


PROBABILITY OF CONTINUOUS USE OF THE DELIVERY SERVICE IN A LIMA COMMUNITY: AN APPLICATION OF THE MARKOV CHAINS

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 21 February 2023</p> <p>Accepted 28 April 2023</p>	<p>Purpose: The objective of this research is to determine the probability of the continuous use of <i>delivery</i> in a Lima community in a scenario of normality so that organizations can predict future scenarios by managing uncertainty and, in addition, plan the efficient use of resources.</p>
<p>Keywords:</p> <p>Cadenas de Markov; Delivery Service; Probability.</p> 	<p>Theoretical framework: Organizations, to increase access to their products, design different distribution channels; These have become strategic actors during the health emergency such as the delivery service The technique used is Markov chains, a method that allows estimating and predicting the behavior of the variables in the state of normality.</p> <p>Design/methodology/approach: The research design is non-experimental; In response, a questionnaire was applied to the sample of a locality in Lima (Peru). Its reliability was measured by Cronbach's alpha; In addition, the technique for estimating probabilities adheres to stochastic methods; these are the Markov Chains.</p> <p>Findings: Among the most relevant results, it was determined that the probabilities can help decide the continuity of this service, along with the possibility of expanding the channels for organizations and the possibility of generating employment in economically vulnerable communities.</p> <p>Research, Practical & Social implications: It is suggested for future research to analyze whole city of Lima and conclude if the probability is similar like community.</p> <p>Originality/value: The results indicate the probability of continuing of service delivery in the normality.</p> <p>Doi: https://doi.org/10.26668/businessreview/2023.v8i5.1848</p>

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PROBABILIDADE DE USO CONTÍNUO DO SERVIÇO DE ENTREGA EM UMA COMUNIDADE DE LIMA: UMA APLICAÇÃO DAS CADEIAS DE MARKOV

RESUMO

Objetivo: O objetivo desta pesquisa é determinar a probabilidade de uso contínuo da entrega em uma comunidade de Lima em um cenário de normalidade para que as organizações possam prever cenários futuros gerenciando a incerteza e, além disso, planejar o uso eficiente dos recursos.

Referencial teórico: As organizações, para aumentar o acesso a seus produtos, projetam diferentes canais de distribuição; estes se tornaram atores estratégicos durante a emergência sanitária, como o serviço de entrega. A técnica utilizada é as cadeias de Markov, um método que permite estimar e prever o comportamento das variáveis no estado de normalidade.

Desenho/metodologia/abordagem: The research design is non-experimental; In response, a questionnaire was applied to the sample of a locality in Lima (Peru). Its reliability was measured by Cronbach's alpha; In addition, the technique for estimating probabilities adheres to stochastic methods; these are the Markov Chains

Resultados: Entre os resultados mais relevantes, foi determinado que as probabilidades podem ajudar a decidir a continuidade deste serviço, juntamente com a possibilidade de expandir os canais para organizações e a possibilidade de gerar empregos em comunidades economicamente vulneráveis.

Pesquisa, implicações práticas e sociais: Sugere-se para pesquisas futuras analisar toda a cidade de Lima e concluir se a probabilidade é semelhante à da comunidade.

Originalidade/valor: Os resultados indicam a probabilidade de continuidade da prestação de serviços na normalidade.

Palavras-chave: Cadenas de Markov, Serviço de Entrega, Probabilidade.

PROBABILIDAD DE USO CONTINUO DEL SERVICIO DE DELIVERY EN UNA COMUNIDAD LIMEÑA: UNA APLICACIÓN DE LAS CADENAS DE MARKOV

RESUMEN

Propósito: El objetivo de esta investigación es determinar la probabilidad del uso contínuo del *delivery* en una comunidad limeña en un escenario de normalidad a fin de que las organizaciones sean capaces de predecir escenarios futuros mediante el manejo la incertidumbre y, además, planifiquen el uso eficiente de los recursos.

Metodología: El diseño de investigación es de tipo no experimental; en atención a ello, se aplicó un cuestionario a la muestra de una localidad de Lima (Perú). Su confiabilidad se midió mediante el alfa de Cronbach; además, la técnica para estimar las probabilidades se ciñe a los métodos estocásticos; se trata de las Cadenas de Markov

Conclusiones: Entre los resultados más relevantes, se determinó que las probabilidades pueden ayudar a decidir la continuidad de este servicio, junto con la posibilidad de ampliar los canales para las organizaciones y la posibilidad de generar empleo en comunidades económicamente vulnerables.

Implicaciones de la Investigación: Se sugiere para futuras investigaciones explorar las adopciones de la manufactura esbelta propuestas en artículos de revistas indizadas con la finalidad de conocer sus experiencias y adaptarlas a la realidad nacional.

Palabras clave: Cadenas de Markov, Servicio de Delivery, Probabilidad.

INTRODUCTION

The work carried out by logistics is currently fundamental for any organization, whether in the industrial or service area. (Tang & Veelenturf, 2019), Since it is in the permanent search to improve the strategies that impact the productivity of the processes involved (Perboli & Rosano, 2019). The different logistics activities are essential for the development of the community, because they generate efficiencies between the entities and economic development in the communities that allow access to competitive prices and obtain jobs linked to this activity

(Adarme et al., 2014). In this sense, logistics is especially relevant to ensure the sustainability of the organization (Patitad et al., 2020), Especially for Peruvian SMEs, as it is an indispensable tool in supporting their growth (Flores, 2020).

Logistics incorporates different types of strategies: such as the case of lean or just-in-time manufacturing. Both are executed to achieve the integration of the operations (Waters, 2018), applicable worldwide. Therefore, it is important as part of the model of reducing time and increasing efficiency. (Wang et al., 2021), since this model allows us to identify problems and eliminate waste. Customers require that products arrive in the shortest possible time, without increasing costs and with the required quality (Carreño, 2018). This system proposes to provide the products whenever they are needed, or request them with almost immediate response capacity (Plazas et al., 2018), Its main function is the mitigation of both the risks and the insecurity of shipments, so that opportunity and convenience are guaranteed through a holistic vision of the outbound logistics process, understood as the completion of the customer experience in the supply chain. (Adarme et al., 2014). As such, proximity to suppliers and proper coordination with customers are the core factors of the effectiveness of this model; Therefore, timely supply is essential to meet consumer requirements. (Sós & Földesi, 2021).

The health crisis forced people to stay at home and, at the same time, keep the family economy stable (Barcena, 2020). The new conditions derived from the pandemic, in turn, generated the challenge of adapting to technology abruptly and quickly, through digital platforms and applications. Then, a consequence of the pandemic was the need for various required products to reach the door of users' homes in compliance with health and biosafety standards; Therefore, the intensive use of applications was favored (Sánchez Suárez et al., 2021). According to Arellano (2019), applications related to *the delivery* service grew exponentially in Lima with the entry of transnational operators that, predominantly, were linked to the restaurant sector. However, *delivery* is very dynamic, as operators enter different economic sectors and help organizations to achieve an additional channel that guarantees their sustainability, This medium increased during the health emergency (Insawan et al., 2022). *Delivery* linked to food was boosted thanks to technology, as it provided access to applications such as Uber Eats (launched in 2017); Glovo, launched in the last quarter of 2017; and Rappi, during the last quarter of 2018. Apps increased transaction volume by 9% and sales by 6% compared to 2018 and 2019 (Correa & Figueroa, 2019). *Delivery* services are fundamental in different commercial sectors, supermarkets, and restaurants since they concentrate on the

largest volume of transactions; in addition, their expansion to other sectors is imminent in Peru (Lozano, 2021).

According to the above, the research aims to meet the objective of knowing the probability of continuity of the delivery service in a community of Metropolitan Lima. For this, stochastic methods were applied using the Markov chain.

LITERATURE REVIEW

The use of applications related to *delivery* services is a striking way to look for opportunities to increase the volume of operations because companies use applications as another channel to increase their revenues. In addition to this, people choose applications as a means to get a job. (BBC News, 2020). An interesting fact is the following: a part of the population adapted to *delivery* services through applications whose intensity in use increased from the health emergency (Aguerrevere et al., 2020). It will be interesting to analyze the development in the coming years according to consumer trends and new habits acquired during the health emergency (Lise, 2021).

Troise (2021) considers as an alternative solution for Latin America the use of delivery services, because for Latin American users it can be a habit, and this behavior was evidenced more frequently in the *delivery* of fast food and other products, generally in the retail sector (Lozano, 2021), where users are inclined to use to consume in restaurants and fast food establishments (Cortés, 2016). According to research de Macías-Rendón (2021), The satisfaction of customers when consuming fast food and requesting it through *delivery* generates a positive perception regarding the use of these applications. Even this can be sustainable in the market because it allows the acquisition of products without leaving home and increases the volume due to the convenience of the use of applications. Companies have already identified this service as a new channel for the growth of their businesses; therefore, it is a way out of the crisis and allows adaptation to the new commercial system. (Jijón, 2020). The increase in the volume of *delivery* service increased by almost 250% due to the health emergency (Lozano, 2021); This phenomenon occurred due to the need to obtain products minimizing the risks of infection and seeking preventive measures against it; In addition, the convenience of the service caused some people to consider it a usual service in the future.

As for methodological procedures, the Markov chain is a technique that allows probabilistic forecasts, as well as being a methodological alternative with which potential predictions about future behaviors are made. (Delgado-Moya & Marrero-Severo, 2018).

These tools are considered successive continuous processes of random variables that are dependent; Thus, the future state of an event depends on its current position and not on past events. (González-Campos et al., 2020), because it incorporates systems that modify its state over time; therefore, it is highly plausible to execute the decision-making that will affect or favor our interests. (Panday et al., 2020). The research of González-Campos (2020) is evidence of the formulation of predictions about student dropouts at a university; to do this, he used the Markov string method as a predictive method.

MATERIAL AND METHODOLOGY

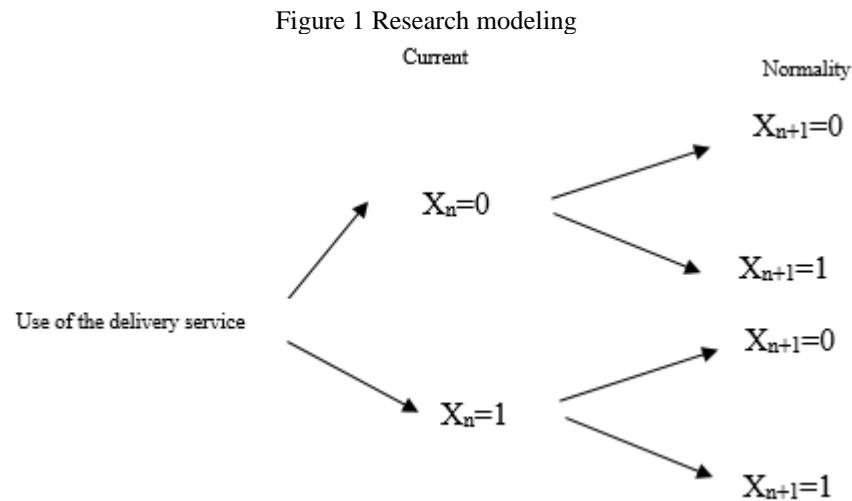
The research is non-experimental, as it analyzes the behavior of users of delivery services in future states (normality); In this sense, it is a study focused on a specific phenomenon, so that, after the analysis, it is possible to observe the causes and consequences of the use that customers evidence (Mastana, 2023), all after the succession of phenomena whose basis is the probability of transition (Cancela et al., 2010). The nature of events is little known in estimating the sustainability of a service related to the use of delivery in a community after the health emergency. In this case, the service was not usual according to the description of its usage profile in the community that was studied. (Garcia & De Amo, 2015).

Markov chains are a key element in determining the evolution of certain business aspects, especially those that are subject to constant variations (Velásquez, 2019). Therefore, they serve as support in addressing economic points (Sánchez, 2018); it is a different way of controlling management factors; for example, it is possible to evaluate such factors in a business, so that approximations or estimates are made based on Markov chains. Additionally, it is considered a method that is far from exact; However, it is very useful to make long or very long-term forecasts depending on the case (Fonollosa, 2017).

Modeling

For the development of the work, probabilistic data were required (Gómez, 2015). According to Albornoz (2006), the Markov chain is a stochastic method based on probabilities of states verified from probability sequences. In this sense, p is the relative probability of the people in the community who use the delivery service (period n). The next period of the study is considered normal. in the period $(n+1)$; In addition, q is the probability of people not using the service in (period n); In the same way, after normality, the state is expressed as $n+1$; that is, the non-use of the service normally. In the states, we denote as 0 the representation of the

current employment of the delivery service, and state 1 would indicate the behavior of non-use of the service. The initial probability would be denoted as $P(X_0=0)$ symbolized as the probability that the user will use the delivery service. In the following state, the probability in normality with the same user behavior is denoted as $P(X_{n+1}=0/X_n=0)$; in addition, the one who is a non-user and who would use in the future would be the following $P(X_{n+1}=1/X_n=0)$; $P(X_{n+1}=1/X_n=1)$; $P(X_{n+1}=0/X_n=1)$ (González-Campos et al., 2020).



Source: Prepared by the authors (2023).

Sample and Population

To carry out the research, official statistical information was used from the 2017 national census, carried out in the district of San Juan de Lurigancho, specifically in the town of Jicamarca, which includes a total of 11,000 inhabitants. In the selection of the sample, simple random sampling was used, because the objects of the studies present the same possibility of being chosen (Pulido, 2021). Population growth was not considered until 2022, since official information regarding the next national census to be held in 2026 was lacking. To obtain the initial probability for the calculation of the sample size, a pilot of 10 people was carried out to know those who use (p) or do not use the service ($q=1-p$), with an estimated error of 5% and a confidence level of 95%.

Table 1 Sample size calculation

CONFIDENCE LEVEL	95 %
p=	80 %
q =	20 %
n =	11 001

Source: Prepared by the authors (2023).

$$n = \frac{(Z_{\alpha/2}^2)(p)(1-p)(n)}{(n-1)(e)^2 + (Z_{\alpha/2}^2)(p)(1-p)}$$

$$n = 240.5$$

As for the research instrument, it is a questionnaire consistent with the Likert scale, that is, it is an instrument that contemplates levels expressed in the following terms: "strongly disagree" (1) and "strongly agree" (5), which are consistent with the work of Herzog (2014). The questionnaires were applied with Markov chains consistent with the work of which the prediction of the safety culture of health personnel of a hospital in Mexico was established. Additionally, the questionnaire was developed in March 2021 in Google forms and a total of 137 were answered and validated.

Table 2 Instrument

<i>Questionnaire questions</i>	1	2	3	4	5
Do you use the <i>delivery</i> service?					
Is the price of these services comfortable for your economy?					
Is the time you arrive home fast and efficient?					
Are biosecurity measures appropriate and safe?					
Are third-party products reliable and efficient?					
Is the Rappi app the most frequently used?					
Is the Glovo app the most frequently used?					
Is the <i>Uber Eats</i> app the most frequently used?					
Would you use the <i>delivery</i> service again after the pandemic?					

Source: Prepared by the authors (2023).

To measure the consistency of internal reliability, Cronbach's alpha was used, defined as the correlation of the scales of the interest group with another study whose size is the same and measures the same construct of analysis (McNeish, 2018); reliability is described as the coherence of the results, which occur at different times or groups (Fallis, 2013). As for the questions, they were processed using Minitab software. The following results were obtained in internal reliability.

Table 3 Results of Minitab Software

Variable	Conteo total	Media	Desv. Est.
p1	137	3.454	1.303
p2	137	3.697	1.239
p3	137	3.711	1.235
p4	137	3.761	1.206
p5	137	3.587	1.213
p6	137	2.693	1.612
p7	137	2.800	1.654
p8	137	3.328	1.577
p9	137	3.872	1.240
Total	137	30.904	9.222

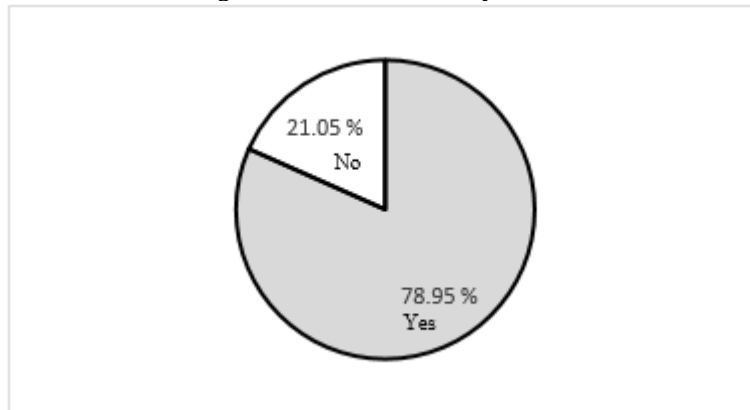
Alfa de Cronbach

The reliability result shows a value of 0.8995 (Cronbach's alpha) obtained in the study. This demonstrates high internal consistency (Adzrie & Armi, 2021).

RESULTS AND DISCUSSION

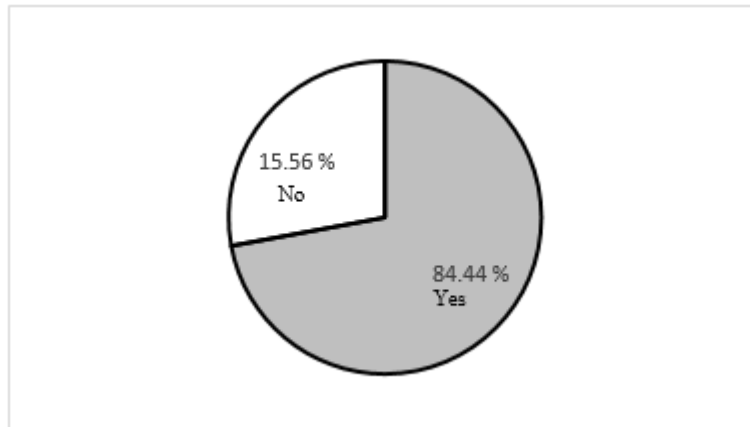
At the end of the study, 137 responses were validated. The descriptive ones were processed and the study of the people who use the *delivery* service was obtained. The result is $P(X_n = 0) = 78.95 \%$. As for those people who do not use the *delivery* service, the result is $P(X_n = 1) = 21.05 \%$

Figure 2 Use of the delivery service



Source: Prepared by the authors (2023).

Figure 3 The continuity of the use of the delivery service



Source: Prepared by the authors (2023).

$P(X_{n+1}=0) = 84.44\%$ indicates that you are completely sure that you will continue to use these services. This result shows a $P(X_{n+1}=1) = 15.56\%$ to an audience that still expresses doubts about its use. This determines that the degree of acceptance of the service is high; In addition, it allows us to project that, in the future, this service will remain one of our consumption habits.

Table 3 shows the data on the behavior of users who use the service and, in the future, will continue or not; in addition, those who do not use it and will use it in the future are included.

Table 4 User behavior research results

	YES	NO	
YES	92	16	108
NO	24	5	29
TOTAL			137

Source: Prepared by the authors (2023).

With the data obtained from the study, the following transition matrix was developed.

Table 5 Transition matrix

	YES	NO
YES	84.35 %	15.65 %
NO	84.78 %	15.22 %

Source: Prepared by the authors (2023).

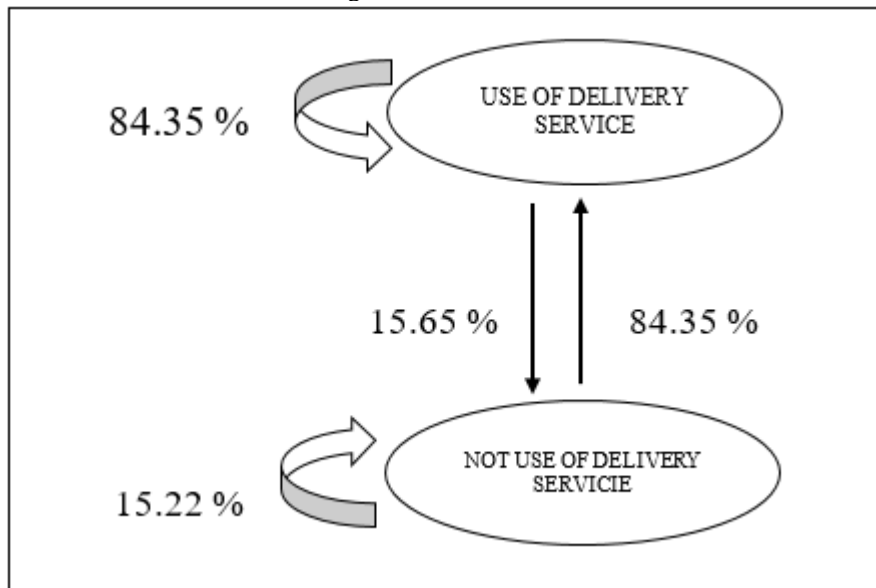
Table 6 Probability of the transition matrix

	YES	NO
YES	$P(X_{n+1}=0/X_n=0) = 84.35\%$	$P(X_{n+1}=1/X_n=0) = 15.65\%$
NO	$P(X_{n+1}=0/X_n=1) = 84.78\%$	$P(X_{n+1}=1/X_n=1) = 15.22\%$

Source: Prepared by the authors (2023).

The above information allows to evidence conditional probabilities; for example, in the case of customers who are using and will continue to use the *delivery* service, the result is de 84.35%. The probability of users who are using and will not continue to use in the future is 15.65%. In the same way, those who do not use the delivery service and who possibly use it yields a result of 84.78%; as for those who do not use the *delivery* service and who will not use it in the future, the result is 15.22%.

Figure 4 Markov chain



Source: Prepared by the authors (2023).

Operating the initial state matrices with the transition matrix, it is detected that the probability matrix yields results on the following: in the future state the customer will continue to use or not the *delivery* service.

Figure 5 Result of development using Markov chains

$$\begin{matrix}
 (0.7895 & 0.2105) & \times & \begin{pmatrix} 0.8435 & 0.1565 \\ 0.8478 & 0.1522 \end{pmatrix} \\
 \text{YES} & \text{NO} & & \\
 [0.8444 & 0.1555] & &
 \end{matrix}$$

Source: Prepared by the authors (2023).

Within the framework of the study, the results show that the users who will continue to use the *delivery* service is 84.44%; regarding those who will not use the service, the percentage is 15.56%. In this sense, it is more likely that this service will be the basis for the development of new service channels and acquire growth prospects; This is important for organizations and

the community because it is a source of employment. Likewise, the use of some application brands will be relative in environments of greater economic vulnerability, since this service adapts to the models created by the same organizations. An additional aspect related to the above is that users adapt to their habits and consumption.

CONCLUSION

The continuity and acceptance of the delivery service is consistent with convenience, affected by the delivery time to the home and the efficiency that this service provides to users; to this are added the non-onerous costs. The research carried out by Macías-Rendón (2021) determines that the satisfaction of customers who opt for the *delivery* service is conditioned by the speed of the service. This determines what factors condition the preference of users in each *delivery* service, as well as the distinction between those who influence or do not and contribute to the strategies. In this way, companies know what they should focus on for this audience.

The probabilities of using the service are not exact quantities, since these are approximations of events in the following state (Fonollosa, 2017). However, the development of the research reduces the uncertainty of the continuity of the delivery service business in a community of Lima (Peru).

It is recommended to conduct research involving the relationship between benefit and cost related to the delivery of the *delivery* service. Possible inquiries should analyze the economic viability and cost that the customer is willing to pay at most for each shipment, in addition to how much would be the minimum amount of dispatch needed by each transport unit to reach equilibrium.

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