RESEARCH ARTICLE

Data Visualization as a Tool for Improving Credit Analysis: A Field Study in the Banking Sector

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Abstract

This study aims to utilize data visualization as a data mining technique for the purpose of credit analysis. It employs the Weka data mining software and the Scatter Plot Matrix technique to identify data trends and patterns, facilitating a logical analysis of the financial situation, and by extension improve the decision-making process. The findings reveal that data visualization significantly enhances data comprehension by extracting pertinent information from the credit database managed by the studied agency of a public bank active in Algeria. This aids in understanding the bank's adopted strategies and various financial trends, which in turn influence customer satisfaction and requirements, as well as the country's overall economic growth.

Citation

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Introduction:

The advent of the digital age has ushered in a proliferation of data forms, including text, images, and video, leading to an exponential increase in data size across various sectors, notably in finance. This surge underscores the imperative for sophisticated techniques capable of distilling and analyzing embedded knowledge within data into actionable insights. Among these, data visualization techniques have gained paramount importance in data mining, particularly within the financial sector, where the complexity and volume of data present unique challenges.

While the concept of data visualization is not novel, having been used to convey ideas from the dawn of civilization as evidenced by cave paintings, the emergence of intelligent systems and contemporary information technology has reinvigorated its application. Today, data visualization serves as an invaluable tool for the analysis and interpretation of complex, multidimensional data, enabling a more profound and expedited understanding of trends, patterns, and relationships. Its utility spans a broad spectrum of disciplines, yet its integration into economic analysis has been transformative, especially in decision-making processes within financial and banking operations. Notably, the analysis of credit analysis immensely from data visualization, offering a lucid representation of loan data, such as amounts, repayment schedules, and client demographics, thereby streamlining the analysis for informed financial decision-making.

✓ Research Problem:

This study is predicated on the query: To what extent do data visualization techniques enhance the credit analysis of bank-granted loans?

✓ Rationale of the Study:

The pivotal role of data visualization in deciphering trends and patterns, particularly within financial and economic datasets, underscores the selection of this research theme. The rationale behind focusing on " Data Visualization as a Tool for Improving Credit Analysis: A Field Study in the Banking Sector" includes:

- A discernible gap in research regarding the impact of data visualization techniques within the banking sector.
- The demonstration of effective information extraction from financial databases using data visualization, serving as a benchmark for subsequent research endeavors.

✓ Research Structure:

This work is methodically divided into two principal segments to address the core research question. The initial segment delves into the theoretical dimensions of various data visualization techniques, categorized based on study objectives, data type, and volume, ensuring accessibility for economists, scholars, and students. The latter segment presents a field study, translating theoretical insights into practice. Here, the Scatter Plot Matrix technique was identified as optimally suited for the database in question, facilitating the extraction and analysis of latent knowledge. The study culminates in a critical discussion of key findings.

✓ Significance of the Research:

The significance of this study lies in its contribution to highlighting a critical data analysis technique within economic and financial realms. It clarifies the selection criteria for the appropriate data visualization technique based on data size, type, and analytical objectives. Moreover, it illustrates the application of descriptive mining techniques in a user-friendly manner, empowering economists and policymakers to leverage these tools without necessitating advanced programming knowledge or a background in computer science.

✓ Research Objectives:

The aim of this study is to elucidate the impact of employing data visualization in the credit analysis of loans dispensed by the Chelghoum Laïd agency of the Regional Consortium of the Bank of Agricultural and Rural Development in the Province of Mila. Specifically, the Scatter Plot Matrix is applied to scrutinize loan performance over a five-year span from 2018 to 2022, unearthing hidden trends and relationships within the dataset.

✓ Literature Review:

Numerous studies have explored the impact of data visualization across various domains, including commerce, decision-making, and analysis. However, research that specifically applies this technique to diverse financial sectors remains relatively scarce in comparison to other fields. This observation was underscored by (Kamrul & Obed , 2023)in their examination of the role of data visualization in the banking sector. Their findings highlighted the considerable utility of graphs and charts in effectively communicating narratives to both the general public and specialized readership, thereby facilitating quicker comprehension of data. Despite this, such visual aids are less prevalent within financial contexts, where professionals predominantly rely on numerical data, percentages, and text-heavy annual reports, often overlooking the potential benefits of visualization. Consequently, non-professional investors may encounter challenges in swiftly grasping complex financial information. It is thus imperative for

companies to enhance their reporting practices by incorporating more graphical representations, particularly within annual reports.

The researchers analyzed a dataset specific to Walmart's compensation structure, concluding that graphs facilitate comprehension of the company's performance. By utilizing graphs to present financial strengths and weaknesses, clarity is enhanced. Furthermore, comparative analysis of data from various companies using graphical representations simplifies performance comparison.

Among the studies aimed at elucidating the significance of integrating data visualization across diverse domains is the theoretical inquiry conducted by (Matthew , Adebowale , Sarhan , & Cajetan , 2016), entitled "Data Visualization." In their analysis, the researchers underscored that data visualization serves as a robust and widely applicable tool for dissecting and interpreting extensive and intricate datasets graphically or visually. They emphasized how various fundamental techniques, including Bar Graphs, Pie Charts, Line Graphs, and Scatter Plots, facilitate the clear, accurate, and efficient conveyance of complex concepts on a global scale. These advantages underscore the utility of data visualization in numerous fields of study, notably within public health, where researchers require sophisticated tools to craft insightful visual depictions of medical data. This need stems from the critical importance of comprehensively analyzing and presenting data to effectively monitor this sector. Beyond the foundational techniques, auxiliary tools like word clouds play a prominent role, particularly in fraud detection. Here, analysts leverage data visualization as a proactive method, identifying patterns indicative of fraudulent behavior.

The study conducted by (Daniel A. , 1996) is renowned for its pioneering work in the field of data visualization, particularly in employing pixel-oriented techniques for effective data representation and analysis. Daniel A. addressed a key challenge prevalent in contemporary data analysis: the exponential growth in data volume. He underscored the limitations of advanced automated systems in analyzing data without human creativity. Consequently, Daniel A. advocated for equipping analysts with techniques to locate and analyze pertinent information within vast datasets. Among the prominent techniques in multivariate data visualization, alongside geometric projection and scatter plots, is pixel-oriented visualization. This method encompasses both queryable and non-queryable visualization approaches. Daniel A. concluded that pixel-based data visualization facilitates obtaining a comprehensive visual overview of the dataset, aiding in identifying unknown correlations and clusters. He stressed that these techniques do not replace statistical methods for multivariate data visualization but emphasized the necessity of integrating exploratory data analysis tools incorporating statistical methods, graphical representations, and data visualization techniques to achieve comprehensive analysis.

(Maria , Juliana , Emerson , & Clélia , 2012) conducted a study with the aim of streamlining the process of selecting a visualization technique for representing data mining outcomes and mitigating associated challenges. This was achieved through the presentation of two methodologies:

The initial approach involved employing visualization techniques as a means to explore latent knowledge within the database. Data underwent a coding process, facilitating the emergence of concepts related to fundamental variables such as data type, task type, size, dimensionality, and attribute positioning in graphical representations. Subsequently, each parameter was analyzed in conjunction with visualization techniques, revealing that each type of data visualization technique possesses a specific configuration reflecting data characteristics and utilization objectives.

Conversely, the second approach focused on the application of visualization techniques to data mining outcomes. This entailed evaluating geometric display techniques and visual representations of symbolic information through feature analysis. However, it is important to note that this evaluation method is subjective, as it reflects the analyst's perspective.

Furthermore, the researchers underscored that the analyst's depth of understanding of the data being studied correlates with a heightened motivation to explore and analyze the data, a phenomenon validated and scrutinized through visualization.

The present study differs from prior research by offering a streamlined approach to selecting the appropriate visualization technique for the examined database and establishing its relevance to the financial sector. This was achieved through an examination of a database concerning loans issued by the Chelghoum Laïd agency of the Regional Consortium of the Bank of Agricultural and Rural Development in the Province of Mila, Algeria. The study aimed to uncover vital insights within the dataset by employing data visualization, specifically utilizing the Scatter Plot Matrix technique, facilitated by the Weka data mining software.

1.Theoretical Background:

Our contemporary era has experienced a remarkable surge in data across diverse fields, encompassing digital, structured, and unstructured data, among others. Initially, grappling with the analysis of such vast datasets presented a

formidable challenge. However, advancements in information technology and computing have given rise to modern IT techniques that streamline the automated analysis and organization of extensive datasets. Among these techniques, data mining methods, which extract knowledge from large databases, have gained widespread adoption across various fields, notably in finance, spanning both developed and developing nations. Notably, data visualization emerges as a prominent technique within this domain, wherein complex datasets are visually represented, rendering them more accessible and comprehensible to users.

Data visualization, as defined by (Matthew , Adebowale , Sarhan , & Cajetan , 2016, p. 12), entails the use of computers to facilitatedata analysis through visual depiction, empowering users to select the presentation format from a repertoire of key techniques, including:(Matthew , et al. 2016, 12)

Bar Graph: Used for comparing a variety of categories.

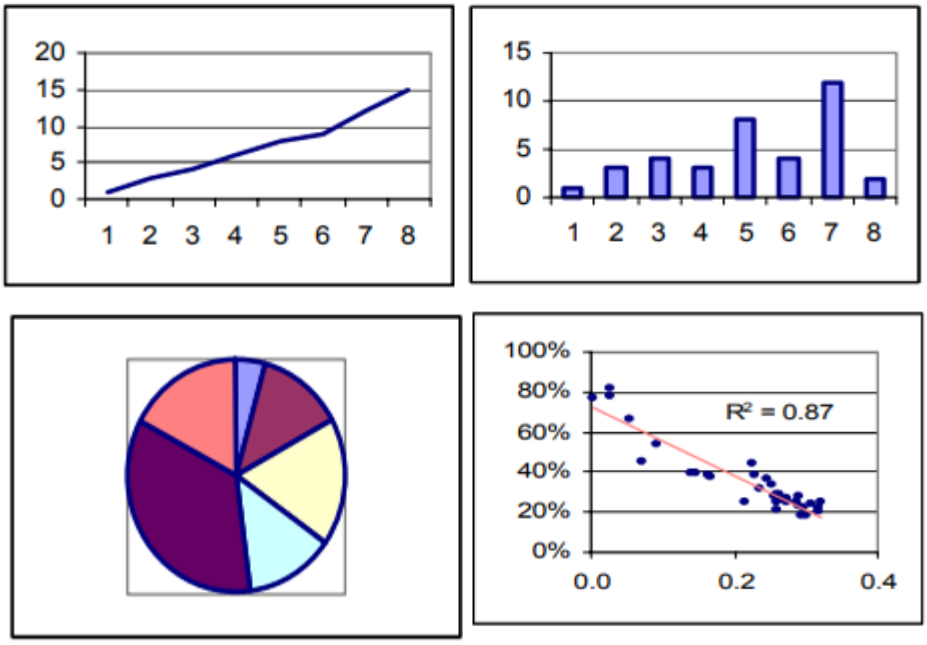
Pie Chart: Utilized to illustrate differences in proportions, facilitating a comparative analysis of all studied segments.

Line Graph: Consists of X and Y axes, showing the relationship between variables and recording changes over time in both dependent and independent variables.

Scatter Plot: Depicts changes in two variables and illustrates their relationship in a two-dimensional format, which will be discussed in detail later.

The following figure demonstrates each of the aforementioned techniques:

Figure 01: Data Visualization Techniques



Source:(Jerzy & Instytut , 2013, p. 10)

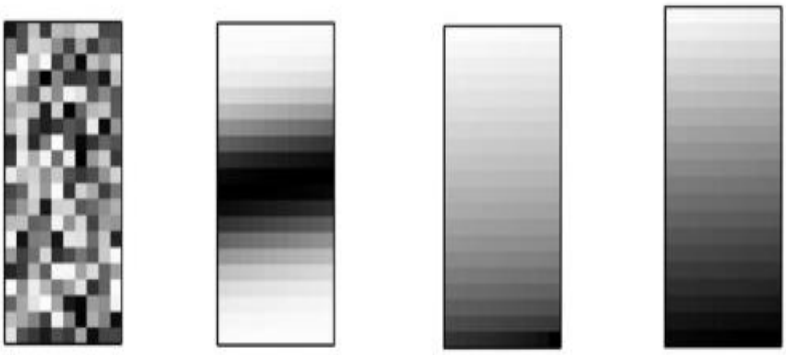
These four techniques form the foundation of visual representation and are often referred to as traditional data visualization techniques. However, multidimensional data visualization types are extensively utilized in data science and computer science. The utility of each data visualization technique varies depending on the objective and the type of data under analysis.

1.1. Multidimensional Data Visualization Techniques

They include, but are not limited to, the following:

- **Pixel-Oriented Data Visualization:** This method is one of the simplest ways to visually represent data through pixel plotting. Each data unit is assigned a black dot (pixel), where an increase in the data's value results in a higher number of black dots used in the plotting, leading to greater shading intensity and vice versa (Mustafa, 2017, pages: 56-57), as illustrated in the following figure:

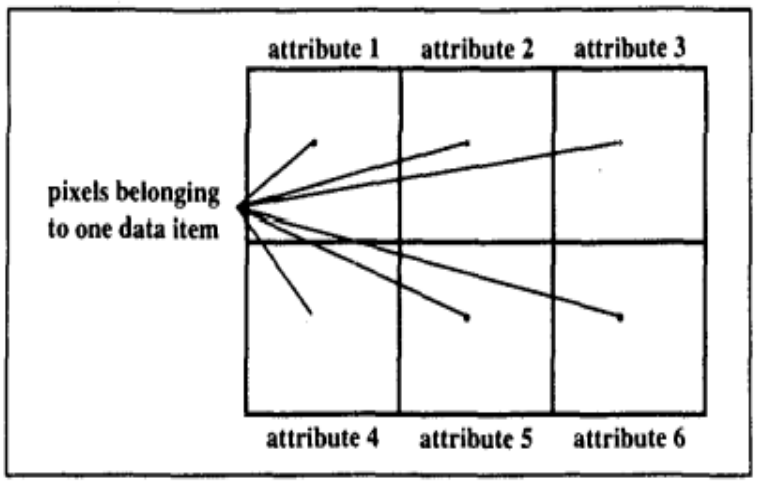
Figure 02: Data Data Visualization via Pixel-Oriented Data Visualization



Source: (Mustafa, 2017, pages: 56-57)

A separate data visualization is created for each attribute in the form of sub-windows, each representing a variable from the studied dataset. In these sub-windows, a pixel is allocated for every data element, positioned at the identical location where the total distance for the element is determined.

Figure 03: The fundamental arrangement of sub-windows for six-dimensional data using Pixel-Oriented Data Visualization.



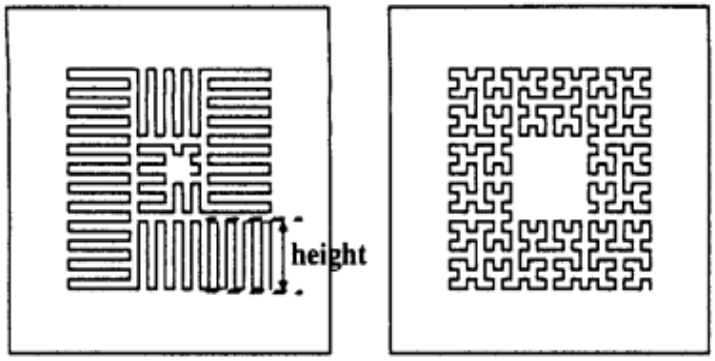
Source:(Daniel A. , 2000, p. 03)

Which in turn is divided into two types: non-queryable and queryable(Daniel A. K., 1996, pp. 36-37)

- **Non-Queryable Data Visualization Techniques:** These techniques involve directly translating specified values in the data into colors without a prior query. This is done by organizing the data from left to right in a row-by-row manner or arranging it from top to bottom in a column-by-column approach, where these arrangements are pixel-based. Typically, these last two methods do not yield accurate or useful results, especially with large databases. This necessitates the application of both screen-filling techniques, which are characterized by good clustering properties, and the recurring pattern technique, which allows the user to influence the data arrangement. Both include several algorithms that work on understanding spatial segmentation to improve the storage and processing of spatial data; (Daniel A. , 1996)
- **Queryable Data Visualization Techniques:** In this approach, data elements are visualized through a specific query set by the user. Instead of directly assigning attribute values to colors, queryable attribute value distances are assigned to colors for identification. Data is organized from left to right or from top to bottom, with data elements that meet the query placed in the center of the display. This is done after arranging related data elements in a spiral shape, where data elements are arranged in a circular and sequential manner in the form of a spiral, with the most

relevant data to the query, i.e., the data with the highest relevance to the query, placed at the center of the spiral, (Daniel A. K., 1996, p. 37) ,as illustrated in the following figure:

Figure 04: Positioning query data at the center of the spiral



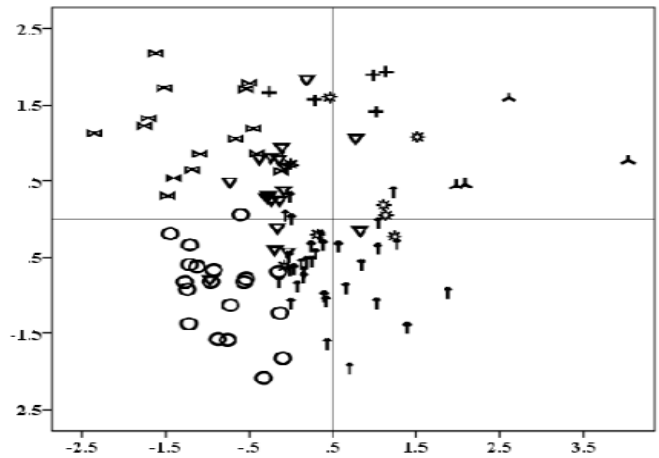
Source:(Daniel A. K., 1996, p. 37)

1.2.Geometric Projection Visualization:

The pixel-oriented data visualization technique lacks the capability to examine and comprehend how data intersect across multidimensional spaces, as it cannot display shaded areas as effectively as it does with separate data columns. Geometric projection visualization aids in generating intriguing projections for multidimensional data categories by presenting them on a flat surface for two-dimensional data, or as three-dimensional cubic forms for three-dimensional data, utilizing scatter plots.

- **2D-Scatter Projection Technique:** Data are distributed according to two axes, X and Y, using a two-dimensional Cartesian coordinate system. A third dimension is added to the geometric plot using different symbols for each value, with their coordinates represented by the intersection points of X and Y values being analyzed(Mustafa, 2017, pp. 57-59), as illustrated in the following figure where each shape represents a different variable.

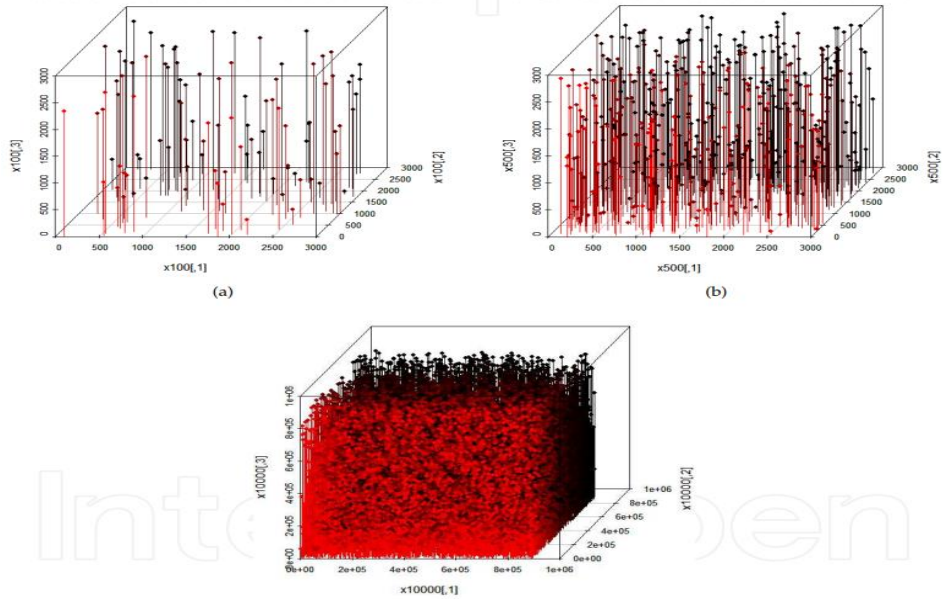
Figure 05:2D-Scatter Projection Technique



Source:(Ranawake, Amarasinghe, & Senanayake, 2014, p. 1044)

- **3D-Scatter Plot Technique:** This technique employs a three-dimensional Cartesian coordinate system, where the three coordinates represent the values of X, Y, and Z. The fourth dimension is represented through shading at the intersection points of these three values (Mustafa, 2017, pp. 57-59). As shown in Figure 06, the geometric projection technique can process up to 10,000 records at a time, even with 05 different variables. It also allows for query intervention in the stage of determining and changing colors to facilitate the user's understanding of the variables' directions. However, as indicated, even with this technique, it is challenging to clearly comprehend the behavior of the variables. Thus, (Maria , Juliana , Emerson , & Clélia , 2012, p. 16) highlighted the Chernoff Faces technique, which can better highlight the relationship between a large number of records. Where example (a) in Figure 06 illustrates the behavior of 100 records, example (b) 500 records, and example (c) 10,000 records.

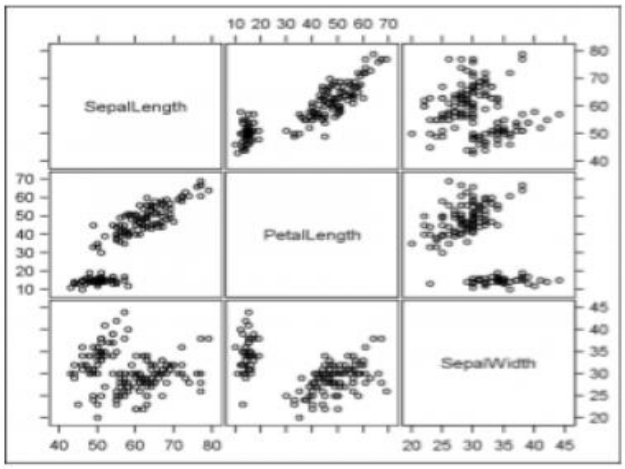
Figure 06: 3D-Scatter Plot Technique



Source: (Maria , Juliana , Emerson , & Clélia , 2012, p. 15)

It's worth noting that when there are multiple variables, users can resort to the Scatter Plot Matrix, which provides a comprehensive display featuring an N x N grid where each cell represents scatter plots for a pair of variables at a time. Below is an example of a scatter plot matrix for 3 variables, meaning the number of cells represents 3x3 for a dataset (Sanjay , 2012).

Figure 07: 3D Geometric Projection Technique



Source: (Sanjay , 2012)

It is observed that the aforementioned techniques are not capable of processing big data, particularly because handling a diverse array of big data represents a significant challenge. Each dataset differs from the other, especially in terms of speed, volume, and variety, which must be considered during data processing and data visualization. Volume refers to the size of data accessible to any organization, which can be in terabytes, petabytes, etc.

Variety refers to the representation of data through audio, video models, texts, and images, and also encompasses both structured and unstructured data. Speed, on the other hand, denotes the frequency of data changes and also pertains to data streaming and batching. (Parul & Jyoti , 2020, p. 05)

1.3.Modern Techniques for Visualizing and Representing Big Data

- **Word Clouds:** Word clouds are a potent technique for processing and visualizing Big Data databases. They work by highlighting only the most significant and frequently occurring words, displaying them in a word cloud with varying colors, sizes, and fonts to immediately draw the analyst's attention. This allows for the automatic recognition of the content of a large collection of text documents instead of reading numerous files. Word clouds have been used for years in various fields, most commonly in information systems, especially those based on the web, such as content management systems(Yordan , 2021, pp. 114-115). The following figure illustrates how a database consisting of 95 papers from the CompSystech 2012 conference is visualized in the form of a word cloud:

Figure 08: Word Cloud of 95 pages

Source: (Yordan , 2021, p. 1 16)

- **Connectivity Charts:** This data visualization technique is employed to illustrate the relationships and the strength of connections between dependent and independent variables within a big data database(Parul & Jyoti , 2020, p. 06) Traditional techniques are unable to provide such data visualizations, as previously explained in the context of geometric projection in Figure 05, where it is represented in the form of a network connecting all related variables.

Despite numerous research efforts aimed at developing new techniques for analyzing big data (Parul & Jyoti , 2020, p. 06) acknowledged their insufficiency for visual representation. For example, Cloudera offers solutions for big data analysis and management among other technologies and companies that process zettabytes and petabytes of data. However, they fall short of providing clear visual representations that can help reduce the time and cost of analysis and facilitate effective communication with users.

2.FIELD STUDY:

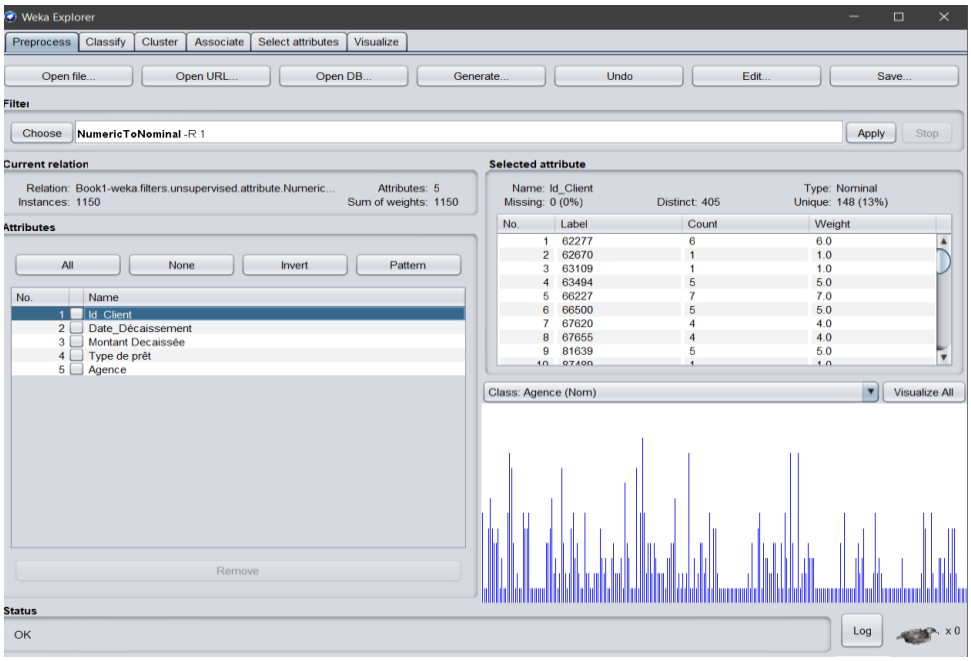
The use of visual representation techniques has become crucial across various fields.Especially those that are based on artificial intelligence programs, since the latter has greatly influenced how various practices are processed digitally in a way that has led to wealth in the technological field. (Ouafi 2024, 591)

Given the scarcity of studies that address the impact of applying visual representation on the discovery and exploration of unknown knowledge in databases within the financial sector, we decided to implement a visual representation technique suitable for a database of loans granted by a particular commercial banking agency, specifically the Regional Consortium for Agricultural and Rural Development Bank in Mila Province, Algeria. This study covers a period of 5 years from 2018 to 2021, presented in detail to facilitate its replication as a reference by researchers, students, or professionals.Considering that the technological gap in this bank, like other Algerian banks, is still large due to many obstacles, and among the most modern analysis techniques that the banks active in the geographical area under study lack is visual data analysis (zahia and meftah 2018, 296), where Visual representation of financial information is particularly important for insiders and stakeholders to achieve effective communication and collaboration and bridge the gap between financial experts and non-experts. It enables stakeholders to make data-driven decisions and uncover risks or opportunities through the data visualization of trends, correlations, and

anomalies. It also allows users to make informed and immediate decisions in a dynamic business environment through interactive exploration of financial data (Kamrul & Obed , 2023, p. 843).

To analyze the database under study, we used the Weka data mining software, converting the data from Excel to CSV format before importing it into the program as follows:

Figure 09: Data Entry in Weka Software



Source: Weka Software Interface

The interface contains 05 variables related to:

Client ID: Typically used to identify the client and facilitate account management, improving the bank's customer service.

Loan Date: Indicates the scheduled time for disbursing agreed-upon credit installments, crucial for both the bank and borrowers to manage liquidity and credit risks.

Loan Amount: Relates to the type of loan granted, usually disbursed in credit installments calculated by the bank.

Loan Type: Financial institutions and banks offer various loans based on several factors like specialization. The Agricultural and Rural Development Bank in Mila focuses on investment and operational loans among others to support farmers, fish breeders, whether institutions or individuals.

Agency: The Regional Consortium in Mila includes 09 agencies, with this study focusing on loans granted by the Chelghoum Laid agency.

The database analysis revealed no missing values, estimated at 0%, indicating all record fields contain values, which enhances the accuracy and objectivity of the analysis and conclusions. This is ideal as decision-makers should not have to compensate for missing data issues that could affect decision-making processes. With that said, various methods to compensate for missing values exist in the software, such as:

Replace missing value: Cleansing data by replacing all missing values with the mean or median, which can be chosen by the data analyst.

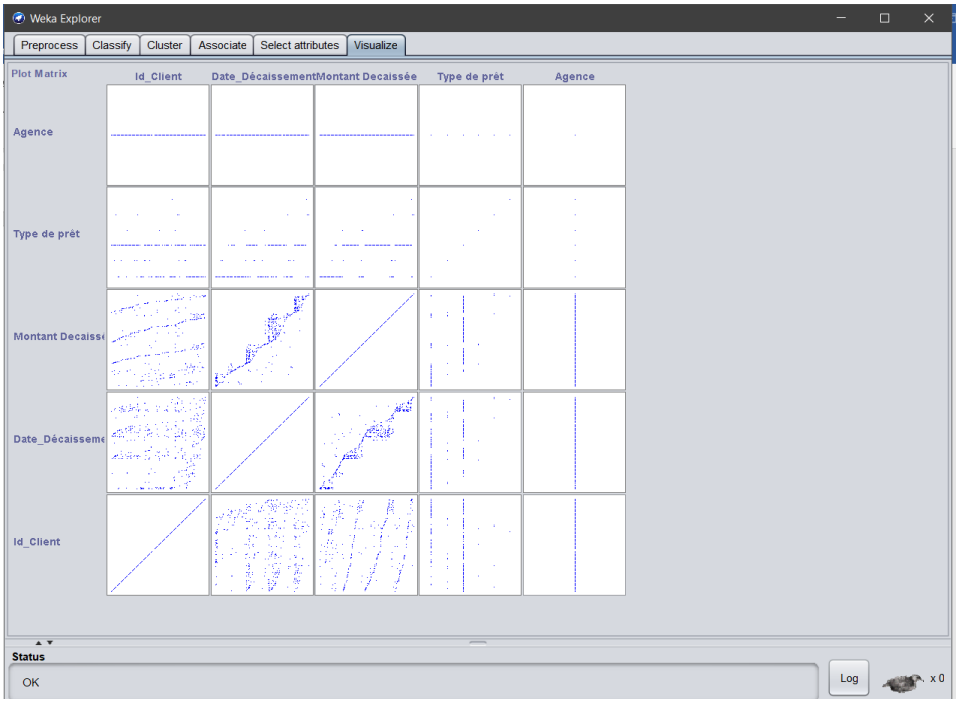
Replace Missing with User Constant: This method replaces errors and missing or deleted values with a user-defined constant value.

Replace with Missing Value: Identifies all missing values to be detected by various techniques and algorithms for easier processing during knowledge extraction, replacing all values with a special marker for missing values.

These methods are viable if the proportion of missing or incorrect values is relatively small, as an increase might affect the validity of the analysis, impacting the credibility and accuracy of decisions, especially in an economic environment that requires precise analysis due to the rapid pace of market information.

To extract and analyze important information within the database and uncover existing knowledge, we conducted a data visualization. Given the data's lack of high complexity, the Scatter Plot Matrix technique was chosen as suitable for analyzing the studied data. It can depict all existing relationships between the five variables, including linear and non-linear relationships, and typical and atypical variations. We observed 5x5 dimensions, i.e., 25 scatter plot curves, as follows:

Figure 10: Scatter Plot Matrix for the database of Chelghoum Laid Agency



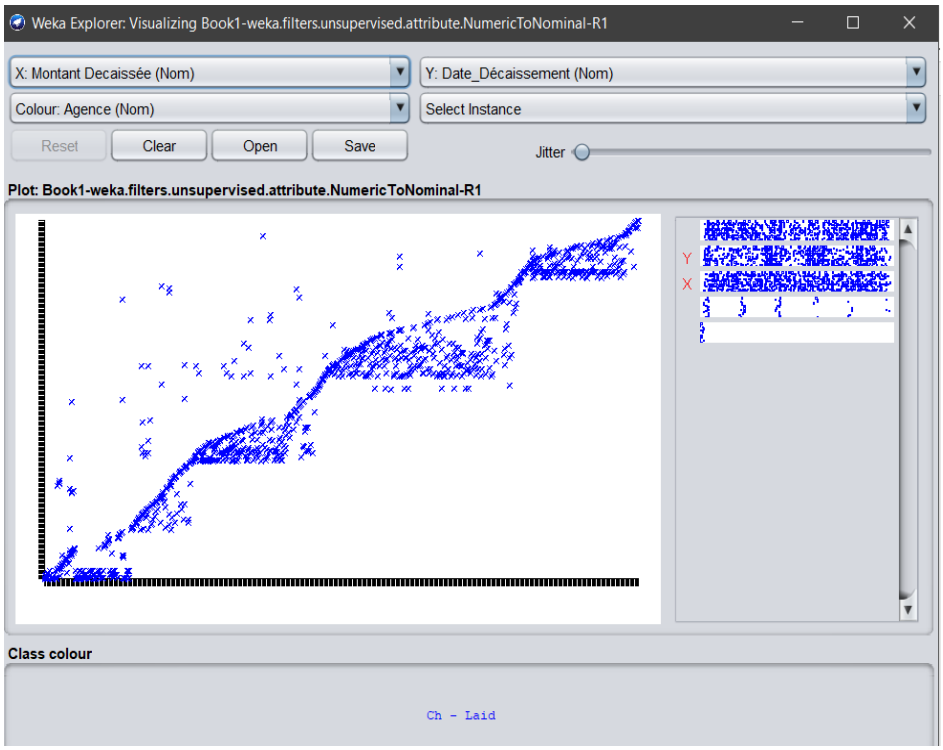
Source: Weka Software Interface

The appearance of a straight line in the scatter plot of the first row is due to the presence of only one agency. As for the other curves represented by a straight line in the Scatter Plot Matrix, this occurs because the variables are the same on both the X and Y axes.

We observe a positive linear relationship between loan granting date and loan amount, which may indicate that as the loan value increases, the loan granting date also increases proportionally. This positively affects the bank, especially in terms of risk-bearing capacity. Granting credit by considering the loan value to determine the credit benefit date ensures the bank maintains a good reputation for fair treatment of all its clients. The strategy of determining the loan granting date based on the loan value itself is a mechanism that enables the bank to assess its ability to bear financial risks that may arise from non-repayment and to take necessary measures to ensure loan recovery, especially for high-value loans. For the client, knowing the expected loan collection dates helps in better budget planning, ensuring it aligns with repayment dates. The distribution of loan installments granted by the bank

helps reduce financial pressure, as it does not oblige the client to bear financial burdens within short time periods. The following curve illustrates this:

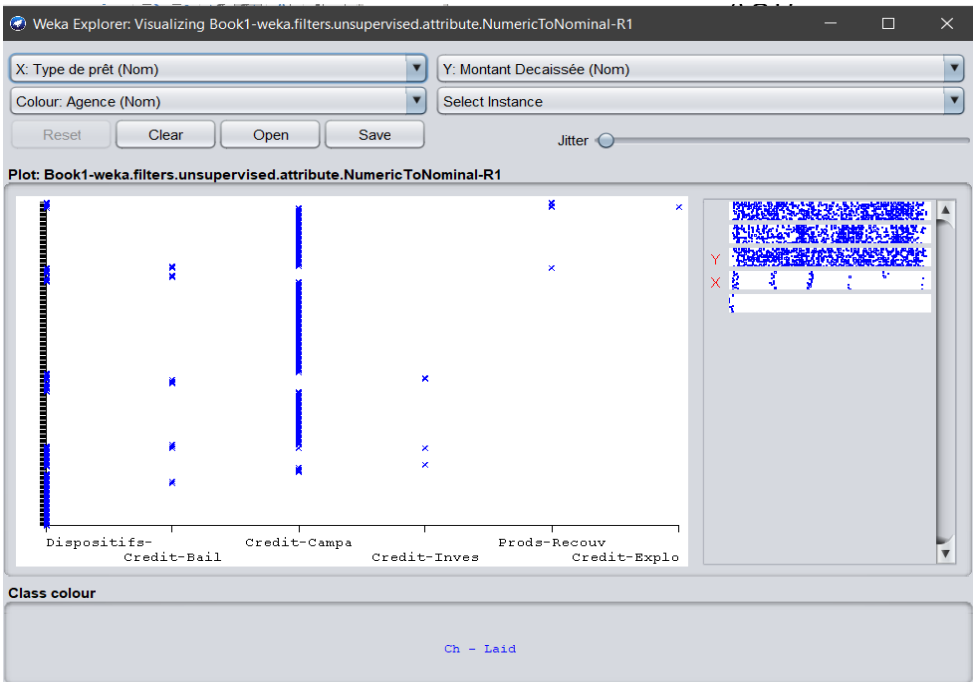
Figure 11: Time Series for Granted Credit Installments



Source: Weka Software Interface

Regarding the granted credit installments according to the type of loans, we observe a concentration in several types, indicating significant repetition in that category. This largely depends on the nature and requirements of the loan, as well as the client's desire and purpose for obtaining the loan, and is demonstrated as follows:

Figure 12: Time Series for Granted Credit Installments



Source: Weka Software Interface

We observe 06 types of loans granted by this agency, represented as follows:

Financial Support Schemes: These loans are aimed at financing 70% of small enterprises for their establishment or expansion. A total of 343 credit installments of this type were granted during the study period. This loan type was popular among clients due to the need for initial capital to realize ideas and visions, especially concerning initial expenses and supplies for starting any project. Additionally, there's a need for extra funding to open new branches and expand the business scope to achieve sustainable growth, especially in recent years where there's been a global shift towards investing in technology and innovation.

Leasing Loans: These are loans for leasing agricultural irrigation equipment or machinery, with 39 credit installments directed to a specific number of clients only. The lack of interest in this loan type is due to various factors like advancements in agricultural technology, which require significant capital investments, leading farmers to prefer buying equipment over leasing.

Investment Loans: Directed towards developing and improving the performance of various agricultural activities, with only 07 installments granted over 5 years. The reluctance towards this loan type may stem from challenges faced by agriculture recently, including weather issues and significant fluctuations in product prices.

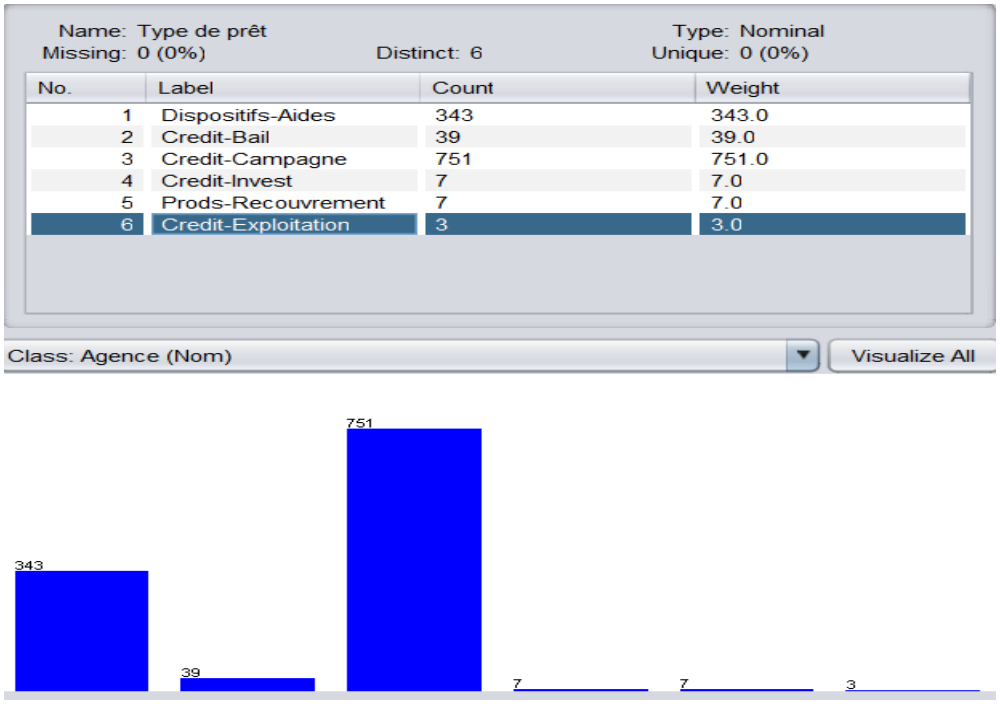
Fisheries and Aquaculture Financing: This loan type is for funding investments in fisheries and related activities. A significant client interest was noted, with the bank granting 751 loans, possibly due to favorable interest rates to encourage such investments, market opportunities, and demand for seafood products.

Operational Loans: These are loans granted for operational activities such as purchasing irrigation equipment, livestock feed, veterinary drugs, farm restructuring, and acquiring agricultural products for storage. Only 03 credit installments were granted over five years, indicating a need for the bank to develop marketing and financing strategies that align with farmers' aspirations to encourage the use of this loan type, especially as the sector moves towards sustainability and innovation.

Non-performing Loans: These are loans that have not been repaid on the agreed-upon due date, with 07 defaults recorded during this period, which is relatively positive for the agency considering the COVID-19 crisis that paralyzed many sectors due to financial and economic downturns locally and globally.

The following figure illustrates the points discussed above:

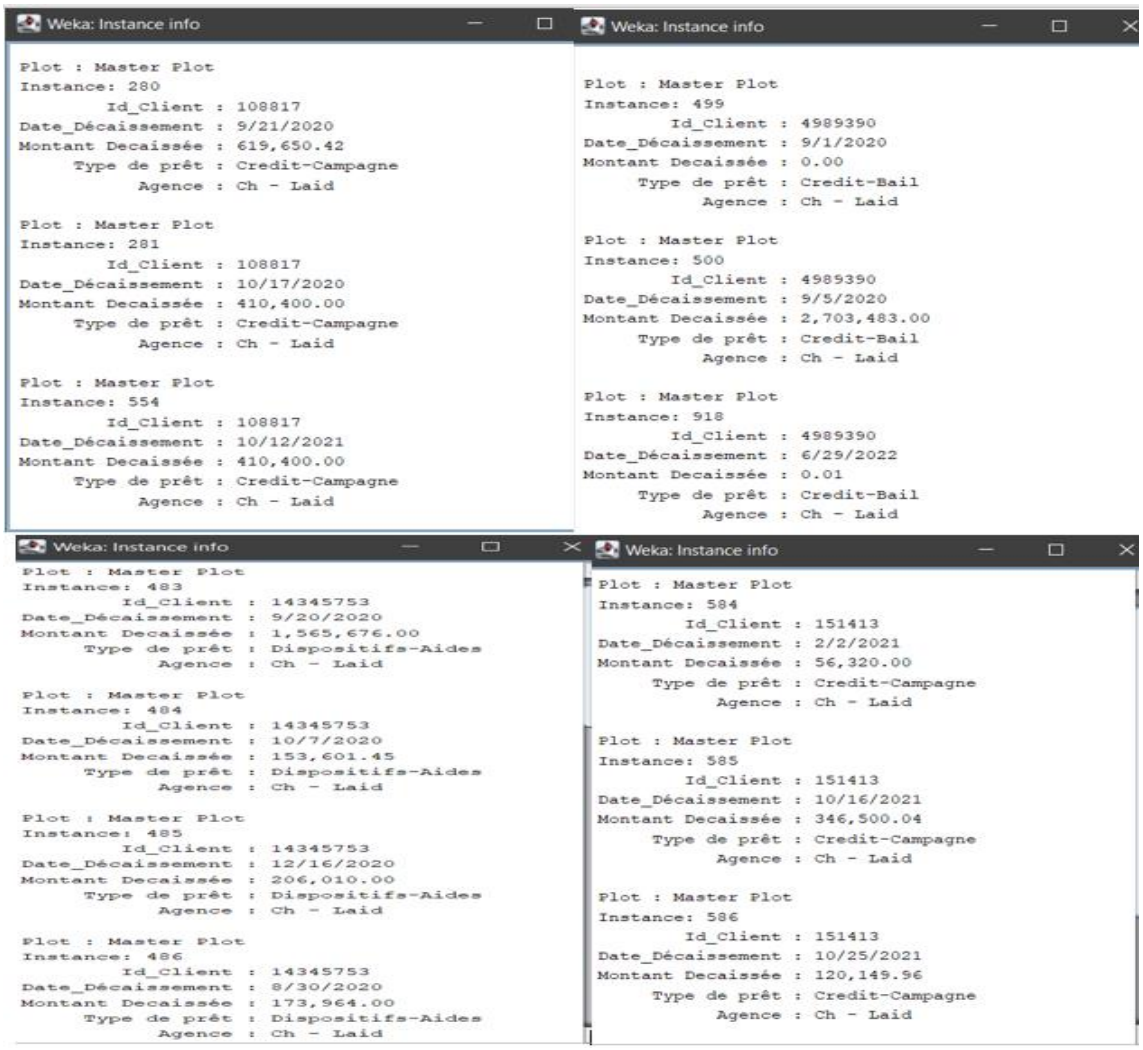
Figure 13: Credit Installments Granted by Type



Source: Weka Software Interface

It's also important to analyze the diversification of financial options available to clients by the bank, i.e., whether the bank offers multiple types of loans to a single client at the same time. We observed that the agency tends to grant only one specific type of loan to each client without offering a variety of financial services and loan options. This approach may be aimed at reducing financial risks associated with the complexities of providing multiple options. While this strategy has been successful in many banks focused on financing specific sectors, it might not fully meet the diverse needs of clients. Below are some of the credit installments granted to certain clients, derived from the scatter plot related to the type of loans for each client.

Figure 14: Type of Credit Granted to Each Client



Source: Weka Software Interface

3. Discussion:

This theoretical and field analysis underscored the significance of comprehending various characteristics that distinguish the database under examination, particularly regarding its size and diversity. This understanding is crucial for determining the optimal method of applying visual representation to process and analyze it. While conventional methods such as bar charts and pie charts prove useful for handling databases with a limited number of straightforward variables to elucidate relationships and trends among them, multidimensional visual representation encompasses a broader spectrum of techniques. These techniques enable the understanding of intricate relationships among a large set of variables, including pixel-oriented data visualization and geometric projection.

Among the most notable modern techniques capable of processing vast amounts of data, reaching zettabytes and petabytes, while offering clear data visualization, are connectivity charts and word clouds. These tools aid analysts in grasping previously unknown knowledge within the database under scrutiny.

The Weka data mining program underwent testing, presenting a diverse array of visual techniques such as plots, graphs, binary data visualization, and visual principal component analysis. Applied to the database of loans granted over a five-year period from 2018 to 2022 by the Chelghoum Laid agency of the Regional Consortium for Agricultural and Rural Development Bank in Mila Province, Algeria, data visualization was employed through

Scatter Plot Matrix. This method analyzed the volume of granted loan installments, depicted through a 5x5 matrix, effectively elucidating all significant relationships in the data.

The study concentrated on a set of default curves illustrating how credit installments are distributed based on the date, revealing a positive linear relationship. This indicates that as the value of the granted loan increases in proportion with the duration between installment dates. This insight aids the bank in assessing its capacity to perceive and manage financial risks stemming from defaults, enabling timely intervention. Moreover, it assists clients in effectively planning their budgets, ensuring consistency in the timing of due dates. Additionally, variations in client preferences for the types of loans offered by the bank were observed, influenced by several factors detailed more precisely for each type. Finally, the bank's adoption of the single loan policy, at times utilized as a tool to direct economic policy, was clarified.

4. Conclusion:

This study aimed to process a database of loans granted by the Chelghoum Laid agency of the Regional Consortium for Mila Province. From the results obtained, it was concluded that using visual analysis to process and analyze the volume of loans granted by the bank can add significant value to interpreting and understanding the data by clarifying various temporal trends and understanding long-term trends through the quantity of loans offered to each client and for each type of loan. This helps understand the diversity in the bank's financing and identify the types that attract the most clients to evaluate this distribution and variance for market trend analysis.

Based on the aforementioned results, we propose the following:

- Enhance the use of data visual analysis across various organizations, especially among analysts and decision-makers.

- Conduct qualitative or field studies related to converting complex databases into sequences that are easily visualizable.

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