SECTION 7 MATHEMATICAL METHODS, MODELS, AND INFORMATIONAL TECHNOLOGIES IN ECONOMICS

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CLASSIFICATION OF CRYPTOCURRENCY ASSETS IN THE MULTIVARIATE FEATURE SPACE

At the current stage of the global monetary system development, both individuals and legal entities are increasingly using cryptocurrencies as an alternative means of non-cash payments. The use of cryptocurrencies allows increasing the speed of payments, significantly reducing commission costs, conducting direct settlements with foreign partners, avoiding the conversion of foreign currency into national currency and vice versa, partially avoiding inflationary risk, and ensuring confidentiality [1-3]. These advantages make it important to study the cryptocurrency market in order to determine the prospects for improving the current practice of non-cash electronic payments in Ukraine, which in turn will help to increase the competitiveness of domestic enterprises.

The aim of the work is to build and implement an algorithm for comparative analysis of the spatial and temporal characteristics of cryptocurrency assets, which includes the following stages:

– analysis of the current state and main trends in the development of the cryptocurrency market;

– determination of a set of basic characteristics that can be used to describe a cryptocurrency as an object in a multidimensional statistical space;

– classification of cryptocurrency assets; development of recommendations for the final choice of cryptocurrency as a means of cashless payments.

Below are the results of implementing these stages of the algorithm. The input data is a time series of daily prices, the data source is Yahoo Finance [4] and Barchart [5].

Each cryptocurrency is considered as a multidimensional object: C=(y,r), where y is the rate of return and r is the risk indicator. Risk and return are calculated using the formulas of standard deviation and variance, respectively. The original data set needs to be normalized beforehand.

Based on the distribution of cryptocurrencies by capitalization level, the cryptocurrencies that are in the top ranking by this indicator at the end of 2023 were selected for the current study[6], namely: Bitcoin (BTCUSD); Ethereum (ETHUSD); Tether (USDTUSD); Binance Coin (BNBUSD); XRP (XRPUSD); Cardano (ADAUSD); Dogecoin (DOGEUSD); Solana (SOLUSD); Tronix (TRXUSD); Polkadot (DOTUSD).

To organize objects in a multidimensional feature space, we use the Euclidean distance. To classify objects in a multidimensional space, we use cluster analysis methods that allow us to divide the original data into relatively homogeneous groups, so that the elements in one group are as “similar” as possible, and the elements from different groups are as “different” as possible from each other. It is planned to obtain a breakdown into 4 clusters in the risk-return space.

The k-means method was used in the study, which allows you to set the desired number of clusters in the final grouping a priori. This method is an iterative optimization method - the procedure is repeated until the optimum of the partitioning criterion is reached. The algorithm of the method can be described schematically as follows:

1) Set the initial approximation of the centers of all clusters

2) Each object is assigned a cluster based on minimizing the distance between the object and the center of the corresponding cluster

3) Recalculate the centers of the newly created clusters

4) Calculate the value of the partitioning objective function and compare it with the threshold value. The algorithm is complete if the objective function threshold is reached. Otherwise, we return to step 2.

The results of the implementation of this algorithm are presented in Table 1 below.

Table 1

Distribution of objects between clusters by year

Year	Cluster			
	High risk, high return	High risk, low return	Low risk, high return	Low risk, low return
2020	SOLUSD	XRPUSD, DOGEUSD, TRXUSD	BTCUSD, ETHUSD, BNBUSD, ADAUSD, LTCUSD	USDTUSD
2021	DOGEUSD	SOLUSD	ETHUSD, BNBUSD, XRPUSD, ADAUSD, TRXUSD	BTCUSD, USDTUSD, LTCUSD
2022	BNBUSD, XRPUSD, DOGEUSD, LTCUSD	SOLUSD	USDTUSD, TRXUSD	BTCUSD, ETHUSD, ADAUSD
2023	XRPUSD, SOLUSD	ADAUSD, DOGEUSD, LTCUSD	BTCUSD, ETHUSD, TRXUSD	USDTUSD, BNBUSD

Source: own calculations

According to Table 1:

- the composition of clusters is not absolutely stable - there are cases of migration of objects from cluster to cluster.

- on the other hand, some signs of stability can still be observed. For example, such currencies as BTCUSD, ETHUSD, USDTUSD have never been classified as high-risk clusters, but have migrated between high and low yield clusters; DOGEUSD, SOLUSD, on the contrary, have never been classified as low-risk groups, but have also migrated between high and low yield clusters.

Additionally, the relative stability of the classification of individual cryptocurrencies in terms of the frequency of their assignment to a particular cluster was analyzed. It should be noted that in the current study, no object demonstrated absolute stability of classification. The following objects showed relative stability: ETHUSD, USDTUSD, TRXUSD.

Conclusions. In order to choose the most suitable option for use in cashless payments among the many cryptocurrencies currently available on the market, it is necessary that the cryptocurrency in question meets a number of requirements in addition to the basic properties that are characteristic of assets of this class and were listed at the beginning of the study. It is obvious that, all other things being equal, a cryptocurrency should have a relatively low level of volatility in order to ensure a certain stability of settlements and avoid losses due to exchange rate differences. Therefore, according to the proposed algorithm and the practical results of its implementation, it is proposed to choose cryptocurrencies that have been classified in the dynamics into low-risk clusters.

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