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# Optimizing Cryptocurrency Investment Decisions Using Plithogenic Hypersoft Sets in MCDM

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## Abstract

This study explores the integration of Plithogenic Hypersoft Sets (PHSS) in Multi-Criteria Decision Making (MCDM) for cryptocurrency investment analysis. Given the volatile and unpredictable nature of the cryptocurrency market, traditional decision-making models often fail to capture the complexities and uncertainties present. By incorporating the advanced concept of PHSS, which accommodates multiple membership degrees (fuzzy, intuitionistic fuzzy, neutrosophic), we propose a more robust framework for investment decision-making. The study normalizes cryptocurrency data and applies PHSS to a set of cryptocurrencies (e.g., BTC, ETH, BNB, SOL, and XRP), analyzing key attributes such as price changes, market cap, volume, and circulating supply. Our results demonstrate that PHSS can enhance the accuracy and reliability of financial decision-making, providing valuable insights for investors.

**Keywords:** Plithogenic Hypersoft Sets; Cryptocurrency Investment; Multi-Criteria Decision Making; Neutrosophic Sets; Fuzzy Logic; Financial Decision-Making.

## 1 | Introduction

Cryptocurrency investments are fraught with challenges due to their inherent volatility, complexity, and unpredictability. Traditional investment models, which often rely on static or binary decision-making frameworks, are ill-equipped to handle the uncertain nature of these digital assets. This paper introduces Plithogenic Hypersoft Sets (PHSS) as a sophisticated extension of traditional set theories (such as Fuzzy, Intuitionistic Fuzzy, and Neutrosophic sets), to improve the decision-making process in cryptocurrency markets.

The goal of this research is to demonstrate how PHSS can be applied to Multi-Criteria Decision Making (MCDM) for cryptocurrency investments, allowing investors to make more reliable and accurate decisions. By considering multiple criteria such as price, market cap, volume, and circulating supply, PHSS offers a nuanced approach to handling market uncertainties. We apply PHSS to a dataset of major cryptocurrencies and evaluate its effectiveness in guiding investment decisions. This paper introduces Plithogenic Hypersoft Sets (PHSS), a significant advancement in set theory, to tackle these challenges. PHSS is a generalization of various soft computing methods (fuzzy, intuitionistic fuzzy, neutrosophic sets) and incorporates the concepts of contradiction and multidimensionality in decision-making. By integrating PHSS with Multi-Criteria Decision Making (MCDM), this research aims to provide a more robust framework for analyzing cryptocurrency investment options.

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The objective is twofold:

- To demonstrate how PHSS can model the complexity of cryptocurrency markets better than traditional MCDM methods.
- To evaluate the performance of PHSS in guiding investment decisions across multiple criteria, such as price, market cap, and liquidity.

# 2 |Materials and Methods

## 2.1 |Plithogenic Hypersoft Sets

PHSS is an advanced concept in set theory designed to represent complex, multidimensional decision-making scenarios where uncertainty and ambiguity are prevalent. It extends traditional set theories (crisp, fuzzy, intuitionistic fuzzy, and neutrosophic sets) by introducing degrees of appurtenance, indeterminacy, and contradiction. For this study, each cryptocurrency is evaluated based on attributes such as price changes (1h, 24h, 7d), market cap, volume (24h), and circulating supply.

## 2.2 |Data Collection

The dataset used for this research was sourced from CoinMarketCap, including real-time data on cryptocurrencies such as Bitcoin (BTC), Ethereum (ETH), Binance Coin (BNB), Solana (SOL), and XRP. The dataset includes various attributes that influence investment decisions, such as price trends and liquidity metrics.

## 2.3 |Data Normalization

Normalization is performed using the Max-Min method to ensure comparability across different attributes. The normalized values allow for a balanced evaluation of cryptocurrencies across multiple dimensions. The formula for normalization is:

$$\text{Normalized Value} = \frac{Value - Min}{Max - Min}$$

## 2.4 |Application of PHSS in MCDM

The normalized dataset is then used to define a Plithogenic Hypersoft Set for each cryptocurrency. Each attribute is assigned a fuzzy, intuitionistic fuzzy, and neutrosophic degree based on its performance. The MCDM framework includes methods such as the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to rank the cryptocurrencies according to their investment potential.

# 3 |Results

The analysis was applied to five major cryptocurrencies: Bitcoin (BTC), Ethereum (ETH), Binance Coin (BNB), Solana (SOL), and XRP. Key findings from the PHSS evaluation are summarized below.

## 3.1 |Cryptocurrency Data Normalization

The table below presents the normalized values for the selected cryptocurrencies based on attributes such as price, market cap, and volume:

| Symbol | Price | 1h Change | 24h Change | 7d Change | Market Cap | Volume (24h) | Circulating Supply |
|---|---|---|---|---|---|---|---|
| **BTC** | 1.000 | 0.342 | 0.882 | 0.000 | 1.000 | 1.000 | 0.000 |
| **ETH** | 0.054 | 0.237 | 0.000 | 1.000 | 0.305 | 0.380 | 0.002 |
| **BNB** | 0.007 | 0.000 | 0.457 | 0.389 | 0.021 | 0.000 | 0.001 |
| **SOL** | 0.002 | 1.000 | 1.000 | 0.178 | 0.014 | 0.041 | 0.011 |
| **XRP** | 0.000 | 0.737 | 0.398 | 0.331 | 0.000 | 0.001 | 1.000 |

### 3.2 | PHSS Evaluation Results

For each cryptocurrency, the Plithogenic Hypersoft Set was calculated, resulting in truth-membership, indeterminacy-membership, and falsity-membership degrees for each attribute. The results are summarized as follows:

| Cryptocurrency | Truth-Membership | Indeterminacy-Membership | Falsity-Membership |
|---|---|---|---|
| **BTC** | 0.603 | 0.132 | 0.397 |
| **ETH** | 0.283 | 0.279 | 0.717 |
| **BNB** | 0.125 | 0.250 | 0.875 |
| **SOL** | 0.321 | 0.070 | 0.679 |
| **XRP** | 0.289 | 0.211 | 0.711 |

## 4 | Applications

The results indicate that Bitcoin (BTC) consistently outperforms other cryptocurrencies in terms of truth membership across all attributes, making it a more stable investment option. Ethereum (ETH) follows closely, though its high indeterminacy and falsity degrees reflect greater uncertainty. Binance Coin (BNB) and XRP show weaker performance, while Solana (SOL) demonstrates high short-term volatility but significant market potential.

The application of PHSS in this study highlights its effectiveness in handling the uncertainty and multidimensional aspects of cryptocurrency markets. By integrating advanced mathematical tools into MCDM frameworks, this research offers a more comprehensive approach to financial decision-making.

## 5 | Conclusions

This study demonstrates the utility of Plithogenic Hypersoft Sets in analyzing cryptocurrency investments. By addressing the complexities of cryptocurrency markets, PHSS allows investors to make more informed decisions based on multiple criteria. Future research could explore the application of PHSS to a broader range of financial assets and incorporate additional factors such as sentiment analysis and macroeconomic indicators.

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## Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

## Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

# References

[1] Haque, T. S., Chakraborty, A., Alrabaiah, H., & Alam, S. (2022). Multiattribute decision-making by logarithmic operational laws in interval neutrosophic environments. Journal of Granular Computing, 7(4), 837-860. https://doi.org/10.1007/s41066-021-00299-7.

[2] Smarandache, F. (2018). Plithogenic set: An extension of crisp, fuzzy, intuitionistic fuzzy, and neutrosophic sets revisited. Neutrosophic Sets and Systems, 21, 153-166.

[3] Smarandache, F. (2018). Extension of soft set to hypersoft set, and then to Plithogenic hy-persoft set. Neutrosophic Sets and Systems, 22, 168-170.

[4] Martin, N., & Smarandache, F. (2020). Introduction to combined plithogenic hyper-soft sets. Infinite Study.

[5] Quek, S. G., Selvachandran, G., Smarandache, F., Vimala, J., Le, S. H., Bui, Q. T., & Gerogi-annis, V. C. (2020). Entropy measures for Plithogenic sets and applications in multi-attribute decision making. Mathematics, 8(6), 965. https://doi.org/10.3390/math8060965.

[6] Alkhazaleh, S. (2020). Plithogenic soft set. Neutrosophic Sets and Systems, 33, 256-274.

[7] Singh, P. K. (2020). Plithogenic set for multi-variable data analysis. International Journal of Neutrosophic Science, 1(2), 81-89. https:/doi.org/10.5281/zenodo.3988028.

[8] Abdel-Basset, M., Mohamed, R., Smarandache, F., & Elhoseny, M. (2020). A new decision-making model based on Plithogenic set.

[9] Ahmad, M. R., Saeed, M., Afzal, U., & Yang, M. S. (2020). A novel MCDM method based on Plithogenic hypersoft sets under fuzzy.

[10] Priyadharshini, S. P., & Irudayam, F. N. (2021). A novel approach of refined plithogenic neutrosophic sets in multi-criteria decision making. Infinite Study.

[11] Abdel-Basset, M., Victor, C., & Abduallah, G. (2019). Evaluation of the green supply chain management practices: A novel neutrosophic approach. Computers in Industry, 108, 210-220.

[12] Atanassov, K. T. (1986). Intuitionistic fuzzy sets. Fuzzy Sets and Systems, 20, 87-96.

[13] Deng, Y., Chan, F. T., Wu, Y., & Wang, D. (2011). A new linguistic MCDM method based on multiple-criteria data fusion. Expert Systems with Applications, 38(6), 6985-6993.

[14] Maji, P., Biswas, R., & Roy, A. R. (2003). Soft set theory. Computers & Mathematics with Applications, 45(4), 555-562.

[15] Pei, D., & Miao, D. (2005). From soft set to information systems. Proceedings of Granular Computing IEEE, 617-621.