Original Researcher Article

A systematic Approach of Crypto-currency and its Market Innovations using Vector Auto-Regression (VAR) Model

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ABSTRACT

In this research study the researcher emphasized the fast growing trends of crypto-currency rather than trends of traditional currency across the world. The current usage of digital currency should be available at different places which are easily accessible to everyone to do transaction for their business purpose. In addition, the evolution of block-chain technology and the digital backbone on which many crypto-currencies are based has many other conventions. Implementing a secure, regulatory framework can help us solve the trust and security issues that have plagued our lives for years. The researcher is stated that the human being disrupt the economy, eliminate inefficiency and human error at the heart of the economy, business and society. This research study is based on basic features of old and new crypto-currency ranking, market value, volume and its moving average. The researcher used the exploratory analysis and Vector Auto-Regression (VAR) Model on features such as open, close, high, low, volume and market cap of the crypto currency market value using data science techniques. During the research study the research found that probability of statistics P-value for open:0.984, P-value for close: 0.987, P-value for high: 0.960, P-value for low: 0.996, P-value for volume: 0.072, P-value for market Cap: 0.986 which are greater than 0.05 significant level, so the researcher concluded that there is a no significant relation between the above features of crypto-currency in market innovations.

Keywords : crypto-currency, block-chain, market value, Vector Auto-Regression (VAR) Model.

1. INTRODUCTION:

The period from the 20th to the beginning of the 21st century was characterized by the intensive development of the global financial sector. Financial systems are actively developing, transforming and adapting to certain economic and technological requirements and creating an environment for the effective functioning of commodity-monetary and financial relations, as they are the circulatory system of world economies. The main catalysts of financial open innovation are recently actively developing processes of globalization and digitization of world economies. Under such conditions, payment systems and instruments are subject to increased regulatory requirements as risks are shared among global economies [1][2].

Digital currencies are able to advance existing payment systems and financial institutions because they represent a new understanding of the form of money and the security of transactions. For example, one of the world's financial leaders - the United States of America - has been actively researching and taking steps to introduce crypto-currencies into the internal payment system since 2019. At the end of 2019, the US Congress passed a bill for consideration called the "Crypto-currency Act of 2020". It reviewed the procedure for the recognition, licensing and registration of digital currencies as a means of payment and also created a list of government institutions responsible for the regulation and control of the new currency[3][4].

Today, it is difficult to assess and evaluate the importance of this technology and the perspective of its development. However, digital currencies can become a new generally accepted means of payment, replacing the usual fiat money. In this case, the most successful crypto-currency system owned by a particular country can gain a significant advantage in the financial "arms" race and leadership in the financial arena. This makes it difficult to analyze the development potential of crypto-currencies in Russia and other global economies at this time. In addition, the transparency of data flow in the network of crypto-currency systems can potentially solve the problems of corruption and shadow or underground sectors of the economy that exist in every state to one degree or another[5][6].

Crypto-currencies are fast becoming competitors to traditional currencies around the world. Digital currencies are available for purchase in many different places, making them accessible to everyone, and as retailers accept different crypto-currencies, this could be a sign that money as we know it is undergoing a major change. In

addition, the block chain technology on which many crypto-currencies are based has many other promising applications with its revolutionary distributed digital backbone. Implementing secure, decentralized systems can help us overcome the organizational problems of trust and security that have plagued our society for ages. In fact, we can fundamentally disrupt the industrial cores of economies, businesses and social structures, eliminating inefficiencies and human error[6].

BACKGROUND OF RESEARCH STUDY

Alexei Mikhail (2020) focused on analyzing the open crypto-currency market to predict sustainable growth in the future. The nature of "the development of crypto-currencies is leading to a rapid increase in their popularity and the expansion of trading in this new market. The high volatility of these assets encourages understanding and predicting their price in an ever-changing market environment. In recent years, the tendency of the number of financial institutions to include crypto-currencies in their portfolios has accelerated. Crypto-currencies are the first purely digital assets that asset managers are embracing. This research study provides a comprehensive overview of crypto-currency trading research by including 146 research papers on various aspects of crypto-currency trading (e.g. crypto-currency trading systems, bubbles and extremes, volatility and return prediction, portfolio construction and crypto assets, technical trading and others) (H. Zhang, T.B. Ho, M.S. Lin (2004)).

Crypto-currencies have seen widespread market acceptance and rapid development despite their recent conception. Many hedge funds and asset managers have begun to include crypto-currency-related assets in their portfolios and trading strategies. Academia has similarly put considerable effort into crypto-currency trading research. This paper seeks to provide a comprehensive overview of crypto-currency trading research, by which we mean any study aimed at facilitating and building crypto-currency trading strategies (R.J. Yan C.X. Ling(2007)). S. Alzahrani and T. U. Daim (2019) stated that crypto-currency is a recent and significant innovation in the financial industry. The goal is to offer a currency that is not tied to, created or backed by a government. Crypto-currency uses Block chain technology as a financial platform. Crypto-currency adoption levels have increased and the market has grown dramatically.

Othman, A.H.A et.al. (2019) highlighted that the return or volatility of the Bitcoin market is symmetric informative and has a long memory to persist in the future. Furthermore, sympathetic volatility is found to be more sensitive to its past values (lagged) than to a new market value shock. However, the asymmetric informative response of volatility to negative and positive shocks does not exist in the Bitcoin market, or in other words, there is

no leverage effect. Ögel, S. and Ögel, İ.Y. (2021) stated that with the development of the Internet and communication technologies, business transactions are becoming more electronic. Findings: A statistically significant and negative relationship was found between perceived financial, time and psychological risk and attitudes toward using bit coin, and a statistically significant and positive relationship was found between attitudes and intention to use bit coin. The findings of the study are expected to contribute to relevant literature and practice by explaining individuals' financial behavior in the context of perceived risk theory.

Rouhani, S. and Abedin, E. (2020) discussed that crypto-currencies, decentralized electronic currency systems, represent a radical change in the financial exchange and economic environment. As a result, it would be attractive for designers and policy makers in this field to find out what social media users think about them on Twitter. The purpose of this study is to investigate social opinions on different kinds of crypto-currencies and to fine-tune the best-suited classification technique to categorize tweets based on sentiment. Chen, K. (2018) highlighted that the financial revolution led by technology firms in the last decade. Many large established tech giants are entering the financial services industry, from Google, Apple to Amazon in the US. The researcher wants to show that technological changes are just the beginning of a new world of financial services. Unprecedented changes are yet to come and it is extremely important to be prepared and even embrace the changes. A special discussion was devoted to the FinTech boom phenomenon in Asia. Last but not least, many new technologies are being developed to combat fraudulent activities in the FinTech space.

Trichilli, Y. and Boujelbéne, M. (2023) investigated the relationship between the Dow Jones Islamic Market World Index, Islamic gold-backed crypto-currencies and the halal chain in the presence of state (regime) dynamics. The authors used a Markov switching model to identify bull and bear market regimes. In addition, dynamic conditional correlations, Baba, Engle, Kraft and Kroner-generalized autoregressive conditional heteroscedasticity and wavelet coherence models are applied to detect the presence of spillover and contagion effects. The findings indicate different spillover patterns between the halal chain, the Dow Jones Islamic Market World index and gold-backed Islamic crypto-currencies in high and low volatility regimes, especially during the COVID-19 pandemic. The dynamics of the contagion really depends on the bullish or bearish periods of the markets.

Cilia Tortell, S.M. (2016) proposes to identify future trends in the retail payments market in Malta and how the main stakeholders are set to respond to the potential that innovative technologies are unlocking in this area. Stakeholders try to keep abreast of developments within

this circuit in an effort to implement a proactive approach within their respective roles. Kant, N. (2021) introduced exploratory notes by discussing whether block chain can help organizations achieve sustainable competitive advantage in view of its widespread applications and untapped potential. Organizations are yet to test its use as an intangible strategic resource at a time when the organizational strategic environment – rapidly changing in a globally connected, digitally empowered world – requires them to improve their ability to combine resources to meet stakeholder expectations.

Yelseli, E., Karaca, H.S. and Karaca, Ö.H. (2018) stated that the sharing economy is a set of economic and social activities where community participants share assets, resources, time and skills across online platforms. The researcher examines whether such success factors are applicable in the Turkish business environment, where internet retailing is at an early stage, trust between people is relatively low, and economic well-being is lower than in more developed economies. Abubakar, M et.al., (2019) emphasized that crypto-currencies are hidden money that are specifically created to be used as digital currencies while having the characteristics of real money. The potential of block chain technology is phenomenal, and recent estimates suggest it will be worth more than $20 trillion in just two years, which is more than the entire US economy. The big question that this chapter has now sought to answer is what are the implications of these developments for the more established and expanding global phenomenon of Islamic finance and its evolution in the Muslim world in relation to aspirations for sustainable economic development.

Alfieri, E., Burlacu, R. and Enjolras, G. (2019) proposed to provide some insights into the true nature of a bit coin and empirically study its performance using robust models widely used in the academic literature. Previous studies evaluate performance using simple measures such as the Sharpe ratio. Such measures are insufficient because they do not take into account the specifics of Bitcoin, such as risk diversification opportunities. Bitcoin performance (α) is positive and significant; this result is robust across period and world region specifications. Research Limitations/Implications: The true nature of Bitcoin is subject to debate and requires further research. In addition, other factors such as those related to investor behavior or political risk should be considered when analyzing Bit coin's performance.

Velappan, S. (2024) examined co-volatility patterns between crypto-currencies and conventional asset classes across global markets, covering 26 global indices ranging from stocks, commodities, real estate, currencies and bonds. She used a multivariate stochastic volatility model to capture dynamic changes in the covariance and correlation of volatility, thereby offering an empirical

insight into the dynamics of co volatility. In contrast to conventional price transmission or return research, these movements notably outperform movements seen in precious metals, industrial metals and global equity indices across regions. Interestingly, with the exception of Japan, stock indices in the US, Canada, Australia, France, Germany, India and China show co-volatility movements. These findings challenge the existing literature on crypto-currencies and provide interesting evidence on the dynamics of their co-volatility.

Kaur, A., Kumar, P., Özen, E. and Vurur, S. (2023) explained Block chain and its application in crypto-currency and various sectors. It provides insight into the level of adoption of Block chain technology globally by industry, country and component. China leads in all countries of the world, followed by the United States. The study will help to understand future research regarding its applications in various sectors of the economy. The study will also help understand the significance and complications surrounding risk and regulation. Its adoption in the logistics and supply chain aims to achieve flawless communication and effective tracking management.

Sharma, R. (2022) suggested that block-chain technology has the potential to revolutionize finance in general and business finance in particular. One of its most prominent offshoots, the Security Token Offering, has evolved into a separate funding source with its own unique characteristics. This research study provides a brief overview of business finance and block chain technology, illustrating their unique aspects. It continues with a discussion of the use of block chain technology in finance in general and in business finance in particular. This discussion is followed by an extensive analysis of the evolution of crypto-finance as a source of finance, listing the various iterations and their implications.

Thakre, A., et.al., (2022) stated that bit coin is among the highest rated digital crypto-currencies in the financial investment markets. This technology relies on a distributed data architecture backbone and a peer-to-peer network model called Block chain. Unlike the current digital economy that is centrally controlled by financial institutions or governments, Block chain is fully autonomous without any third party involvement. Bit coin's runaway success has attracted investors, scientists, and organizations alike to look into this lucrative technology for possible uses in areas other than crypto-currencies.

PROBLEM STATEMENT AND RESEARCH OBJECTIVES

The research study is on "A systematic Approach of Crypto-currency and its Market Innovations using Vector Auto-Regression (VAR) Model", the researcher

formulated some of the research objectives which are stated as:

To study and analysis the current markets trends of crypto-currency and its usage.

To study the exploratory analysis of the crypto market using data science techniques.

To analyze the current and future trends of crypto-currency for market innovations.

NATURE DATASETS AND ATTRIBUTES

Source of Data: Kaggle.com

Range Index: 365 entries, 0 to 364

Data columns (total 7 columns):

#	Column	Non-Null Count	Data type
0	open	365 non-null	float64
1	high	365 non-null	float64
2	low	365 non-null	float64
3	close	365 non-null	float64
4	volume	365 non-null	float64
5	market Cap	365 non-null	float64
6	date	365 non-null	objects

RESEARCH DESIGN AND METHODOLOGY

This research study is designed using vector auto-regression models, the time series is modeled as a linear combination of its own lags. That is, the past values of the series are used to forecast the current and future. Vector Auto-regression (VAR) is a forecasting algorithm that can be used when two or more time series influence each other. That is, the relationship between the time series involved is bi-directional. In this research study , we will see the concepts, intuition behind VAR models and see a comprehensive and correct method to train and forecast VAR models in python using Jupiter Notebook to interpret training and testing data to find out crypto-currency and its market innovations.

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \epsilon_t$$

Where α is the intercept, a constant and β1, β2 till βp are the coefficients of the lags of Y till order p.

VAR model- Algorithms

Analyze the time series characteristics

Test for causation amongst the time series

Test for stationarity

Transform the series to make it stationary, if needed

Find optimal order (p)

Prepare training and test datasets

Train the model

Roll back the transformations, if any.

Evaluate the model using test set

Forecast to future

RESULT AND DISCUSSION
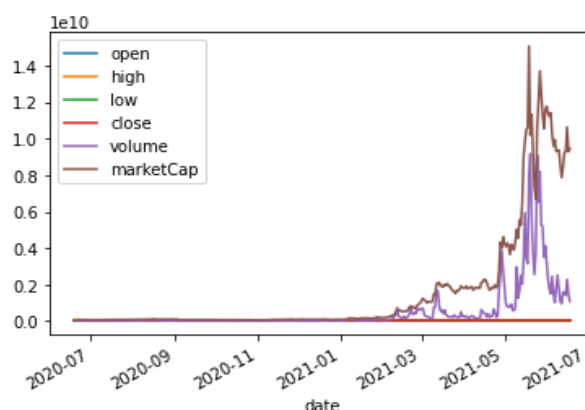
Fig.1.1: Statistical Analysis of Crypto- Currency

DATA ANALYSIS

The above data analysis report is showing the exploratory report on crypto-currency market status value in between 2020 to 2021. The statistical report is showing that January 2021 to July 2021 is big fluctuation in market value of crypto- currency (Fig.1.1).

STATISTICAL ANALYSIS REPORT

P-value for open: 0.984

P-value for close: 0.987

P-value for high: 0.960

P-value for low: 0.996

P-value for volume: 0.072

P-value for market Cap: 0.986

Fig.1.2: Statistical Analysis of Crypto- Currency Differencing

Data Pre-process Process

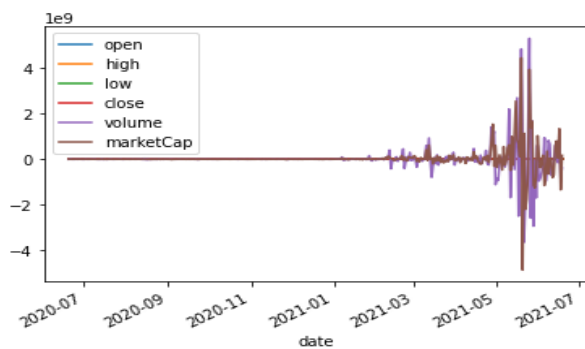When building models to forecast time series data, another pre-processing step is differencing the data (calculating sequentially xt−xt−1) until we get to a point where the series is stationary. Due to huge variation on data the researcher used the data pre-process process to handle the missing data items, skewness and variance. The researcher used the standard mapping process in between dependent and independent variables and used the mode value which is in missing value in between July 2020 to July 2021(Fig 1.2).
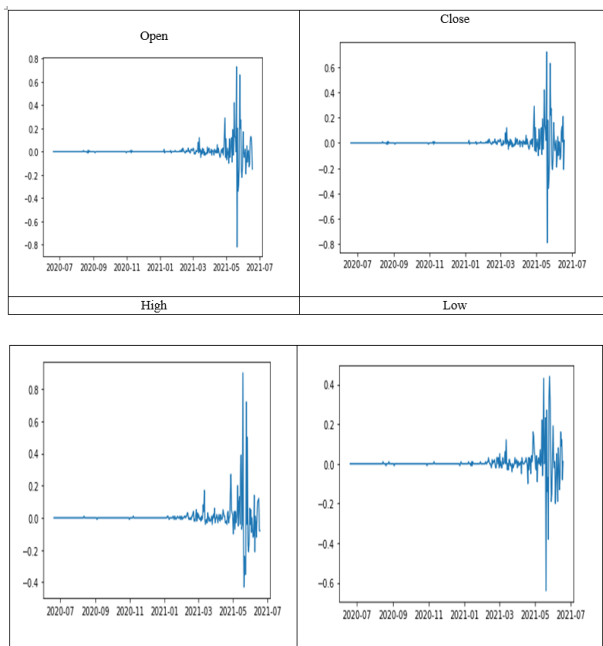

Fig.1.3: Statistical Analysis of Crypto- Currency: Open/Close/High/Low

PRICE FORECASTING: VAR Model

Vector auto regression is a statistical model used to capture the relationship between multiple variables as they change over time. A VAR is a type of stochastic process model. VAR models generalize the univariate autoregressive model by allowing for multivariate time series. Like the autoregressive model, each variable has an equation modeling its evolution over time.

This equation includes the lagged (past) values of the variables, the lagged values of the other variables in the model, and the error term. VAR models do not require as much knowledge of the forces affecting the variable as structural simultaneous equation models. The only prior knowledge required is a list of variables that can be assumed to interact over time.

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p}$$

Summary of Regression Results

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Model:	VAR
Method:	OLS

No. of Equations:	6.00000	BIC:	-44.7412
Nobs:	254.000	HQIC:	-45.0908
Log likelihood:	3635.95	FPE:	2.06612e-20
AIC:	-45.3261	Det(Omega_mle):	1.75515e-20

Results for equation open

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	coefficient	std. error	t-stat	prob

Const	-0.000000	0.000000	-1.816	0.069
L1.open	-0.000000	0.000000	-8.000	0.000
L1.high	0.000000	0.000000	8.524	0.000
L1.low	-0.000000	0.000000	-3.848	0.000
L1.close	1.000000	7496147372523864.000	0.000000	0.000
L1.volume	-0.000000	0.000000	-5.942	0.000
L1.marketCap	-0.000000	0.000000	-5.320	0.000

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Results for equation high

	coefficient	std. error	t-stat	prob
const	0.000426	0.000342	1.245	0.213
L1.open	-0.334941	0.089650	-3.736	0.000
L1.high	-0.389202	0.089540	-4.347	0.000
L1.low	0.239894	0.090577	2.649	0.008
L1.close	-0.093368	0.148938	-0.627	0.531
L1.volume	0.000000	0.000000	3.617	0.000
L1.marketCap	0.000000	0.000000	6.968	0.000

	coefficient	std. error	t-stat	prob
const	0.000632	0.000307	2.057	0.040
L1.open	-0.136107	0.080446	-1.692	0.091
L1.high	0.162107	0.080347	2.018	0.044
L1.low	0.229960	0.081278	2.829	0.005
L1.close	-0.490443	0.133647	-3.670	0.000
L1.volume	0.000000	0.000000	1.818	0.069
L1.marketCap	0.000000	0.000000	3.124	0.002

Results for equation low

	coefficient	std. error	t-stat	prob
const	0.000197	0.000281	0.702	0.483
L1.open	0.053623	0.073664	0.728	0.467
L1.high	-0.277211	0.073574	-3.768	0.000
L1.low	-0.205951	0.074426	-2.767	0.006
L1.close	0.188558	0.122380	1.541	0.123
L1.volume	0.000000	0.000000	6.590	0.000
L1.marketCap	0.000000	0.000000	5.339	0.000

Results for equation volume

	coefficient	std. error	t-stat	prob
const	1655096.126418	3068227.883414	0.539	0.590
L1.open	-5918941754.065879	803701090.778264	-7.365	0.000
L1.high	3582111759.481435	802716538.730825	4.462	0.000
L1.low	-1669897913.009130	812011771.068527	-2.056	0.040
L1.close	-3475913456.564016	1335209951.306225	-2.603	0.009
L1.volume	-0.331628	0.066098	-5.017	0.000
L1.marketCap	1.778942	0.283745	6.270	0.000

Results for equation close

Results for equation market Cap

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            coefficient   std. error    t-stat      prob
---------------------------------------------------------------
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const              3079018.652960    1363652.160641
2.258      0.024
L1.open        -378883916.150195   357199259.831252
-1.061     0.289
L1.high         468954127.951902   356761682.644104
1.314      0.189
L1.low         1468696487.630008   360892882.849110
4.070      0.000
L1.close        184481455.634362   593424609.967948
0.311      0.756
L1.volume          0.075200       0.029377        2.560
0.010
L1.marketCap      -0.084893       0.126109            -
0.673      0.501
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Correlation matrix of residuals

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=====================================
          open      high      low      close     volume
marketCap
open       1.000000 -0.005343 -0.006747 -0.006120 -
0.020243 -0.001503
high      -0.005343  1.000000  0.516282  0.625369
0.607915  0.563483
low       -0.006747  0.516282  1.000000  0.389368
0.170305  0.403435
close     -0.006120  0.625369  0.389368  1.000000
0.385144  0.881440
volume    -0.020243  0.607915  0.170305  0.385144
1.000000  0.294298
marketCap -0.001503  0.563483  0.403435  0.881440
0.294298  1.000000
```

EVALUATE THE FORECASTS

Forecast Accuracy of: open

mape : inf

me : 0.06103078815062737

mae : 0.11049739658236693

mpe : inf

rmse : 0.17211052319479025

corr : 0.001758836710041211

minmax : 1.2006262726965111

Forecast Accuracy of: close

mape : inf

me : 0.03192951267883104

mae : 0.09574577584290393

mpe : inf

rmse : 0.162877020131308

corr : 0.004412386113930464

minmax : 1.4881447989808685

Forecast Accuracy of: high

mape : inf

me : 0.05129285144662431

mae : 0.10969064356317275

mpe : inf

rmse : 0.17190269737769165

corr : -0.005159257683334315

minmax : 1.274969319134256

Forecast Accuracy of: low

mape : inf

me : 0.051300258075914464

mae : 0.09095956495653684

mpe : inf

rmse : 0.13729038452597886

corr : 0.01901245731548698

minmax : 1.1605686160959845

Forecast Accuracy of: volume

mape : 6.2006992152763765

me : 110266178.990089

mae : 647314562.3227189

mpe : 2.7536349890570286

rmse : 1130982372.5629303

corr : -0.016331712178946765

minmax : 3.316300298912994

Forecast Accuracy of: marketCap

mape : 2.0031665921956936

me : 149408788.01586166

mae : 558269196.105566

mpe : -0.777950483758405

rmse : 989828666.474588

corr : 0.01282577085474876

minmax : 1.5565296816240561

DATA ANALYSIS

The above data analysis report is compiled by Vector Auto-Regression (VAR) Model using Jupiter notebook using python programming. The researcher used the features such as open, close, high , low, volume and market cap of the crypto currency market value to map the data in between July 2020 to July 2021. In data analysis report the individual variable forecast analysis, correlation between different factors, standard errors, and probability of statistics P- Value at 0.05 significant level. The correlation coefficient is considered in between 0 to 1, where 0.2 to 0.4 showing the weak correlation, 0.6 as moderate and 0.8 and above showing the strong correlation between features.

The probability of statistics of features of crypto-currency which are less than 0.05 significant level, in that case the null assumption is rejected and result would be the significant. At this stage the researcher concluded that features such as open, close, high, low, volume and market cap are the significant with respect to the crypto currency market value in business industries. In case of negative correlation the factors which are having negative impact on the crypto currency market value.

VII. SUMMARY AND CONCLUSIONS

In this research study the researcher concluded on" A systematic Approach of Crypto-currency and its Market Innovations using Vector Auto-Regression (VAR) Model" based on features such open, close, high , low, volume and market cap are significant towards this research study based on statistical assumption and probability   theory. The researcher used the exploratory analysis and Vector Auto-Regression (VAR) machine learning model on features such as open, close, high , low, volume and market cap of the crypto currency market value to predict the future trends based current features. During the research study the research found that probability of statistics P-value for open: 0.984, P-value for close: 0.987, P-value for high: 0.960, P-value for low: 0.996, P-value for volume: 0.072, P-value for market Cap: 0.986 which are greater than 0.05 significant level, so the researcher concluded that there is a no significant relation between above features of crypto-currency in market innovations. In this research study Artificial intelligence (AI) and machine learning are included to find the moving average of crypto-currency value towards markets innovations.

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