Evaluation of efficiency in predicting municipal taxes (IPTU and ISS): the case of municipalities in Functional Region 7 of COREDES in Rio Grande do Sul

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Abstract
The research seeks to analyze the efficiency of the public revenue budgeting process, especially the revenues from the Tax on Property and Urban Land, and the Tax on Services of Any Nature, in 77 municipalities of the Functional Planning Region 7, constituted by Coredes Missões, Colonial Northwest, Barn, and Northwest Frontier, in the state of Rio Grande do Sul. The survey covered the years 2001 to 2019. To measure the level of efficiency in the revenue budgeting process, the average Hit Margin was calculated. Municipalities were organized into two groups, following the distinction deliberated by the Fiscal Responsibility Law: municipalities with a population of more than 50,000 inhabitants and with a population of less than 50,000 inhabitants, population estimate of the Brazilian Institute of Geography and Statistics, 2017. If identifying, by the Analysis of Variance test, that the average hit margins between the municipalities of each of the groups are statistically different, in addition, through the cluster analysis, the municipalities with homogeneous average hit margins were grouped, regardless of their population size. The results of the

study indicate that there is a low level of efficiency in the revenue budgeting process for most municipalities, regardless of their stratification, which can bring a negative performance to the management, due to the lack of rationality in the establishment of government priorities, with the assumption of commitments, without the respective financial availability, imbalance in public accounts and the low quality of services offered to society.
Keywords: Public Budget. Revenue. Tax Prediction.

Avaliação da eficiência na previsão de impostos municipais (IPTU e ISS): o caso dos municípios da Região Funcional 7 dos COREDES no Rio Grande do Sul

Resumo

A pesquisa busca analisar a eficiência do processo de orçamentação da receita pública, sobretudo as receitas do Imposto sobre Propriedade Predial e Territorial Urbana, e do Imposto sobre Serviços de Qualquer Natureza, em 77 municípios da Região Funcional de Planejamento 7, constituída pelos Coredes Missões, Noroeste Colonial, Celeiro e Fronteira Noroeste, no estado do Rio Grande do Sul. A pesquisa compreendeu os anos de 2001 a 2019. Para mensurar o nível de eficiência no processo de orçamentação das receitas foi calculado a Margem de Acerto, média. Os municípios foram organizados em dois grupos, seguindo a distinção deliberada pela Lei de Responsabilidade Fiscal: municípios com população superior a 50 mil habitantes e com população inferior a 50 mil habitantes, estimativa populacional do Instituto Brasileiro de Geografia e Estatística, de 2017. Pôde-se identificar, pelo teste da Análise de Variância, que as margens de acerto médias entre os municípios de cada um dos grupos são estatisticamente diferentes, além disso, através da análise de cluster, os municípios com margens de acerto médias homogêneas foram agrupados, independentemente de seu quantitativo populacional. Os resultados do estudo indicam que existe um baixo nível de eficiência no processo de orçamentação das receitas para a maioria dos municípios independente de sua estratificação, o que pode trazer um desempenho negativo para a gestão, pela falta de racionabilidade no estabelecimento das prioridades governamentais, com a assunção de compromissos, sem a respectiva disponibilidade financeira, desiquilibro nas contas públicas e a baixa qualidade dos serviços ofertados a sociedade.

Palavras–chave: Orçamento Público. Receita. Previsão de Impostos.

Evaluación de la eficiencia en la predicción de impuestos municipales (IPTU e ISS): el caso de los municipios de la Región Funcional 7 de COREDES en Rio Grande do Sul

Resumen

La investigación busca analizar la eficiencia del proceso de presupuestación de los ingresos públicos, especialmente los ingresos del Impuesto sobre la Propiedad y Suelo Urbano, y el Impuesto sobre los Servicios de Cualquier Naturaleza, en 77 municipios de la Región de Planificación Funcional 7, constituida por Coredes Missões, Noroeste Colonial, Granero y Frontera Noroeste, en el estado de Rio Grande do Sul. La encuesta abarcó los años 2001 a 2019. Para medir el nivel de eficiencia en el proceso de presupuestación de ingresos, se calculó el margen de acierto promedio. Los municipios fueron organizados en dos grupos, siguiendo la distinción deliberada por la Ley de Responsabilidad Fiscal: municipios con población de más de 50.000 habitantes y con población de menos de 50.000 habitantes, estimación de población del Instituto Brasileño de Geografía y Estadística, 2017. Si identificándose, mediante la prueba de Análisis de Varianza, que los márgenes de acierto promedio entre los municipios de cada uno de los grupos son estadísticamente diferentes, además, mediante el análisis de conglomerados se agruparon los municipios con márgenes de acierto promedio homogéneos, independientemente de su tamaño poblacional. Los resultados del estudio indican que existe un bajo nivel de eficiencia en el proceso de presupuestación de ingresos para la mayoría de los municipios, independientemente de su

estratificación, lo que puede traer un desempeño negativo a la gestión, debido a la falta de racionalidad en el establecimiento de las prioridades gubernamentales. , con la asunción de compromisos, sin la respectiva disponibilidad financiera, desequilibrio en las cuentas públicas y la baja calidad de los servicios ofrecidos a la sociedad.

Palabras clave: Presupuesto público. Ingresos. Pronóstico de Impuestos.

1 Introduction

The study aimed to analyze the quality level of the public revenue budgeting process in a set of municipalities from 2001 to 2019 in Functional Planning Region 7 (RF7), which serves as the basis for state planning in Rio Grande do Sul (RS). RF7 is comprised of the COREDES Missões, Northwest Colonial, Celeiro, and Northwest Frontier (SEPLAG/DEPLAN, 2019), as illustrated in Image 1.

Image 1 - Functional Planning Region 7 (RF7)
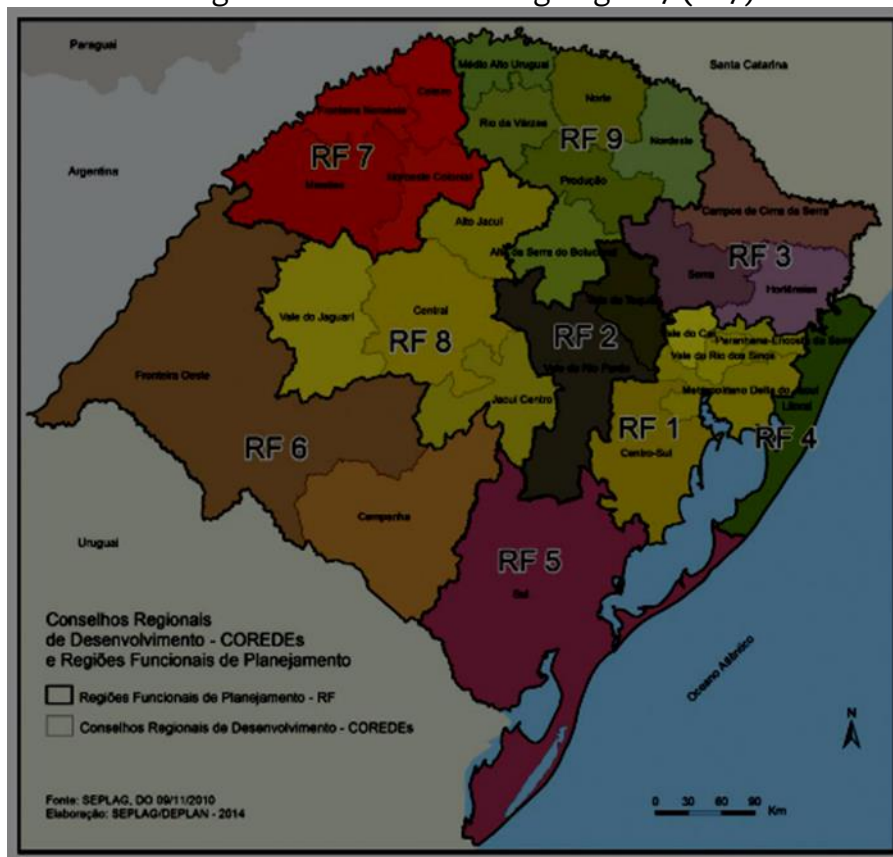
Source: (SEPLAG/DEPLAN, 2019).

This regionalization process was strengthened in the RUMOS STUDY (2015)[1], based on economic, environmental, and social criteria, including employment, transportation patterns, urban hierarchy, and the organization of the health and higher education services network, among other criteria used by the institution.

Taking into account the region, the research aims to address the new administrative framework established with the enactment of the Fiscal Responsibility

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[1] RUMOS 2015: Study on Regional Development and Transportation Logistics in Rio Grande do Sul / SCP-DEPLAN; DCAPET. Porto Alegre, 2006.

Law (LRF/2000) in public management, especially in planning and controlling public resources. Since then, administrative practices have been not only scrutinized by legislators and social controls but also by Audit Courts, which have gained importance in this control process.

It is acknowledged that the Fiscal Responsibility Law challenges and concerns public administrations by emphasizing the effective control of financial resources under their management, with continuous monitoring of revenue collection and special attention to planning. Therefore, this study seeks to address a concern: what is the level of quality in the municipal tax predicting process for the Urban Property Tax (IPTU) and the Tax on Services of Any Nature (ISS) in the municipalities of the region?

In this regard, it is assumed that it is essential for the public budget to be in line with local needs, especially when formulated and applied properly, to achieve the expected results for society. Thus, this process needs to focus on local development so that public entities seek to enhance budget prediction.

This implies that the public budget must have an efficient and dynamic planning component when presenting plans and work programs. By substantiating budgetary procedures, reliable planning requires well-elaborated accounting information to qualify the entire budget predicting process.

It is understood that the public space constitutes a convergence category of various processes and different social structures, reflecting the diversity of economic, social, cultural, and environmental determinants, resulting in different stages of development in the organization of municipalities. This becomes a challenge and, at the same time, an extremely important study area. A journey that can contribute to a better understanding of the municipal-level public management process. Thus, this article, beyond this introduction, is structured into four more sections: Theoretical Foundation, Methodology, Data Analysis, and Final Considerations.

2 Theoretical Foundation

The method for projecting budgetary revenues relies on the adoption of mathematical procedures to establish and predict the behavior of revenues over a specific period. It utilizes the historical revenue collection series to project revenue for future periods, with each type of revenue requiring an assessment of the most suitable mathematical model for this projection.

The projection of revenues is fundamental in determining expenditures, as it serves as the foundation for their allocation. One of the methods to project the collection of budgetary revenues involves the use of incremental models in its estimation. According to MTO (2015), the revenue predicting methodology aims to assimilate the behavior of collecting a particular revenue in past fiscal exercises to project it into a subsequent period, using mathematical and statistical models.

The equation of the revenue projection model, as per the Budgetary Revenue Projection Methodology outlined in the Public Revenue Procedures Manual of the National Treasury, adjusts the collected values by the indices of price, quantity, and legislation as follows: Projection = Calculation Base X (price index) X (quantity index) X (legislation effect).

Farias, Santos, Graça e Silva (2015, p. 59) emphasize that "demand projection techniques derive from quantitative analysis based on time series, applied when information from the past is available and can be quantified in numerical data." Various scientific studies demonstrate the importance of using time series analysis with the employment of mathematical and statistical models to provide greater accuracy in projection.

Zonatto and Hein (2013) assessed the effectiveness of budgetary prediction in municipalities in the state of Rio Grande do Sul between 2005 and 2009 through cluster analysis, based on differences in the average errors of revenue predictions. The authors concluded that many municipalities did not have effective predictions during the studied period. On the other hand, Zonatto, Rodrigues Junior, and Filho (2014) found that the predicting model proposed by the Federal Budget Office (SOF), replicating the methodology of projecting budgetary revenues from the Public Revenue Procedures Manual, which encompassed the 10 most populous municipalities in the state of Rio Grande do Sul from 1999 to 2010, had an average prediction error of 14.26%. In contrast, the application of the Koyck model resulted in an error of only 6.13%.

More recently, the study by Farias, Santos, Graça e Silva (2015) estimated the collection of revenues in the city of Aracaju, state of Sergipe, using three derivative techniques of time series: Linear Exponential Smoothing of Brown (SELB), Biparametric Exponential Smoothing of Holt (SEBH), and Quadratic Exponential Smoothing of Brown (SEQB), during the period between 2000 and 2013. The authors concluded that the Biparametric Exponential Smoothing model of Holt exhibited a lower prediction error.

The study by Fiirst et al. (2017) investigated the efficiency of budgetary predictability of public revenue in municipalities in the state of Paraná between the years 2002 and 2013. Finally, the study by Pamplona, Fiirst, Hein, and Zonatto (2019) analyzes the performance of the Autoregressive Moving Average (ARMA) model in predicting budgetary revenues of municipalities in the state of Paraná for the year 2013. Findings indicate that the ARMA model, in general, demonstrates better performance in predicting public revenues, with an average error of 7.05% from the 120 conducted observations, achieving superior performance in 74 cases (61.67%). In contrast, the SOF model was better in 46 instances (38.33%), indicating that the ARMA model exhibited better quality in predicting revenues compared to the SOF model.

Therefore, all studies present various mathematical and statistical methodologies for revenue predicting; however, they tend to show a similarity in the results obtained: (1) inefficiency in revenue predicting by the entities, and (2) among the mathematical and statistical models used in the majority of the studied samples, these models demonstrate better quality in revenue predicting compared to the SOF model. Regardless of the mathematical model used for revenue prediction, it must be properly implemented and adapted to each reality. Thus, analyzing the level of quality in the revenue-predicting process is essential for the continuous improvement of this process.

3 Methodology

The following detailed methodology follows the guidelines of Rocha (2008), whose study objectives resemble those of this research. The author aimed to measure the level of efficiency in the budgetary planning process of municipal tax revenues for the period from 2001 to 2006 in 24 municipalities in the state of Rio Grande do Norte.

To diagnose the level of efficiency in the budgetary planning of municipal tax revenues, Rocha (2008) calculated accuracy margins (MA) by municipality size and performed statistical assessments of dispersion, represented by standard deviation (SD) and coefficient of variation (CV). Additionally, the author used ANOVA (Analysis of Variance) to observe if there is a difference in the average accuracy margins among municipalities categorized as large, medium/large, and medium. Furthermore, through cluster analysis, the author attempted to group municipalities with similar accuracy margins for IPTU and ISS revenues, regardless of their size.

However, this research differs from that of Rocha (2008) as the municipalities studied here belong to the state of Rio Grande do Sul, and the number of observations analyzed is significantly higher, encompassing 77 municipalities for the period from 2001 to 2019.

Thus, the research aimed to comprehend the level of efficiency in the budgetary planning process for Functional Planning Region 7 (RF-7) in Rio Grande do Sul, specifically for the Urban and Rural Property Tax (IPTU), and the Tax on Services of Any Nature (ISS). Additionally, as outlined in Article 156 of the Federal Constitution, this study also includes the Tax on the Transfer of Real Estate (ITBI), which is under municipal jurisdiction. The chosen timeframe was intentional, encompassing only the fiscal years starting from the enactment of the Fiscal Responsibility Law (LRF).

The study covers the 77 municipalities belonging to Functional Planning Region 7 (RF-7), which coincides with Intermediate Region Ijuí (RII), with an estimated population of 787,221 inhabitants (IBGE, 2017) - 6.95% of the estimated population for the state of Rio Grande do Sul (IBGE, 2017). It includes the Corede regions of Celeiro, Missões, Fronteira Noroeste, and Noroeste Colonial.

The 77 municipalities were organized into two groups, following the classification defined by the LRF: municipalities with a population exceeding 50 thousand inhabitants (Group A) and municipalities with a population below 50 thousand inhabitants (Group B), according to the population estimate from the Brazilian Institute of Geography and Statistics (IBGE) in 2017. The group consisting of municipalities with over 50 thousand inhabitants has a population of 241,802 inhabitants, representing 2.14% of the total population of the state of Rio Grande do Sul.

The group of municipalities with less than 50 thousand inhabitants has a population estimated by IBGE (2017) of 545,419 inhabitants, representing 4.82% of the estimated population of the state of Rio Grande do Sul. This division was made with the aim of reducing possible distortions in the analysis, determined by the population contingent, which would hinder the highlighting of results. Following a distinction that the LRF itself brings in its Article No. 63 when dealing with entities with more than 50 thousand inhabitants more precisely.

Queries regarding the budgetary revenue of municipalities, containing the prediction and collection of revenue, come from the Information System for Audit and Accountability (SIAPC) of the State Court of Auditors. The SIAPC data has not been reviewed by TCE/RS; therefore, it is the sole responsibility of each municipality.

To analyze the efficiency in the budgetary process of IPTU and ISS revenues of municipalities in Functional Region RF 7, in the state of Rio Grande do Sul, the following information was collected from 2001 to 2019: IPTU and ISS budgeted by municipalities, also known as predicted revenue; IPTU and ISS effectively collected, also referred to as executed. This enables an understanding of the level of efficiency in the budgetary processes of municipalities, thus establishing an analysis of the value of predicted and collected revenues for each fiscal year. This process can be verified by the formula: Deviation = Executed Revenue (ER) – Budgeted Revenue (BR).

This made it possible to calculate the Accuracy Margin (AM) by comparing the collected and predicted values, facilitating the identification of the efficiency of municipal budget planning. This process involves two calculation methodologies to achieve an index number with a maximum limit of 100%: (a) when the budgeted value is less than the executed: Budgeted Tax / Executed Tax X 100; and (b) when the budgeted value is greater than the executed: Executed Tax / Tax X 100.

For a better understanding, an Analysis of Variance (ANOVA) was conducted to identify significant differences between the average accuracy margins in the two groups of municipalities. The p-value corresponds to the significance level of the test, indicating the probability of making an error. Consequently, a confidence level of 95% was adopted (GUJARATI, 2000). The descriptive level of the test (p-value) is provided by the ANOVA statistic. The statistical tests were calculated using the SPSS - Statistical Package for the Social Sciences, version 22.0, and graphical diagrams were created using Excel 2016.

4 Data Analysis

The dataset used in the study pertains to individualized information for each municipality within the group of taxes, specifically related to the Urban Property Tax (IPTU) and the Tax on Services of Any Nature (ISS). This is because municipalities have the legal competence to institute, predict, and collect these taxes.

4.1 Analysis of the Existence of Statistical Differences Among Municipalities' Results for IPTU

The average percentage of the average accuracy margin for the Functional Planning Region 7 (RF-7), for municipalities with more than 50 thousand inhabitants and less than 50 thousand inhabitants in the period from 2001 to 2019, is shown in Graph 1.

Graph 1 – Average Percentage Accuracy Margin for IPTU in the Functional Planning Region 7 (RF-7) Municipalities
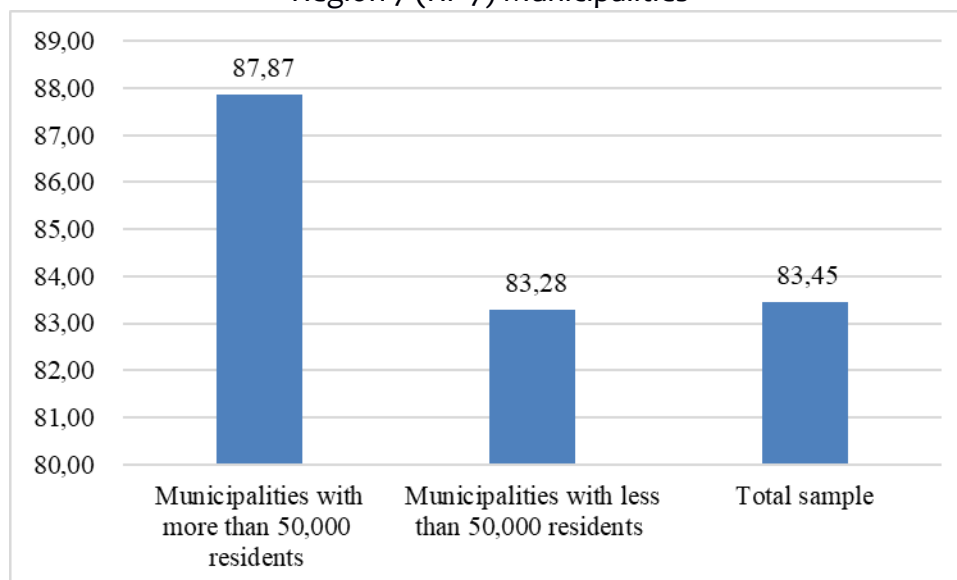
Source: The authors, based on the research data.

The superficial analysis of Graph 1 suggests a potential association between the size of the municipality and the observed average accuracy margin over the period, meaning that the observed average accuracy margin is higher in municipalities with more than 50 thousand inhabitants. However, it is necessary to statistically confirm this difference, which is done through the ANOVA test. The F-statistics, as well as its probability, can be seen in Table 1.

Table 1 – Analysis of Variance (ANOVA) for IPTU Accuracy Margin Data

Source of Variation	SQ	gl	MQ	F	P-Value	Critical F
Between groups	60,83	1,00	60,83	0,94	0,34	3,97
In the groups	4.859,79	75,00	64,80			
Total	4.920,63	76,00				

Source: The authors, based on the research data.

The F test, at a significance level of 5%, provides empirical evidence for accepting the hypothesis of equality between the levels of accuracy margin in both groups of municipalities analyzed together. In other words, at a 95% confidence level, there is no significant difference in the absolute accuracy margin for IPTU between the groups of municipalities with more than 50 thousand inhabitants and those with less than 50 thousand inhabitants.

4.1.1 Analysis of Cluster – Analysis of IPTU Accuracy Margin Regardless of Municipality Size

Given the ANOVA test, analyzed in the previous section, which showed that the average accuracy margin among municipalities classified with more than 50 thousand inhabitants and less than 50 thousand inhabitants is not statistically

different. Therefore, in this stage, we seek to determine more homogeneous groups, considering the accuracy margins for all municipalities, regardless of their size - measured by the number of inhabitants. To do so, the k-means cluster analysis was used, grouping the municipalities into 7 clusters, as shown in Table 2.

Table 2 – Cluster Association for Absolute Accuracy Margin for IPTU
(it continues)

Number of cases	Municipality	Clustering	Cluster	MA
1	Tuparendi	Group B	1	92,41
2	Três de Maio	Group B	1	91,20
3	Giruá	Group B	1	89,46
4	Ijuí	Group A	1	89,24
5	São Luiz Gonzaga	Group B	2	88,45
6	Santo Ângelo	Group A	2	87,19
7	Panambi	Group B	2	86,43
8	Santa Rosa	Group A	2	85,62
9	Alecrim	Group B	2	85,48
10	Caibaté	Group B	2	85,34
11	Boa Vista do Buricá	Group B	2	84,31
12	Campo Novo	Group B	2	83,79
13	Crissiumal	Group B	2	83,45
14	Três Passos	Group B	2	82,81
15	Santo Augusto	Group B	2	82,71
16	Santo Cristo	Group B	2	82,58
17	Humaitá	Group B	3	81,91
18	Catuípe	Group B	3	81,78
19	Porto Xavier	Group B	3	81,50
20	Senador Salgado Filho	Group B	3	80,36
21	Campina das Missões	Group B	3	80,31
22	São José do Inhacorá	Group B	3	80,20
23	Augusto Pestana	Group B	3	79,83
24	Novo Machado	Group B	3	79,64
25	Doutor Maurício Cardoso	Group B	3	79,45
26	Redentora	Group B	3	79,41
27	Tenente Portela	Group B	3	79,06
28	São Paulo das Missões	Group B	3	79,01
29	São Martinho	Group B	3	78,16
30	Ubiretama	Group B	3	78,09
31	Chiapetta	Group B	3	77,75
32	Pejuçara	Group B	3	77,29
33	Cerro Largo	Group B	4	76,45
34	Esperança do Sul	Group B	4	76,37
35	Nova Candelária	Group B	4	75,43
36	Santo Antônio das Missões	Group B	4	75,24

Source: The authors, based on the research data.

Table 2 – Cluster Association for Absolute Accuracy Margin for Property Tax (IPTU)
(conclusion)

Number of cases	Municipality	Clustering	Cluster	MA
37	Miraguaí	Group B	4	74,32
38	São Pedro do Butiá	Group B	4	74,28
39	Tucunduva	Group B	4	74,27
40	Coronel Bicaco	Group B	4	73,99
41	Tiradentes do Sul	Group B	4	73,92
42	Sete de Setembro	Group B	4	73,29
43	Guarani das Missões	Group B	4	73,20
44	Horizontina	Group B	4	72,99
45	Independência	Group B	4	72,98
46	Porto Mauá	Group B	4	72,72
47	São Nicolau	Group B	4	72,51
48	Condor	Group B	5	71,54
49	Entre-Ijuís	Group B	5	71,42
50	Cândido Godói	Group B	5	70,80
51	Pirapó	Group B	5	70,76
52	Porto Lucena	Group B	5	70,32
53	Alegria	Group B	5	70,22
54	Ajuricaba	Group B	5	69,08
55	Porto Vera Cruz	Group B	5	68,88
56	Braga	Group B	5	68,56
57	Inhacorá	Group B	5	68,48
58	Garruchos	Group B	5	68,27
59	Bossoroca	Group B	5	67,89
60	Dezesseis de Novembro	Group B	5	67,14
61	Nova Ramada	Group B	5	66,68
62	Vista Gaúcha	Group B	5	66,66
63	Joia	Group B	6	65,63
64	Bozano	Group B	6	65,46
65	São Miguel das Missões	Group B	6	64,45
66	Eugênio de Castro	Group B	6	64,33
67	Derrubadas	Group B	6	63,30
68	Salvador das Missões	Group B	6	62,22
69	Coronel Barros	Group B	6	61,98
70	Bom Progresso	Group B	6	61,58
71	Roque Gonzáles	Group B	7	60,65
72	Vitória das Missões	Group B	7	59,97
73	São Valério do Sul	Group B	7	59,64
74	Sede Nova	Group B	7	59,10
75	Barra do Guarita	Group B	7	58,52
76	Rolador	Group B	7	57,32
77	Mato Queimado	Group B	7	56,16

Source: The authors, based on the research data.

The number of cases for each cluster and the respective average accuracy margins of these clusters can be viewed in Table 3.

Table 3 – Number of Cases and Final Cluster Centers for Property Tax (IPTU)

Cluster	Final Cluster Centers	Number of cases
1	93,47%	9
2	89,01%	27
3	83,62%	17
4	77,46%	11
5	72,54%	8
6	67,52%	4
7	57,44%	1
Valid		77
Absent		0

Source: The authors, based on the research data.

The group that presents the best cluster center - 93.47% - is Group 1, composed of the municipalities of Alecrim, Três de Maio, Caibaté, São Paulo das Missões, Ajuricaba, Augusto Pestana, Catuípe, Santo Augusto, and Três Passos. Group 2 presents the second-best cluster center - 83.62% - and is formed by 27 municipalities, including two with more than 50 thousand inhabitants: Ijuí and Santa Rosa. Santo Ângelo is in cluster 3, which encompasses a total of 17 municipalities and has a cluster center of 83.62%. The cluster with the worst performance in average accuracy margins is cluster 7, formed solely by the municipality of Bozano, with an average of 57.44%. A second grouping whose average cluster is 67.52% - cluster 6 - includes the municipalities of Senador Salgado Filho, Entre-Ijuís, Garruchos, and Salvador das Missões.

In Table 4, the results of the ANOVA test are displayed to indicate whether the cluster formation performed is significant, that is, whether municipalities with homogeneous accuracy margins were indeed selected within each group.

Table 4 – ANOVA test to verify whether the cluster formation for IPTU is significant

Source of variation	SQ	gl	MQ	F	P-value	Critical F
Between groups	236.134,67	1	236.134,67	6.852,03	0,00	3,90
In the groups	5.169,29	150	34,46			
Total	241.303,96	151				

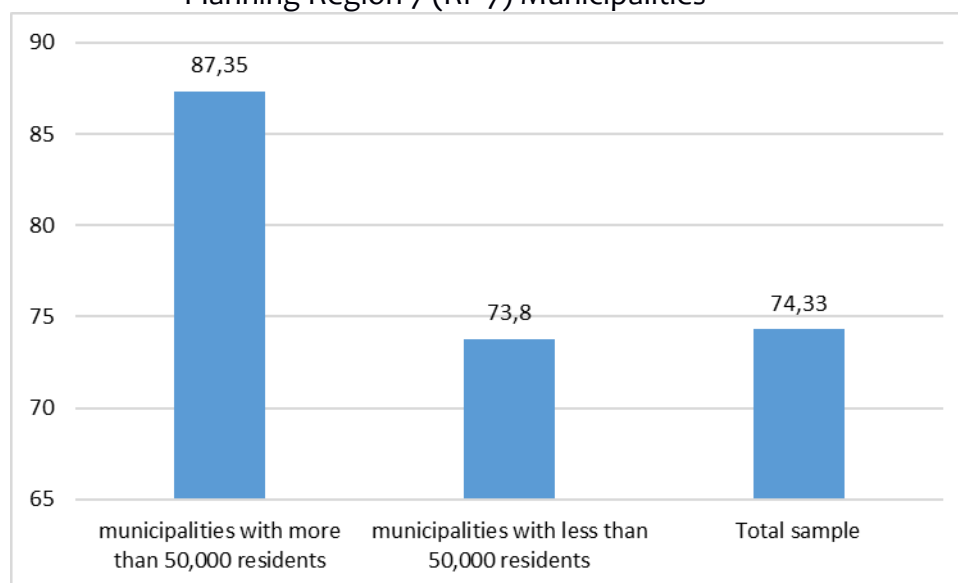Source: The authors, based on the research data.

According to Table 4, adopting a significance level of 5%, the formation of seven well-defined clusters is verified, because the p-value was lower than 0,05 - significance level of 5%. It is possible to notice that there is no relation between the size of the municipalities and their quality in the process of predicting the IPTU revenue, because inside the best-developed clusters - cluster 1 and cluster 2 - in the

process of IPTU revenue budgeting there are municipalities representing both classifications and with more-varied populational extracts.

4.2 Analysis of the Existence of Statistical Differences Among Municipalities' Results for ISS

The average percentage of the average accuracy margin for the Functional Planning Region RF 7, for municipalities with more than 50 thousand inhabitants and less than 50 thousand inhabitants in the period from 2001 to 2019 for ISS is evidenced in Graph 2.

Graph 2 – Average Percentage Accuracy Margin for ISS in the Functional Planning Region 7 (RF-7) Municipalities

Source: The authors, based on the research data.

In the same way that it was seen in the analysis of the averages of the percentage accuracy margin for IPTU and ITBI, the superficial analysis of Graph 2 directs to a potential association between the size of the municipality and the observed average accuracy margin over the period, meaning that the observed average accuracy margin is higher in the municipalities with more than 50 thousand inhabitants. However, it is necessary to statistically confirm this difference, which is done through the ANOVA test. The F statistics, as well as its probability, may be viewed in Table 5.

Table 5 – Analysis of Variance (ANOVA) for ISS Accuracy Margin Data

Source of variation	SQ	gl	MQ	F	P-value	Critical F
Between groups	529,59	1,00	529,59	7,23	0,01	3,97
In the groups	5.490,71	75,00	73,21			
Total	6.020,30	76,00				

Source: The authors, based on the research data.

The F test, at a significance level of 5%, provides empirical evidence for accepting the hypothesis of equality between the levels of accuracy margin in both groups of municipalities analyzed together. In other words, at a 95% confidence level, there is no significant difference in the absolute accuracy margin for ISS between the groups of municipalities with more than 50 thousand inhabitants and those with less than 50 thousand inhabitants.

4.2.1 Analysis of Cluster - Analysis of ISS Accuracy Margin Regardless of Municipality Size

The ANOVA test analyzed in the previous section showed that the average accuracy margin among municipalities classified with more than 50 thousand inhabitants and less than 50 thousand inhabitants for ISS is not statistically different. Therefore, it is necessary, as it was carried out in section 4.1.1 in the IPTU analysis, to determine, in this stage, more homogenous groups, considering the accuracy margins for all municipalities, regardless of their size - measured by the number of inhabitants. To do so, the k-means cluster analysis was used, grouping the municipalities into 7 clusters, as shown in Table 6.

Table 6 – Cluster Association for Absolute Accuracy Margin for ISS (it continues)

Number of cases	Municipality	Clustering	Cluster	MA
1	Tuparendi	Group B	1	92,41
2	Três de Maio	Group B	1	91,20
3	Giruá	Group B	1	89,46
4	Ijuí	Group A	1	89,24
5	São Luiz Gonzaga	Group B	2	88,45
6	Santo Ângelo	Group A	2	87,19
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9	Alecrim	Group B	2	85,48
10	Caibaté	Group B	2	85,34
11	Boa Vista do Buricá	Group B	2	84,31
12	Campo Novo	Group B	2	83,79
13	Crissiumal	Group B	2	83,45
14	Três Passos	Group B	2	82,81
15	Santo Augusto	Group B	2	82,71
16	Santo Cristo	Group B	2	82,58
17	Humaitá	Group B	3	81,91
18	Catuípe	Group B	3	81,78
19	Porto Xavier	Group B	3	81,50
20	Senador Salgado Filho	Group B	3	80,36
21	Campina das Missões	Group B	3	80,31
22	São José do Inhacorá	Group B	3	80,20
23	Augusto Pestana	Group B	3	79,83
24	Novo Machado	Group B	3	79,64
25	Doutor Maurício Cardoso	Group B	3	79,45

26	Redentora	Group B	3	79,41
27	Tenente Portela	Group B	3	79,06
28	São Paulo das Missões	Group B	3	79,01

Source: The authors, based on the research data.

Table 6 – Cluster Association for Absolute Accuracy Margin for ISS

(it continues)

Number of cases	Municipality	Clustering	Cluster	MA
29	São Martinho	Group B	3	78,16
30	Ubiretama	Group B	3	78,09
31	Chiapetta	Group B	3	77,75
32	Pejuçara	Group B	3	77,29
33	Cerro Largo	Group B	4	76,45
34	Esperança do Sul	Group B	4	76,37
35	Nova Candelária	Group B	4	75,43
36	Santo Antônio das Missões	Group B	4	75,24
37	Miraguaí	Group B	4	74,32
38	São Pedro do Butiá	Group B	4	74,28
39	Tucunduva	Group B	4	74,27
40	Coronel Bicaco	Group B	4	73,99
41	Tiradentes do Sul	Group B	4	73,92
42	Sete de Setembro	Group B	4	73,29
43	Guarani das Missões	Group B	4	73,20
44	Horizontina	Group B	4	72,99
45	Independência	Group B	4	72,98
46	Porto Mauá	Group B	4	72,72
47	São Nicolau	Group B	4	72,51
48	Condor	Group B	5	71,54
49	Entre-Ijuís	Group B	5	71,42
50	Cândido Godói	Group B	5	70,80
51	Pirapó	Group B	5	70,76
52	Porto Lucena	Group B	5	70,32
53	Alegria	Group B	5	70,22
54	Ajuricaba	Group B	5	69,08
55	Porto Vera Cruz	Group B	5	68,88
56	Braga	Group B	5	68,56
57	Inhacorá	Group B	5	68,48
58	Garruchos	Group B	5	68,27
59	Bossoroca	Group B	5	67,89
60	Dezesseis de Novembro	Group B	5	67,14
61	Nova Ramada	Group B	5	66,68
62	Vista Gaúcha	Group B	5	66,66
63	Joia	Group B	6	65,63
64	Bozano	Group B	6	65,46
65	São Miguel das Missões	Group B	6	64,45
66	Eugênio de Castro	Group B	6	64,33
67	Derrubadas	Group B	6	63,30
68	Salvador das Missões	Group B	6	62,22
69	Coronel Barros	Group B	6	61,98
70	Bom Progresso	Group B	6	61,58

Source: The authors, based on the research data.

Table 6 – Cluster Association for Absolute Accuracy Margin for ISS

(conclusion)

Number of cases	Municipality	Clustering	Cluster	MA
71	Roque Gonzáles	Group B	7	60,65
72	Vitória das Missões	Group B	7	59,97
73	São Valério do Sul	Group B	7	59,64
74	Sede Nova	Group B	7	59,10
75	Barra do Guarita	Group B	7	58,52
76	Rolador	Group B	7	57,32
77	Mato Queimado	Group B	7	56,16

Source: The authors, based on the research data.

The number of cases for each cluster and the respective average accuracy margins for ISS can be seen in Table 7.

Table 7 – Number of Cases and Final Cluster Centers for ISS

Cluster	Final Cluster Centers	Number of cases
1	90,15	5
2	84,52	11
3	79,61	16
4	74,13	15
5	69,11	15
6	63,62	8
7	58,77	7
Valid		77
Absent		0

Source: The authors, based on the research data.

The best final cluster center - 90,15%, is cluster 1, composed of the municipalities of Ijuí, São Luiz Gonzaga, Giruá, Tuparendi, and Três de Maio, which had a higher performance than the other municipalities of the Functional Planning Region RF 7. Cluster 2 presents the second-best final cluster center - 84,52%, composed of 11 municipalities: Três Passos, Santo Augusto, Crissiumal, Campo Novo, Panambi, Santo Ângelo, Caibaté, Santo Cristo, Santa Rosa, Boa Vista do Buricá, and Alecrim, which are in the clustering of the best performance for budgeting in the extract for the ISS revenue.

The cluster with the worst performance of average accuracy margins is cluster 7, formed by the municipalities of Sede Nova, São Valério do Sul, Barra do Guarita, Vitória das Missões, Roque Gonzáles, Rolador, and Mato Queimado. Table 8 provides the result of the ANOVA test, to indicate whether the cluster formation performed is significant, that is, whether municipalities with homogeneous accuracy margins were indeed selected within each group.

Table 8 – ANOVA Test to Verify whether the cluster formation for ISS is significant

Source of variation	SQ	gl	MQ	F	P-value	Critical F
Between groups	187.547,01	1,00	187.547,01	4.499,61	0,00	3,90
In the groups	6.335,47	152,00	41,68			
Total	193.882,48	153,00				

Source: The authors, based on the research data.

According to Table 8, adopting a significance level of 5%, the formation of seven well-defined clusters is verified, because the P-value was lower than 0,05 - significance level of 5%. It is possible to notice that there is no relation between the size of the municipalities and their quality in the process of predicting the ISS revenue because inside the best-developed clusters - cluster 2 and cluster 1 - there are municipalities representing both classifications - with more than 50 thousand inhabitants and less than 50 thousand inhabitants, and with more-varied populational extracts. It reflects the scenario exposed in section 4.1.1, on the analysis of the average accuracy margin for the IPTU revenue. Finally, in the next section, we conclude the present study, presenting the final considerations.

Final Considerations

The present study presents the analysis of the efficiency of the public revenue budgeting process, keeping in mind the revenues of the Urban Property Tax (IPTU) and the Tax on Services of Any Nature (ISS), in 77 municipalities of the Functional Planning Region 7 (RF-7), in Rio Grande do Sul, from 2001 to 2019. It means to establish public accounts, which composes one of the foundations under which the Fiscal Responsibility Law was enacted, and demands a coherent, and, above all, realistic planning, seeking to adjust the prediction of the revenues and the real capability of collection, once the public revenue guides the fixation of this public expense.

Therefore, in the presence of the highlight that the LRF gave to the revenue control, especially regarding its excellent management, through methodologies that may predict more precisely, in this way, the study verified the revenue budgeting process for IPTU, ITBI, and ISS. It can be highlighted that the quality observed in the prediction process of such revenues could be examined through the gathering of the budgeted and collected values by the state municipalities.

In this way, the research used information contained in the Rio Grande do Sul State Court of Auditors' (TCE/RS) database, for each of the 77 municipalities that were objects of study. The municipalities were organized into two groups, following the classification defined by the LRF: municipalities with a population higher than 50 inhabitants and with a population lower than 50 thousand inhabitants, according to the population estimated by the Brazilian Institute of Geography and Statistics (IBGE) in 2017, allowing the calculation of the Accuracy Margin (MA).

The study also aimed to verify, through the Analysis of Variance (ANOVA) test, whether there is a significant difference between the average accuracy margins in the two groups of municipalities, and, then, we aimed to group, through the cluster

analysis, the municipalities with similar accuracy margins for IPTU and ISS revenues, regardless of their classification as a municipality with more than 50 thousand inhabitants or less than 50 thousand inhabitants. The result of the analysis of the accuracy margin by Group of municipalities indicates that the municipalities with more than 50 thousand inhabitants, formed by the municipalities of Ijuí, Santa Rosa, and Santo Ângelo, presented the best levels, that is, were more effective in the budgetary process of revenue for IPTU and ISS.

This analysis addresses a possible association between the municipality size and the observed average accuracy margin in the period, in other words, the accuracy margin is higher in municipalities with more than 50 thousand inhabitants. However, it was necessary to statistically confirm this difference, through the ANOVA test. The F test, at a significance level of 5%, provides empirical evidence for accepting the hypothesis of equality between the levels of accuracy margin in both groups of municipalities analyzed together. In other words, at a 95% confidence level, there is no significant difference in the absolute accuracy margin for IPTU and ISS between the two groups of municipalities with more than 50 thousand inhabitants and those with less than 50 thousand inhabitants.

To determine more homogenous groups, considering the accuracy margins for all the municipalities regardless of their size - measuring in number of inhabitants, the k-means cluster analysis was used, which grouped the municipalities into 7 clusters. The result of the ANOVA test for the formation of the clusters is significant, that is, the municipalities that were selected were indeed the ones with homogeneous accuracy margins inside each group. Adopting a significance level of 5%, it is possible to verify the formation of 7 well-defined clusters, because the P-value was lower than 0,05 - significance level of 5%. It was noticed that there is no relation between the size of the municipalities and their effectiveness in the budgetary prediction process because, inside the best-developed clusters in the budgetary process of revenue for IPTU and ISS, there are municipalities representing both classifications.

The average accuracy margin for IPTU for municipalities with more than 50 thousand inhabitants is 87.87%, compared to 83.28% for the average accuracy margin for the group of municipalities with less than 50 thousand inhabitants. The average accuracy margin for IPTU for the entire observed sample is 83.45%. Finally, the average accuracy margin for ISS observed in municipalities with more than 50 thousand inhabitants totals 87.35%, compared to 73.80% for the average accuracy margin for the group of municipalities with less than 50 thousand inhabitants. The average accuracy margin for ISS for the entire observed sample is 74.33%

It is worth mentioning that the municipal taxes studied are urban taxes, a consequence of the tax structure, having less budgetary weight for the municipalities in the group of municipalities with less than 50 thousand inhabitants and consequently for the generation of development, whose economic base is mostly agricultural. Thus, there is a predominance of dependence on the resources from the Municipalities Participations Fund (FPM) for these municipalities. On the other hand, for municipalities with more than 50 thousand inhabitants, the dependence is greater in relation to the Tax on Circulation of Goods and Services (ICMS).

Embracing the premise of Slomski's concept (2005), as cited by Rocha (2008), that there are no reasons for the elaboration of budgetary items that are not

executable in at least 90% of what was predicted, one observes a low level of efficiency in the process of predicting the IPTU and ISS revenue for nearly all municipalities in the sample. This signals inefficiency in the revenue budgeting process, which can lead to negative management performance due to a lack of rationality in setting priorities, objectives, and result targets.

With this in mind, different implications for the public governing and the society arise, among which are, in the case of an overestimated revenue, (1) the non-fulfillment of the government program expected by the society; (2) the imbalance of public accounts and (3) assuming commitments without the necessary resources to fulfill the obligations. And in the case of an underestimated revenue, (4) the low quality of the services offered to society. The mismatch identified in the budgeting of revenues in this study reflects unrestrictedly on the execution of expenses, being one of the causes of inefficient management. Furthermore, accurate revenue prediction enables public managers to effectively conduct governance based on territorial needs.

Finally, the objective of the study was accomplished, given the finding of a low level of efficiency in the process of predicting municipal taxes (IPTU and ISS) for the vast majority of municipalities in the Functional Planning Region 7 (RF-7) of the state of Rio Grande do Sul, for the period from 2001 to 2019. As a perspective for future studies, it is suggested to discuss methodologies for revenue prediction, aiming to provide more accurate predictions in budget proposals. The goal is that the outcome of this study will boost the importance of such discussions in the academic sphere.

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