheaper to mine such as Ethereum and Polkadot that may be more profitable.

## **6 Conclusion**

In summary, we have looked into simulating the net profitability of mining Bitcoins using the Monte-Carlo approach, based on several criteria, including the value of Bitcoins mined and the amount of electricity consumption. We have also explained how the information can be used to determine the best Bitcoin miner in order to maximise net profit. The simulation models we have discussed here can also be applied to other altcoins such as Etheruem and Polkadot, taking into account different equipment used for mining and different blockchain designs. As the report is based on data from May 2020, it is important to note that the net profitability of Bitcoin mining would be vastly different in today's context. Nonetheless, we also acknowledge that the discussions in this report are still quite rudimentary, and that the calculation of Bitcoin mining profits in real-world market scenarios is much more complex, requiring further research.

## **References**

- [1] Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Decentralized Business Review*, 21260.
- [2] Konoth, R. K., van Wegberg, R., Moonsamy, V., & Bos, H. (2019). Malicious cryptocurrency miners: Status and Outlook. *arXiv preprint arXiv:1901.10794*.
- [3] Bitcoin USD (BTC-USD). (2021). Yahoo! Finance. Retrieved November 6, 2021, from <https://finance.yahoo.com/quote/BTC-USD/history?p=BTC-USD>.
- [4] Saengchote, K. (2021). Where do DeFi stablecoins go? A closer look at what DeFi composability really means. A closer look at what DeFi composability really means.(July 26, 2021).