

Bitcoin's Crypto Currency: An Analysis from Operational Research and Information Management

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Abstract

Objective: This article focuses on an analysis that interrelates elements of information management with aspects of operations research, with the intention of demonstrating how the behavior of the Bitcoin crypto currency can be predicted.

Methods/Statistical Analysis: Initially, Bitcoin crypto currency is characterized (price history, behavior in the market, variation over a period of time, etc.). Then, the data and information collected are applied to two techniques associated with operations research: Markov Chains and Queue Theory. Finally, the information that has emerged is transformed into valuable knowledge based on an information management process. **Findings:** This research demonstrates how techniques associated with operations research and information management (quantitative analysis and qualitative analysis) can be combined to characterize an object or process, capture data and information associated with it, predict its behavior and transform that information into a knowledge that generates added value, allowing the right decision making, in a specific context. In this way, it is possible to demonstrate how Bitcoin crypto currency is a really stable resource and an asset capable of supporting and transferring value in current and future markets, with a constant upward trend and a behavior very similar to that of conventional currency. **Application/Improvements:** This analysis establishes that no matter how complex or novel an object or process may be, it can be studied with tools such as these. The key is to implement them in other contexts.

Keywords: Added Value, Bitcoin Crypto Currency, Information Management, Markov Chains, Operations Research

1. Introduction

As it is in framework of the information society, in which the human being is currently developing and which corresponds to a supremely globalized world, the search for development opportunities based on information management becomes an important task.

Within this context, there is a marked interest on the part of many people in order to find differential elements that allow them to obtain the best dividends before this reality, which is the reason why the generation of value based on this information becomes an unquestionable desire, particularly if it can pay dividends, many of them, economic, important.

This is how the market of crypto currencies has emerged and is gaining strength, which has a wide

variety of crypto actives (including information), which are constantly generating investment opportunities and unexpected possibilities of prosperity in this modern society; due to its constant movements and fluctuation, and to the information that nourishes the previously mentioned market and that this market generates.

For this reason, this context becomes an interesting scenario for analysis, which can be studied from different academic perspectives, including the management of information, from a qualitative point of view (social sciences), and operations research, from a quantitative perspective (engineering), with the intention of seeking a synergy between both components, which allows to understand and study this topic from two shores that seem distant but that can be complemented according to the study that is desired here.

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In this way, this article uses the theory of Markov Chains to find such synergy and to guide the subjects immersed in the information society towards a possibility of obtaining relatively new added value, in which they can find, through the collection of information from the crypto currency market (the most representative: Bitcoin), a viable option for data and information management, and even investment, and in which they can understand the risks and benefits that this crypto active can give them, with a very little analysis (at least in this way), but so influential in this increasingly globalized world.

2. Management Information and Operations Research

2.1 The Management of Information as an Element for the Generation of Added Value

Information management is a process in which the information contained in a given context can be explored, exploited and you can take advantage of it, helping to optimize that resource, sometimes undervalued, allowing its use, processing and dissemination¹.

It is through this process that we can identify the data that is really relevant, think about unification processes for of the already mentioned data in information, generate or implement procedures for the management and transformation of information (even supported by technological instruments²) and form systemic structures that facilitate the flow of the informational element³.

In this way, the appropriate use of information and its appropriate management can offer greater possibilities of success in the scenario where it is used, allowing identifying which informational elements can be truly useful and relevant⁴.

In this sense, any process that involves an adequate management of information can increase the possibility of finding differentiating elements that allow facing increasingly competitive environments⁵. Current environments not only need to facilitate the construction of information, but also to manage it correctly so that it is assimilated and used for individual and collective benefit⁶.

And it is precisely here that alternatives should be sought so that the previously management makes it possible to appropriate the informational resource, with

the purpose of transforming the instances that use it and, if necessary, to the reality itself⁷. And this is the case of the use of information management in the context of this article, where it is expected that information related to the Bitcoin crypto currency can be managed in order to find in it distinctive and unique elements that allow suggesting this crypto active as a viable option of development, and even investment, generating value for the subjects immersed in the information society.

2.2 Operations Research as a Mechanism for Generating Inputs for Decision Making

Operations research consists on the use of mathematical models, statistics and algorithms to support decision-making processes and contribute to the increase of productivity⁸.

It means that it is a practical analysis tool that as the information management process described is based on the use of data and key information so that individuals and entities can support their actions, in order to obtain a benefit based on these elements⁹.

For this reason, operations research can be seen as an alternative to the traditional technical analysis that is used to predict events, without being as informal as the analysis can be qualitatively or as complex as sophisticated modelling or simulation processes.

The investigation of operations, allows even differentiate, based on the information provided, the possibility of taking decisions that involve some type of uncertainty or risk¹⁰, and even develop various strategies and activities as they can be the theory of games^{11,12}.

In the specific case of investment or monetary, universes where Bitcoin crypto currency has its place, operations research can serve to demonstrate mathematically how the money supply and mining of the Bitcoin protocol works, allowing the person to review and analyse its performance without needing to depend on a specialist¹³.

And it is in this context that it becomes essential to resort to the Markov Chain, an element associated with the theory of probability, as an alternative to "predict" future events^{14,15}, dependents of immediately previous events, with the intention of determining the behavior of the object analyzed (Bitcoin crypto currency) and its associated variables, over a period of time.

2.3 Confluence between Information Management and Operations Research

Case: Bitcoin Crypto Currency

When a common person decides to participate in the market of crypto currencies, he/she does it with little or no information, a situation that implies a high risk in his decision possibility, associated to the investment, especially if the object in which he/she is going to invest belongs more to an intangible world.

This is where it is proposed from this stage that the subject leans on decision tools such as information management and operations research (including the Markov Chain), with the intention of identifying what data and information should be considered for the previous realization of the corresponding analysis to this new market.

This is the way in which the present document proposes an exercise in where elements of both tools come together, so that the user can access this market in an easier way and can count on more inputs to carry out movements in relation to this new object (Bitcoin), thus obtaining certain added value, derived from the adequate treatment of the information.

The conjunction of alternatives for the treatment of information must necessarily generate value, through the ease of use and access. The selection and processing of information should be the cause of development and generators of innovation¹⁶.

As it can be seen, there is a clear necessity to effectively operationalize and manage the information, and it is through the proper implementation and regulation of processes and / or mechanisms for this purpose, that individuals and entities will be able to develop appropriate explicit actions and transformation of information, in order to generate differential value¹⁷, a value that ultimately is the main objective of the management of Bitcoin in current markets, assigned to the information society.

3. Experimental Work

In order to carry out what has been proposed, the following procedure is performed, where each of the activities is articulated with the subsequent to facilitate the understanding of each process, all consistent with the order of the information presented in the subsequent section of the results .

In the first instance, a characterization of the cryptoactive (Bitcoin) on which the research is supported; is carried out, defining the parameters that will be taken into account for its analysis (its price history, its behavior in the market, its variation in a period of time, etc.).

Next, the collected data and information on the cryptoactive are presented, which are located through the techniques associated with information management and operations research, including the Markov Chains, with the intention of identifying the most relevant aspects associated with the cryptocurrency.

Finally, the interpretation of the information is presented, transforming it into valuable knowledge for those interested in the subject, all in order to demonstrate the importance of the techniques and processes used, as well as their articulation, having as scenario and object of analysis the market and instrument studied here.

4. Results and Discussion

As it has been mentioned, for the development of this work it is decided to take the Bitcoin crypto currency as a reference; this is due to the fact that there is a global concern about its usefulness and functioning^{18, 19} given the variable of its behavior, although recognizing its boom in the last time (Figure 1).

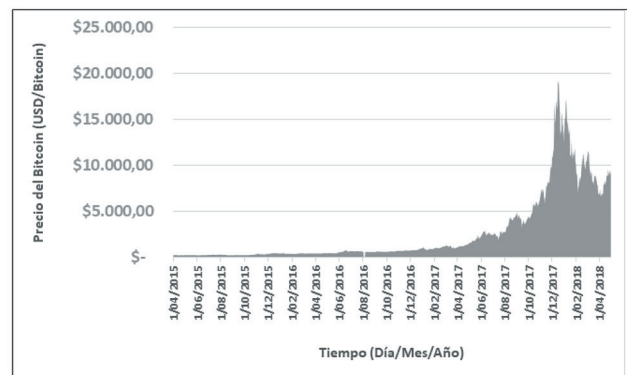


Figure 1. Behavior of the Bitcoin price in USD (April / 2015-April / 2018)²⁰.

Complementing the information above, Figure 2 shows the volatility of the cryptoelement, recognizing that from the investigation of operations said data, starting point of the information to be managed, corresponds to a stochastic process that involves an indexed collection of random variables $\{X_t\}$, where the index t takes daily values of an annual T set.

Fecha	Último precio USD/BTC	Apertura	Mínimo	Máximo	Vol.	% var.
01/04/2015	\$ 246,93	244,51	248,53	239,5	23,54K	1,06%
02/04/2015	\$ 253,23	246,93	254,92	244,55	26,22K	2,55%
03/04/2015	\$ 254,23	253,23	256,42	250,7	28,36K	0,39%
04/04/2015	\$ 253,60	254,24	255,69	250,39	9,42K	-0,25%
05/04/2015	\$ 260,50	253,6	261,25	251,55	23,93K	2,72%
06/04/2015	\$ 255,61	260,5	262,43	253,72	20,82K	-1,88%
07/04/2015	\$ 253,71	255,61	257,9	253,03	10,53K	-0,74%
08/04/2015	\$ 244,92	253,7	254,99	243,05	39,68K	-3,46%
09/04/2015	\$ 243,58	244,92	246,79	236,52	22,75K	-0,55%
10/04/2015	\$ 236,12	243,58	243,74	230,76	37,33K	-3,06%
11/04/2015	\$ 236,86	236,12	240	233,76	17,64K	0,31%
12/04/2015	\$ 236,38	236,86	238,7	232,82	10,17K	-0,20%
13/04/2015	\$ 225,00	236,38	237,7	220,25	47,16K	-4,81%
14/04/2015	\$ 220,19	225	225,75	216,37	40,75K	-2,14%
15/04/2015	\$ 223,98	220,16	224	219,01	23,60K	1,72%
16/04/2015	\$ 228,47	223,98	230	223,01	29,32K	2,00%
17/04/2015	\$ 222,40	228,47	228,98	219,61	27,14K	-2,66%
18/04/2015	\$ 223,08	222,4	224,16	219,94	11,90K	0,31%
19/04/2015	\$ 222,21	223,08	226,83	222,1	17,64K	-0,39%
20/04/2015	\$ 224,21	222,16	227	221,5	19,97K	0,90%
21/04/2015	\$ 235,80	224,21	236,2	224,19	30,99K	5,17%
22/04/2015	\$ 234,14	236,96	238,99	232,42	22,86K	-0,70%
23/04/2015	\$ 236,01	234,14	236,98	233	8,81K	0,80%
24/04/2015	\$ 231,38	236,01	236,2	228,7	22,53K	-1,96%
25/04/2015	\$ 226,10	231,38	232,7	225,78	13,38K	-2,28%
26/04/2015	\$ 219,70	226,1	221,48	214	40,92K	-2,83%
27/04/2015	\$ 227,68	219,7	232	218,24	35,14K	3,63%
28/04/2015	\$ 225,30	227,13	228,05	222,22	17,29K	-1,05%
29/04/2015	\$ 225,23	225,3	227,78	222,67	12,20K	-0,03%
30/04/2015	\$ 236,11	225,23	240,2	224,65	41,29K	4,83%
...	...	...	...	...	...	...
01/05/2018	\$ 8.955,00	9.240,70	9.240,70	8.829,10	27,07K	-3,08%

Figure 2. Historical data of Bitcoin price in USD (April / 2015-April / 2018)²⁰.

In this way, X_t is defined as the price (USD) of Bitcoin, which probabilistically evolves in discrete time; however, it must be proved if this stochastic process complies with the Markov property to formally apply the associated theories to operations research.

To do this, you must take the data from the time series “Last price USD / BTC”, of Figure 2, and apply two linear regressions through the Excel Solver tool to demonstrate that the future behavior of the USD / BTC does not depends on the past but on the present.

Next, Figure 3 shows three columns: the first column P_t corresponds to the time series “Last price USD / BTC” of the present, the second column $P_t - 1$ corresponds to the time series “Last price USD / BTC “Lagged one day, and the third column $P_t + 1$ corresponds to the time series” Last Price USD / BTC “advanced one day.

Now, in order to perform the first linear regression one should try to predict the series $P_t + 1$ as a function of the P_t values to check how “appropriate” the forecast is, then, to perform the second linear regression, the same process is done including the $P_t - 1$ series (Table 1, Section 1).

P_t	$P_t - 1$	$P_t + 1$
\$ 246,93		
\$ 253,23	\$ 246,93	\$ 254,23
\$ 254,23	\$ 253,23	\$ 253,60
\$ 253,60	\$ 254,23	\$ 260,50
\$ 260,50	\$ 253,60	\$ 255,61
\$ 255,61	\$ 260,50	\$ 253,71
\$ 253,71	\$ 255,61	\$ 244,92
\$ 244,92	\$ 253,71	\$ 243,58
\$ 243,58	\$ 244,92	\$ 236,12
\$ 236,12	\$ 243,58	\$ 236,86
\$ 236,86	\$ 236,12	\$ 236,38
\$ 236,38	\$ 236,86	\$ 225,00
\$ 225,00	\$ 236,38	\$ 220,19
\$ 220,19	\$ 225,00	\$ 223,98
\$ 223,98	\$ 220,19	\$ 228,47
\$ 228,47	\$ 223,98	\$ 222,40
\$ 222,40	\$ 228,47	\$ 223,08
\$ 223,08	\$ 222,40	\$ 222,21
\$ 222,21	\$ 223,08	\$ 224,21
\$ 224,21	\$ 222,21	\$ 235,80
\$ 235,80	\$ 224,21	\$ 234,14
\$ 234,14	\$ 235,80	\$ 236,01
\$ 236,01	\$ 234,14	\$ 231,38
\$ 231,38	\$ 236,01	\$ 226,10
\$ 226,10	\$ 231,38	\$ 219,70
\$ 219,70	\$ 226,10	\$ 227,68
\$ 227,68	\$ 219,70	\$ 225,30
\$ 225,30	\$ 227,68	\$ 225,23
\$ 225,23	\$ 225,30	\$ 236,11
\$ 236,11	\$ 225,23	\$ 231,78
\$ 231,78	\$ 236,11	\$ 234,81
...	...	...
\$ 9.240,00	\$ 231,78	\$ 8.955,00
\$ 8.955,00	\$ 9.240,00	\$ -

Figure 3. Sample of the time series “Last price USD / BTC” (April / 2015-April / 2018)²⁰.

Table 1. Summary of the linear regression applied to $P_t + 1 = f(P_t)$ and $P_t + 1 = f(P_t, P_t - 1)$

Regression statistics	$P_t + 1 = f(P_t)$ - Section 1	$P_t + 1 = f(P_t, P_t - 1)$ - Section 2
Multiple correlation coefficient	0,99686896	0,99687577
Coefficient of determination R^2	0,99374772	0,99376131
R^2 adjusted	0,99374208	0,99375004
Typical error	303,603183	303,410086
Observations	1110	1110

When making the difference between the coefficient of determination R^2 of Section 2 with the coefficient of determination R^2 of Section 1, a minute marginal increase of 0.00136% is obtained, which shows that the time series “Last price USD / BTC” in the future only depends on your time series in the present, complying with Markov property.

Next, the transient states of the problem are declared, three possible scenarios of Bitcoin price behavior (USD / BTC) over a period of three years: a) A: Bullish scenario, b) E: Stable scenario and c) B: bass guitarist Scenario. Finally, the random variable to be analyzed is declared: X_t : Bitcoin returns at time t .

Now, you can continue to apply the theory of Markov Chains.

4.1 Case 1: Markov Chains

To calculate the probabilities of the transitory states in a period of three years, the percentage of yield of the “Last price USD / BTC” towards the previous day must be determined. It is not recommended to use the value of the price itself because that variable continued in time would generate infinite possible values with little repetition, that is, infinite temporary states.

To determine the percentage of performance (Figure 4) the function “LN” (natural Logarithm) of Excel is used, putting as numerator the present data of the P_t series and as denominator the previous data of that same series and then the function is dragged until the last data, followed by this a nested function is defined with the SI function of Excel, to know qualitatively if that percentage of performance was: a) A = INCREASED (percentage of performance > 1%), b) E = STABILIZED (percentage of performance > -1% but < 1%) and c) B = LOW (percentage of performance < -1%).

After this, Excel’s CONCATENATE function is used to unite the qualitative values of the nested function (this represents the transition of states A, E, B and corresponds to the principles of articulation of information and systemic information of the management of the information), giving the following combinations: AA, AE, AB, EA, EE, EB, BA, BE and BB.

Next, the repetition of these transient states is counted, using the Excel COUNTIF function for the entire data series “TRANSITION (CONCATENATED)”.

With the above information, the Transition Matrix P and probabilities is constructed (Table 2), from which

LN t	ESTADO (ANIDADO)	TRANSICIÓN (CONCATENADO)
2,52%	A	AE
0,39%	E	EE
-0,25%	E	EA
2,68%	A	AB
-1,90%	B	BE
-0,75%	E	EB
-3,53%	B	BE
-0,55%	E	EB
-3,11%	B	BE
0,31%	E	EE
-0,20%	E	EB
-4,93%	B	BB
-2,16%	B	BA
1,71%	A	AA
1,98%	A	AB
-2,69%	B	BE
0,31%	E	EE
-0,39%	E	EE
0,90%	E	EA
5,04%	A	AE
-0,71%	E	EE
0,80%	E	EB
-1,98%	B	BB
-2,31%	B	BB
-2,87%	B	BA
3,57%	A	AB
-1,05%	B	BE
-0,03%	E	EA
4,72%	A	AB
-1,85%	B	BA
...	...	...
-3,95%	B	BA

Figure 4. Sample percentage yield of the time series “Last price USD / BTC” and its transition to another state

Table 2. Transition matrix p and probabilities over a three years’ period

	Transition Matrix P - Section 1			Probabilities - Section 2		
	A	E	B	A	E	B
A	166	121	120	40,79%	29,73%	29,48%
E	117	206	94	28,06%	49,40%	22,54%
B	124	90	69	43,82%	31,80%	24,38%

the probabilities are derived by dividing the number of repetitions, thus, obtaining the information in Section 1, on the total number of repetitions of the row in Section 2.

From this last Table, some interpretations can be made such as: “the probability that the Bitcoin being at an upward yield level will rise even more after three years is 40.79%”, “the probability that Bitcoin being at a level of performance to the downside remained stable after three years is 31.80% “and” the probability that the Bitcoin being at a stable performance level would go down after three years is 22, 54% “, among many others.

Now, if an investor asks: “What is going to happen with the level of performance of Bitcoin within two, three and four periods of time (6 years, 9 years, 12 years)?, the answer is found by multiplying the information in Table 2 (Section 2) by itself the desired number of periods (Figure 5).

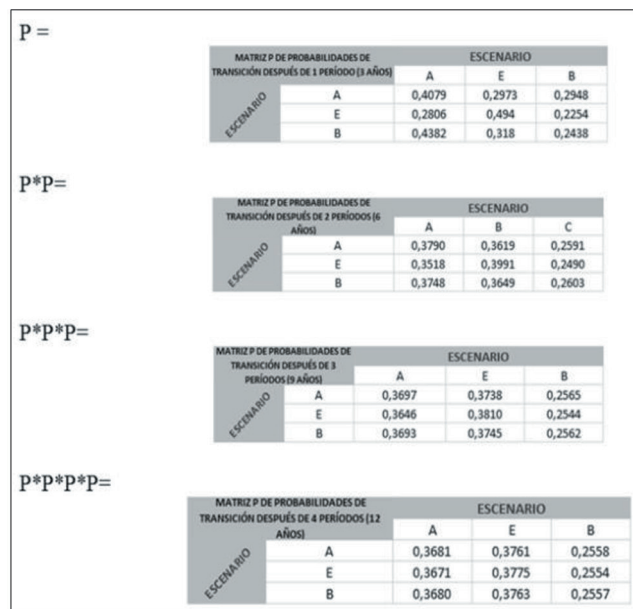


Figure 5. Possible scenarios based on the transition matrix P.

In addition, if the same investor asks: “But ... and in the long term, remains the same?” For this the probabilities of stable state must be calculated, but first it must be demonstrated that the Markov Chain to be analyzed is an ergodic or totally random chain, for which its corresponding graph must be analyzed (Figure 6).

Based on this Figure, the following statements can be made, also related to the systemic information used and analyzed: “all states (scenarios) are accessible to each other and to themselves”, “all states communicate with each other”, “All the states that communicate with each other form a single class”, “this single class is transitory”, “the periodicity of this class is 1 (because the three scenarios

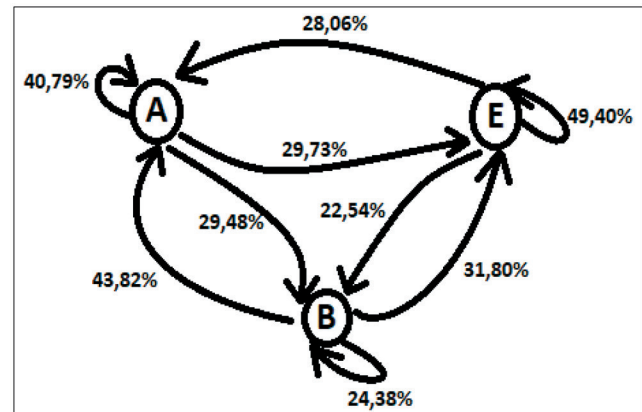


Figure 6. Price behavior of Bitcoin in the scenarios Bullish (A), Stable (E), Bearish (B) in a period of three years.

have a cycle of length 1, and therefore their common maximum The divisor of the lengths of the cycles in that class is 1), that is to say that it is aperiodic “and” is a finite and homogeneous Markov Chain”.

Therefore, it can be stated with complete certainty that the Markov Chain of the problem is an ergodic chain, which means that it will stabilize at some point and the probabilities of the steady state can be calculated by means of the Total Probability Theorem.

Then, be:

π_j the probabilities of stable state of the problem.

π_A the probability of the steady state associated with state A.

π_E the probability of the steady state associated with the state E.

π_B the probability of steady state associated with state B.

$$\pi_A + \pi_E + \pi_B = 1.$$

Thus,

$$\pi_A = (0,4079)\pi_A + (0,2806)\pi_E + (0,4382)\pi_B$$

$$\pi_E = (0,2973)\pi_A + (0,4940)\pi_E + (0,318)\pi_B$$

$$\pi_B = (0,2948)\pi_A + (0,2254)\pi_E + (0,2438)\pi_B$$

$$\pi_A + \pi_E + \pi_B = 1$$

In this way, it is solved out of desperation in the terms of π_B , is obtained: $(4)(1,438429473334) \pi_B + (1,473606882257) \pi_B + \pi_B = 1$

$$(3,912036355592)\pi_B = 1$$

$$\pi_B = 0,2556$$

$$\pi_E = 0,3766$$

$$\pi_A = 0,3675$$

What answers the investor's question: “In the long term, the probability of having a bullish scenario in yields

is 36, 75%. The probability of having a Stable scenario is 37,66%. And the probability of having a Stable scenario is 25, 56%”.

On the other hand, an investor can also ask: “How much average time must pass so that starting from a bearish scenario (B) for the first time you reach a bullish scenario (A) for the first time in the performance of Bitcoin?

To solve this, the following equations are constructed:

$$\mu_{BA} = 1 + PBB * \mu_{BA} + PBE * \mu_{EA}$$

$$\mu_{EA} = 1 + PEB * \mu_{BA} + PEE * \mu_{EA}$$

Then, values are cleared Pij:

$$\mu_{BA} = 1 + (0,2438) * \mu_{BA} + (0,318) * \mu_{EA}$$

$$\mu_{EA} = 1 + (0,2254) * \mu_{BA} + (0,494) * \mu_{EA}$$

Moreover, solving the system of equations one has to:

$$\mu_{BA} = 2,65$$

$$\mu_{EA} = 3,16$$

This means that the average time that the Bitcoin cryptocurrency must wait for the downward scenario to reach the Bullish scenario (A) is 2.65 periods, that is, 7.95 years.

4.2 Case 2: Queuing Theory

Another example of how the fusion between theory and practice associated with information management and operations research can be used occurs with what has been called the theory of queues.

In this sense, with the creation of the Bitcoin crypto currency, ATMs have begun to appear that allow the purchase or sale of Bitcoins in a physical manner, strategically located in the most crowded places by users, allowing them to buy the digital currency without needing a bank account, debit card or credit card.

In the city of Cali, Colombia, within the Unicentro Shopping Center, a Bitcoin cashier was put into operation, and being something so striking and novel, many users began using their service which generated a “queue” or waiting line.

For the company that owns this ATM it is important to know the characteristics of the service it is providing, to evaluate the feasibility of its implementation, tending to inquire about: the length of the line that is formed to use its service, the average time what happens for a user to be treated, the probability that the cashier is busy, etc.

For this, the entity wishes to apply a study of waiting lines, and the first thing to do is to obtain the data during the “peak hour” of a day, which represents what is known as the average rate of arrival of users and the average rate of service of the cashier, situation that will allow obtaining the characteristics of the service through an M / M / 1 model.

After obtaining these data, before calculating the average arrival rate and the average service rate, with them a goodness test should be performed and adjustment in both to ensure that they follow a Poisson distribution and an exponential distribution respectively.

To perform the goodness test and fit with the Chi-square distribution χ^2 , the following process must be carried out:

1. Obtain the observed frequency (F.O), coming from a survey, study or experiment.
2. Determine the expected frequency (F.E), using the probability distribution that the data is expected to follow.
3. Set the significance level (α).
4. Determine the degrees of freedom in the following way: g.d.l. = K - 1, where K is the number of categories (rows) of the sample. For each population parameter that has to be estimated from the sample data, one (1) additional degree of freedom is subtracted.
5. Raise the hypothesis: H0: what supports the supposed value of the parameter; H1: what contradicts the supposed value of the parameter?
6. Calculate the value of χ^2 by clearing the values F.E and F.O in the equation:

$$\chi_c^2 = \sum_{i=1}^n \frac{(F.O - F.E)^2}{F.E}$$

7. Calculate the value of χ^2 according to its distribution table using the values of (α) and g.d.l.
8. Compare the value of the calculated χ^2 with the value of χ^2 in the table, yes:

Value of calculated χ^2 < Value of χ^2 of the Table:

THE H0 IS NOT REJECTED, otherwise

THE H0 IS REJECTED and H1 is accepted.

For this problem, the Excel program will be used to perform the goodness and adjustment test. Next, the

process is developed step by step for the arrival data of users to the cashier:

1. See Tables 3 and 4.
2. To obtain the expected frequency (F.E) one must first obtain the probability of occurrence of each number of arrivals using the Poisson distribution. To do this, calculate the average (λ) of the data whose value

Table 3. Data of arrival of users to the bitcoin ATM in "Rush Hour"

Arrivals (X)	Observed frequency
0-2	6
3	9
4	13
5	10
6	7
7 or more	5
Total	50

Table 4. Bitcoin cashier service time data at "Rush Hour"

Time (minutes)	Observed frequency
0-2	9
2-2,5	8
2,5-3	5
3-3,5	4
3,5-4	3
>4	1
Total	30

Table 5. Results of the goodness test process and adjustment for user arrival data to the cashier

K	Arrivals (X)	Observed frequency	P(X) according to the distribution of	Sample	Expected frequency	(FO-FE) ² / FE
1	0-2	6	0,2381	50	11,91	2,9291
2	3	9	0,1954	50	9,77	0,0604
3	4	13	0,1954	50	9,77	1,0691
4	5	10	0,1563	50	7,81	0,6111
5	6	7	0,1042	50	5,21	0,6152
6	7 or more	5	0,1107	50	5,53	0,0515
	Total	50	1,0000	-	50,00	-
λ	4	α	0,05	Chi square calculated		5,3364
Freedom degrees (g.d.l)			4	Ci square table		9,4877

obtained should be rounded to the nearest whole number.

Then, those values of λ are used as parameters of the function POISSON.DIST, to calculate the probabilities of each category respectively (in this case, for the first category the probabilities of the number of arrivals "0", "1" and "2").

Then each probability obtained is multiplied by the total number of data used to find the expected frequency according to the Poisson probability distribution.

3. For this problem a significance level (α) of 5% will be used.
4. In this case, the value of K is 6, having to determine the value of λ previously, therefore: g.d.l. = 6 - 1 - 1 = 4.
5. The hypotheses of the problem are:
H0: the observed frequency of the number of arrivals per hour at the Bitcoin ATM in Unicentro follows a Poisson distribution.
H1: the observed frequency of the number of arrivals per hour at the Bitcoin ATM in Unicentro DOES NOT FOLLOW a Poisson distribution.
6. The values F.E and F.O, previously obtained for each category in a respective way, are cleared then all these values are added to calculate the value of χ^2 .
7. To obtain the value of the χ^2 according to its distribution table, the CHI.INV TEST function is used and the value of α and g.d.l of the problem are used as parameters.

The result of this process should be as shown in Table 5.

8. When comparing the calculated Chi squared with the Chi square of the Table, it can be concluded that: “with a level of significance of 5% and a calculated chi-square of 5.3364 less than the chi-square of table 9.4877, it is established that the observed frequency of the number of arrivals per hour to the Bitcoin ATM in Unicentro follows a Poisson distribution”.

Subsequently, the same process is developed to calculate the weather service cashier Bitcoin Unicentro in “rush hour”, but this is not shown to not make repetitive article, as the first solution serves as a reference for what here it is intended to demonstrate.

5. Conclusions

The articulation between different processes that previously seemed disconnected, given their origin and their scarcely interrelated analysis techniques, now becomes, thanks to the multisectorial environment allowed by the information society, a viable possibility.

Such is the case of the confluence that may exist between the theory of information management, which are based on qualitative analysis, and those of operations research (especially Markov Chains), whose techniques are more suited to analysis quantitative, from where the present article is constructed to show a practical case of management and transformation of information, having as an epicentre the Bitcoin cryptocurrency.

As can be seen throughout the text, the results presented allow evidence that it is possible to combine both techniques to characterize this cryptocurrency, determine its evolution in the market and forecast, somehow, its future performance, providing thus valid information and timely, that allows its users a little more reliable handling from the scientific point of view.

In this way, it was established that, according to the probabilities, the Bitcoin crypto currency is a really stable resource, and it can even be said that in the long term it will continue to be used to transfer value, with a constant upward trend, with a similar behavior, measuring the proportions, to what happens with an asset as safe as gold is.

Finally, it can be said that this article shows that no matter how complex, volatile, emergent, novel or modern an object or process may be, it can be studied with the classical analysis tools associated with information,

especially now that there are possibilities for its complementarily in this type of exercises, as it has been in evidence.

6. References

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