ISSN:
3091-1796
Vol. 4 No. 10 PP. 278-296

DOI:
https://doi.org/10.56519/3z2v7634
Agosto 2026

APLICACIÓN DE MODELOS MATEMÁTICOS PARA FORTALECER LA SOSTENIBILIDAD Y COMPETITIVIDAD DE LOS EMPRENDIMIENTOS EMPRESARIALES EN ECUADOR

APPLICATION OF MATHEMATICAL MODELS TO STRENGTHEN THE SUSTAINABILITY AND COMPETITIVENESS OF BUSINESS VENTURES IN ECUADOR

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Fecha de recepción: 13/07/2026 / Fecha de aceptación: 16/08/2026 / Fecha de publicación: 25/08/2026

RESUMEN: Los emprendimientos y las micro, pequeñas y medianas empresas (MiPyMEs) son motores fundamentales de la economía ecuatoriana; sin embargo, su supervivencia es frágil debido a la falta de planificación estratégica y herramientas de gestión adecuadas a los requerimientos administrativos, principalmente en lo que se refiere a la implementación de modelos matemáticos financieros de utilidad práctica en el día a día. Por esto, el objetivo principal de esta investigación es analizar la importancia de los modelos matemáticos en la eficiencia de la gestión empresarial de los emprendimientos en Ecuador, y así determinar su utilidad en la reducción de la incertidumbre, la metodología empleada es de enfoque cualitativo, de alcance descriptivo, en el que se emplea un diseño no experimental y de corte transversal, en la que se implementa como técnica de recolección de datos la revisión sistemática de bibliografía de publicaciones comprendidas entre los años 2022 y 2026, empleando el método prisma. Los hallazgos obtenidos al analizar investigaciones científicas de otros autores, revelan una marcada tendencia hacia la gestión empírica e intuitiva de los emprendedores en Ecuador y otros países de América Latina, identificando la existencia de una distancia significativa entre la teoría financiera y su ejecución práctica, herramientas como la programación lineal y el análisis predictivo incrementa significativamente la eficiencia y la rentabilidad, siendo los recursos tecnológicos intangibles el factor de mayor impacto en el rendimiento organizativo. Se concluye que la sostenibilidad de los emprendimientos depende de la transición hacia una planificación basada en datos y modelos cuantitativos que permitan identificar puntos de equilibrio y optimizar recursos, por lo cual, resulta imperativo fortalecer la formación técnica de los gestores para mitigar riesgos y asegurar la competitividad en mercados volátiles.

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Vol. 4 No. 10 PP. 278-296
DOI: https://doi.org/10.56519/3z2v7634
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Palabras clave: ***Modelos matemáticos, emprendimiento, gestión administrativa, toma de decisiones, sostenibilidad financiera***

ABSTRACT: Entrepreneurship and micro, small, and medium-sized enterprises (MSMEs) are fundamental drivers of the Ecuadorian economy; however, their survival is fragile due to a lack of strategic planning and management tools suited to administrative requirements, particularly regarding the implementation of practical financial mathematical models for daily operations. Therefore, the main objective of this research is to analyze the importance of mathematical models in the efficiency of business management for entrepreneurship in Ecuador, and thus determine their usefulness in reducing uncertainty. The methodology employed is qualitative, descriptive, and uses a non-experimental, cross-sectional design. Data collection is carried out through a systematic literature review of publications from 2022 to 2026, using the PRISMA method. The findings obtained from analyzing scientific research by other authors reveal a marked trend toward empirical and intuitive management by entrepreneurs in Ecuador and other Latin American countries. A significant gap exists between financial theory and its practical application. Tools such as linear programming and predictive analytics significantly increase efficiency and profitability, with intangible technological resources being the factor with the greatest impact on organizational performance. It is concluded that the sustainability of ventures depends on the transition to planning based on data and quantitative models that allow for the identification of break-even points and the optimization of resources. Therefore, it is imperative to strengthen the technical training of managers to mitigate risks and ensure competitiveness in volatile markets.

Keywords**: Mathematical models, entrepreneurship, administrative management, decision-making, financial sustainability

INTRODUCTION

At the current time, entrepreneurship, micro, small and medium-sized enterprises (MSMEs) have established themselves as important drivers of economic activity and job creation, both in Ecuador and globally, this largely responds to the impact of new technologies and the transition of commercial activities towards the digital era, as well as the need of the population to build independent means of income in the face of the financial uncertainty of recent times both nationally and internationally, contributing to energizing emerging economies (1).

However, its permanence over time is still considered fragile in the Ecuadorian context, despite having one of the highest rates of entrepreneurial activity in Latin America, critical levels of discontinuity and permanence are recorded, this can be attributed to the lack of strategic planning and the implementation of appropriate management tools (8). Despite the indisputable role of MSMEs as drivers of local development, a significant disconnect persists between the abstract rigor of financial mathematics and the daily decision-making of small business owners. This theoretical-practical gap has not been effectively resolved so far, which generates a void in this field of knowledge. Most

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traditional management models have been formulated for large companies and corporations with a formal structure, on the other hand, in the pedagogical field.

The teaching of mathematics applied to administration has historically been characterized by rigid, theoretical and decontextualized approaches. This lack of didactic articulation generates a low motivation towards learning and even a marked anxiety in students, as well as a lack of interest in applying them in everyday life situations or commercial processes of particular initiative. In addition, microentrepreneurs who start their businesses empirically usually base their management on intuition or the urgency of daily cash flow. fear or distrust of formal methods, which they may consider complicated or exclusive to banking entities or overestimate their own skills and previous experiences, wrongly assuming that strategic and technical planning is not necessary for the survival of the business (1).

This is why this research seeks to delve into a little explored area and contribute with solid and practical contributions, for the efficient application of the tools that mathematics can provide in a tangible way, analyzing the way in which the application of algebraic limits, linear programming and predictive analysis act as preventive diagnostic tools and providing a contextualized financial literacy framework that translates scientific precision into viable operational decisions for all micro-entrepreneurs.

The competitiveness of any commercial organization is linked to its ability to innovate and adapt to a globalized market in constant transformation. Scientific research in this field has evolved from merely theoretical postulates to models focused on the analysis of determining factors of organizational success and sustainability. In this context, mathematical models are defined as logical structures and simplified representations of reality that use statistical principles to describe, analyze and predict complex behaviors.

“The mathematical model is an effective tool for business management [...] allowing precise quantitative solutions to be obtained, providing a solid basis for making informed and effective decisions in the business context" (19). Their importance lies in the fact that they represent a fundamental link between academic theory and practical execution, facilitating a greater understanding of the causes that encourage business development (1; 16).

Despite its usefulness, there is a significant lack of coherence between the theory of financial mathematics and real business practice in which decisions based on intuition, empirical experience or the urgency of daily cash flow predominate, leaving aside technical analysis on the value of money, interest rates or projected profitability.

Financial mathematics, as a discipline, offers rational tools to evaluate decisions related to the time value of money, interest rates, financing, investment, amortization and profitability (5). Research in this field reveals that entrepreneurs rarely apply structured knowledge in their business management, which increases exposure to unnecessary financial risks and compromises the efficiency of the organization (Chocobar-Reyes, 2023).

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The implementation of quantitative tools, such as linear programming, allows companies to optimally allocate resources such as capital, raw materials and labor in order to maximize profits or minimize operating costs (9).

Beyond basic accounting, decision making can be made more technical through calculation. Sánchez (2023) proposes a model where 'the data are managed in a single equation that, when derived mathematically, allows establishing the economic value of a product' (p. 1), which gives the entrepreneur a scientific basis to choose the most profitable segmentation strategy (2).

Likewise, predictive analysis transforms large volumes of data into practical knowledge, allowing organizations to anticipate market demands, detect vulnerabilities and strengthen their operating conditions (17), Currently, the integration of technologies such as artificial intelligence enhances administrative efficiency and resilience in the face of market volatility, however, the effective appropriation of these models faces critical cultural and cognitive barriers (3).

New technologies including artificial intelligence provide important contributions to the management of different mathematical and financial functions, the findings of Colmenero-Fonseca et al (2026) demonstrating that the relationship between formal mathematical modeling and AI not only. It is theoretical, but has strong practical effects. In its simulations, the application of machine learning algorithms to optimize energy and productive resources allowed a “potential increase in economic development of up to 40%” (p. 7930).

In general, entrepreneurs do not know how to implement these tools, and there is a general perception that they are excessively complicated or alien to the reality of small businesses, "intuitive decisions predominate, based on personal experiences, informal advice or the urgency of daily cash flow. This disconnection between theory and practice has caused significant gaps that can compromise the economic efficiency of ventures" (5).

On the other hand, social factors and the lack of contextualized financial training limit the use of technical formulas, reinforcing a business culture based on immediate survival rather than long-term planning (6). The transition from an empirical enterprise to a technical one requires that the manager abandon exclusive dependence on intuition.

The adoption of models based on the theory of expected utility and Bayesian decision allows organizations to “identify scenarios, present probability calculations, anticipate adverse situations, externalities and make decisions to mitigate impacts and take advantage of opportunities” (7). This paradigm shift is vital to transform a subsistence initiative into a sustainable company over time.

This is why the main objective of this research is to analyze the importance of mathematical models in the efficiency of business management of ventures in Ecuador. In order to publicize its usefulness, and the benefits of its implementation through different means and training processes, taking into consideration that the success of this type of business contributes to economic strengthening at the national level.

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To guide the development and discussion, the following working hypothesis was proposed:

The systematic adoption of structured quantitative models, such as linear programming, algebraic limits and predictive analysis, supported by an interdisciplinary didactic model and financial literacy will allow overcoming the intuitive and empirical nature of the traditional management carried out by entrepreneurs and small businesses in Ecuador.

MATERIALS AND METHODS

This research is guided by a qualitative approach with a descriptive and explanatory scope. A non-experimental and cross-sectional design is used, using the systematic review of literature through the prism methodology, as the main information collection technique. It is qualitative and non-experimental given that the phenomena are analyzed and observed in their natural environment without the deliberate manipulation of the study variables, while the cross-sectional section is justified by delimiting the data analysis to a specific time period between the years 2022 to 2026 (1).

Its scope is descriptive because it allows to systematically and orderly characterize the particularities of the current state of financial management and quantitative mathematical models in the efficiency of managerial decision making of ventures. To substantiate this process, an exhaustive exploration and scientific abstraction of written sources and formal records were carried out that provide scientific validity to the theoretical framework of the research. Data collection was structured based on a systematic search of scientific literature in databases of high relevance and academic rigor, such as Scielo, Redalyc, Dialnet and Scopus, as well as official university repositories (2).

The search and documentary selection route was guided by the methodological guidelines of the structured filtering and purification system. The search terms and key descriptors used, both in Spanish and English, were managed using Boolean operators, structuring the following query syntax: “mathematical models” OR “linear programming” OR “algebraic limits”, AND, “entrepreneurship” OR “MiPyMEs”, AND, “decision making” OR “financial sustainability” (1, 2).

Strict eligibility criteria were established for the purification and elimination of documents, the inclusion criteria considered that they were empirical, experimental or review studies published preferably in a range of no older than five years from 2022 to 2026, prioritizing the most recent scientific literature, research focused directly on the application of quantitative models, predictive analysis or mathematical optimization algorithms in the context of administrative, service or production management of microenterprises and MSMEs in Ecuador and Latin America.

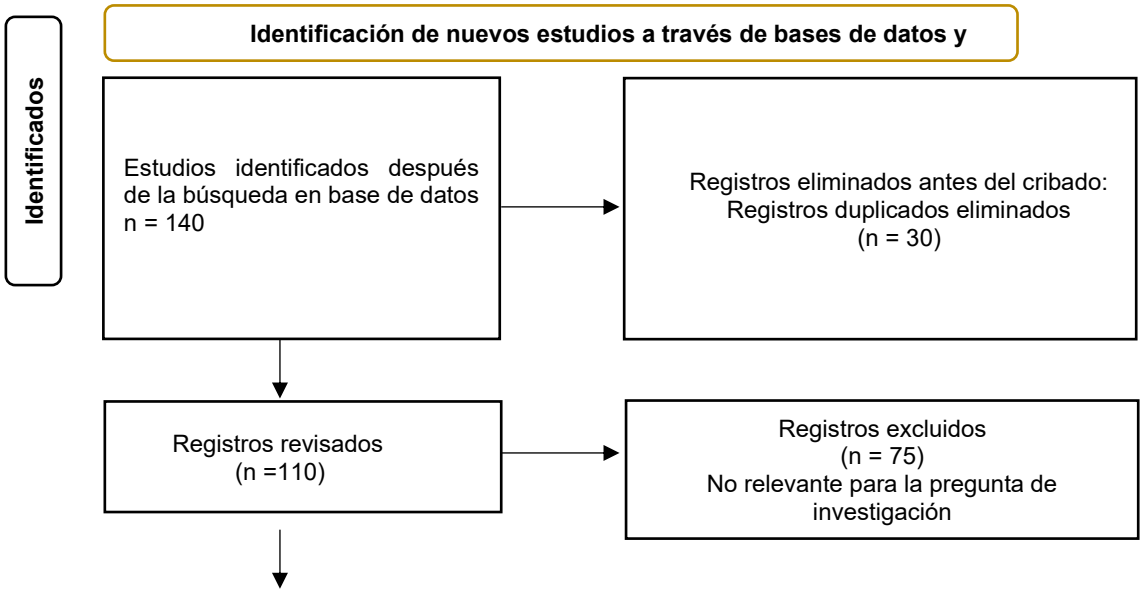
As exclusion criteria, it was considered not to admit abstract mathematical or pure theoretical modeling research that does not present a practical application or direct relationship with business administration or corporate decision making, duplicate

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publications in the databases consulted, documents without explicit methodological rigor or those that did not belong to the thematic areas of business, economics or decision sciences.

The information extracted from the selected documents was carefully organized and tabulated in an analysis matrix, which allowed the analyzed research to be classified under three axes of categorization, identification of the source, indicating the author, year of publication, country of origin and database of origin. The applied mathematical dimension, in which the identification of the analyzed model will be indicated, for example, linear programming, multiple regression, algebraic limits or stochastic simulation. The operational variable evaluated, in this case, the documented impact on the dimensions of profitability, cost minimization, resource optimization, production volume or reduction of financial risk, the findings obtained were contrasted and contextualized taking into consideration the cultural, educational and economic dimension of Ecuador compared to the Latin American reality (4).

RESULTS



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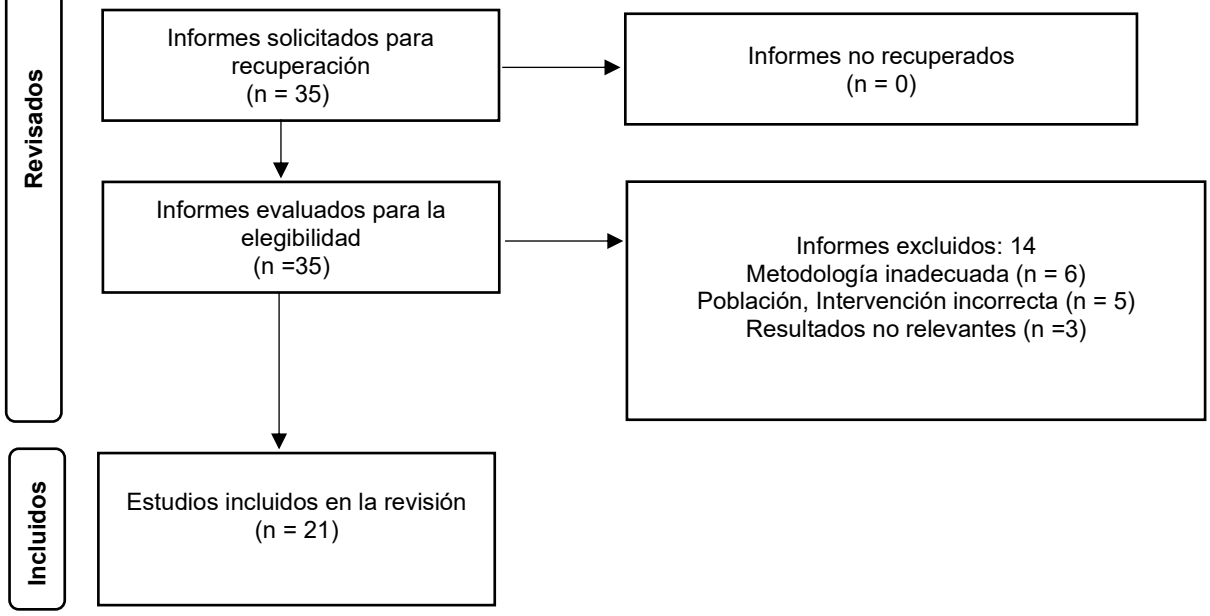


Figure 1. Selection of Research Articles applying the Prism Method.

The selection and purification process of the scientific literature was structured under the standards of the PRISMA 2020 declaration. The initial search in the PubMed, Scopus and Cochrane databases reported a total of 140 potential records, after eliminating 30 duplicate records, a total of 110 articles were subjected to an initial review of title and abstract, excluding 75 documents for not being directly related to the research question or for lacking a focus. of practical application.

Subsequently, 35 reports were requested for complete recovery, and all of them were recovered. In the eligibility phase, a full-text critical reading of the 35 reports was carried out, excluding 14 articles due to the following specific causes: inadequate methodology (n = 6), incorrect scope of application (n = 5) and results not relevant for the mathematical modeling analysis (n = 3). Finally, 21 empirical and experimental studies rigorously met all the inclusion criteria and were incorporated into the systematic review for subsequent tabulation and analysis

Table 1. Document Systematization and Analysis Matrix.

Source (Vancouver)	**Country of Origin / Database**	**Applied Mathematical Dimension**	**Evaluated Operational Variable**	**Finding / Key Contribution of the Modeling**
Sánchez (2023) [2]	Costa Rica National Administration Magazine	**Differential Calculus (Market equation based on first-order derivatives)**	• Segmentation strategies • Profit maximization • Economic value of products	It allows the profitability of each potential level of segmentation to be scientifically determined through a unique equation that links the unit cost with the market coefficient.

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Sarmiento-Tito et al. (2025) [6]	Ecuador Economy and Politics Magazine	**Multiple Linear Regression (Training with 80% of data and validation with 20%)**	• Organizational performance • Financial profitability • Intangible technological resources	It quantifies the impact of management variables in associative ventures in Zone 6, identifying that infrastructure and intangible technological resources are the determinants with the greatest explanatory weight on performance.
Moyano & Taborda (2024) [9]	Colombia Free University	**Linear Programming and Inventory Models (EOQ and Just In Time Systems - JIT)**	• Minimization of operating costs • Supply chain optimization • Raw material purchasing management	Demonstrates how mathematical modeling in operations research optimizes resource allocation and physical-operational flow, reducing storage costs and avoiding shortages.
Reinoso-Salazar et al. (2024) [11]	Ecuador Knowledge Pole	**Algebraic Limits (Analytical modeling through temporal trend lines)**	• Monthly net profitability • Financial break-even point • Income and sales projections	Using mathematical limits as a function of time, it projects the viability and monthly net profit of a local food enterprise ("Empanadas Express"), scientifically determining its equilibrium point and optimal profitability.
Muñiz Arana (2026) [14]	Ecuador International Strategic Knowledge	**Mathematical Programming and Multivariate Analysis (Linear regressions and K-means clustering)**	• Financial risk management • Corporate leverage • Liquidity analysis	Establishes with statistical precision the critical impact of financial leverage on corporate risk ($\beta = 0.48$) and the inverse correlation between available liquidity and instability.
Salgado (2024) [18]	Argentina Revista Unión	**Algebraic-Functional Modeling (Matrix operations and multivariable functions)**	• Structuring of production costs • Projections under inflation (CPI) • Analysis of marginal costs	Develops a dynamic total cost model ($C = CF + CV$) that integrates matrices of threads per amigurumi and adjusts the future values of raw materials by indexing

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				them to the Consumer Price Index.
Farinango-Salazar & Porres-Requenes (2024) [19]	Ecuador RILCO / Dialnet	**Linear Programming (Graphic method, definition of feasible region and objective function optimization)**	• Profit maximization • Optimization of raw materials • Planning production of clothing	Exactly determines the optimal production mix (pillows for furniture vs. bedroom) for the microenterprise "Confecciones Gloria", maximizing economic returns under a budget of $1160.
Romero-Peña & Escudero-Ramírez (2024) [20]	Mexico Strategies, Models and Trends	**Algebraic Breakeven Point (Linear models of costs and income)**	• Setting sales prices • Required sales volume • Projection of profits for 5 years	Develops a practical simulation for the commercial and financial structuring of a food business, calculating the exact number of units to sell to cover fixed and variable costs.
Neri-Guzmán (2024) [1]	Mexico Development Problems / Synectics	**Structural Equation Modeling (SEM) (Validation of the theoretical model of planned behavior using AMOS software)**	• Intention entrepreneurial • Support infrastructure • Attitude and behavioral control	Quantify through a structural model that the intention to undertake has a direct and strong relationship with the academic and institutional support infrastructure (0.576), surpassing subjective family norms (0.35).
Cuellar-Chaves (2025) [7]	Colombia European Public & Social Innovation Review	**Organizational Decision Theories (Scenario simulation, expected utility and Bayesian decision)**	• Risk mitigation • Decision making strategic • Planning under uncertainty	Develops risk models to outline proactive decisions in uncertain environments, integrating Bayesian decision theory with new market evidence to optimize profitability and resilience.
Coronado-Guaita (2025) [8]	Ecuador KIRIA: Scientific Journal	**Quantitative Correlational Analysis (Pearson correlation coefficient and rubric quality metrics)**	• Business plan design • Financial plan viability • Entrepreneurial skills in the classroom	Identifies a significant correlation ($r = 0.64$; $p < 0.01$) between active teaching methodologies and the quality of the business plan in BGU students, revealing that the financial

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				area represents the lowest performance (2.8).
Jiménez-García et al. (2024) [16]	Colombia Fundamentals and perspectives of entrepreneurship	**Process Modeling by Regulation (MPR) (Modeling of information flows and strategic management indicators)**	• Sustainability and scalability • Cost structuring • Operational articulation	It proposes a standard knowledge management model that complements the traditional components of the business model, serving as a bridge for the planning of the value proposition to move effectively towards sustainability.
Calderón-López & Rodríguez-Romano (2025) [21]	Mexico Studies and Perspectives	**Descriptive-Psychometric Modeling (Statistical analysis of frequencies and crossing of variables)**	• Stability emotional/Self-control • Decision-making capacity • Tolerance to uncertainty	Verifies the strong connection between emotional intelligence and entrepreneurship, determining that 73.5% of leaders base their decisions on this capacity, with determining factors such as vision (84.1%) and creativity (67.3%).

DISCUSSION

From the information collected in the applied instruments, the initial findings show a marked trend towards the operation of business processes empirically, the data show that a significant percentage of owners support decision making in the company intuitively and based on their experience (1) The review of the scientific literature, which has analyzed statistical data of the operational variables, shows that organizations that incorporate structured quantitative tools achieve higher levels of efficiency in their operational processes, Particularly, the application of linear programming is directly associated with a more efficient allocation of critical inputs, raw materials and labor (5, 6).

Businesses that configure their production margins under these scientific-mathematical principles achieve a significant reduction in their operating costs and, simultaneously, maximize their profits compared to those that operate under a strictly empirical model. Likewise, the results suggest that the use of preliminary predictive analyses, aimed at anticipating fluctuations in market demand, contributes to reducing exposure to financial risk and provides a solid basis to mitigate the fragility of emerging economies.

Sánchez (2023) highlights the importance of the use of derivatives for market segmentation, as the author points out, "the data are managed in a single equation that,

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when mathematically derived, allows establishing the economic value of a product or service in a certain market condition" (p. 1), which reflects the practical usefulness of numerical calculations for any type of business (2).

Rivero-Fernández et al (2025), in a research titled "Analysis of financial decision-making in small businesses: gaps between financial mathematics theory and business practice, the authors identified three factors that influence the identified problems, among which are mentioned the lack of understanding of basic technical concepts such as projected cash flow or amortization, the difficulty of trained entrepreneurs to integrate technical knowledge into daily management, and the generalized belief that mathematical models are exclusive tools. of large companies or banking institutions, which are not applicable to small-scale businesses (5).

The research concludes that to ensure the sustainability of these businesses, it is urgent to move from a culture of survival towards strategic planning supported by financial literacy programs contextualized to the reality of microentrepreneurs, which also allows predicting situations that may affect the stability of the business, "predictive models are a powerful tool that can provide valuable information and make accurate predictions in a variety of applications and scenarios" (Viada González et al., 2025, p. 8).

Other important contributions to support the importance of the implementation of mathematical models and strategic planning in ventures are presented by the research of Sarmiento Tito et al. (2025), titled "Predictive Model of the Performance of Associative Enterprises in Zone 6", whose results allow us to quantify the success factors in these management models in the Ecuadorian context (6).

The findings of Rivero-Fernández et al. (2025) show that although a high percentage of entrepreneurs make decisions that commit their capital, only a minority of approximately 20% resorts to the technical calculation of profitability (5). This lack of implementation of mathematical models in small businesses and the results of customer perceptions that are evident through different interviews and surveys, allow us to identify that the application of financial mathematics is usually perceived as overly complex processes or an exclusive tool for large corporations. Microentrepreneurs tend to carry out management based on intuition and empirical processes that focus mainly on the urgency of daily cash flow, drastically increasing the risk of errors in administrative processes.

The weakness in financial planning observed in the studies analyzed coincides with the regional panorama described by Bullón-Solís et al. (2024), who point out that “in Latin America there is low participation in entrepreneurship research” (p. 53). This lack of high-impact technical literature explains why a gap persists between theory and practice, preventing the local ecosystem from being consolidated as an axis that is truly linked to innovation (12).

Without the support of research that validates optimization and linear programming models, startups in South America will continue to face high mortality rates due to the lack of tools that document and expand proven successful strategies (12).

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When contrasting these data with the results of Sarmiento-Tito et al. (2025), it is observed that not taking technical analysis into consideration can have a high opportunity cost; the authors, using a linear regression model, 'identified variables with a high impact on performance, such as intangible technological resources, infrastructure, networks, financial profitability and the disposal of solid waste.' These results validate the importance of intangible assets and financial planning over the mere accumulation of traditional physical assets" (6).

The fact that intangible technological resources present the highest impact coefficient on organizational performance validates the premise that modern competitiveness does not depend only on physical assets, but on the ability to process information for decision making. This aligns with Schumpeter's vision of "creative destruction", where disruptive innovation and the use of predictive models allow new companies to overcome resistance to change and gain ground in volatile markets (Leite et al., 2023).

On the other hand, the application of algebraic limits proposed by Reinoso-Salazar et al. (2024) demonstrates that mathematical modeling is not a merely theoretical exercise, but rather a preventive diagnostic tool, which also provides important tools in administrative processes (11). Cedeño-Ortega (2026) presents significant findings on the possible causes of these difficulties in addressing mathematical processes in businessmen and entrepreneurs who have not had professional training in the administrative or business area. These discoveries are mainly linked to the educational training of students. Accordingly, he points out that teachers in the area do not have sufficient tools to encourage the development of these skills (15).

Identifying that the break-even point is reached after 10 months and one week allows the entrepreneur to move from a culture of survival, which generates uncertainty and does not contemplate adequate responses for strategic planning. As Romero Peña and Escudero Ramírez (2024) point out, the equilibrium point is fundamental because “it represents the price at which the quantity of goods that producers are willing to offer coincides exactly with the quantity that consumers wish to acquire” (p. 121). Without this calculation, the entrepreneur is exposed to setting prices that do not cover their operating costs or that distance them from the real market (20).

Finally, it is considered imperative to address the root of the problem from academic training (18), the study by Coronado-Guaita et al. (2025) reveals that, although high school students in Ecuador excel in identifying social problems, their performance in preparing financial plans is notably low, which represents a basic problem that can significantly affect the perception in relation to the complexity that exists regarding the use of mathematical functions in administrative processes (8).

Through the findings obtained in this research, it was possible to identify the importance and strategic potential of quantitative tools and their effective application in ventures, the findings of authors such as Rivero-Fernández et al. (2025) show that although a high percentage of entrepreneurs make decisions that commit their capital, only a minority of approximately 20% resorts to the technical calculation of profitability (1).

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This lack of implementation of mathematical models in small businesses and the results of customer perceptions that are evidenced through different interviews and surveys, allow us to identify that the application of financial mathematics is usually perceived as too complex processes or an exclusive tool for large corporations. Microentrepreneurs tend to carry out management based on intuition and empirical processes that focus mainly on the urgency of daily cash flow, drastically increasing the risk of errors in administrative processes. (1).

In this context, the design of efficient value propositions appropriate to the context of the entrepreneurship system is of fundamental importance (2). On the other hand, the application of algebraic limits proposed by Reinoso-Salazar et al. (2024) demonstrates that mathematical modeling is not a merely theoretical exercise, but rather a preventive diagnostic tool, which also provides important tools in administrative processes (3).

Cedeño-Ortega (2026), presents significant findings on the possible causes of these difficulties in addressing mathematical processes in businessmen and entrepreneurs who have not had professional training in the administrative or business area. These discoveries are mainly linked to the educational training of students, according to this, he points out that teachers in the area do not have sufficient tools to encourage the development of these skills (4).

From the information collected in the applied instruments, the initial findings show a marked tendency towards the operation of business processes empirically, the data show that a significant percentage of owners support decision making in the company intuitively and based on their experience (1). The review of the scientific literature, which has analyzed statistical data of the operational variables, shows that organizations that incorporate structured quantitative tools achieve higher levels of efficiency in their operational processes, particularly, the application of linear programming is directly associated with a more efficient allocation of critical inputs, raw materials and labor (5,6).

In Ecuador, this problem is reflected very markedly in the data from higher education admission exams, where the national average in the logical-mathematical area stood at just 655 points out of 1000. This figure corroborates that traditional pedagogical approaches, based on the rote repetition of abstract processes without a practical or contextualized application, cause a quantitative structural weakness that students carry from secondary education (4).

As direct evidence of this training gap, it has been documented that in the Unified General Baccalaureate (BGU), students achieve outstanding performance when identifying problems in their social environment, with an average of 4.2 out of 5, but they systematically fail when structuring the financial component of their proposals, registering an average of just 2.8 out of 5 (7).

Finally, from a cultural perspective it is observed that there is a tendency to take financial risks, promoting the internalization of personal effort and merit, overestimating intuitive abilities over systematic planning (8). This explains why 73.3% of microentrepreneurs base complex debt or pricing decisions purely on intuition or

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informal advice from family members (1), ignoring that success depends mostly on variables of infrastructure, technology and organizational social capital (9).

Finally, scientific discussion should not be limited to the rigor of numerical data. As Calderón-López and Rodríguez-Romano maintain, entrepreneurship is a dual process where technical stability requires humanistic support. Making effective financial decisions is strongly influenced by emotional intelligence, since factors such as vision (84.1%), creativity (67.3%) and determination (60.2%) are the catalysts that allow the microentrepreneur to face unforeseen situations and overcome the cognitive inertia of fear of risk, allowing mathematical precision to be effectively executed in organizational practice (10).

The scientific literature shows that the intention to undertake a business has a direct and strong relationship with the academic infrastructure and institutional support with a weight of 0.576, which exceeds the influence of subjective family norms located at 0.35 (11). Given this panorama, the development of structured risk models that allow schematizing proactive decisions in uncertain environments becomes a priority, integrating Bayesian decision theory and expected utility as mechanisms to optimize the profitability and adaptive capacity of local entrepreneurship (12).

Given this panorama, the development of structured risk models that allow for schematizing proactive decisions in uncertain environments becomes a priority, integrating Bayesian decision theory and useful mathematical models as mechanisms to optimize the profitability and adaptive capacity of local entrepreneurship. Fear and distrust towards formal methods, mistakenly perceived as exclusive to large corporations or banks, gains more strength in the face of scenarios of social upheaval and economic crises characteristic of the Ecuadorian reality in which formal structuring and the use of more rigorous methods seem distant and inapplicable in the face of the immediacy of daily survival

The existence of weakness in the technical processes linked to financial administration, combined with the factors already mentioned generate a cognitive perception in merchants that financial strategies based on mathematical models are not applicable to small businesses and ventures. The financial sustainability of any business, including those just starting out, depends directly on its ability to identify the break-even point using quantitative tools, such as algebraic limits and linear regression), as this allows strategic management to anticipate risk scenarios, optimize the allocation of technological resources and reduce vulnerability to economic volatility.

ISSN: 3091-1796
Vol. 4 No. 10 PP. 278-296
DOI: https://doi.org/10.56519/3z2v7634
Agosto 2026

Therefore, it is considered that in order to strengthen business competitiveness, a reform in the teaching-learning processes that integrates mathematical models with the development of soft skills and the entrepreneurial spirit is important and urgent; as well as, incorporating contextualized financial education and the use of business simulations that could transform business management, moving from reactive planning to one based on scientific evidence and real data, as well as the development of both aptitude and attitudinal skills that together allow students to have comprehensive training for their future activities.

CONCLUSIONS

The incorporation of structured quantitative models is a strategic factor of fundamental importance to mitigate the marked tendency towards empirical and intuitive management that characterizes the microbusiness ecosystem in Ecuador, which fully validates the general research hypothesis. The data obtained from scientific studies carried out on this topic reflect that owners make complex financial decisions regarding debt or pricing intuitively, based on subjective experience or informal advice from family members. Mathematical models based on linear regression, linear programming and predictive analysis offer support that facilitates technical analysis and significantly increases operational efficiency and reduces uncertainty in highly volatile markets. The analysis of economic variables corroborates that the real performance of organizations depends on assessments of specific management determinants, in which intangible technological resources represent the quantitative factor with the greatest explanatory weight on business competitiveness, followed by physical infrastructure and financial profitability.

It is concluded that the practical application of algebraic limits and linear programming responds in a scientific and efficient manner to the objectives of resource optimization, minimization of operating costs and maximum generation of profits in small-scale enterprises. Temporal modeling using algebraic limits acts as an ideal diagnostic and predictive instrument to project viability and determine the financial equilibrium point before the start of physical operations. Which allows us to rigorously anticipate that the monthly net profits will safely exceed the initial accumulated investment estimated at $1,486.90, starting after 10 months and one week of operation. On the other hand, linear programming demonstrates that, under strict working capital budget constraints, weekly profit maximization is achieved through an optimal distribution of raw materials and labor, evidencing that concentrating production capacity on a high turnover item significantly exceeds the economic returns of traditional empirical diversification.

Furthermore, the urgent need to implement an interdisciplinary teaching model and active learning methodologies in the education system at all levels is confirmed, in order to overcome the severe technical weaknesses that future entrepreneurs have in the field of financial planning. The findings found in the research process confirm the existence of a basic structural weakness due to the predominance of rote and abstract approaches decontextualized from productive reality. Problem-based learning (PBL) and project-based learning (PBL) are pedagogical strategies that can effectively contribute to integrating mathematical knowledge with real business practice, enhancing both hard

quantitative competencies and soft skills essential for the development of a competitive professional profile.

REFERENCES

1. Neri-Guzmán JC. Universidades públicas en México: análisis del emprendimiento. *Problemas del Desarrollo*. 2024;55(216):141-168. DOI: https://doi.org/10.22201/iiec.20078951e.2024.216.70026
2. Sánchez JD. Ecuación de mercado y segmentación por derivación matemática: un modelo gerencial de toma de decisiones empresariales. *Revista Nacional de Administración*. 2023;13(2). DOI: https://doi.org/10.22458/rna.v13i2.4478
3. Varela-Guerrero MI, Santiago-Moreno A, et al. Análisis de la capacidad de los estudiantes en la resolución de identidades trigonométricas. En: Bouza Herrera CN, et al., editores. *Desarrollo y aplicación de modelos y métodos matemáticos para gestión decisional*. La Habana: Pitzilein Books; 2025. p. 68-80. URL: https://novapraxisrevista.com/index.php/RENOVA/article/view/17
4. Colmenero-Fonseca F, Cárcel-Carrasco J, Palomino Bernal JF. Modelo Geoespacial-Matemático Integrado para el Desarrollo Económico Regional Mediante Inteligencia Artificial y Energía Sostenible. *Ciencia Latina*. 2026;10(1):7888-7933. DOI: https://doi.org/10.37811/cl_rcm.v10i1.22870
5. Rivero-Fernández RR, Velazco-Gonzales AR. Análisis de la toma de decisiones financieras en pequeños emprendimientos. *Revista Minerva*. 2025;6(Número Especial):28-32. DOI: https://doi.org/10.47460/minerva.v6isp.204
6. Sarmiento-Tito M., Vintimilla-Álvarez P., Peña-González S.. Modelo Predictivo del Rendimiento de Emprendimientos Asociativos en la Zona 6. *Revista Economía y Política*. 2025;(42):100-120. DOI: https://doi.org/10.25097/rep.n42.2025.06
7. Cuellar-Chaves M. Postulados de Emprendimiento Basado en Modelos Teóricos para la Toma de Decisión. *European Public & Social Innovation Review*. 2025;10:1-15. DOI: https://doi.org/10.31637/epsir-2025-1559
8. Coronado-Guaita L., Parra-Taboada M., Soria-Chicaiza N., Andrade-García M. Estrategias para el diseño del plan de negocios. *KIRIA*. 2025;3(6):85-99. DOI: https://doi.org/10.53877/q43yqy55
9. Moyano J., Taborda F. Aplicación de los modelos matemáticos y estadísticos en la cadena de suministro. Bogotá: Universidad Libre; 2024. *(Nota: Esta publicación no cuenta con DOI o URL en tus documentos fuente).*
10. Arias-Gonzáles J, Covinos-Gallardo M. Diseño y metodología de la investigación. *Enfoques Consulting EIRL*. 2021;1(1):66-78. URL: https://gc.scalahed.com/recursos/files/r161r/w26022w/Arias_S2.pdf
11. Reinoso-Salazar S., Pinto-Ibarra J., López-Cobo R., Vallejo-Cueva A. Evaluación de rentabilidad por aplicación de límites algebraicos: Caso de estudio empanadas. *Polo del Conocimiento*. 2024;9(6):2958-2982. DOI: https://doi.org/10.23857/pc.v9i6.7527
12. Bullón-Solís O, Méndez-Gutiérrez LL, Gutiérrez-Justo K., Valero-Palomino F.. Estudio bibliométrico del emprendimiento empresarial entre el 2011 y 2021 en Scopus. *Revista San Gregorio*. 2024;1(58):46-55. DOI: http://dx.doi.org/10.36097/rsan.v1i58.2466

13. Medina-Beltrán V, Gaitán-Angulo M, et al. Competitividad sostenible un elemento esencial para el emprendimiento. En: Bouza Herrera CN, et al., editores. *Desarrollo y aplicación de modelos y métodos matemáticos para gestión decisional*. La Habana: Pitzilein Books; 2025. p. 54-67. *(Nota: Esta publicación de libro no cuenta con DOI o URL en tus documentos fuente).*
14. Muñiz-Arana, D. Programación Matemática en la Gestión del Riesgo Financiero Empresarial. *Saber Estratégico Internacional*. 2026;4(1):63-83. DOI: https://doi.org/10.70577/s.e.v4i1.24
15. Cedeño-Ortega M. Métodos didácticos y desarrollo de habilidades emprendedoras. Análisis de casos prácticos en la enseñanza de matemáticas [Tesis de grado]. Jipijapa: Universidad Estatal del Sur de Manabí; 2026. URL: https://repositorio.unesum.edu.ec/handle/53000/9249
16. Jiménez-García D., Montoya-Restrepo I., Castellanos-Domínguez O.. Modelos de negocio y de gestión orientados al emprendimiento. En: Castellanos OF, editor. *Fundamentos y perspectivas del emprendimiento*. Bogotá: Universidad Nacional de Colombia; 2024. p. 41-68. *(Nota: Esta publicación de libro no cuenta con DOI o URL en tus documentos fuente).*
17. Viada-González C, Bouza-Herrera C., Allende-Alonso S., et al. Revisión de modelos para el análisis predictivo. En: Bouza Herrera CN, et al., editores. *Desarrollo y aplicación de modelos y métodos matemáticos para gestión decisional*. La Habana: Pitzilein Books; 2025. p. 1-9. *(Nota: Esta publicación de capítulo de libro no cuenta con DOI o URL en tus documentos fuente).*
18. Salgado, D. Enseñanza por investigación en la universidad: modelización matemática entorno a una pregunta relacionada con la economía. *Unión*. 2024;(71):1-24. URL: https://revistaunion.org/index.php/UNION/article/view/1634
19. Farinango-Salazar R., Porres-Requenes J. Análisis de maximización de beneficios mediante el uso del modelo de programación lineal en la empresa “Confecciones Gloria". *RILCO*. 2024;6(57):26-40. URL: https://dialnet.unirioja.es/servlet/articulo?codigo=9786755
20. Romero-Peña J., Escudero-Ramírez L. Matemáticas para el emprendedor, caso de estudio Hotdog de pavo. En: Castro Lara RJ, et al., editores. *Estrategias, Modelos y Tendencias*. México: Pitzilein Books; 2024. p. 121-128. *(Nota: Esta publicación de capítulo de libro no cuenta con DOI o URL en tus documentos fuente).*
21. Calderón-López M, Rodríguez-Romano W. Inteligente Emocional y Emprendimiento en los Negocios. *Estudios y Perspectivas*. 2025;5(1):1273-1294. DOI: https://doi.org/10.61384/r.c.a..v5i1.911