Descriptive Analysis Model to Improve the Pension Contributions Collection Process for Colpensiones

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Abstract. The objective of this work is to show how, with the use of Big data techniques, the results of a descriptive analysis of the collection for pension contributions of the COLPENSIONES income management process; because the sustainability of the average premium regime must be guaranteed by the collection by the employers; in order for the pension system to be maintained. Payments are made through the Integrated Contribution Settlement Form–PILA by spanish Planilla Integrada de Liquidación de Aportes–, after registering with an information operator, which can be completed on the information operators' website or through an advisor to them. The information operator is the company in charge of facilitating the creation, modification, validation, correction and sending of PILA. Additionally, it directs information, records and payments to the different social security and parafiscal administrators, in a safe and timely manner. Therefore, we want to make known the importance of this process within the company with this article, from the information found in the payment tables for contributors during the years 2013 to 2017, thanks to COLPENSIONES. A descriptive analysis methodology of the collection process is implemented current situation and the construction of a model based on the different variables that can influence collection management, also validating the existence of methods for predicting collection or non-payment within the company. Through the CRISP DM methodology, apply each of the different stages that it contains within the development of the process.

Keywords: Pensions · Descriptive · Big data · Collection

1 Introduction

At the pension level, Colombia has wanted to propose a pension reform; The analysis presented by entities such as ANIF (National Associations of Financial Institutions) and ASOFONDOS (Colombian Association of Pension and

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Unemployment Fund Administrators) is indisputable to carry out, as part of the problems the Evasion of payments is presented, which consists of not making the payment of contributions to the Social Protection System. Therefore, taking the technological development that is taking place with the use of large information databases, and being able to give it the import value that these represent for both public and private entities. Big data techniques are being used as a tool for managing large volumes of information and the added value they give to information for decision making. The way to identify variables, trends and groupings on specific bases, becomes an interactive process in a transformation and use of information. All focused on implementing automated processes to improve response times and respective collection of the company [21]. Data analysis is the important underpinning of many projects worldwide in different sectors. Applying the above to a system as sensitive as the pension system in Colombia, generates greater importance in the strategies that are linked to risk analysis within the sector [19,20]. Big data techniques are not frequently used for the creation of planning in the collection processes in the pension sector, and it is intended to be useful in management to be able to create actions that reduce the non-payment of contributions in collection and power reduce delinquency in employers. Taking into account the importance of the pension sector, its behavior in the market and the influence it exerts on the Colombian economy, this work develops a methodology through a descriptive model allowing to adequately estimate the number of contributors per month who make payments, classified by city, Quote Value and in this way ensure that Colpensiones obtain tools to reduce evasion or non-payment for contributions from the emperors. This is possible, through the application of descriptive statistical methodologies and different Big Data techniques that have made it possible to identify and quantify levels of collection directed at all companies that make pension payments; For this, the collection made during the years 2013 to 2017 (Information provided by the Bank Payments Log) of the companies in question was taken as a basis, through them a collection analysis was carried out, based on the georeferencing and amounts of payments made. The main objective is to determine quantitative variables that group and determine higher collection areas, where it is determined where there is no coverage for collection and if collection policies and commercial management for the emperors should be changed. The article consists of five sections, where Sect. 1 is the introduction and the importance of the pension systems in Colombia is explained, in Sect. 2 the theoretical and normative framework is proposed and developed, on which the existing obligation to make the contribution payments, as well as the methodology proposed for the development of the model in the third section, some articles will be reviewed where descriptive models were made on the collection process, and finally section four presents the results of this work.

2 Methodology and Materials

2.1 Background

The Colombian health system created with Law 100 of 1993 [1] incorporates in its design several mechanisms aimed at making it an efficient and equitable system and, in the Latin American context, The universal character of affiliation to the General System of Social Security in Health (SGSSS) established by article 153 of the law, entails two types of obligations: on the one hand, the obligation of every employer to affiliate their workers to this System, and on the other, the obligation of the State to facilitate the affiliation to those who lack a link with an employer or the ability to pay.

Payments must be made through PILA, after registering with an information operator, which can be completed on the information operators' website or through an advisor to them.

The information operator is the company in charge of facilitating the creation, modification, validation, correction and sending to the PILA. Additionally, it directs the information, records and payments to the different social security and parafiscal administrators, in a safe and timely manner.

Law 100 of 1993 [1], establishes in its articles 13, 17 and 22 the following:

ARTICLE 13. Characteristics of the General Pension System. The General Pension System will have the following characteristics:

a Membership is mandatory except as provided for independent workers;
b The selection of any one of the regimes provided by the previous article is free and voluntary on the part of the affiliate, who for this purpose shall state his choice in writing at the time of joining or transferring. The employer or any natural or legal person who is unaware of this right in any way, will be entitled to the sanctions referred to in paragraph 1. Article 271 of this Law;
c The affiliates will have the right to the recognition and payment of disability, old-age and survivor benefits and pensions, in accordance with the provisions of this Law;
d Membership implies the obligation to make the contributions established in this Law;
e Members of the General Pension System may choose the pension scheme they prefer. Once the initial selection has been made, they may only be transferred from the regime once every 3 years, counted from the initial selection, in the manner indicated by the national government;
f For the recognition of the pensions and benefits contemplated in the two regimes. It will be taken into account: the sum of the weeks quoted prior to the effective date of this Law, the Social Security Institute or any box, fund or entity of the sector public or private, or the time of service as public servants, whatever the number of weeks quoted or the time of service.
g For the recognition of the pensions and benefits contemplated in the two regimes, the sum of the weeks contributed to any of them will be taken into account;

h In development of the principle of solidarity, the two regimes provided by article 12 of this Law guarantee to their affiliates the recognition and payment of a minimum pension in the terms of this Law;
i There will be a Pension Solidarity Fund designed to expand coverage by subsidizing population groups that, due to their characteristics and socioeconomic conditions, do not have access to social security systems, such as peasants, indigenous people, independent workers, artists, athletes and community mothers;
j No member may simultaneously receive disability and old-age pensions;
k The administrative entities of each one of the regimes of the General Pension System will be subject to the control and surveillance of the Banking Superintendency.

ARTICLE 17. Obligation of Contributions. During the validity of the labor relationship, mandatory contributions to the General Pension System Regimes must be made by the affiliates and employers, based on the salary that they earn.

Except for the provisions of article 64 of this Law, the obligation to contribute ceases at the moment the member meets the requirements to access the minimum old-age pension, or when the member retires due to disability or early.

ARTICLE 22. Obligations of the Employer. The employer will be responsible for the payment of his contribution and the contribution of the workers in his service. For this purpose, it will deduct from the salary of each affiliate, at the time of payment, the amount of the mandatory contributions and that of the voluntary contributions that the affiliate has expressly authorized in writing, and will transfer these sums to the entity chosen by the worker, together with those corresponding to their contribution, within the terms determined by the Government for this purpose. As we determine the importance and obligation that employers have within the process, we will evaluate in more detail each of the study variables that the entire collection process has, where we will define which are the most important. Topics and technologies are identified and ranked, and key use cases are highlighted [2]. Data mining presents many methodologies for carrying out projects, in this project we will focus on developing and publicizing the CRISP DM. Giving its full scope and identifying the different phases it contains [3].

1. Understanding the business: Understanding the objectives and requirements of the project. Definition of the Data Mining problem.
2. Understanding the data: Obtaining the initial set of data. Exploration of the data set. Identify the quality characteristics of the data. Identify the obvious initial results.
3. Data Preparation: Data Selection. Data cleansing
4. Modeling: Implementation in Data Mining tools
5. Evaluation: Determine if the results coincide with the business objectives. Identify the business issues that should have been addressed.

6. Deployment: Install the resulting models in practice. Settings for data mining repeatedly or continues.

Descriptive analysis as a research source will allow us to summarize and interpret some of the characteristics and properties of a data set; generating information such as the average, the median, the geometric mean, the variance, the standard deviation among others. These measures offer us key properties for the project. A critical issue in ensuring the long-term sustainability of pension funds is making reliable decisions. To design a more comprehensive performance measure+ [4], all of this starts from collection. This also impacts money returns, the valuations of financially solid companies, and those that are strengthening, respond better to the financing of pension plans [5].

3 Related Work

In Canada, the types of pension plans offered to Canadian employees are changing. As membership in traditional defined benefit pension plans declines [6], in Colombia we are taking the same path in search of improving our pension system.

Within the information that we have in Colombia, we can generate great changes in improving people's rights in pension issues, as in Europe, which It did an analysis that focuses on 20 European countries using a large number of data available, including a set of 20 possible explanatory variables for the period 2001–2015 [7].

Over the past decade, many countries have reformed their retirement systems by reducing the generosity of benefits, tightening provisions for obtaining a pension, introducing undefined benefit plan options, and even replacing plans. Many of these reforms have affected the post-employment benefits public workers will receive when they retire [8].

In response to the aging population, the United Kingdom (UK) government, like many others, has increased the State Pension Age. This has implied equalizing the state pension age of women and men, raising it from 60 to 65 years [9].

Mexico introduced a Defined Contribution Pension System in 1997. They analyzed the behavior of affiliated workers under the institutional design of the reformed system. Before the reform, 75% of affiliated workers could receive a lifetime annuity upon retirement; They projected that under the new rules only 30% of participants will be able to transform savings into pension income [10].

Due to the fails in the Colombian pension system, it can be reflected in fiscal changes, which leads to a pension reform, as stated by Olivia S. Mitchell and Robert S. Smith [11], where they explore the determinants of pension financing in the public sector. They evaluated the financial characteristics even related to the 80s were analyzed, and shows the great changes and variations in financing practices where it suggests that past financing has to be perpetuated, and that financing it is sensitive to tax pressure [12].

For Colombia, the level of coverage is highly variable determined by access to information, displacement of people, what most influence is the companies omitting payments; Garcia M.T.M. [13] validates the expansion of the coverage of

private pension plans is considered an alternative to address the growing pension gap. In fact, due to recent reforms, lower public pension system replacement rates are expected for future generations of retirees. However, in most countries, private provision remains voluntary and observed coverage rates remain very low. Several factors could explain this evidence and various policy options have been suggested to increase coverage in private pension plans. However, the questions regarding both the decision of the type of occupational pension plan, the defined benefit or the defined contribution, as well as the characteristics of the personal pension plans, are more important and complex, since the implications to achieve the adequate retirement income adequacy are diverse. This document reviews these issues and the coverage of these pension plans. Another interesting article where you can see where the pension system could go in Colombia where it did not act in a balanced way in the changes or reforms on issues such as increased contributions, increased weeks or increased pension age, Diamond, Peter A. and Orszag, Peter R [14] review the financial position of Social Security, present a plan to save it, and discuss why Social Security income should not be diverted to individual accounts. Our approach preserves the value of Social Security by providing a basic level of benefits for workers and their families that cannot be decimated by stock market crashes or inflation, and that lasts for the life of the beneficiary; increases benefits for some particularly needy groups, such as those who have worked at low wages for long careers and widows and widowers with low benefits; It eliminates the long-term Social Security deficit without resorting to accounting gimmicks, putting the program and the federal budget on a stronger financial footing. Also as part of research in Colombia, the Universidad Libre, in an article [15], analyzes the Spanish public pension system, describing its components and the incidence of its changes since the 1978 Constitution.

4 Methodology

Colpensiones has 6,527,193 affiliates at the end of December 2017, continuing with the achievement of having a third of the affiliates to the general pension system in Colombia. Of the aforementioned affiliates, 2,349,505 correspond to contributing Affiliates and 4,177,688 are Non-contributing Affiliates, that is, they are citizens who did not make their mandatory contribution during the last month. During the 2017 period, 100,370 were affiliated [16]. Colpensiones managed to exceed the goal established for income for the year 2017 by 119% in relation to the programmed income for the different collection concepts, the total amount collected amounted to 15 trillion with respect to the projected income of 12.7 trillions. The main sources of income are Collection of Pension Contributions (contributions of 16%) for a value of 8.7 billion (distributed in 8,105,717 billion of the funds and 592,084 million corresponding to the 1.09% commission of the Administrator) [16]. As of December 2017, the number of companies and commercial establishments active in the commercial register of the Bogotá Chamber of Commerce is 728,784 [4], which would be obliged to make payments to the Social Protection System. The growth that uncertainty

has had within Colombians in which they can achieve their pension and due to the levels of non-payment of contributions has generated great concern within the pension sector, the proposal to create a descriptive model to rethink strategies and decision making within the collection process. Statistical tools should be used in the creation of descriptive models for monitoring, coverage [17] of the collection. The database that will be used for the work corresponds to the one generated by the bank payment logs that this structure in the contributor payment table. For the ordering of the variables and the necessary calculations, the Statistical Analysis and Statistics software SAS Enterprise Guide will be used in its version number 9.4.

The database contains the historical contribution payments of 53,803,746 employers made for the years 2013 to 2017 with a monthly average of 896,729 contributors who make contributor payments, with a cut-off date in December 2017, where 32 variables are identified in relation to each employer registry of the entity.

The dependent variable will be the Quotation_Cycle that corresponds to the period or month for which the payment of contributions is in default or in default, this is used to calculate and evaluate the portfolio, within the debt settlement process it is taken as the starting point for the respective liquidation of arrears. The remaining variables will explain and determine the dependent variable explained in the proposed model of the 20 variables that are available, 6 that are better related to the structure of the proposed model will be taken.

1. Department: Place where the payment was made; 32departments, a capital district Bogotá and Exterior correspond to payments by affiliates outside of Colombia.
2. Type of Contributors: They define some characteristics of the contributors and the types of contributors that can be linked according to Resolution 634, which parameterizes the content of the Single Form or Integrated Form for the Settlement of Contributions.
3. Document Number: It is the identification of the contributor for the Unique Form or Integrated Form for the Settlement of Contributions.
4. Contribution Value: Corresponds to the contribution to the pension fund made by the employer, which is still 16% of the base contribution income.
5. Number of Workers: Determines the number of affiliates for whom the contribution payment is made.
6. Payment Date: Determines the date on which the contributor made the payment, which can validate whether it was made within the established dates or outside of them.

5 Results

The results generated from the project after discarding the variables that are involved in the collection, results in a descriptive model where useful strategies are obtained, which allow the increase collection reduction by contributions. An

employer is considered to be any natural or legal person who has the obligation to make contributions to the General Pension System (SGP) on his behalf or on behalf of third parties, that is, they can be employers and/or independent persons. In Fig. 1 is possible to see the number of contributors per month who make payment. The graph illustrates the monthly variation of the population of employers that pay contributions, at the arithmetic mean of the sample is 1,005,922 contributors, clearly seeing the increase for the period 2017-05 due to changes in the regulations by entry Resolution 2082 of 2016 of the UGPP (Pension and Parafiscal Management Unit) in force.

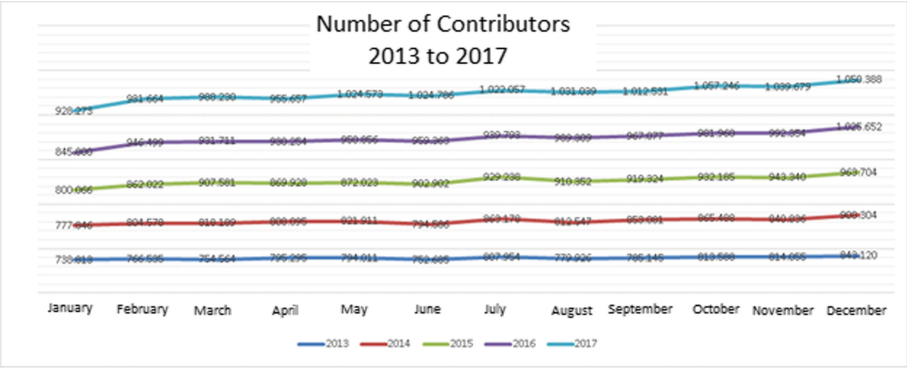

Fig. 1. Number of Contributors from 2013 to 2017 in thousands

In Fig. 2 shows the quote value per month of payment. The graph illustrates the monthly variation of the listed value made by payment of contributions, the arithmetic mean of the sample is $689,142 Million pesos, clearly seeing the decrease for the period 2017-03 due to changes in the regulation by entry Resolution 2082 of 2016 of the UGPP (Pension and Parafiscal Management Unit) in force.

In Fig. 3 shows the distribution of payments by city per year. We can see that the largest amount of payments made during 2017 is in the city of Bogotá DE 3,553,769 Billions which corresponds to 42.2%, followed by Antioquia with 17% and Valle with 10.2%, these three departments correspond to the 69.8% of payments made in Colombia.

5.1 Geographical Zones

In the descriptive model used, the result was a scenario applicable to the general process of collection of contributions, which allows improving collection and reducing the evasion of payment of pension contributions. 74% of companies or employers have problems with data quality. This is demonstrated by the study made as we will see it below and it is possible to see in Fig. 4. Employers' contact

Fig. 2. Quote Value per Month from 2013 to 2017 in Millions

DEPARTMENT	2.013	2.014	2.015	2.016	2.017	AVERAGE	INCREASE	PARTICIPATION 2017
BOGOTA	2.148.088	2.409.715	2.726.418	3.133.058	3.553.769	2.794.209	65,44%	42,2%
ANTIOQUIA	827.432	924.825	1.080.526	1.262.854	1.459.632	1.111.054	76,41%	17,4%
VALLE	487.844	556.007	638.021	745.582	859.861	657.463	76,26%	10,2%
OTHERS DEPS	1.524.516	1.751.746	1.984.939	2.191.023	2.538.163	1.998.077	66,49%	30,2%
TOTAL	4.987.880	5.642.292	6.429.903	7.332.516	8.411.426	6.560.803		

Fig. 3. Distribution of Payments by City per Year from 2013 to 2017 in Millions

details, although we presented that 69.8% are distributed in 3 cities, validating in more detail the issue of Addresses only for the year 2017 corresponds to 12 million payments, it is found that there are 4,180,556 almost 35% of these addresses they do not match, the employers are not traceable. According to the Data Governance Technical Guide of the Ministry of Information Technologies and Communications -MINTIC [18], entities must choose to follow an adequate management of data governance, taking into account areas such as governance, quality, migration, life cycle and master data management. The National Government through Decree 1008 of 2018 established the general guidelines of the Digital Government Policy, which aims to promote the use and exploitation of information and communication technologies to consolidate a State and citizens that are competitive, proactive, and innovative, that generate public value in an environment of digital trust. One of the fundamental purposes of the Digital Government Policy is aimed at ensuring that public entities make decisions based on data. Decision-making based on data requires the implementation of an effective governance of data, from the definition of a data governance policy based on the adequate articulation of its fundamental components, such as the people who are part of a digital society, processes and technology. As a complement to the Digital Government Policy, there are documents from the National Council for Economic and Social Policy - CONPES, No. 3854 of April 2016 related to the National Policy of Digital Security and No. 3920 of April 2018 corresponding to the National Data Exploitation Policy (Big Data).

The National Digital Security Policy includes risk management as one of the most important elements to address digital security through the active participation of all interested parties, ensuring shared responsibility among them.

The National Data Exploitation Policy (Big Data) aims to increase the use of data, by developing the conditions for it to be managed as assets to generate social and economic value.

Therefore, as a result of the work, it is suggested to create *MANUAL OF DATA GOVERNMENT POLICIES AND GUIDELINES*, whose purpose is to define the guidelines that guarantee the creation, storage, processing, delivery, exchange and elimination of data and information, digital archival objects. and physical documents that are developed under quality standards, processes and procedures allowing the Entity to make decisions for the development of policies, regulations, plans, programs, projects, application development, among others, with the participation of citizens, users and stakeholders.

Where it has a scope that involves all areas, processes, and establishes the mechanisms to meet the information needs of all interested parties in the organization in terms of availability, security and quality of information, continuously improving the quality of the information. Data, information, digital archival objects and physical documents. The content of this document must include:

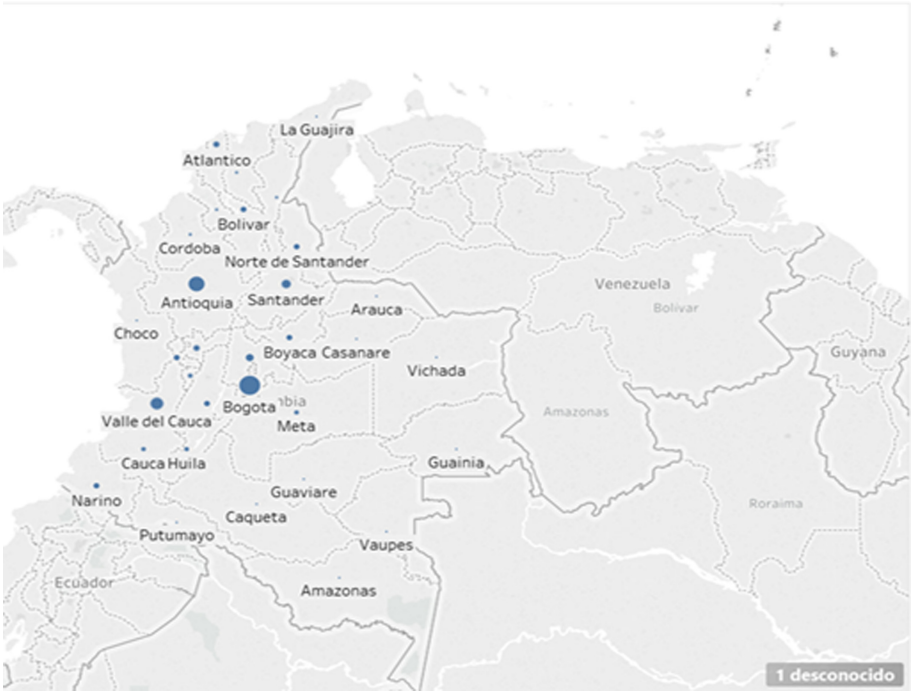

Fig. 4. Geographical zones of payments for 2017

- Background of the Data Governance Framework in COLPENSIONES
- Mission and Vision of Data Governance
- General principles
- General policies and guidelines
- Roles and responsibilities
- Data Governance Domains in COLPENSIONES
- Data governance activities

6 Conclusions and Future Work

It was identified that between the years 2013 to 2017 employers have increased by more than 200,000, making their contributions, maintaining an average of 1,002,922 contributors. It is also reflected that in all years the increase has occurred during the months of December 7%.

69.8% of the contributors belonged to the city of Bogotá with the highest percentage of payment 42%, the Valle del Cauca and Antioquia departments that complete the remaining percentage 27.8%, in these areas are the vast majority of companies in Colombia due to their geographical location and job creation.

Also as a complementary conclusion we see that the remaining 32 departments of Colombia only have 30% of the total collection for contributions; We can see that there is a lack of coverage within these cities that can be generated by a lack of collection points or labor informality.

As future work, an attempt will be made to explain if the Periodic Economic Benefits Program (BEPS) can replace the coverage or not; The BEPS program was created by the Government of Colombia, in 2015, through legislative act 01, with its voluntary savings plan for those people who will not meet the requirements to retire, but who have the capacity to generate some surplus over their expenses can improve coverage.

Additionally, include in the model the issue of informality as a social and economic problem where Colombia has a large gap; High informality exacerbates inequalities, because the informal sector has limited access to financing and public benefits, and intensifies the difficulties faced by the tax and pension system by reducing the contribution and tax base. Depending on the definition, informal employment represents between 50% and 70% of total employment, according to 2018 figures from DANE.

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