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Scientific and Technological Research Article

Business intelligence to stimulate the commercial turnaround in the microcenter of an intermediate-sized city

Inteligencia empresarial para estimular el giro comercial en el microcentro de una ciudad de tamaño intermedio

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ABSTRACT

The microcenter of Bahía Blanca (Argentina) has been hard hit by the pandemic and the economic crisis. Traffic is falling sharply, and many stores have been closed for good. Consequently, the final objective of this research is to have a software tool for decision-making that allows the establishment of intelligent marketing strategies. The chosen software resource is an Intelligent Decision Support System (IDSS). This paper describes the conceptual design of a generalized IDSS that will improve the commercial turn of Bahia's micro-center. Artificial intelligence is included in the data collection and analysis and in an optimizer that employs a predictive genetic algorithm. Among the innovative contributions of this study, the combination of predictive and prescriptive analytics is highlighted as a valuable tool to address the non-trivial task of optimizing the urban commercial turn. This IDSS can evaluate and categorize hypothetical scenarios, providing clues about their economic feasibility and desirability. It is the first tool in our region aimed at reorganizing physical stores to sustain jobs in the sector.

Keywords: commercialization, artificial intelligence, decision theory, urbanization.

JEL classification: M29; D79

RESUMEN

El microcentro de la ciudad de Bahía Blanca (Argentina) fue muy afectado por la pandemia y la crisis económica. La circulación está cayendo abruptamente y se ha producido el cierre definitivo de muchos comercios. En consecuencia, el objetivo final de esta investigación es disponer de una herramienta de software para toma de decisiones que permita establecer estrategias inteligentes de comercialización. El recurso informático elegido es un Sistema Inteligente para Soporte de Decisión (IDSS). En este artículo se describe el diseño conceptual de un IDSS generalizado que contribuirá a mejorar el giro comercial del microcentro bahiense. La inteligencia artificial está incluida en la recolección y análisis de datos y en un optimizador que emplea un algoritmo genético predictivo. Dentro de los aportes innovadores de este estudio, se destaca la combinación de análisis predictivos y prescriptivos como una herramienta valiosa para abordar la tarea no trivial de optimizar el giro comercial urbano. Este IDSS es capaz de evaluar y categorizar posibles escenarios hipotéticos, brindando pistas acerca de su factibilidad y conveniencia económicas. Es la primera herramienta en nuestra región destinada a la reorganización de las tiendas físicas, con miras al sostenimiento de las fuentes de trabajo del sector.

Palabras clave: comercialización, inteligencia artificial, teoría de la decisión, urbanización.

Clasificación JEL: M29; D79

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INTRODUCTION

Today's competitive marketplace requires companies to be more flexible, innovative and responsive to their customers' needs. It, therefore, challenges small and medium-sized companies to change their traditional business models and adopt new ones that facilitate collaboration with suppliers and customers. Next-generation companies will form complex collaborative supply chain networks that value information sharing to achieve their respective time, cost, and quality objectives. The availability of information enables managers to make the right decisions at the right time and react responsively based on individual objectives.

Business analytics (BA: Business Analytics) is an emerging area in data-driven corporate decision-making. BA refers to anticipating future trends through Key Performance Indicators (KPIs) in order to guide an organization in its business planning and effective decision-making. This approach is different from, but complementary to, the concept of business intelligence (BI). To analyze raw data from multiple business sources, BI employs a broad set of data analysis algorithms, techniques, and tools, such as those from the fields of descriptive and prescriptive statistics, information technology, mathematical modeling, simulation, optimization, and data mining. In a broad sense, BI incorporates the classical tools of BA by directing the study towards the same overall objectives (Sahay, 2018).

The multifaceted definitions of BI frame the area in three main perspectives: product-based aspects, technological tools, and managerial goals (Chee et al., 2009). A BI system is considered as an evolving and integrated product of a variety of IT tools and techniques, including data warehousing, online analytical processing, visualization techniques, data mining, data quality, and web technologies. Thus, a decision support system can be considered a BI system since it is a concept of integrating reasoning capabilities with data analysis and knowledge acquisition.

BI and BA are among the contemporary terms associated with decision support systems (DSS), which can be defined as structures capable of analyzing large amounts of data and contributing to decision-making (Turban et al., 2011).

Traditional DSSs only allowed decisions to be made through data modeling and numerical calculations. By incorporating artificial intelligence (AI: Artificial Intelligence), the decision-making process can combine qualitative and quantitative analyses. In particular, Intelligent Decision Support Systems (IDSSs: Intelligent Decision Support Systems) are those in which AI methods, such as Machine Learning (ML: Machine Learning) and metaheuristics, are incorporated to improve organizational decision making (Arnott & Pervan, 2014).

Research in the field of DSS has evolved and matured in recent years. According to Phillips-Wren et al. (2017), expert systems (ES: Expert Systems) emerged in the 1980s as a powerful tool for decision-making. An ES incorporates the knowledge of expert decision-makers and attempts to induce or deduce new wisdom using the system's a priori knowledge, inferred knowledge, and real-world data. Therefore, one of the keys to ES research would be to devise a knowledge representation scheme that is suitable for including and encoding human knowledge and that is also suitable for use in automated induction and deduction. The integration of ES with DSS can improve the quality and efficiency of both computer systems; Turban & Watkins (1986), for example, examined the possible connections between the two technologies and discussed some issues related to their integration. Remus & Kottermann (1986) proposed an ES and used scenarios to illustrate their system's potential. Subsequently, Shevtshenko et al. (2009) implemented a collaborative cross-merchant IDSS that applies Bayesian networks and integrates historical databases with external network-based data. Phillips-Wren et al. (2009) proposed an evaluation framework for a real IDSS that coordinates urban infrastructure management.

A complete overview can be found in Phillips-Wren (2012) and Gupta et al. (2022). The former produced a review of papers about AI tools that have been successfully integrated into IDSS for real applications. The latter presented a literature review based on the approaches taken to develop IDSS along with the underlying theories, emphasizing an integrative view between IA and DSS. They stated that the design of IA architectures can improve trust, ethical concerns, and social aspects among different stakeholders during decision-making. They noted that advanced versions of intelligent systems can solve complex problems by also fostering knowledge dissemination in multi-cultural and multi-format environments. This facilitates the work of decision-makers, even in an uncertain environment, rather than replacing decision-makers.

In particular, Jung et al. (2020) proposed a conceptual framework of an IDSS for disaster management, paying special attention to wildfires and cold/heat waves. This IDSS is a response system that uses data collected from an open application programming interface and AI algorithms to help decision-makers make faster and more accurate decisions. In addition, the system also considers connecting to open source intelligence (OSINT: Open Source Intelligence) to identify vulnerabilities, mitigate risks, and develop more robust security policies than existing ones to prevent cyberattacks.

Technologies are not an end in themselves but a means to improve our practices as designers working in community. So how can we use them to improve our society's living conditions? In this paper, we present the conceptual design of an IDSS that is an answer to this research question.

Research objectives and purposes

The microcenter of the city of Bahía Blanca (province of Buenos Aires, Argentina) has been hard hit by the pandemic and the economic crisis. Traffic is falling sharply, and many stores have been closed for good. Consequently, the overall objective of this research is to create a decision-making software tool to establish intelligent marketing strategies. The software resource chosen to solve this problem is the development of an IDSS; an ideal tool, as it will allow the fusion of concepts from the areas of IA, Economics and Data Science to achieve greater competitive advantages and added value of what is offered to customers.

It is expected to optimize the courses of action of retail stores, encouraging sales based on predictions based on data about the relationship between the flow of people and the flow of sales. For this reason, one of the specific objectives is to improve business competitiveness in the city of Bahía Blanca.

For this purpose, first of all, the magnitude of the problem must be diagnosed, and with this information, the IDSS must be planned. In this way, it will be possible to identify and classify the necessary data; it is likely that certain essential information will not be available. Obtaining this information is the next step in achieving the overall objective.

This paper describes the design of an IDSS to boost sales in the microcenter of Bahia, in order to provide organizations with a diagnostic tool to propose policies that contribute to improve the urban commercial turn. The system is specially adapted to decision makers. Therefore, the user will be a member of the entity representing the productive sector, such as an economist belonging to a chamber of commerce in charge of evaluating the commercial turn in the city.

METHODOLOGY

In the early 1970s, the phrase "Decision Support Systems" (DSS) was coined to name a computer program capable of helping users to make unstructured decisions. Its traditional methodology consists of a logical structure, which can be subdivided into the following phases: i) Analysis ii) Design iii) Construction iv) Implementation v) Training vi) Use vii) Evaluation viii) Evolution (Tejeda, 1994).

As the development of any system depends on the project, several methodologies have emerged as guidelines for the treatment of problems. In the case at hand, it is necessary to adopt a strategy that adapts to the urban organizational and operational environment and even to the idiosyncrasies of the city's merchants and inhabitants. The system will be oriented towards a specific entity, which will be the driving force behind decision-making in the city of Bahía Blanca (Argentina). In this situation, a high level of user and merchant participation is required, which is why it is essential to define the requirements jointly and to develop the DSS capabilities by mutual agreement. In this framework, it is necessary to use an adaptive methodology based on the design concept of Keen and Morton (1978). Its main characteristics are: i) The user is strongly involved in the development process; ii) The system evolves and adapts over time. A disadvantage of this approach is the loss of coherent planning and monitoring of the system under development.

This obstacle arises due to the total dependence of the designer caused by the permanent interaction with the user. To avoid this serious drawback, the methodology adopted for a custom-designed DSS in the case at hand is to strategically combine the traditional technique with the adaptive one. First, we start without third-party intervention by elaborating on the first two phases of a traditional development process, the work described in this manuscript. Then, as a terminal phase, we will interact with users using the adaptive methodology to evaluate and correct the system, dynamically adapting it to the environment before its final implementation and continuing with the remaining phases of the traditional methodology.

Method of data collection and analysis

Forecasts have always been at the forefront of planning and decision-making. Naturally, they are based on knowledge of the present and past behavior of the variables of interest. The emphasis should be on how to manage the various information flows input to the IDSS. In order to have the most relevant features available, data collection from the companies involved should be carried out, together with opinion surveys. A data collection protocol should be developed to ensure consistency and repeatability. It is planned to employ a semi-structured, face-to-face interview technique to encourage merchants to speak freely about how they manage performance. Interviews should be conducted with more than one researcher in all case studies to reduce informant bias. It is advisable to keep questionnaires brief. For triangulation purposes, it is also advisable to conduct interviews with store employees and use secondary data in the form of internal reports and media publications. In some cases, supplementary follow-up interviews will need to be conducted through visits or phone calls. All of these features are strongly associated with the real value a piece of information can have. It is necessary to consider all the information flow characteristics to manage and obtain good value from the information flow (dimension, direction, parameters, quality, and types).

Broadly speaking, the IDSS seeks to minimize risks and maximize profits, which implies contemplating uncertainties in order to achieve realistic results. Petropoulos et al. (2022) presented an encyclopedic work on prognosis, covering theoretical and practical aspects. When formulas that represent the real scenario are unavailable, AI-based methodologies are often employed. Typically, neural networks have been used as predictive tools; however, their use depends heavily on the amount of historical data related to the phenomenon to be predicted. Huge volumes of data are needed to train these models, which is why it is challenging to investigate other predictive methods that can be used using smaller tabular databases. So far, the literature on the use of AI in urban planning and commercial management is somewhat limited. The sector could benefit from alternative optimization methods, such as metaheuristics, in a flexible and user-friendly environment. In particular, we will use feature engineering concepts for the design at hand. In this context, we aim to minimize prediction errors.

Feature engineering is often the most indispensable part of human intervention in ML processes, as human intuition and experience are very much needed. ML techniques have been widely applied in Internet companies for various tasks, acting as an essential driving force, and feature engineering has been generally recognized as a crucial task when building machine learning systems. Shi et al. (2020) proposed a staged approach called SAFE (Scalable Automatic Feature Engineering), which provides excellent efficiency and scalability, along with the necessary interpretability and promising performance. Their results are important as the adequate scalability of the proposed method ensures its application in large-scale industrial tasks.

In the application at hand, the size of the actual enterprise data is always very large, which introduces extremely high requirements for spatial and time complexity. At the same time, due to the rapidly changing business, there are also high demands on the flexibility and scalability of the algorithms. To computationally efficiently select the most broadly informative features, we will use a three-step feature selection process: predictive capability evaluation, redundancy detection, and final classification.

First, features with low predictive power will be eliminated depending on the information value. To this end, we will use regression algorithms to develop an analytical model of the information flow value (Biyeme et al., 2023), where a shared IF well (IF THEN) brings added value to the business strategy. This methodology is based on the consideration of all information flow characteristics. For each of them, a weight will be given; then, redundant features will be discarded, according to Pearson's correlation coefficient. The relevant features, once weighted, will be combined to form the different shared information flow scenarios based on the hypotheses formulated. From these scenarios, the data set of the different scenarios will be constructed and analyzed by the regression algorithm. Finally, associative classification techniques will classify the remaining features (Weydan, 2014).

Such classification is a supervised learning algorithm that combines association rule mining with classification, using association rules to predict an instance's class label based on its attributes' values. The first step is to find all possible combinations of elements (attributes) that appear together frequently in the dataset. These combinations are called frequent element sets. The second step is to build a classifier using these frequent itemsets as features or attributes. The classifier predicts the class label of an instance by comparing the values of its attributes with those present in the frequent itemsets.

Characterization of Bahía Blanca city

Bahía Blanca is a port city with a population of 335,190 inhabitants, according to the latest census of the Argentine Institute of Statistics and Census (INDEC) in 2022 (INDEC, 2023). The city has one of Argentina's main ports, as well as a petrochemical industrial complex, and a network of road and rail communications. Bahía Blanca, with universities and research centers, is a city of intermediate size at the provincial and national levels (Bolay & Kern, 2019).

Although the development of the urban microcenter is a topic of high public profile and growing importance worldwide, the situation is quite different in different parts of the world, according to cultural traits and each country's income level. Looking around the world at the way many municipalities handle urban management, it is evident that there is great room for improvement. For emerging countries, the main barriers to the development of environmental management tend to be:

1. Insufficient financial resources: little government support; 2. poor infrastructure
2. Poor infrastructure
3. Lack of adequate legislation
4. Lack of appropriate new technologies
5. Lack of formal and informal private sector participation

Just as cities directly impact our daily lives and happiness, they also impact our families, the opportunities available to our children, and local communities. As such, urban development offers the opportunity to drive social change throughout society.

It is hoped that this study will help the Bahia microcenter find more effective ways to strengthen its competitive advantage from a theoretical and practical perspective. Park (2020) examined the mutually beneficial causal relationship between Creating Social Value (CSV) and Corporate Social Responsibilities (CSR) activities on productive behavior through work engagement. In addition, this study considers innovative behavior as a series of activities by organizational members to apply new ideas to work in order to contribute to improving their work performance and that of the organization.

CSV has recently become a concept aimed at strengthening companies' competitiveness by creating social values. Designing an inclusive environment in friendly environments is, in essence, a way to leverage the lived experience within the community.

With respect to CSR, the approach is based on accepting the needs of society, striving to solve social problems, and improving social welfare or quality of life. For example, improving accessibility by repairing wheelchair access ramps to sidewalks, innovating by providing street performances (music, dance, etc.) on pedestrian walkways, or encouraging cultural activities in downtown theaters would attract customers to circulate and consume in the microcenter, as long as the arteries are beautiful, accessible and adequately illuminated. Although the CSR approach may require an initial investment and time, both business and society can benefit from increased economic value and strategic benefits if the revenues of small merchants can be increased using the expertise and resources of the municipality.

Design of an intelligent decision support system

"Smart cities" are urban settlements that make conscious efforts to capitalize on new Information and Communication Technologies (ICT) strategically, seeking to achieve prosperity, effectiveness, and competitiveness at multiple socioeconomic levels (Angelidou, 2014). Cities aiming to be "smart" focus on improving the intelligence of specific economic-social aspects, such as business, housing, commerce, education, health, and community, providing solutions to solve everyday problems. A perspective determined by the geographical space, the prevalent character, and the main functions of Bahia's microcenter inspires us to develop an IDSS to organize and sustain its commercial efficiency. Its purpose, to facilitate decision-making, is also broad and far-reaching, including operational and strategic decisions related to multiple outcomes such as: investment, staffing, suppliers, customers, processes, products, and services. This innovation is targeted to specific groups who will enjoy the benefits of the city where they live and work.

Additionally, the IDSS creation process includes six iterative stages: 1) needs assessment; 2) conceptual development; 3) prototyping; 4) interaction and usability studies; 5) implementation; and 6) debugging. The methodology described in this paper corresponds mainly to the approach of the second stage. Moreover, it is generalizable as the approach could be applied to any medium-sized city. Naturally, in a customized development, the adaptive phase will differ in order to adapt the concept to local characteristics.

Research in DSS and data processing is continuous due to the constant emergence of new business models. Therefore, the prototype must be flexible for the later addition of specialized modules. This IDSS is knowledge-based and provides users with information consistent with business processes and knowledge of the environment. It is also data-driven as it uses data mining techniques to discern trends and patterns, allowing it to predict future events. The data that drives the system resides in a knowledge base that is continuously updated and maintained by a knowledge management system.

Figure 1 shows an innovative Intelligent Decision Support System (IDSS) for a local chamber of commerce; such a system is designed to provide a solid foundation for decision-making for all the business entities that make up its conglomerate. The IDSS is articulated in three fundamental modules, where data science techniques converge with advanced technological tools.

RESULTS

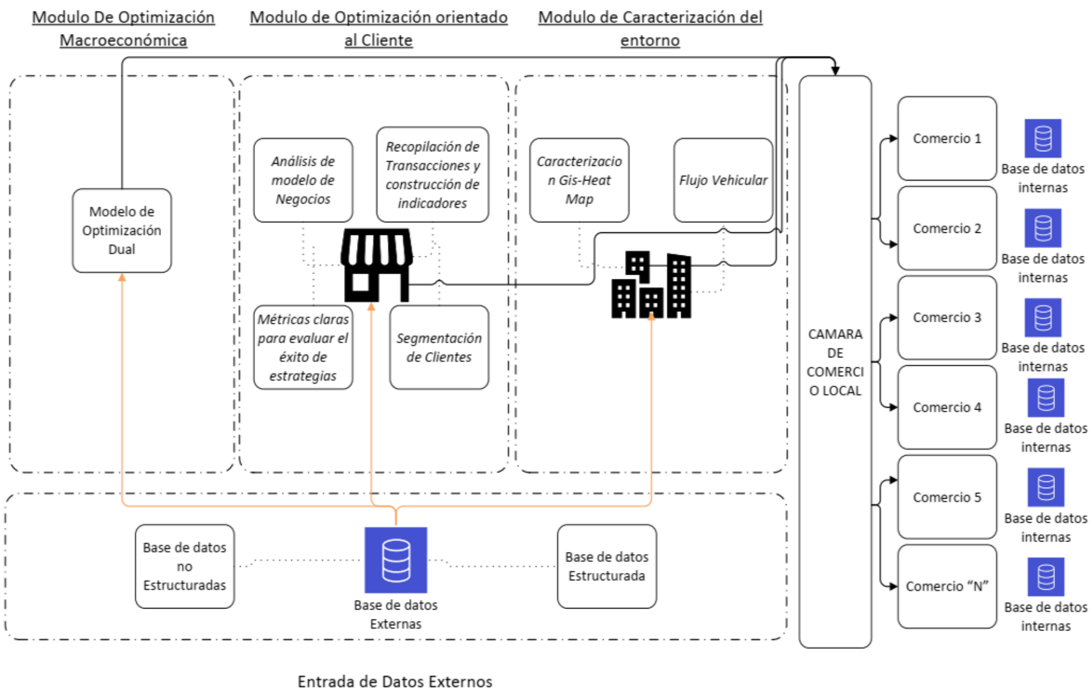
Macroeconomic Optimization Module: Holistic Prediction and Optimization

The first module is related to Macroeconomic Optimization. It relies on the application of Genetic Algorithms (GA) in order to provide substantial insights into the economic outlook, both in its macro and micro dimensions. Through the conjunction of optimization and forecasting techniques, this module deploys economic trend projections that internalize both macroeconomic and microeconomic factors. This capability enables business entities to make informed decisions in the context of economic fluctuations, proactively adapting to market changes.

Customer Oriented Module: Advanced Segmentation and Analysis

The second module is based on the Customer-Centric Approach. It capitalizes on the potential of machine learning to facilitate a comprehensive analysis of consumer behavior and needs. By implementing customer segmentation techniques, IDSS identifies clusters of consumers exhibiting similar attributes, enabling commercial entities to personalize marketing strategies and enhance the customer experience. Additionally, this module evaluates sales strategies through specific metrics and analyzes business models, providing a complete overview of business operations and opportunities.

Figure 1.
IDSS conceptual scheme to stimulate the commercial turnaround in a medium-sized city



Source: own elaboration.
Note: the figures appears in its original language

Environment Characterization Module: Geospatial Data for Strategic Decisions

The third module deals with Geospatial Analysis. It makes use of geospatial technologies, such as Geographic Information Systems (GIS), to shed light on the environment in which business entities operate. Through the collection and analysis of geographic data, IDSS provides essential information on aspects such as traffic, safety, and other relevant environmental variables. This information empowers commercial entities to make strategic decisions regarding location selection, logistics, and security.

Ultimately, each of these modules is fed by both internal data generated by the specific operation of each entity and external data from reliable sources. This data integration enriches the IDSS's ability to generate valuable insights and sound recommendations that inform decision-making. By empowering business entities with accurate and detailed information, the Chamber of Commerce is facilitating agile adaptation, constant innovation, and sustainable growth in the ever-evolving business landscape.

Evolutionary methodology of optimization: genetic algorithms.

The use of optimization methodologies can be combined with the respective economic analysis to propose integral solutions that contribute to strengthening the sector's productive capacities. The development of optimization algorithms using metaheuristics, i.e., iterative procedures that guide a subordinate heuristic by intelligently combining different concepts to explore and properly exploit the search space, has recently aroused great interest. Currently, there are computational tools based on Artificial Intelligence that could collaborate in decision-making related to improving commercial competitiveness.

Computers are considered important for developing trading strategies, financial analysis, and portfolio optimization because humans have limited cognitive capacity and can be inconsistent in decision-making. Evolutionary Computing (EC: Evolutionary Computing) offers attractive methods for solving decision problems because of its ability to exhaustively explore the domain space and its potential for exploitation to locate maxima or minima. Decision-making models can benefit from EC in several ways. Typically, several models are available to represent the decision problem; evolutionary optimization can help in choosing an optional structure for a decision model. Multiple criteria are often involved in decision problems, and CE allows them to be optimized simultaneously as part of the solution process. Unlike classical optimization techniques, CE provides a number of potential solutions on its way to the optimal solution, and these suboptimal solutions can provide insight into the problem that can aid decision-making.

In particular, metaheuristic algorithms inspired by nature have shown some promising results in a variety of applications where optimization is difficult. In particular, GAs are often flexible, efficient, highly adaptive, and easy to apply. Moreover, GAs can be effectively applied to broad practical problems by tailoring both individuals and genetic operators to the specific combinatorial problem under study. Holland (1975) presented the original formulation of GAs, and their basic principles are explained in detail in Goldberg & Holland (1988). Subsequently, GAs have taken many forms and, in some cases, bear little resemblance to Holland's genuine conception. The GA methodology has been widely used to solve various optimization problems related to finance, production and operations management, and supply chains.

Fast variants of GA for moving horizons are described in the literature to enhance metaheuristics due to their combination. Jankauskas et al. (2019) focused on discrete-time mixed integer linear programming (MILP) solvers for medium- and long-term capacity planning and scheduling. In a meta-optimization framework, Particle Swarm Optimization (PSO) and GA algorithms were combined to find the best genetic operators before tackling the capacity planning problem using GA. The convergence speed of a GA depends on its parameters. Hence, it was dynamically accelerated by PSO, which performed automatic adjustment of crossover and mutation operators to replace manual adjustments.

Meanwhile, Narwadi & Subiyanto (2017) presented a hybrid variant of the GA that was developed to solve the Travelling Salesman Problem (TSP) and employing the Google Maps Android API (Application Programming Interface) to manage access to Google Maps servers, data download, and map visualization.

The basic elements of GAs are chromosome representation, fitness selection, and biologically inspired operators. Chromosomes, also called individuals, are considered as points in the solution space. According to the specific application, the definition of individuals plays an important role in the algorithmic design. Katoch et al. (2021) have suggested GA as a suitable means to solve real-life problems, emphasizing the need to develop new coding schemes. Since the beginning of GA, chromosomes have adopted the binary string format, where each specific position has two possible alleles: 0 and 1. Naturally, binary genes are well suited to represent decision-making since decisions can be summarized in Boolean variables (YES=1/NO=0).

Then, with the incentive of solving various real-world problems, the chromosome design was evolved to give rise to encodings where the genes are real numbers. Two-dimensional chromosomes have been proposed to relate times to account for the influence of future dynamics. Jankauskas et al. (2019) created each chromosome as a matrix of tuples, comprising a product label and the corresponding production length for a given time period. As this encoding sometimes resulted in a computationally expensive search, they employed a moving horizon method to achieve more efficient exploration. In turn, Borisovsky et al. (2020) also applied the horizon method of a hybrid technique combining a decomposition strategy, a GA, and a constructive heuristic based on MILP.

On the other hand, handling infeasible solutions is a critical aspect of solving real-world optimization problems. Global optimization solvers often make use of primal heuristics to reduce their search space by using feasible solutions that have been found early in the solution process (Schewe & Schmidt, 2019). Regarding GAs, Michalewicz (1995) concluded that infeasible individuals should not be eliminated. Rahimi et al. (2023) studied constraint management techniques in population-based optimization and pointed to GAs as the most promising algorithms. In summary, a single-objective GA can use or combine the following constraint management strategies:

i. Death penalty: unfeasible solutions are discarded.
ii. Penalty function: the suitability of unfeasible solutions is reduced.
iii. Elaboration of operators: feasible solutions are always produced.
iv. Chromosome repair: infeasible solutions are transformed into feasible ones.

Predictive Genetic Algorithm Design

GA is an optimization and search technique based on the principles of genetics and natural selection that allows a population composed of many individuals (chromosomes) to evolve under specific selection rules toward a state that maximizes the individual's fitness (fitness). For this problem, we formulated fitness using the weighted averaging method. The GA will try to maximize the difference between profitability indicators and business vulnerability indicators.

$$Fitness = \sum_{i=1}^{NIR} w_i \, z_i \; f_i - \sum_{j=1}^{NIV} w_j \, z_j \, g_j \qquad (1)$$

The fitness function (from the above equation) is a real number that represents an evaluation score of the qualitative assessment of a possible scenario. Once the data collection and analysis has been carried out, as explained in the relevant section, the required number of profitability and vulnerability indicators, NIR and NIV, respectively, can be specified.

In order to adapt to the new ways of competing in the environment, assertive indicators are required to guarantee the permanence and success of any business in the medium and long term. In the fitness function, it is appropriate to incorporate mathematical formulas of a set of KPIs that allow measuring the performance of companies engaged in the marketing activity. The KPIs are expressed using monetary variables of units or percentages. To normalize all the summands, the following conversions are introduced .

In order to drive the increase in the company's sales volume, it is desired to increase the key profitability indicators f_i ,i=1,...NIR. In order to provide assertive information and evaluate the effectiveness of the sales process leading to the fulfillment of the strategic objectives of the microcenter, it is advisable to consider, among others, the following profitability indicators:

i) Total number of sales per store,
ii) Average value of purchase invoices,
iii) Total sales per potential customer,
iv) Monthly income

Equation 1 also takes into account the impact of situations of financial vulnerability in which a company may find itself, i.e. when faced with changes in external factors, the business has a high probability of not being able to meet its payment obligations. In this sense, it is reasonable to incorporate some of the following indicators of vulnerability:

i) Currency mismatch indices
ii) Increase in taxes and fees
iii) Exchange rate instability
iv) Variability of employee salaries

The weight factors w_i ,w_j i=1,...,NIR;j=1,...,NIV are the optimization variables of the problem, which is why they are the chromosome genes of this GA. More specifically, the problem consists of apportioning the contribution of the different indicators to identify the optimal combination. Therefore, for the individual to be feasible, the constraint indicated in Eq. 2 must be verified.

$$\sum_{i=1}^{NIR} w_i + \sum_{j=1}^{NIV} w_j = 1 \qquad (2)$$

CONCLUSIONS

Livability describes the conditions necessary for all inhabitants of cities, regions, and communities to enjoy a dignified life, including their physical, social, and mental well-being. It is about optimizing the performance and integrity of human life. By rethinking the living conditions in our cities, we can create livable and resilient communities. While many serious problems and barriers prevail, there are also many opportunities for government and community to work together to achieve solutions with the help of modern research and development tools. Enhancing progress by including new forms of organization and engineering management techniques is possible.

This paper describes the design of a software prototype (IDSS) that will constitute a support tool on which organizations can rely to propose policies that contribute to improving commercialization in the city center, considering central aspects of sustainable development: economic, social, and environmental. The diagnosis provided by the IDSS will serve as a guide to promote the commercial turn of the urban microcenter. In this way, the effectiveness of the policies adopted will be improved, thus contributing to the productive development of the region.

As a case study, the city of Bahía Blanca (Argentina), which is of intermediate size, was chosen. However, the prototype can be generalized, which is why it will be applicable to the analysis of other urban centers of similar size with the aim of identifying policies for attracting and retaining customers. In the future, with an ad hoc adaptation, this DSS could become a driver for the productive development of other urban centers characterized by a cluster of retail stores. Therefore, it is hoped that the experience gained through the writing of this paper will serve as a guide for future developments of algorithms that are robust to real-world problems.

The applications of the proposed IDSS can be varied and provide bi-directional input: for business-to-business and business-to-consumer segments. New interaction mechanisms, permanent variations in urban traffic, and customer satisfaction efforts are also the center of inspiration for the proposed system's new applications.

In terms of scientific contributions, this article proposes the combination of predictive and prescriptive analytics as a valuable tool to address the nontrivial task of optimizing the urban commercial turn.

Decision support tools greatly enhance the value of the data. The proposed IDSS will support and manage the flow of information, cleaning and analyzing it; facilitate fast and convenient collection of the necessary information; help select the right analytical tool for better decision-making; and enable users to study unstructured problems systematically. Thus, it will be possible to take advantage of IA to assess the local situation, carry out strategic planning for growth, evaluate a priori the suitability of projects, and finally, monitor the results of the implementation of the IDSS.

This work is original because it is the first tool in our region aimed at reorganizing physical stores, with a view to sustaining jobs in the sector and the urban space. The generation of computational tools applied to urban planning is a new line of research. In addition, the problem of an interdisciplinary study involves elements of economic, engineering, social, and mathematical-computational analysis, all elements that are part of this paper.

Finally, it is very important to develop programming tools for optimal commercial planning with a view to the design of sustainable cities. These results can contribute to social and productive development, as well as to the optimization of the use of state resources. A plan that applies the recent developments of automated learning methods to concrete local problems represents a breakthrough, both for the transfer areas of the scientific sector and for the public policy decision-making spheres.

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