Empowering Nanostores: Predictive Modeling for Economic Sustainability in Culiacán

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Maximiliano Osuna Zatarin[1]   Ismael Alexander Cruz López[2]
Alejandro Ibarra Espinoza[3]   Diego Alejandro Malo Osuna[4]   Iván Pacheco Soto[5]

[1,2,3,4,5]Instituto Tecnológico y de Estudios Superiores de Monterrey
[1,2,3,4]Estudiante licenciatura, [5]Profesor
E-mail: {[1]A01742931, [2]A01743131, [3]A01743290, [4]A01741785, [5]ipacheco}@tec.mx

I   Introduction

Nanostores, small family-owned businesses in Mexico known as *tienditas*, *changarros*, or *fonditas*, are vital to the local economy, especially in low-income areas. They sell daily necessities like food, beverages, and cleaning supplies, playing a significant role in supporting family economies for generations. However, modern retail formats like supermarkets and chain convenience stores threaten their survival.

Research shows nanostores' resilience and adaptability. Mora-Quiñones et al. (2021) highlighted their coexistence with modern retail formats in Mexico City, indicating that nanostores thrive despite increasing competition from chain convenience stores and modern channel stores. Eustis and Sonnenberg (2023) proposed innovative business models to support nanostores in emerging markets, emphasizing the importance of direct feedback from store owners. Escamilla et al. (2021) suggested enhancing nanostores' competitiveness by improving supply chain agility, adaptability, and alignment.

This collaboration with the Low Income Firm Transformation Lab of the Massachusetts Institute of Technology (MIT LIFT Lab) aims to build on these studies by developing mathematical models to understand the factors influencing nanostores' success and sustainability in Mexico. By using primary survey data and secondary data from INEGI, the study aims to provide actionable insights to improve the performance and longevity of nanostores.

II   Objective

The primary goal is to identify factors that influence nanostores' success and longevity in Culiacán, Sinaloa, Mexico. This involves using surveys and secondary data from INEGI to develop predictive models that enhance stores' efficiency, focusing on specific goals such as conducting surveys, developing regression models, and publishing the findings.

III   Statistical methods employed

The MIT LIFT Lab provided a 42-item questionnaire and training on data collection and analytics using Tableau and Python. The survey was administered face-to-face using a Google Form with GPS location recorded automatically. A non-probability, convenience-based sampling method was used to select nanostores, ensuring geographic diversity. Data collection involved 47 students from Tecnológico de Monterrey, each tasked with gathering information from five nanostores near their homes for security reasons.

Collected data were cleaned and organized for analysis. Descriptive statistics were used to summarize data distribution. Geospatial analysis was conducted using the Mapa Digital de México app and the software Tableau. Python scripts located nanostores by AGEBS, with code available on GitHub.

Linear regression techniques were primarily used for predictive modeling, identifying significant predictors of nanostore success. The model was improved using dummy variables, Box-Cox transformation, and step-by-step selection methods.

IV   Main results

The analysis identified significant predictors of nanostore success, such as business type, neighborhood, monthly sales, impact of crime, competition, bank credits, and the owner's age and education. Visualizations of nanostore locations with variables like longevity highlighted contrasts between downtown and outlying areas.

The initial linear regression model provided an R-squared value of 72.45%, showing a strong fit. After optimization with Box-Cox transformation and step-by-step regression, the R-squared value improved to 88.56%, indicating high predictive accuracy.

A dashboard was created in Looker Studio to publish findings, incorporated into a website named Abarrotek, which includes relevant information for nanostore managers.

V   Conclusions

The developed model effectively predicts nanostores' longevity, highlighting the importance of factors like business type and neighborhood. Tailored strategies based on these models can significantly enhance nanostores' economic performance and sustainability.

Keywords

Nanostore, retail, multiple linear regression, spatial analysis.

References

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