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Teaching Case
The Initial Coin Offering Marketplace: A Data Analytic Case

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ABSTRACT

This case uses data analytic techniques to expose students to the context of the initial coin offering marketplace. The exercise is well-suited as a group activity in an undergraduate or graduate business analytics course in which students have been taught analytic techniques such as word cloud, descriptive statistics, basic visualizations, and decision tree analysis. The data comes from the real-world initial coin offering market, so students learn about the business aspects of the initial coin offering market and the underlying technology of blockchain. As a result, the students gain a chance to practice basic analytic techniques and leverage those techniques to learn more about the business context. This project-based case provides scripts for instructors using the free, open-source software R; however, an instructor may choose alternative analytic platforms to implement the analysis. The activity may also be made accessible for novice analytics students as a first experience in R by providing the accompanying solution scripts to the students.

Keywords: Blockchain, Initial coin offering, Bitcoin, Decision-tree analysis, Visualization, Data analytics

1. CASE SUMMARY

The initial coin offering (ICO) marketplace has emerged as a new financial vehicle for generating funding for organizations to pursue innovative projects and ventures. At the same time, the general public is intrigued by the unique characteristics of the digital currencies that are offered through initial coin offerings and a growing number of investors have elected to buy and sell currency in the market based on the new technology. Bitcoin, Ethereum, and other digital currencies have yielded huge financial gains for some traders, but financial success has proven difficult to predict.

This case asks students, as developing business analysts, to use statistical and visualization techniques to assess the initial coin offering marketplace and draw implications about this new context from the analysis. The dataset for the analysis contains information about worldwide initial coin offerings in 2017. Many of the ICOs have failed, but many survived and some have experienced extreme growth in terms of valuation. The case provides background material to build understanding of the initial coin marketplace and its underlying technology of blockchain. The case then asks students to produce an assessment of the marketplace through a series of directed questions. The student analysts will produce statistical output and visualizations and draw conclusions from those analyses that will enhance their understanding of the ICO marketplace.

2. BUSINESS ANALYTICS CASE: ANALYZE THE ICO MARKET

In recent years, blockchain based crowd funding such as initial coin offerings (ICO) and initial exchange offerings (IEO) has emerged as a popular mechanism to fund startup ventures. Through these new forms of crowd funding, entrepreneurs raise capital by creating and selling a virtual currency or "token." This can be a utility token, security token, or payment token. These tokens or coins can be traded after the initial offer on unregulated platforms, thus sharing the transferability characteristics of equity shares and bonds (Myalo & Glukhov 2019). The technology allows investors around the world to contribute to projects with decentralized currencies such as Bitcoin or Ethereum. Blockchain based crowdfunding has the potential to democratize access to financial capital in that access will no longer be controlled by a central institution or platform, but instead decentralized to include a broad range of participants.

Companies or individual investors may benefit from the use of analytics to assess the viability of new investment opportunities such as initial coin offerings. Developing such analytic capabilities across internal operations and in understanding the external environment allows a company to create distinctive capabilities and differentiate itself from its competitors (Wamba et al., 2017). The employee who

understands analytics can make informed financial decisions based on the best quantitative tools and evidence (Davenport & Harris, 2017). Your role in this case is to develop and practice those analytic skills within the context of evaluating potential investments in initial coin offerings.

As a business analyst, you are requested by an important client to provide some insights into this new investment venture and advise on the opportunities and risks of investing in this innovative and unregulated market. Based on what you have read online and in the technology press, you understand that investing in this market can be very profitable. For example, a Boston College study recently analyzed ICO data over various timelines and found that the risk of ICOs is commensurate with their rewards. According to the study, an average investor earns a return of 179% from the ICO price to the first day's opening market price. They earn 48% abnormal returns in the first 30 days after trading begins (Benedetti & Kostovetsky, 2021). The potential for extremely high returns is very high, yet there is also significant downside risk as many of the offerings lose all value within six months of the initial offering. Unlike in traditional capital markets, such as in initial public offerings (IPOs), in which strict disclosure requirements are regulated, there is a dearth of verifiable and accurate information for the investor to assess the value and riskiness of the businesses, and to properly price and sell the new securities. In ICOs, such financial intermediation is absent, and the failure rate is extremely high, with more than half of ICOs failing within four months.

In order to understand the applications of blockchain technology and evaluate the financial potential of the projects seeking funding through initial coin offerings, analysts must have a basic understanding of blockchain technology and cryptocurrency. The next section provides background information on blockchain technology and a brief introduction to cryptocurrency built on that technology.

2.1 Blockchain Technology

Blockchain technology is a digital ledger shared across computer networks without the need for a lead authority, such as a central bank in the financial industry. Blockchain is the underlying technological foundation of many digital currencies, such as Bitcoin. Blockchain can be thought of as the combination of several existing technologies. These component technologies include public key cryptography and distributed ledger.

2.1.1 Public Key Cryptography. Public key cryptography is the use of verifiable identifiers embedded in messages that allow messages to be coded and hidden from interpretation by the general public. Instead, public key encryption allows for the decoding of messages by the intended recipient. Encryption, or coding, makes use of an algorithm to transform information into an unreadable format and requires a "key" to decrypt the data into its original, readable format. Public and private keys refer to the computer algorithms used to encrypt and decrypt information.

The public key is made available to everyone via a publicly accessible directory. The private key remains confidential to its owner. Information encrypted with a public key may only be decrypted by its corresponding private key, and vice versa. As an example, in Figure 1(a), Bob knows Alice's public key and uses it to encrypt the message. Alice uses her private key to decrypt the message. In Figure 1(b), Alice signs a message with her private key. Bob can verify that Alice sent the message and that the message has not been modified. This verifiable marking of messages is also referred to as digital signature.

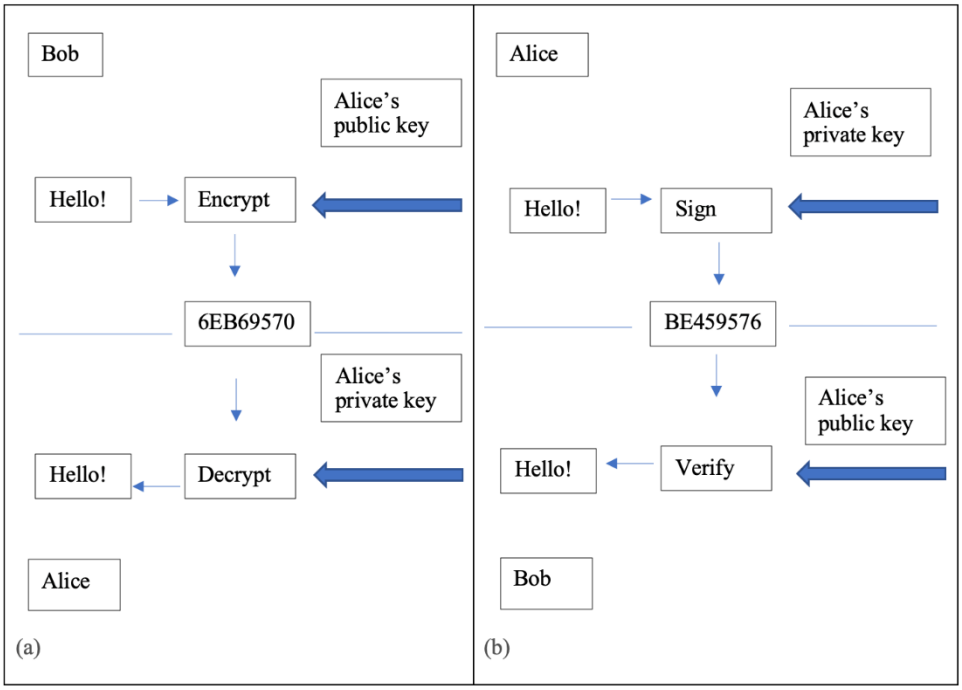

Figure 1. Examples of Public Key Cryptography

2.1.2 Distributed Ledger. A distributed ledger, is a ledger that is replicated, shared, and synchronized geographically across computers in multiple sites, countries, or institutions. So, whereas a traditional ledger is held centrally by one party (e.g., on a server at a bank's data center), the information of a distributed ledger is stored on multiple computers across different locations.

Blockchain technology combines the digital signature of the cryptography with the distributed ledger technology. A large network of individuals acts as validators to reach a consensus about the authenticity of transactions.

Bitcoin, a virtual currency system that was designed and built by computer programmers and not financial experts, is one of the first and best-known examples of blockchain technology (Böhme et al., 2015). When a user sends bitcoins to a new owner, the user creates a transaction, attaching the new owner's public key to this amount of coins, and signs it with the originating user's private key. When this transaction is broadcast to the bitcoin network, this lets all the computer nodes know that the new owner of these coins is the owner of the public key. The user's signature on the message verifies that the message is authentic. The design of the system is that transparency of the transactions is high, but the participants' identities remain private. However, some scholars have found that the identity of participants may be revealed even after participants implement Bitcoin recommended privacy measures (Androulaki et al., 2013). Bitcoin is further designed to maintain complete independence among all participants, yet there are incentives for dishonest participants to collude with others to gain an advantage, thereby negating the designed autonomy of the network (Eyal & Sirer, 2014).

Transactions are stored in packages called "blocks." The Bitcoin network is intended to produce roughly one block every ten minutes, with each block containing a timestamp, a nonce, which is a number used once to identify the block, and a reference to the previous block (i.e., the hash of the previous block). Hashing processes the data from a block through a mathematical function. This results in an encrypted value - a series of numbers and letters that does not resemble the original data, and a list of all of the transactions that have taken place since the previous block. Figure 2 is an example of blocks. Over time, this transactional process creates a persistent, ever-growing "blockchain." This complete history of transactions is kept by all computer nodes in the network, and constantly updates to represent the latest state of the Bitcoin ledger, so anyone can verify the current owner of any particular set of coins (Narayanan et al., 2016).

2.2 What Is Cryptocurrency?

A cryptocurrency is a digital or virtual currency that uses cryptography for security. Many cryptocurrencies are decentralized systems based on blockchain technology. A cryptocurrency is difficult to counterfeit because of these security features of blockchain technology.

The first decentralized cryptocurrency was Bitcoin, which was launched in 2009 by an individual or group known under the pseudonym, Satoshi Nakamoto. Though the efficiency of Bitcoin as a commodity or investment market has been questioned (Urquhart, 2016), Bitcoin's success in terms of its ability to garner initial funding and increase in value has spawned a number of cryptocurrencies, known as "altcoins," such as Litecoin, Ethereum, Ripple, and Cardano. Data from Coinmarketcap, an advanced cryptocurrency tracking firm, revealed that the market capitalization value of the cryptocurrency market stands at $319 billion as of September 2020 (CoinMarketCap, 2020).

2.3 What Is an Initial Coin Offering?

An initial coin offering (ICO) is a fundraising mechanism for startup companies. In an ICO, a startup creates and distributes its digital tokens or coins, typically in exchange for Bitcoin, Ethereum, or fiat currencies (government backed legal tender, e.g., U.S. dollars) to raise capital to fund their operations (Li et al., 2019). The return from investing in the ICO token depends on the eventual success of the underlying project and the corresponding increases in token value. One of the most successful ICOs in terms of initial market capitalization is Ethereum (An open-source platform to write and distribute decentralized applications). In 2014, Ethereum raised $18.4 million through a single ICO, marking a significant ICO breakthrough. Other companies such as block.one have raised more money in initial funding yet have encountered legal trouble as a result of fraud (Ripp et al., 2020). Similar to an ICO, an initial exchange offering (IEO) is a new development that is a variant on initial coin offerings, operated directly by cryptocurrency exchanges. In an IEO, a company sells tokens using the service of an organized online exchange for cryptocurrencies such as Binance, LBANK, and Coinbene. An IEO makes the digital asset immediately available through the online exchange and is designed to minimize risks, liquidity problems, and delay in listing tokens at the end of the token sale (Miglo, 2020).

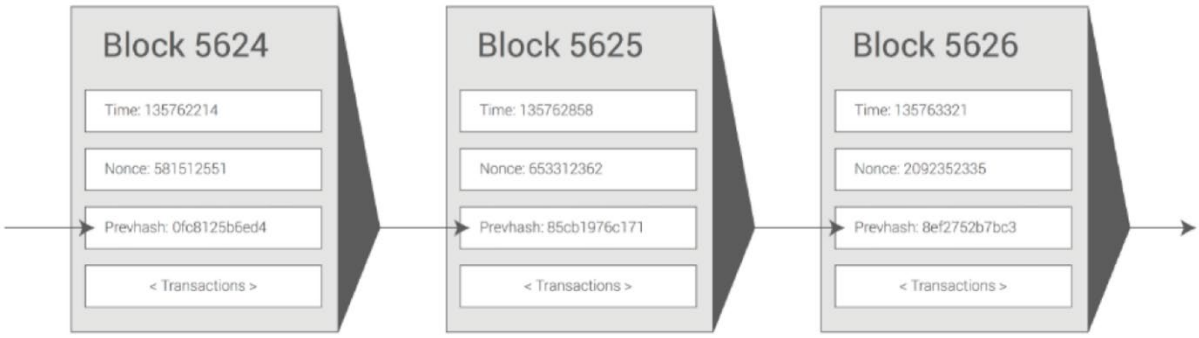

Figure 2. Example Blockchain (Ethereum, 2020)

3. INITIAL COIN OFFERING ACTIVITY

The activity incorporates multiple aspects of a successful business analytics learning model. This includes the use of active learning exercises using real business data and substantial in-class discussion (Romanow et al., 2020) to underscore the key takeaways from the exercise. The hands-on approach in this analysis is designed to build analytic capabilities among students in a real-world business context, a highly sought skill of business students (Davenport & Harris, 2017). The exercise includes elements of all stages of analysis using data - acquisition, preparation, analysis, visualization, and interpretation (Jeyaraj, 2019). While some real-world learning exercises focus on the importance of analysis in organizational decision making (e.g., Nestorov et al., 2019), this activity instead highlights the new emerging technology of blockchain and its associated industry.

3.1 Initial Coin Offering Dataset

The dataset is collected from ICObench.com, a leading online ICO rating and evaluation platform (Bourveau et al., 2022), where organizations promote their projects to potential investors through a pitch video and by sharing project related information. Figure 3 shows the layout of the main page of an ICO project on ICObench. The dataset includes the description and industry of the ICO project, key words, team members, milestones, ICO platform used, financial information (token price of the ICO, number of tokens for sale in ICO, pre-ICO status, soft/hard cap, percentage of tokens distributed through ICO, etc.), and the experts' and platform's ratings of the project. The dataset includes 754 ICOs which were completed during 2017.

In analyzing the ICO market, students are encouraged to examine a few projects on ICObench, watch the project videos, and understand the business models of these projects. A discussion will be held among the group members and then with the whole class. Students will discuss based on their observations, what aspects of a project may be important factors in predicting the success of an ICO project and why? If you were investing, how would you evaluate projects and choose the most promising projects?

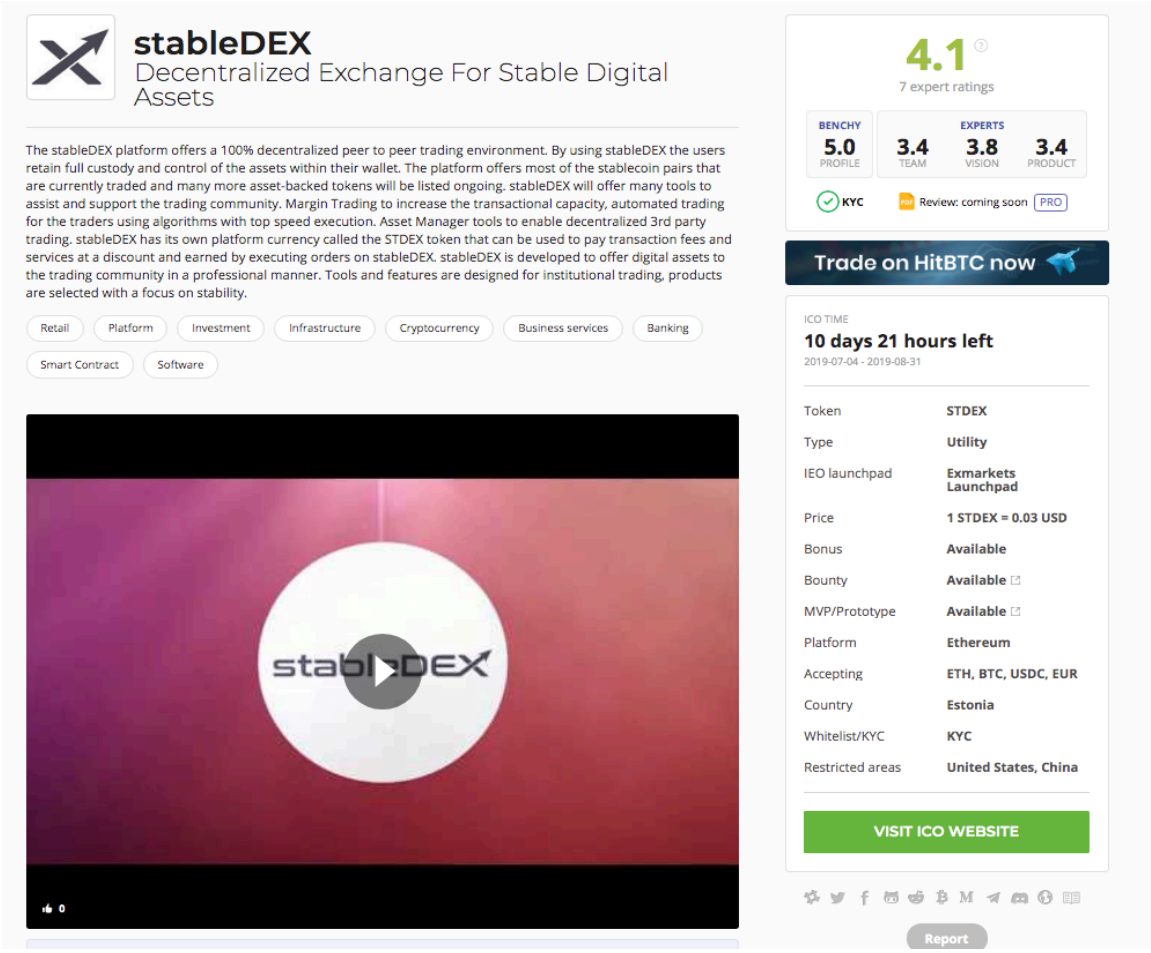

Figure 3. Example ICO Project Profile in ICObench.com

3.2 Using Descriptive Statistics and Visualization to Understand the ICO Context

Descriptive statistics and visualizations are very helpful to get a sense of the data. They can provide an intuitive understanding of the relationships between factors and are often included as the first steps for any data analysis. Part of the assessment should include a descriptive analysis that provides insight into the ICO marketplace.

3.3 Supervised Learning

In supervised learning, there is a pre-determined outcome variable for which we seek to understand the influencing factors, or decision rules. For example, how can potential investors predict whether an ICO investment would succeed or fail? To answer this question, students first need to define investment "success" and "failure." Then, a supervised learning method should be selected. In this project, a method, such as decision tree induction, that can provide insights regarding important factors that lead to a successful ICO would be ideal.

4. STUDENT ASSIGNMENT INSTRUCTIONS

All students will need to install R software to complete the assignment. The latest versions of the free and open-source software package R and R studio are available at:

https://cloud.r-project.org/

https://rstudio.com/products/rstudio/download/

Depending on your system, you may encounter warning messages when doing the assignment indicating that Rtools is required to install certain packages. This warning may be ignored without complications. However, if you prefer to resolve these warning messages, Rtools is available for installation at:

https://cran.r-project.org/bin/windows/Rtools/

Use the datasets to perform the following analyses and respond to the questions. The first five questions are descriptive statistics, while the final question asks you to perform supervised learning using a decision tree induction methodology.

1) Make a word cloud of the most frequent words used in project key words. Use the word cloud to identify the most popular industries for blockchain applications.
2) Create a visualization that answers the following question: What is the number of ICO projects from each country?
3) What are the mean, standard deviation, median, and range of the total funds raised in each ICO (FundRaisedICO)? Present the distribution of the funds raised with a graph (remove outliers if the distribution is too skewed). Add color to the graph to distinguish each ICO project's platform as either "Ethereum" or "Other" platform.
4) Visualize the relationship between the experts' evaluations of team, vision, product, and overall expert rating (Expert.Rating) for each ICO and the outcome of funds raised. Do these experts' evaluations of ICO projects appear trustworthy?
5) Plot the coin price that investors paid during ICO (Price.in.ICO), and the current trading price for each coin (Trading.Price).
6) Apply a decision tree induction algorithm. Generate a decision tree to predict the likelihood that an ICO investment will succeed. In this example, we use whether the ICO project is trading at a non-zero value after six months as the criteria for success (or failure). Use the test dataset to evaluate the accuracy of the algorithm. Discuss the decision rules learned from this decision tree.

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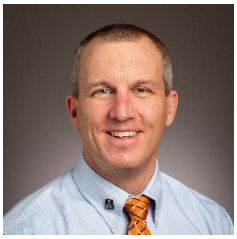

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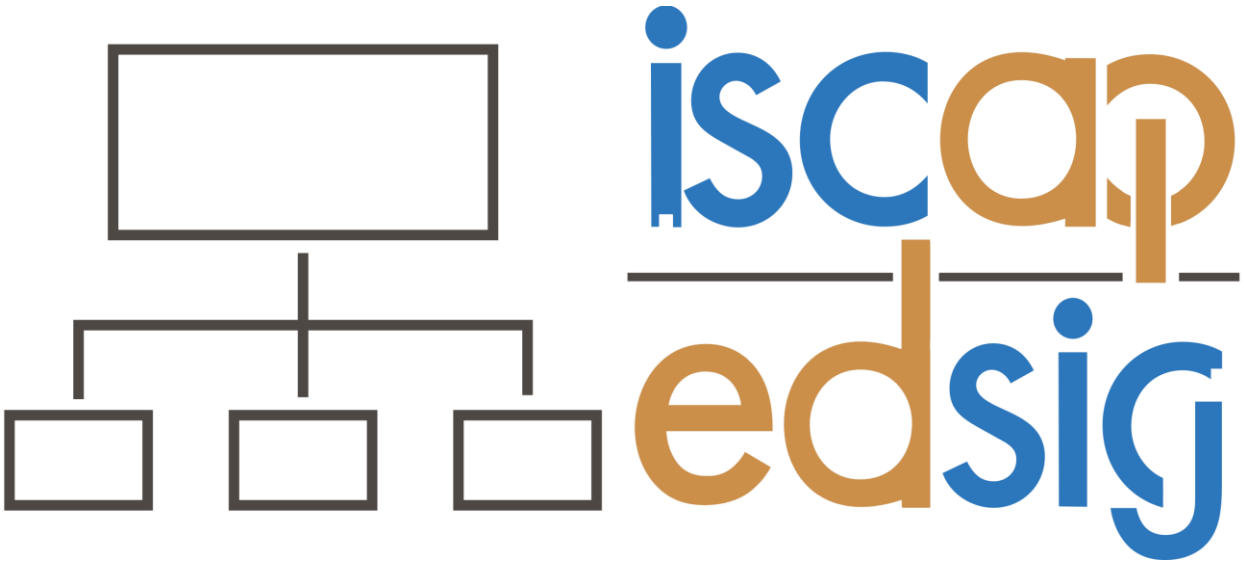

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