

Zero-Base Budgeting and Artificial Intelligence Applied to the Brazilian Public Sector

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Abstract

This paper assesses the intersection between Zero-Based Budgeting (ZBB) and Artificial Intelligence (AI) in the context of the Brazilian public sector, emphasizing their combined potential to increase efficiency, transparency, and rationality in the allocation of public resources. While ZBB demands full justification of each expenditure from a zero base, breaking with the inertia of incremental budgeting, AI provides the analytical and computational infrastructure necessary to support such scrutiny through data-driven modeling and predictive analytics. The incorporation of intelligent technologies—such as machine learning, big data, and blockchain—into budgetary processes allows for the automation of information collection and processing, the identification of inefficiencies, and the support of evidence-based public decisions, aligning fiscal choices with measurable social outcomes. This study adopts an analytical and interdisciplinary perspective, exploring the opportunities and challenges inherent in the Brazilian institutional context, characterized by normative complexity, bureaucratic rigidity, and technological asymmetries. It argues that AI-assisted Zero-Based Budgeting (ZBB) is a transformative mechanism to redefine the logic of fiscal governance, promoting greater coherence between public policies, fiscal responsibility, and the constitutional principles of efficiency and administrative morality. Ultimately, the convergence of these two dimensions represents more than a managerial reform: it is a paradigmatic shift towards a strategic, data-driven, and ethically conscious model of public administration, able to align technological rationality with democratic objectives and national development. Furthermore, this paper focuses on the critical and dogmatic analysis of artificial intelligence (AI) in the context of public budgeting in Brazil. The central assumption is that the introduction of predictive automation into the budgetary cycle inaugurates a profound paradigmatic shift, moving the axis of decisional rationality from legal norms and political deliberation to statisti-

cal inference and mass data. Under the aegis of a theoretical-doctrinal and interdisciplinary approach, which articulates Artificial Intelligence, Financial Law, Administrative Law, and public ethics, the work examines the challenges posed by algorithmic incommensurability and the risk of budgetary discrimination, confronting the pursuit of technical efficiency with the imperative of democratic legitimacy. The hypothesis is that the harmonious coexistence between technological innovation and the public budget is only perfected through the establishment of a robust algorithmic governance system, anchored in the pillars of explainability (XAI), public auditing, and non-delegable institutional responsibility. Finally, a legal and institutional framework for budgetary AI in Brazil is proposed, aiming to safeguard the constitutional principles of legality, transparency, and administrative morality.

Keywords

Artificial Intelligence, Zero-Based Budgeting, Algorithm Governance, Public Budget, Accountability, Explainability (XAI)

1. Introduction

The increasing complexity of public governance and the growing pressure for fiscal responsibility have intensified the search for more rational, transparent, and efficient budgetary practices. Traditional incremental budgeting, historically adopted in many jurisdictions, tends to reproduce past allocations without sufficiently questioning their effectiveness or alignment with current public needs. In this context, Zero-Based Budgeting (ZBB) emerges as an alternative approach that requires each expenditure to be justified from a zero base, promoting critical reassessment of public spending and enabling more efficient allocation of scarce resources.

At the same time, the rapid advancement of artificial intelligence (AI) has introduced new possibilities for enhancing decision-making processes within the public sector. By enabling large-scale data processing, predictive analysis, and pattern recognition, AI systems can support governments in identifying inefficiencies, optimizing resource allocation, and improving the overall quality of public policies. However, the incorporation of such technologies also raises significant legal and institutional challenges, particularly regarding transparency, accountability, and compliance with constitutional principles governing public administration.

This study aims to analyze the potential integration of artificial intelligence into Zero-Based Budgeting within the Brazilian public sector, examining both its operational advantages and its legal implications. The central hypothesis is that AI can function as an analytical infrastructure capable of strengthening the rationality and effectiveness of budgetary decision-making, provided that its use is aligned with constitutional safeguards and appropriate governance mechanisms.

Methodologically, the research adopts a theoretical-doctrinal and interdisciplinary

nary approach, grounded in the critical analysis of legal doctrine, constitutional principles, legislation, case law, and comparative regulatory experiences. The study is based on qualitative examination of normative frameworks and scholarly literature, without the use of empirical data collection, statistical sampling, or survey-based methods. Its objective is to develop a propositional legal framework that contributes to improving transparency, accountability, and efficiency in public budgeting.

The article is structured as follows. Section 2 examines the role of artificial intelligence in public administration and its implications for governance. Section 3 analyzes Zero-Based Budgeting and proposes an AI-assisted model for its implementation. Section 4 discusses the legal and institutional challenges associated with algorithmic decision-making in the public sector. Section 5 evaluates the current regulatory framework in Brazil, with particular attention to data protection and emerging AI legislation. Finally, Section 6 presents the main conclusions of the study.

2. Social Impacts of Adopting Artificial Intelligence

Allen (2023) argues that the current relationship between technological development and democracy is marked by tension, particularly due to the use of disinformation and the disruptive social impacts of artificial intelligence. The author does not advocate rejecting technological development; rather, the author highlights both its benefits and the current lack of institutional preparedness to address its societal impacts.

In this sense, the author argues that, at the present moment, there is not adequate preparation to face the social impacts of the transformations promoted by artificial intelligence. Therefore, it proposes that a pause is necessary for collective learning about what has already been created in this field. Furthermore, it states that it is necessary to regulate it from a legal standpoint and guarantee the possibility of accountability for the creation and use of new tools in case of violations of rights.

In Brazil, a step has already been taken in this direction. Bill No. 2.338/2023, currently under legislative debate and not yet enacted, proposes a risk-based regulatory framework for artificial intelligence nationally (Brazil, 2023).

Although still in its early stages, the topic raises relevant debates, especially regarding its impacts on the exercise of political power and its implications for the democratic regime. Therefore, this section of this work is an attempt to contribute to this debate. The focus here will be on outlining the path for a possible implementation of artificial intelligence technologies in the field of Financial Law, aiming to improve the efficiency of public spending control and optimize the oversight of the budgetary process.

2.1. Artificial Intelligence and Budgeting Process

Brazilian legal scholarship increasingly recognizes artificial intelligence as a cen-

tral theme in contemporary legal debates, highlighting both its growing application in law and the need to ensure that its use respects fundamental rights and constitutional mandates (Maranhão, Florêncio, & Almada, 2021; Abraham, 2019; Soares, 2023).

Abraham (2019) and Soares (2023) emphasize that artificial intelligence is already an operational reality in law and public administration, while highlighting the need to ensure its alignment with constitutional principles, particularly in the formulation, implementation, and evaluation of public policies. They also point out the structural difficulties in translating normative frameworks into effective policies within an unequal and asymmetric federation.

Among measures to create a “normative implementation agenda in the Brazilian fiscal debate, particularly from the perspective of municipal realities,” Élidea Graziane Pinto proposes “the eGov dimension” (Pinto, 2023). According to the author, “insufficient understanding regarding the possibilities of computerization and automation in municipal public service” would be a problem (Pinto, 2023). For this reason, she proposes “developing a roadmap to encourage local diagnosis of technological transition, where the cost of implementing computerization solutions does not exceed the operating cost of the current management model” (Pinto, 2023).

This demonstrates that the national public law doctrine has increasingly approached the theme of the intersection between digital technologies and public law. Internationally, there are also reports of this movement, especially regarding the relationship between artificial intelligence and public budgets, which may shed light on an important line of research yet to be explored.

Valle-Cruz, Gil-Garcia, & Fernandez-Cortez (2020) note that artificial intelligence has become a central issue on governmental agendas worldwide. As the key identified benefits of AI in government included improved decision-making, efficiency gains, and enhanced service delivery, there were also highlighted risks related to data quality, algorithm design, and ethical considerations.

In this context, artificial intelligence emerges as an important factor of innovation in the cycle of formation and implementation of public policies, precisely because of its data processing capacity, which brings benefits to the administration, while at the same time drawing attention to possible negative impacts on the lives of citizens.

Valle-Cruz, Fernandez-Cortez, & Gil-Garcia (2022) argue that artificial intelligence is reshaping the entire policy cycle, from agenda-setting to evaluation, by enabling data-driven learning processes and expanding analytical capacity within public institutions. The authors also highlight that public budgeting must be integrated into the broader process of digital transformation, given its central role in shaping public policies and societal outcomes.

Studies have been conducted to assess the impact of implementing digital artificial intelligence technologies on the budget cycle. Fernandez-Cortez, Valle-Cruz, & Gil-Garcia (2020) argue that artificial intelligence can transform problem anal-

ysis and support more effective decision-making in the public budget, contributing to the design of better public policies.

In another study, the same authors suggest that “government agencies should explore artificial intelligence techniques but should be aware that their potential does not always mean that decisions should be made automatically” (Valle-Cruz, Gil-Garcia, & Fernandez-Cortez, 2020, p. 241). Therefore, artificial intelligence should be used creatively to assist in the analysis and understanding of data used for specific government programs and policies. Valle-Cruz, Gil-Garcia, & Fernandez-Cortez (2020) emphasize that the use of artificial intelligence does not eliminate the role of public officials; rather, it enhances their capacity to make better-informed decisions.

Therefore, it is not a matter of replacing public officials with artificial intelligence systems, as David Runciman reports, as one of the possible ways to end democracy (Runciman, 2019). On the contrary, it is an attempt to improve the democratic regime, optimizing the state decision-making process to promote administrative efficiency, without, however, dispensing with human action in all its stages, including the oversight and control of this entire process.

Garcia, Pinto, & Ferraz (2005) discuss the challenges of maintaining deliberative democracy in large urban centers, highlighting the growing difficulty of citizen participation in increasingly complex societies. The authors point to the use of information and communication technologies as a means of revitalizing democratic engagement, particularly by enabling new forms of participation and interaction between citizens and public authorities.

Pinto (2022) argues that the persistence of inefficiencies in the Brazilian budgetary cycle is not due to normative insufficiency, but rather to a structural failure to enforce existing constitutional mechanisms of evaluation and accountability. According to the author, the Brazilian legal framework already provides for periodic review of revenues and expenditures, yet these instruments are systematically neglected, allowing distortions driven by political and economic interests to persist.

The high data processing capacity of artificial intelligence, combined with the expansion of participatory channels, positions AI as a mechanism capable of enhancing both administrative efficiency and democratic accountability in public financial management.

2.2. AI in Budgeting: Case Law of the Courts of Audits

The transition from merely formal control to algorithmic auditing is already evident in concrete cases in the actions of Brazilian courts of audits. The experience of the Alice System at the Federal Court of Audits (Tribunal de Contas da União, TCU) and similar initiatives in state courts demonstrate that AI is not only subject to regulation but also a tool for oversight (Tribunal de Contas da União (TCU), 2025).

The Alice system uses algorithms to cross-reference massive amounts of public

procurement data, identifying risk patterns and anomalies that indicate potential fraud or inefficiency. Although Alice operates in the execution and control phase of the budget, and not directly in its creation, its existence imposes a new reality: that the public manager is under the scrutiny of an algorithmic auditor.

The case law of the Courts of Audits regarding the use of AI in public management, although not yet consolidated specifically in the field of budget preparation, signals the need for traceability and justification of automated actions. Decisions by the Brazilian Federal Court of Audits (Tribunal de Contas da União, TCU) have required public administrations to demonstrate the validity and reliability of the statistical models used, especially when these result in the restriction of rights or the allocation of resources (Tribunal de Contas da União (TCU), 2019).

The expansion of AI in budget preparation will require auditors to develop audit paradigms that go beyond merely verifying formal legality. It will be necessary to develop techniques which encompass:

- a) Algorithm Design Audit: aiming to assess whether the model was designed for public purposes and whether it incorporates bias mitigation mechanisms from its origin;
- b) Input Audit (Data): aiming to verify the quality, representativeness, and legality of the datasets used in training the model, in accordance with the LGPD (Brazilian General Data Protection Law);
- c) Output Audit (Result): the purpose of which is to analyze the impact of algorithmic predictions and suggestions on the equity and effectiveness of public policies.

By adopting algorithmic auditing, the Court of Audits takes the lead in defending informational legality, ensuring that technological innovation does not become an instrument of uncontrollable technical discretion (Bliacheriene & Araújo, 2021).

2.3. Budget as an Instrument for Social Transformation in the AI Era

Despite all the risks and challenges, artificial intelligence has transformative potential for public budgeting, provided it is used under an algorithmic governance regime. AI can be the catalyst for budgeting to become a more effective instrument for social transformation.

AI's predictive capabilities allow for evidence-based resource allocation, enabling AI to more accurately identify areas of greatest need and the real impact of public policies, thus allowing for more efficient and targeted resource allocation.

At the same time, it helps combat fraud and waste, since the automated detection of anomalies and risk patterns (as in the Alice System) frees up resources that would otherwise be diverted, allowing them to be reallocated to priority areas.

AI also enables qualified citizen participation, as it can process and summarize large volumes of data and suggestions from civil society, improving public debate and making the budgetary process more inclusive and transparent (Bliacheriene

& Araújo, 2024).

Budgetary AI, when subjected to ethical and legal scrutiny, can overcome the crisis of teleological rationality and bring the budget closer to its constitutional ideal: to be the main instrument for realizing fundamental rights and reducing social inequalities.

3. Budgeting from the Liberal State to the Algorithm

The trajectory of the modern public budget is inseparable from the evolution of the very concept of the State and its underlying rationality. The budget document, which begins as a mere instrument for limiting the monarch's power and political control (the Budget-Law of the Liberal State), transforms into a tool for economic intervention and social planning (the Program-Budget of the Social State) and, at the dawn of the 21st century, faces the challenge of redefining itself within the context of the Algorithmic State.

In the Liberal State, the budget was the ultimate manifestation of formal-legal rationality, according to Max Weber's classic analysis. Legality, in this context, was the principle that guaranteed predictability and legal certainty, limiting the discretion of the Executive branch. The budget, therefore, was seen as a legal act of forecasting revenues and authorizing expenditure necessary to satisfy the needs of the State and its citizens.

With the advent of Keynesian theories and the consolidation of the Welfare State, the budget transcends its merely limiting function and acquires a material and programmatic dimension. It becomes the vehicle for goals, objectives, and public policies, requiring a teleological rationality—oriented towards ends and results.

The emphasis is on efficiency in the allocation and management of resources, giving rise to the program budget, which seeks to link spending to the delivery of goods and services to society. This model, widely adopted in Brazil, involves the coexistence and simultaneous coordination of three budget laws: the multi-year plan (PPA), the budget guidelines law (LDO), and the annual budget law (LOA), each with its specific objective, outlined in the 1988 Brazilian Federal Constitution.

However, AI radicalizes instrumental rationality. It does not operate on formal legality or political teleology, but rather on statistical predictability. The algorithm, trained on historical big data, is capable of identifying complex patterns, projecting revenues with greater accuracy, and suggesting optimal resource allocations based on probabilistic models. The focus is no longer on a priori legal authorization or a posteriori evaluation of results, but on automated inference during the process.

This shift in focus, from the norm to the data, transfers the decision-making axis. If previously the budgetary decision was the culmination of a political-legal process, today it can be the result of a technical-statistical calculation.

As Shoshana Zuboff warns, algorithmic rationality, when left unchecked, tends

to turn the citizen into mere data and the State into a manager of information flows (Zuboff, 2019). The challenge, therefore, lies in integrating the predictive efficiency of AI without dismantling the popular sovereignty expressed in the budget.

3.1. The Program-Budget and the Teleologic Rationality Crisis

The program budget, consolidated in Brazil by Act No. 4.320/64 (Brazil, 1964) and the 1988 Federal Constitution, with its planning instruments (PPA, LDO, LOA), assumes a clear link between spending and the expected result. The rationale here is that of public purpose, where the allocation of resources must be justified by a previously defined social or economic purpose.

By optimizing the allocation process, AI can inadvertently induce a crisis of teleological rationality. In suggesting the most efficient allocation (the one that maximizes a given indicator), the algorithm may neglect the political and social dimensions of spending. For example, an algorithm trained to maximize savings in healthcare spending might suggest reducing investments in areas with low population density but high social vulnerability, to the detriment of the principle of equality and universal access. In other words, the uncritical use of algorithmic processes resulting from the massive use of artificial intelligence can lead to the complete distortion of the political and social dimensions of the public budget, as in the example mentioned.

In this scenario, technique risks replacing political will. The budget ceases to reflect the political spirit of a society (Schumpeter, 1961) to become a mere expression of instrumental reason in its purest form: optimization calculus. Overcoming this crisis requires that AI be used as a powerful informational input for human decision-making, and not as a substitute for fundamental political deliberation.

3.2. The Algorithm State and Zero-Based Budgeting (ZBB)

According to Prado, the Algorithmic State is the contemporary expression of public administration that delegates decision-making functions, or decision support functions, to autonomous AI systems (Prado, 2025). In the fiscal field, this manifests itself in the transition from Program Budgeting to Digital or Predictive Budgeting, where the ability to forecast revenues and expenditures is drastically improved.

International experiences, such as the use of machine learning in detecting tax fraud in the United States and the implementation of the KrattAI Framework in Estonia for the ethical governance of AI, demonstrate the irreversibility of this trend. In Brazil, the digitization of processes (SIAFI, Tesouro Gerencial, Transparency Portals) paved the way for the adoption of algorithms in pilot projects for expense classification and revenue collection support (Tribunal de Contas da União (TCU), 2025).

In 2016, we developed a thesis at the University of São Paulo, in which we had

the opportunity to present and propose a profound change in Brazilian budgeting techniques through the adoption of the zero-budget biopolitical budgeting technique (Oliveira, 2017).

The traditional budgetary model presents structural limitations that affect its capacity to ensure efficiency, transparency, and alignment with public policy objectives. These limitations are reflected in rigid allocation patterns, insufficient mechanisms for systematic evaluation, and reduced adaptability to changing social and economic demands. As a result, budgetary decisions often fail to adequately reflect current priorities, compromising the effectiveness of public spending. This has led us to the hypothesis that, with the advent of parliamentary amendments, the exhaustion of the program-budget model based on three budget laws—the multi-year plan, the budget guidelines law, and the annual budget law—was decreed.

The purely incremental program budget, as foreseen by the 1988 Constitution, and the lack of transparency in budget execution highlight the need for a broad institutional reform that ensures the effectiveness of public spending.

Beyond the persistent weaknesses of Brazilian external control, this study adopts a methodology aimed at critically examining the effectiveness of public spending and the institutional design of budgetary governance. The analysis is grounded in the interpretation of legal doctrine, constitutional principles, legislation, case law, and comparative regulatory experiences. Methodologically, the research is based on qualitative analysis of normative frameworks and scholarly literature, without the use of empirical data collection, statistical sampling, or survey-based instruments. The objective is to develop a propositional legal framework capable of enhancing transparency, accountability, and efficiency in public budgeting.

We conclude by proposing measures aimed at combating corruption and improving the effectiveness of public policies, including the adoption of Zero-Based Budgeting (ZBB), which, in this study, is seen as enhanced by the incorporation of artificial intelligence. This work stemmed from the observation that the program-budget model foreseen by the 1988 Constitution faces structural limitations related to transparency deficits, inefficiencies, and challenges in delivering effective public policies. It argues that the budget should be understood as a biopolitical apparatus, that is, an instrument for managing life and citizen dignity, whose institutional design directly influences the distribution of power, the reproduction of asymmetries, and the performance of public policies.

The central hypothesis defended was that the ineffectiveness of policies and the persistence of corruption result from a combination of structural weaknesses in external control, inadequate institutional incentives, and the absence of budgetary techniques capable of revealing priorities, real costs, and the tragic choices inherent in the finite nature of public resources.

The identified problem lay in maintaining an incremental, opaque budget, susceptible to political manipulation and incapable of integrating planning, execution, control, and social participation. The research demonstrated that Brazilian

anti-corruption agencies lack independence, coordination, and adequate investigative tools, which can be revitalized and made effective through the clear and transparent use of tools provided by artificial intelligence.

As solutions, Zero-Based Budgeting (ZBB) seeks to identify and reorder priorities and break with incrementalism. The proposal, better described below, aims to reconstruct the Brazilian budgetary logic, strengthen accountability, and ensure greater effectiveness of public spending.

3.2.1. Zero-Based Budgeting (ZBB)

With the enactment of Act No. 4.320, dated March 17, 1964, the program budget began to be adopted by the Union, the States, the Federal District, and the Municipalities, regardless of their actual capacity to implement this complex technique of planning and budgeting. In practice, the institute was emptied of its content, being considered basically a bureaucratic requirement.

With the Fiscal Responsibility Act (LRF), Complementary Act No. 101, dated May 4, 2000, the complexity in the preparation of budget laws became even greater, as it began to incorporate requirements to guarantee greater transparency and accountability in fiscal management.

In order to address such complexity and manage scarce resources, it is necessary to review authorized expenditures in detail each fiscal year (Al-Attar, Mashkour, & Hassan, 2020). In the private sector, this elementary idea is a basic premise for the continuity or generation of new expenses or investments, a practice that does not occur in the Brazilian public sector. Companies such as Xerox, Magnavox, United California Bank, and Southern California Edison (Padoveze & Tarranto, 2015: pp. 43-44) in addition to North American cities such as Orlando, use the technique with significant results since the 1980s (Moore, 1980).

In Brazil, government planning has reached such a scale and complexity (Velloso, 2011), given that it is understood as “a strategic and technical-political tool that governments have at their disposal to plan, implement, monitor and evaluate their programs” (Ministry of Planning, 2014). This complexity intensifies with the coexistence not of one, but of three budgetary laws in force simultaneously in each federative entity, to determine and guide the budgetary management of States, Municipalities and the Union itself, namely, the Multi-Year Plan Law (PPA), the Budget Guidelines Law (LDO) and the Annual Budget Law (LOA).

Over time, the inability of those in power to provide concrete answers to the population’s needs generates discredit towards those leaders and a capture of public funds by members of Congress who, to a large extent, use their amendments as a means of misappropriating public resources through embezzlement and corruption schemes (Sodré & Alves, 2010). This distortion of the political nature of the legitimate choice of where public spending will be carried out ends up configuring the state budget as a “coded instrument of domination of society” (Oliveira, 2015).

Regarding the Annual Budget Law itself, Giacomoni particularly criticizes the lack of flexibility in the budgets, which leads them to develop a merely incremental

character, characterized by spending allocation decisions that perpetuate themselves “[...] in each new fiscal year, in addition to not giving way to others, these programs end up gaining an advantage in the struggle for any new resources in the process of appropriation” (Giacomoni, 2001). Zero-based budgeting appears as a legitimate alternative to address this state of affairs, having already been implemented with absolute success in developed countries and multiple companies, as in other countries.

This study, which allows for a comprehensive exploration of the public budget from both theoretical and practical perspectives, traces the historical evolution of the budget concept from its origins in 18th-century Great Britain to the modern definition of a budget as a fiscal plan encompassing a government’s projected revenues and expenditures. Syeda Jilani also discusses the three essential financial functions of government: economic stability, development, and well-being, and analyzes various budgetary structures, including balanced, surplus, and deficit budgets (Jilani, 2025).

A central focus is the classification and evaluation of nine distinct budgeting methodologies: static, flexible, functional, general, zero-based, participatory, tax, rolling, and annual budgeting. Each is assessed for its strategic application, benefits, and limitations in real-world economic governance. With ZBB, the budget is seen as a vital instrument for achieving fiscal accountability, transparency, and efficient resource allocation. Ultimately, it highlights that a deep understanding of budgeting practices is crucial for effective public administration, economic planning, and national development.

When specifically assessing the advantages of adopting Zero-Based Budgeting (ZBB) in the public sector, its capacity to boost public policies directed at the most vulnerable segments of the population becomes apparent. In this way, it is possible to more closely review spending on maintaining unproductive government structures, assessing the reasons for their continued inclusion in the budget.

Zero-Based Budgeting (ZBB), created by Peter A. Pyhrr (Pyhrr, 2012), was tested and implemented by Texas Instruments in the 1960s. Zero-Based Budgeting is a process that requires reviewing all of an organization’s programs without any reference to previous budgets or activities. It is a fundamental reassessment of the objectives, methods, and resources required by the programs. It begins with identifying an agency’s organizational structure and objectives, management, and decision-making units (entities within the organizational structure whose managers prepare the initial decision packages), and subsequently measuring the entity’s objectives. The second stage involves developing decision packages, examining alternative ways to achieve an objective, and identifying different levels of funding, activity, or performance for that alternative. Agencies then review the decision packages and rank them by priority (this includes ranking by both high-level and low-level managers and final consolidation of the packages). Budget preparation and presentation complete the process. Issues related to implementing Zero-Based Budgeting (ZBB) require an interested agency to select an implementation advi-

sory team and a team to train managers on its concepts, prepare a calendar of events, and develop a manual for its application (Sarant, 1978).

Pyhrr (1981: p.11) emphasizes that each decision package must include a detailed justification of costs, objectives, alternatives, and expected outcomes, allowing managers to assess both the necessity and consequences of each expenditure.

In the reality of Brazilian public administration, it is crucial to resume a process of permanent reflection regarding the necessity or not of certain expenditures, due to the growth of the state apparatus, on the one hand, and the limitation of resources, on the other.

As a rule, the public budget only increases each year, since detrimental practices such as spending appropriations at all costs, even unnecessarily, to avoid having to return them to the central planning body, are already part of entrenched administrative practices. Pyhrr (1981) highlights the need to critically assess whether existing activities remain efficient and whether resources should be reallocated to higher-priority programs.

The need to fight rising costs and inefficiencies in the use or allocation of resources demands a new budgeting basis. The zero-based approach requires a complete reassessment of expenditures, abandoning historical references and demanding full justification of all budget allocations (Paludo, 2013).

This is the assumption of Zero-Based Budgeting, in the sense of prioritizing the allocation of resources, abandoning unproductive or inefficient spending that prevents the optimized application of public resources.

Each year it is necessary to reassess the need to allocate expenses to the public budget, so that establishing new needs is compatible with other priorities and projects already included in previous budgets.

Thrisha Soni (Soni, 2025) clarifies that zero-based budgeting is a process of allocating resources for specific expenses based on a program of efficiency and need, rather than relying on historical budget data. Zero-based budgeting requires managers to justify all their budgeted expenses, instead of the more common approach of requiring justification only for incremental changes to the budget or actual results from the previous year. Thus, it is theoretically assumed that a manager has a baseline of expenses equal to zero (hence the name of the budgeting method). In reality, it is assumed that a manager has a minimum amount of funding for the basic operations of the department, above which additional funding must be justified.

The intent of the process is to continually redirect funding toward core business objectives and to terminate or reduce any activities that are no longer related to those objectives. Zero-based budgeting is a far-reaching cost transformation effort that adopts a “blank sheet of paper” approach to resource planning.

It differs from traditional budgeting processes by examining all expenses for each new period, not just incremental expenses in obvious areas. Zero-based budgeting requires managers to scrutinize all spending and demands justification for every expense item that must be maintained. It allows companies to radically re-

design their cost structures and increase competitiveness.

Zero-Based Budgeting analyzes which activities should be performed at what levels and frequency and examines how they could be better executed—potentially through streamlining, standardization, outsourcing, offshoring, or automation. The process is useful for aligning resource allocation with strategic goals, although it can be time-consuming and difficult to quantify the return on some expenses, such as basic research (Chinniah, 2013).

The literature also points out that the traditional budget is based on an incremental approach (Hansen & Mowen, 2001), with the zero-based methodology, the manager is obliged to justify why money is being spent on a particular activity, requiring greater commitment from the manager in selecting the best alternatives and balancing the intended achievements with the available resources (Paludo, 2013: p. 11).

The sets of expenses constitute alternatives (decision packages), organized in order of priority, and which will be subject to selection by the manager. Decision packages are structured to support cost-benefit analysis, prioritization, managerial decision-making, and performance control, while also promoting organizational alignment and participatory budgeting processes (Souza, Barbalho, & Lima, 2015).

3.2.2. The Decision Package as the Fundamental Element of ZBB

A decision package constitutes the fundamental analytical unit of Zero-Based Budgeting (ZBB), representing a distinct activity, function, or governmental operation subject to evaluation and prioritization. Its formulation requires the systematic identification of core elements, including: 1) purpose; 2) consequences of non-execution; 3) performance indicators; 4) alternative courses of action; and 5) associated costs and benefits. This structure enables comparative assessment across competing public expenditures and supports rational allocation of scarce resources.

In this context, artificial intelligence enhances the formulation and evaluation of decision packages by providing analytical infrastructure for data processing and decision support. Natural Language Processing (NLP) techniques allow the extraction and structuring of information from legal texts, policy documents, and prior budget reports, facilitating the identification of objectives, constraints, and performance metrics. Predictive analytics models enable the estimation of expected outcomes and cost-efficiency, while anomaly detection algorithms identify redundancies and inefficiencies in public spending. Additionally, machine learning classification models support the prioritization of decision packages based on criteria such as social impact, fiscal sustainability, and alignment with public policy objectives. Thus, AI does not operate as an external tool, but as an intrinsic component of the decision-making architecture within ZBB.

Within the Brazilian constitutional framework, the formulation of decision packages must also consider the distinction between mandatory and discretionary expenditures, as well as the legal constraints imposed by budgetary and administrative law. This includes, among others, personnel expenses, ongoing programs,

public services, and capital investments. Consequently, the decision package becomes not only a managerial instrument but also a juridical device that links fiscal choices to constitutional principles such as legality, efficiency, and accountability.

The central requirement of a decision package lies in demonstrating the public value generated by a given expenditure. Rather than presuming the continuity of existing policies, ZBB demands explicit justification of each budgetary allocation. This shift introduces a logic of critical reassessment, in which public policies are evaluated in terms of necessity, effectiveness, and opportunity cost. In this sense, prioritization mechanisms enable decision-makers to compare competing demands and allocate resources according to transparent and rational criteria.

The literature on ZBB highlights that traditional budgeting models often suffer from structural limitations, including misalignment between objectives and allocated resources, premature decision-making under uncertainty, and insufficient adaptation to changes in institutional responsibilities. In contrast, Zero-Based Budgeting introduces a methodological break with incrementalism, requiring that each expenditure be justified from a zero base, independent of past allocations.

Accordingly, the decision package can be understood as a structured informational instrument that consolidates relevant data for budgetary decision-making. It typically includes a detailed description of the activity, its objectives, expected results, costs, alternatives, and consequences of non-implementation. This format allows for systematic comparison across programs and supports hierarchical prioritization within the budgetary process.

Ultimately, the integration of artificial intelligence into the formulation of decision packages transforms ZBB into a dynamic and data-driven governance tool. By enhancing analytical capacity and enabling evidence-based decision-making, AI contributes to improving transparency, efficiency, and accountability in public budgeting, provided that its use remains subject to legal, ethical, and institutional constraints.

According to Padoveze and Taranto, Zero-Based Budgeting emerged due to three common problems with traditional budgeting:

- 1) objectives and goals set were not realistic in relation to the budgeted amount, which generated significant distortions;
- 2) at the time the budget was being prepared, some operational decisions affecting the required quantities had not yet been made;
- 3) budget allocations were not strictly tailored to changes in responsibility and workload. (Padoveze & Taranto, 2015: p. 43).

Zero-Based Budgeting thus emerges as a structural counterpoint to incremental budgeting, with its philosophy being a break with the past. It assumes that reliance on past allocations may reproduce distortions and inefficiencies, starting from scratch. Each expense is considered a new spending initiative, and its need must be proven each year.

According to the authors Padoveze & Taranto (2015: p. 45) argue that Zero-Based Budgeting eliminates the need for protective budgeting practices by requir-

ing precise identification of activities and their actual performance, whether they are actually being executed well.

They further conceptualize the decision package as a detailed description of an activity and its associated costs, enabling comparative prioritization (Padoveze & Taranto, 2015: p. 46)

Ultimately, the integration of artificial intelligence into decision package formulation transforms Zero-Based Budgeting into a dynamic, data-driven governance mechanism, enhancing allocative efficiency while reinforcing transparency and accountability, provided that its deployment remains subject to constitutional and institutional safeguards.

PROPOSED DECISION PACKAGE MODEL FOR OBPZ (Oliveira, 2017: p. 608)

DECISION PACKAGE

Name → Agency → Activity → Accounting Classification → Project → Position

Construction of a Basic Health Unit - UBS → Secretariat of Health → Assistance in the Basic Health of the Citizen → 2.5 - Secretariat of Health 10.301.186.001

4.4.1.90.51.00 → 045 - Construction of UBS → Architecture project in progress

Description of the purpose

The construction of a Basic Health Unit (UBS) is necessary to meet the municipal demand, given the great need for initial care to be provided close to where citizens live, relieving pressure on regional hospitals and reducing healthcare costs.

Results of Actions

Basic healthcare services will be provided more quickly, preventing urgent and emergency cases from overwhelming priority care in hospitals serving the municipality and the region.

Consequence of not approving the package

If the proposal is not approved, patient care for minor procedures cannot be provided quickly, overloading the municipal health system, which will have to dispatch ambulances to the healthcare network, including hospitals, further straining their resources. The per capita cost of expenses will be considerably affected by primary procedures that could require less expenditure. The effectiveness of spending on public health actions and services will be negatively impacted.

Quantitative Measures

Description → Years → Source of Necessary Resources → Years

YEAR 1 → YEAR 2 → YEAR 3 → YEAR 1 → YEAR 2 → YEAR 3

Assistance Provided → 1.000 → 1.200 → 1.500 → Owner → 3.000 → 7.000 → 10.000

Cost of Assistance → 13.00 → 15.83 → 25.15 → Transferences/Partnerships → 7.000 → 12.500 → 15.500

Alternatives

Since health is a right enshrined in the Constitution of the Republic and in sub-constitutional legislation (Act No. 8.080/90, Complementary Act No. 141/12), if the proposed package is not approved, the services provided would continue to be

carried out in the conventional manner used to date, that is, by transferring citizens to hospitals that serve the municipality and the region. In this scenario, the current projected costs of R\$25.15 per patient per service would be adjusted and could reach R\$45.75, representing an increase of approximately 83% if the service were provided at the Primary Health Care Unit (UBS).

Sources of resources to fund the Decision Package Proposed

Description → Years → Resource Projection → Years

YEAR 1 → YEAR 2 → YEAR 3 → YEAR 1 → YEAR → YEAR 3

Federal Resources → 500 → 600 → 700 → Federal Resources → 5.200 → 8.000 → 10.000

State Resources 300 400 500 State Resources → 3.000 → 6.000 → 8000

Municipal Resources → 200 → 200 → 300 → Municipal Resources → 1.800 → 5.500 → 7000

Nature of the Expense → Years

YEAR 1 → YEAR 2 → YEAR 3

BUDGETARY → 10.000 → 19.500 → 25.000

Current Expenses → 3.000 → 12.000 → 16.000

Capital Expenses 7.000 → 7.500 → 9.000

3.2.3. ZBB and the Traditional Budget

Zero-Based Budgeting is recognized as a method that does not adhere to the figures mentioned in the previous budget when preparing a new budget project. Instead, each year it starts anew with its list of expenses and prioritizations, that is, from scratch. In ZBB, priority is not given to programs and projects already underway and previously approved. When considering new projects and the necessary allocation of funds, a reduction in funding or cancellation of ongoing projects is assumed, as it may have been found, in the evaluation carried out, that their efficiency is low and that their return is not compatible with their cost. Therefore, the advantages of the Zero-Based Budgeting system can be defined based on the following aspects:

1. To improve spending effectiveness in achieving the goals adopted by the government, given the implications this includes, such as setting targets for service centers and the need to link them to the overall government spending targets.
2. To eliminate inconsistencies in the targets of government units through the participation of different administrative levels in defining targets and in preparing and organizing decision packages.
3. To achieve an efficient distribution of resources among the different tasks, due to the evaluation contained in the decision packages, organizing them according to their priority and then allocating resources to the important decision packages in each task (Al-Attar, Mashkourb, & Hassanc, 2020).

Based on the reality of private companies, Guilherme Moojen (Moojen, 1981) shows a comparative table between the traditional budget, as seen below:

Table—Traditional budget versus Zero base

Traditional budget → Zero base

It starts from an existing base of monetary units; → It begins with a “blank” base of purposes and objectives;

It is concerned with resources, personnel, materials and equipment; → It is concerned with actual results;

It pays little attention to existing programs and activities; → It requires evaluation and justification of existing and new programs on an equal footing;

It estimates the costs of current activities; → It assesses current and alternative activities;

It requires less information; → It requires additional information;

Decision based on expense elements (inputs); → Decision-making based on results (final products);

Less involvement in the budgetary process by managers at lower levels of the organizational hierarchy; → It requires greater involvement in the budgeting process from management at all levels;

Financial planning parallel to budget preparation. → It requires financial planning before budget preparation.

Zero-based budgeting supports cost reduction because it avoids automatic budget increases, resulting in savings for the organization, promoting operational efficiency, and challenging rigorous budget criteria—a hallmark of the current program budget, with its constitutional and legal constraints that stem from the false premise that the element guaranteeing the effectiveness of public policies is the guarantee of an ever-increasing supply of financial resources.

Another advantage of adopting zero-based decision-making is not its method imposed by high bureaucracy; on the contrary, it is a bottom-up process that incorporates the participation of lower hierarchical levels of the entity in decision-making. [Santana \(2025\)](#) argues that the approval of decision packages tends to increase managerial commitment and engagement in budget execution.

On the downside, zero-based accounting is a costly, complex budgeting process which is very time-consuming, since it is rebuilt from scratch annually.

The list of prioritized decision packages can also be used during the operational year to identify which activities should be reduced or expanded, whether expenditure levels have changed, or whether actual costs have deviated from the budget.

In Zero-Based Budgeting (ZBB), as a preliminary planning step to begin preparing decision packages, the administrator should start by identifying the entity's activities and operations for the current year, in order to “[...] identify the activities that generate this expense (activities around which he will later prepare his decision packages) and calculate or estimate the cost of each activity” ([Pyhrr, 1981](#)).

It is seen that despite the tangible advantages of adopting Zero-Based Budgeting (ZBB) reported in the literature, its effective success depends on a robust methodology to guide the entire process. Administrative units differ from one another, which is why there must be different procedures according to the needs of each one, so that the ZBB methodology is successful. The budget planners of each unit

must take some preparatory measures prior to the execution of the methodology, namely:

1. Define decision-making units (an important department or program, or at a specific level of the government unit).
2. Each director (responsible party) analyzes each decision unit within a decision set according to its importance, which together constitute the overall budgetary needs for that unit.
3. All decisions are organized according to the decreasing characteristics and benefits of the government unit. Perhaps this organization determines priorities based on the tasks defined across the entire decision set.
4. Distribution of funding sources for the unit (the actual allocation of the institution's resources using the organization according to the high degree of success of the separate levels in the unit's structure) reflecting the programs and activities (set of decisions) with the unit's planning budget structure (Al-Attar, Mashkourb, & Hassanc, 2020).

Given these steps, the Zero-Based Budgeting methodology, if adopted in Brazil, has enormous transformative potential in how the Brazilian budgetary legislative process is currently managed, starting with the drafting of the budget bill which, not infrequently, overlooks effective cost control, despite repeated attempts (Moura, Cheibub, & Neto, 2001) of government projects and programs that will be funded, their usefulness and, above all, a serious reflection on the need for their continuation or not.

In Brazil, it has become routine for the public budgets of all federative entities, starting with the Union, to be repeatedly and increasingly in deficit year after year, largely amounting to mere "pieces of fiction" (Saganuma, 2020). Changing this reality is a Herculean challenge that only those with a genuine commitment to the long-term sustainability of Brazilian public finances dare to face, since it entails a significant and radical shift from traditional budgetary methods.

It must be acknowledged that, in public budgets, it is acceptable to adopt the so-called Systematic Deficit Theory, developed by Sir William Beveridge, which was based on the economic theories of Lord Keynes, for whom "the budget deficit is considered a way to ensure economic expansion during a period of unemployment and to achieve full employment, thus serving to revive a depressed economy" (Komine, 2019). However, when such deficits are repeated, excessive, and perpetuated over decades, they constitute a true state of affairs in which only rentiers succeed in their task of tearing apart the finances of an entire nation.

3.2.4. Zero-Based Budgeting Proposed Model (ZBB)

Stage 1: Institutional Preparation and Data ("Base Infrastructure")

Zero-Based Budgeting (ZBB) requires the justification of all expenses from a "zero" base, without automatic reference to the spending history of the previous fiscal year. This demands a mature organizational structure, with financial governance, reliable data, and the participation of managers who understand priorities, functions, and public activities. These are therefore essential elements of this

stage:

- a) Governance and Qualification Building: empower budgetary units and technical staff in Zero-Based Budgeting (ZBB) and the use of AI—including specific training in the analysis of public data, processes, and the use of computational tools;
- b) Data Quality and Integration (Data Infrastructure): centralize and standardize databases of taxes, public acts, revenues and expenses, programs and performance indicators, so that they are electronically readable for AI algorithms;
- c) Definition of Scope and Goals: establish strategic goals and priorities for the public entity to guide the reconstruction of the budget (“essential programs”, priority public services, etc).

The role of AI tools in this process is to support the automatic classification of expenses, analysis of large volumes of financial data, detection of patterns or duplicates, and extraction of relevant information, accelerating the preparation of the databases necessary for Zero-Based Budgeting (ZBB).

Stage 2: Implementation of the AI-Assisted ZBB (Modeling and Analysis)

During the implementation phase, Zero-Based Budgeting (ZBB) requires each unit to reconsider every budget item, justifying its necessity, cost, and impact. This is traditionally a time- and effort-intensive process—precisely where AI can deliver significant efficiency gains. The practical steps for using AI would be as follows:

- a) Data classification and cleaning with AI, as it performs the aggregation, classification, and standardization of budgetary and financial data, reducing manual work and inconsistencies;
- b) Automated spending analysis and justification, since AI models (such as machine learning) provide insights into cost-effectiveness, efficiency, duplication, or waste, supporting managers in justifying each budget item. AI can prioritize activities based on defined criteria (social impact, performance indicators, legal commitments, and public goals) and suggest allocation alternatives;
- c) Dynamic simulations and scenarios, since AI tools allow the creation of alternative allocation scenarios, projections, and automatic simulations that help predict the effects of cuts or reallocations. This improves the quality of budgetary decisions.

Stage 3: Continuous Monitoring and Learning (“Feedback and Improvement Cycle”)

The advantage of integrating AI with Zero-Based Budgeting (ZBB) lies in transforming budgeting from a static annual process into a dynamic and continuous cycle of review, evaluation, and adjustment, aligned with public policy goals and fiscal reality.

Its main components are:

- a) Real-time monitoring, since AI can continuously track budget execution, com-

paring planned vs. actual figures and highlighting deviations or opportunities for savings in a timely manner;

- b) Interactive alerts and dashboards: Intelligent AI-powered dashboards provide predictive alerts about the risk of cost overruns or insufficient resources, supporting real-time adjustment decisions;
- c) Automated learning and adjustments: with machine learning, systems can learn from previous budget cycles to refine forecasts, recommend adjustments, and optimize allocations throughout the fiscal year;
- d) Transparency and auditing: AI tools can also fuel public transparency initiatives by extracting and making budget information available in a way that is understandable to citizens, promoting accountability.

By adopting these steps, benefits from AI integration are expected, including a reduction in manual workload and time spent by analysts, as well as greater data accuracy and consistency. In turn, an enhanced capacity for analyzing complex scenarios and support for data-driven decision making are also expected.

The three proposed stages—institutional preparation and data, AI-assisted implementation, and continuous monitoring—transform zero-based budgeting (ZBB) from an intensive justification exercise into a dynamic, evidence-driven, and results-oriented public management practice. AI, when well-governed (with ethical criteria, transparency, human oversight, and technical expertise), not only automates mechanical functions but also improves the quality of budgetary decisions and promotes greater efficiency in the use of public resources.

The implementation of Zero-Based Budgeting (ZBB) in the Brazilian public sector requires overcoming the traditional paradigm of program budgeting structured in the Annual Budget Law (LOA), the Budget Guidelines Law (LDO), and its formal compatibility with the Multi-Year Plan (PPA). ZBB assumes that each administrative unit justifies, year by year, the need for each expenditure, based on decision packages that detail activities, operational costs, priorities, and alternatives, allowing managers to compare demands, prioritize choices, and distribute resources in a way that is compatible with fiscal reality. Once defined, each package becomes a budget allocation, enabling a simpler, more flexible, and adjustable budget law throughout the fiscal year (Oliveira, 2017: p. 357).

The implementation of Zero-Based Budgeting (ZBB) requires strict adherence to the Fiscal Responsibility Law, especially regarding the monitoring of revenue performance (Article 13), the disbursement schedule, and the limitation of commitments (Articles 8 and 9). This structure allows for periodic reassessments—fiscal targets, revenue re-estimates, expense adjustments, seasonality, and earmarking—making the budgetary process more closely aligned with the manager's daily activities. Even mandatory recurring expenses, as stipulated in Article 17 of the Fiscal Responsibility Law, are now more rigorously controlled, requiring proof of sustainability through a permanent increase in revenue or a reduction in expenses, in order to contain the uncontrolled growth of these items.

The adoption of Zero-Based Budgeting (ZBB) contributes to preventing cor-

ruption, increasing transparency, and ensuring greater effectiveness in public spending, especially by strengthening the role of technical agents who work on the front lines of planning and execution. In a context of fiscal crisis, recurring waste, and scarcity for essential policies, ZBB aims to restore institutional rationality and align the budget with the principles of fiscal responsibility and distributive justice.

The next step in this movement is the incorporation of artificial intelligence as an analytical infrastructure for the new budgetary methodology. The use of AI expands the capacity for calculation, anomaly detection, and impact prediction, but also introduces significant tensions: algorithmic opacity, especially in deep learning models, can generate a fiscal technocracy impenetrable to democratic control. Therefore, the use of AI in the budgetary process must be verifiable, auditable, and explainable, preserving the primacy of human judgment and the state's duty to justify choices and provide accountability.

In short, ZBB, enhanced by AI, offers the Brazilian State an institutional path to rebuild the budget as an instrument of rationality, integrity, and efficiency—provided that technological innovation is subject to the ethical, legal, and democratic limits that guarantee its legitimacy.

3.3. The Legal and Ethical Challenges of Algorithmic Incommensurability

The integration of artificial intelligence into the core of public financial management, particularly in budget preparation, is not merely a technical optimization, but rather a vector of profound legal and ethical challenges that call into question the foundations of Public Law. The main challenge lies in the incommensurability of algorithmic decisions—the sometimes-insurmountable difficulty of tracking, justifying, and auditing the decision-making process that culminates in a revenue projection or expenditure allocation (Kroll et al., 2017). Algorithmic incommensurability refers to the structural difficulty—or even impossibility—of fully translating complex algorithmic decision-making processes into human-understandable legal justifications, particularly when based on opaque models such as deep learning systems.

The principle of publicity, established as a constitutional pillar of Public Administration (article 37, caput, of the Brazilian Federal Constitution of 1988), requires that management acts be transparent and accessible to social scrutiny. In the budgetary domain, publicity is vital for democratic control, allowing citizens and the Legislative Branch to understand the choices made in the distribution of resources.

However, the most advanced AI systems, such as deep neural networks (deep learning), operate as true “black boxes”. The complexity of the interaction between the data processing layers makes the path between input (training data) and output (the budget forecast) virtually undecipherable to humans, including specialists (Adadi & Berrada, 2018).

This opacity in decision-making is the antithesis of public ethics. If the public

manager cannot explain why the algorithm suggested a particular allocation, the motivation for the budgetary administrative act vanishes. Publicity, in this context, cannot be limited to the disclosure of the final forecast result. On the contrary, it needs to become an active publicity of the algorithmic criteria. The Algorithmic State demands algorithmic transparency revealing: a) the datasets used in training; b) the mathematical models employed; and c) the impact and bias reports of the system. Without this transparency, the constitutional principle of publicity is formally fulfilled, but substantially violated, transforming the budget into an act of faith in technique.

The principle of budgetary legality (article 167 of the Brazilian Federal Constitution of 1988, in conjunction with article 5, II) mandates that expenditure must be fixed and all revenue foreseen in the annual budget law (LOA). Administrative Intelligence, by acting in the drafting phase, projects scenarios and suggests priorities, effectively exerting a decisive influence on the formation of administrative will.

Tension arises when the delegation of authority to machines becomes excessive. The risk is that the algorithm, due to its predictive capacity and its aura of technical neutrality, will become the *de facto* decision-maker, relegating the human manager to the mere function of ratification. This delegation, even if implicit, contradicts the non-delegability of the decision-making function in Administrative Law (Di Pietro, 2024).

From a doctrinal perspective, the solution does not lie in prohibiting AI, but in reaffirming the primacy of human judgment. AI should be conceived as an Intelligent Decision Support (IDS) tool, not as a substitute for public officials. By incorporating algorithmic suggestions into the budget bill, managers assume full institutional responsibility for the act.

In this new scenario, legality requires the law (or sub-legal normative act) to establish the limits of delegation and the criteria for controlling AI. The algorithm cannot operate in a normative vacuum. On the contrary, it must be subject to informational legality, which regulates the form and manner in which information is processed and used for public decision-making purposes (Nohara & Bataglia, 2025).

3.4. Biopolitics of Algorithms: Discrimination and the Perpetuation of Biases

The budget is the means of implementing policies whose effectiveness can be strengthened by the massive use of AI, within an idea of promoting public services aimed at improving the quality of life of the population, in what Foucault called biopolitics, a concept that deals with the management of life and the population by state power (Foucault, 2022). AI expands the power of social control and enables automated resource management, which some authors call the biopolitics of algorithms.

The biopolitics of algorithms refers to the use of data-driven systems by the

State to manage populations, allocate resources, and shape life conditions, whereby algorithmic decisions influence the distribution of rights, opportunities, and public services. The most serious ethical risk lies in algorithmic discrimination and the perpetuation of biases. AI systems are trained on historical data. If such data reflects structural inequalities (such as the historically lower allocation of resources to less developed regions or to certain social groups), the algorithm, in seeking optimization based on these patterns, will tend to reinforce and automate the inequity (Barocas & Selbst, 2016).

The pursuit of effective use of public resources requires that AI systems be designed to promote equity, not just formal rationality. This necessitates the implementation of: a) Bias Audits on training datasets to identify and mitigate biases; b) Fairness Testing on model output to ensure that budget projections do not result in unequal allocations without constitutional justification; and c) the creation of Algorithmic Ethics Committees with multidisciplinary and social participation to monitor the social impact of automated decisions (Jobin, Ienca, & Vayena, 2019).

AI in budgeting cannot be an automated instrument of social control that prioritizes efficiency over the effectiveness of spending in reducing social inequalities. Ethics in public management demands that technology be a vector for inclusion and correction of inequalities, not a mechanism that fails to promote them under the guise of technical neutrality.

3.5. Algorithmic Sovereignty and the Primacy of Constitutional Law

The massive integration of Artificial Intelligence systems into the core of public decision-making, particularly in the budgetary process, requires a profound reflection on the concept of Sovereignty. If sovereignty is traditionally defined as the supreme power of a State, not subordinate to any other, what happens when fundamental resource allocation decisions are informed, or even determined, by algorithms developed by private entities or by inscrutable technical models? (Polido, 2024).

In this context, the concept of algorithmic sovereignty emerges, which can be understood from two perspectives: a) De facto algorithmic sovereignty, which considers the risk that technological dependence on software and datasets from private companies grants them power to influence state decisions, subverting popular sovereignty and state autonomy; b) de jure algorithmic sovereignty, understood as the need for the state to maintain effective control over the design, input, and output of the AI systems used, ensuring that the technology serves constitutional values and does not become a parallel power.

The budget, as an act of popular sovereignty par excellence, cannot be held hostage to technological sovereignty exercised by private players or by opaque technical models. The primacy of Constitutional Law requires AI to be used as an instrument for expanding popular sovereignty, not restricting it.

This implies that the State must invest in its own technological capacity (in-house), develop open and auditable models, and ensure that the data infrastructure (the training datasets) is treated as a strategic public asset, subject to rigorous access and usage controls. Sovereignty, in the digital age, is also manifested in the State's ability to exercise technological dominance over the tools that inform its most crucial decisions (Bliacheriene, Araújo, & Coutinho, 2024).

4. Algorithmic Governance and the Explainability Imperative (XAI)

Given the challenges posed by the opacity and biases of artificial intelligence in budget preparation, international doctrine and practice have converged on the pressing need to establish an Algorithmic Governance regime. This regime consists of the set of rules, processes, and institutional structures that aim to ensure that AI systems are developed, implemented, and operated in an ethical, legal, transparent, and responsible way (Dignum, 2019). In the context of Financial Law, Algorithmic Governance is the set of regulations that allows for a balance between the technical efficiency of AI and the democratic legitimacy of the budget.

As Michael Veale and Reuben Binns defend, Algorithmic Governance should be structured around three fundamental pillars, which translate into Digital Accountability requirements for public management, namely:

- a) Technical transparency is essential because simply publishing the results is not enough; it is imperative to disclose the training datasets, the algorithmic models used, and the performance and equity metrics;
- b) Institutional responsibility is essential because there must be a clear designation of a human responsible for the final decision, even if based on AI recommendations, and the maintenance of immutable audit trails (logs) that allow for the traceability of the entire decision-making process;
- c) Participation and scrutiny are essential because civil society and oversight bodies must have effective mechanisms to monitor and question automated decisions, requiring an explainable model (Veale & Binns, 2017).

Digital accountability in the budgetary sphere requires public managers to justify resource allocation not only based on law and public policy, but also on the algorithmic criteria that guided their decisions. The absence of a robust governance system turns AI into a factor that dilutes accountability, which is incompatible with the principle of administrative morality.

4.1. Explainable AI (XAI) as a Requirement of the Budgetary Act

Overcoming decisional opacity necessarily involves the adoption of Explainable Artificial Intelligence (XAI). XAI is a field of computer science dedicated to creating AI models whose decisions and predictions can be understood by humans, especially non-experts (Arrieta et al., 2020).

In Administrative and Financial Law, the XAI (Explanatory Action of the Budget) ceases to be a mere technical convenience and becomes a requirement for

the validity of the budgetary administrative act. The motivation of the act, an essential element for its legality, cannot be replaced by an unintelligible technical result. The XAI provides the means for the manager to fulfill their duty of justification, allowing them to demonstrate: a) which inputs (variables) were most relevant to the forecast (for example, the use of techniques such as SHAP or LIME); b) how the algorithm arrived at that conclusion (the logic of the model's operation); c) why the algorithmic suggestion was or was not accepted by the human manager.

International doctrine proposes the notion of proportional explainability, according to which the degree of detail in the explanation should be commensurate with the risk and importance of the act. In public budgeting, which deals with the allocation of scarce resources and affects fundamental rights, the requirement for proportional explainability should be at its maximum, especially for systems classified as high-risk (European Union, 2024).

4.2. Interpretative and Procedural Harmonization and Algorithmic Auditing

The Courts of Audits (TCs) play a crucial role in the external control of public management. With the emergence of Predictive Budgeting, the scope of TC oversight must evolve from an accounting and legality audit (focused on the past) to an Algorithmic Audit (focused on the present and future of the decision-making process), although we must recognize that this new challenge of establishing this type of audit within the Brazilian courts of audits is extremely incipient, as they still lack, among other things, harmonizing rules for their operation and interpretation of national laws (Tribunal de Contas da União (TCU), 2024).

The proposed Constitutional Amendment (PEC No. 38/2025), currently under legislative deliberation and without normative force, aims to introduce changes in the structure of public administration, including mechanisms related to governance and oversight.

PEC n. 38/2025 - Administrative Reform (Brazil, 2025)

Art. 71 § 6° The Federal Court of Audits may, by a two-thirds majority vote of its members, approve a summary that, from the date of its publication in the Official Federal Gazette and on its website, will have binding effect on the State Courts of Audits, the Federal District, and the Municipalities.

The provision under examination is unconstitutional and inconvenient in several respects, especially due to the lack of hierarchy and subordination among the Courts of Audits. The 1988 Constitution of the Republic established, in Article 71, that external control will be performed by the Legislative Branch with the assistance of the Courts of Audits. The respective constitutional provision also conferred specific powers on the Courts of Audits, which are reproduced by subnational entities in their respective state constitutions and organic laws.

From reading Article 73 of the Brazilian Federal Constitution of 1988, one can deduce the autonomy and independence of these courts, which are not subordinate to or part of any of the three branches of government. It is also seen that, of

the 33 existing Courts of Audits in Brazil, each has a specific jurisdiction, whether it be the auditing of the accounts of the federal government, the accounts of the Federal District, the accounts of the States, the municipal accounts, and even the specific municipalities of Rio de Janeiro and São Paulo, which have their own courts of audits. In this sense, it is possible to infer the absence of hierarchy between the Federal Court of Audits and the state, municipal, and local courts.

Conversely, it is observed that within the Judiciary there is a hierarchy, structured in levels of jurisdiction (instances). Thus, the existence of binding precedents is not incompatible with judicial procedural practice. Currently, as provided for in Article 103-A of the Brazilian Federal Constitution of 1988, issuing binding precedents is the sole responsibility of the Supreme Federal Court, the highest body of the Judiciary, and these precedents are mandatory for all other bodies of said government branch and for the direct and indirect public administration at the federal, state, and municipal levels.

The proposal for a regulatory device aimed at creating binding force for the rulings of the Brazilian Federal Court of Audits (Tribunal de Contas da União, TCU) is not new. Article 172 of Bill No. 4.253/2020, which became Act No. 14.133/2021 (New Act on Bidding and Contracts), provided for:

Art. 172. The oversight bodies shall be guided by the pronouncements of the Federal Court of Audits regarding the application of this Law, in order to guarantee uniformity of understanding and to provide legal certainty to those concerned.

Sole paragraph. The decision that does not follow the guidance referred to in the heading of this article must present relevant reasons duly justified.

However, the absence of hierarchy and subordination between the courts of audits resulted in the veto of the aforementioned provision by the President of the Republic, who justified it as follows, in verbis:

The proposal establishes that oversight bodies should be guided by the statements of the Federal Court of Audits regarding the application of this Law, in order to guarantee uniformity of understanding and to provide legal certainty to those concerned.

However, and despite the merits of the proposal, the provision, by creating binding force for the rulings of the Federal Court of Audits, violates the principle of separation of powers (Article 2, CF), as well as the principle of the federal pact (Article 1, CF) and the autonomy of the States, the Federal District and Municipalities (Article 18, CF) (Brazil, 2021).

The proposed wording for Article 73, § 6, of the Administrative Reform Amendment is not in accordance with the legal system, that is, it is unconstitutional. It should be noted that the standardization of certain understandings of the courts of audits would be beneficial, as it would correct differing interpretations by the courts on fiscal matters and strengthen the role of external control in public administration. However, as explained, a binding precedent issued by the Brazilian Federal Court of Audits (Tribunal de Contas da União, TCU) would not be a convenient solution, given the creation of a hierarchy within the scope of external

control exercised by the Courts of Audits, electing as the issuing body a court that does not have authority over state, municipal, and local courts of audits.

Since the Brazilian Federal Court of Audits (Tribunal de Contas da União, TCU) is not constitutionally designated as the superior body capable of analyzing appeals from state and municipal courts of audits, it is not advisable to choose it as the body competent to issue binding precedents in order to standardize interpretation and expedite the application of understandings by local courts.

One possible solution to the need to standardize procedures and understandings among the various courts of audits in the country would be to enact a national procedural law for audits and a national administrative body that is both equal and equitable.

The creation of the National Council of Courts of Audits (CNTC) is an integral part of the aforementioned proposed constitutional amendments. The most recent proposed text seeks, in addition to creating an administrative, budgetary, financial, and disciplinary oversight body, the creation of a Chamber for the Unification of Jurisprudence, in order to standardize the core activities of the Courts of Audits regarding matters of clear national importance on which there is recognized controversy regarding normative interpretation.

It should be emphasized that the proposed composition for the National Council guarantees the representation of each external control jurisdiction, with members from the Brazilian Federal Court of Audits (Tribunal de Contas da União, TCU), State Courts of Audits (TCEs), Federal District Court of Audits (TCDF) and Municipal Courts of Audits (TCMs), thus not infringing on the autonomy and independence of these courts, as a reflection of the federal pact.

Given the need for conceptual uniformity in light of the unprecedented nature of Algorithmic Auditing, this process of systematic and independent evaluation of AI systems used by the Public Administration, with the objective of verifying their compliance with the principles of legality, morality, efficiency and, above all, equity, should be carried out in a democratic and equitable forum, within the scope of all courts of accounts, according to the federative principle that does not allow for hierarchy between entities of internal public law.

Within this new mandate, therefore, the courts of accounts must promote the massive technical training of external audit officers for the scrutiny of mathematical and statistical models, which will become an institutional imperative. External control cannot be held hostage by technical complexity. On the contrary, it must seize the tools of data science to ensure that AI serves the public interest and does not become a new focus of opacity and discretionary power (Silva et al., 2024).

4.3. The Primacy of Human Judgment over Algorithmic Calculation

A critical and dogmatic analysis of the integration of artificial intelligence (AI) in the preparation of the public budget reveals a profound paradigmatic shift in Financial Law. The budget, which historically has been consolidated as a legal and political act, guided by legality and intersubjective deliberation, is moving towards

becoming a predictive budget, informed and, at times, determined by algorithmic rationality and statistical inference (Santos & Pinheiro Junior, 2025).

The possibility of reconciling the technical efficiency of AI with the democratic legitimacy of the budgetary process is confirmed, but contingent upon strict adherence to a robust and constitutionally oriented algorithmic governance regime. AI, due to its opaque nature and the risk of perpetuating historical biases, cannot be treated as a neutral tool, but rather as a new locus of power that demands social control and institutional scrutiny (Neves & Romão, 2024).

The main challenges identified—decisional opacity (algorithmic incommensurability), tension with budgetary legality (delegation of competence to the machine), and the risk of discrimination (biopolitics of algorithms)—show that technical sophistication cannot be a safe conduct for the emptying constitutional principles. Publicity must evolve into the active transparency of algorithmic criteria, and legality must be complemented by informational legality, which regulates how information is processed for public decision-making purposes.

The key to overcoming these challenges lies in the imperative of explainability (XAI) and the reaffirmation of the primacy of human judgment. XAI, by allowing predictive models to be understood by non-experts, becomes a requirement for the validity of the budgetary administrative act, ensuring that the manager fulfills the duty of justification.

At the institutional level, the proposal for a legal-institutional framework for AI in the Brazilian budget, anchored in the high-risk classification of Bill 2.338/2023 and the requirement for Algorithmic Impact Assessment (EIA) and Algorithmic Impact Reports (EIR), aims to create the necessary system of checks and balances. The proactive role of the courts of audits in algorithmic auditing and the safeguarding of Article 20 of the LGPD—which ensures the right to human review—are mechanisms that shield the process against opaque technocracy and the dilution of responsibility.

Ultimately, artificial intelligence in public budgeting should be conceived as a tool to support qualified fiscal rationality, and not as a substitute for democratic deliberation. Efficiency is only legitimate when it serves fiscal justice and social equity.

Algorithmic calculation, however precise, must always be subordinate to human judgment, which is the only one capable of weighing the constitutional and ethical values that give meaning and legitimacy to *res publica*.

The great lesson of the algorithmic age is that technology should be a means to enhance democracy and not a force for its silent subversion, which is why it is necessary to protect even the principles and rules present in the Brazilian General Data Protection Law, which we will discuss in the following section.

5. LGPD and the Predictive Budgeting Framework

The General Data Protection Act (LGPD), Act No. 13.709/2018, has a critical intersection with the use of AI in budget preparation, especially when predictive

budgeting relies on personal data to project demands for public services (health, education, security) or to monitor revenue collection.

It is essential to distinguish between binding legal norms and legislative proposals currently under deliberation. While the Brazilian General Data Protection Law (LGPD—Law No. 13.709/2018) constitutes a fully enforceable legal framework, Bill No. 2.338/2023 and the proposed Administrative Reform (PEC No. 38/2025) (Brazil, 2025) remain under legislative discussion and do not yet produce binding legal effects.

The use of citizens' data for budget forecasting purposes, even if anonymized or aggregated, requires strict adherence to the principles of the LGPD (Brazilian General Data Protection Law), notably those of purpose, necessity, and transparency. Personal data, even if indirectly used to infer the behavior of social groups and project expenditures, must be treated with the utmost caution. As a binding legal instrument, the LGPD already establishes enforceable safeguards applicable to the use of artificial intelligence in public budgeting.

Article 20 of the LGPD (Brazilian General Data Protection Act) is the main mechanism for defending citizens against automation. It establishes the right to human review of decisions made solely based on automated processing. In the budgetary context, this translates into the right of an individual affected by an allocation decision (e.g., denial of a social benefit based on an algorithmic risk projection) to demand that a human manager reassess the case, providing an explanation of the algorithm's criteria.

The National Data Protection Authority (ANPD), in turn, assumes a regulatory role for AI in the public sector, in conjunction with the Courts of Audits. The ANPD can require the preparation of Data Protection Impact Assessments (DPIAs) for budgetary AI systems that involve the large-scale processing of personal data, ensuring that risks to privacy and fundamental rights are mitigated from the model design stage.

Therefore, the LGPD (Brazilian General Data Protection Act) is not an obstacle to innovation, but an ethical and legal imperative that demands that AI in the budget be human-centered, ensuring that the pursuit of efficiency does not violate the dignity and autonomy of the citizen (Doneda, 2019).

The urgency to regulate the use of Artificial Intelligence in the public sphere is not an isolated phenomenon to Brazil. The international community, aware of the risks and benefits of technology, has been advancing in the creation of regulatory frameworks as a reference for the development of an Artificial Intelligence Law (Crawford, 2021). A comparative analysis of models such as the European Union's AI Act and the North American approach is fundamental to guiding the proposed Brazilian legal and institutional framework.

5.1. The European Union's AI Act and the North American Experience

The European Union's AI Act, although not applicable to Brazil, serves as an important comparative benchmark. The European Union Artificial Intelligence Reg-

ulation is the world's first comprehensive regulatory framework on AI. Its main feature is its risk-based approach, which classifies systems into four levels: unacceptable risk, high risk, limited risk, and minimal risk.

In the context of public budgeting, the AI Act establishes that AI systems used to “assess the eligibility of individuals for public benefits and services” or for “credit risk assessment” are classified as High Risk. Although budget preparation *stricto sensu* is not explicitly listed, the application of AI to project the demand for social services or to optimize the tax collection from individuals falls into the High-Risk category.

The High Risk classification imposes strict obligations on providers and users (the State), such as:

- a) Quality and Risk Management Systems: implementation of a management system to ensure continuous compliance;
- b) Transparency and Information Provision: duty to provide clear and understandable information about how the system works;
- c) Human Supervision: requirement that the system be designed to allow effective human supervision.

The European model reinforces the argument that Budgetary AI should be treated as a technology with high social impact, requiring a compliance and governance regime that transcends mere administrative discretion.

In the United States, the regulatory approach has been less centralized in a single law and more focused on federal guidelines, executive orders, and agency initiatives. The emphasis is on AI ethics, bias mitigation, and accountability.

An Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence established safety standards and guidelines for the use of AI in the federal government, focusing on fairness and the protection of civil rights. Agencies such as the National Institute of Standards and Technology (NIST) developed the AI Risk Management Framework (AI RMF), which offers voluntary guidance for managing AI risks, including identifying and mitigating biases.

The main contribution of the North American model is its emphasis on accountability and bias auditing. Doctrine and practice in the US have deepened the creation of tools and methodologies for fairness testing, recognizing that AI in the public sector should be designed to promote equity, not just efficiency.

The complexity and social impact of Artificial Intelligence on public management, especially in budgeting, suggest that the existing regulatory framework is insufficient to address the challenges of the algorithmic age. The creation of a legal and institutional framework for AI in the public sector becomes imperative (Puschel, Rodrigues, & Valle, 2022).

Reconciling algorithmic innovation with legal certainty within the public budget requires structuring a robust and adaptable Legal-Institutional Framework. This framework should leverage existing regulatory instruments in Brazil, such as the General Data Protection Act (LGPD) and the Bill of the AI Legal Framework Bill

(PL 2.338/2023), to establish clear guidelines for the use of Budgetary Artificial Intelligence (Brazil, 2023).

5.2. Article 20 of the LGPD and the Non-Delegability of Human Decision-Making

Law No. 13.709/2018 (LGPD), while focused on the protection of personal data, offers a fundamental safeguard against the unrestricted automation of public decision-making. Article 20 of the LGPD establishes the right of the data subject to request a review of decisions made solely on the basis of automated processing of personal data that affect their interests.

In the budgetary context, decisions involving the allocation of resources for social programs or the tax auditing of individuals are directly impacted. The requirement for human review implies that the decision-making function remains non-delegable to the algorithm. The AI system is a support tool, but the final decision, with its respective responsibility, rests with the public manager.

The manager must be able to explain the criteria that led to the algorithmic suggestion, providing clear and adequate information about the model, in accordance with the XAI imperative (Bercholz, Papagni, & Prince, 2023).

Article 20 of the LGPD (Brazilian General Data Protection Act) acts as an institutional safety brake, requiring the government to maintain effective human oversight (Human-in-the-Loop) over automated processes. Its application to the public budget reinforces the argument that technical efficiency cannot overshadow the fundamental right to justification and review of administrative acts.

5.3. The Legal Framework for AI and the Classification of Budgetary Use

Bill No. 2.338/2023, currently under discussion in the Brazilian Congress and not yet enacted, aims to establish the Legal Framework for Artificial Intelligence in Brazil, and adopts a risk-based approach, similar to European regulations (AI Act). This model classifies AI systems into categories (unacceptable risk, high risk, and low risk) and imposes obligations proportional to each of them (Brazil, 2018).

The use of AI in budget preparation, given its capacity to affect the distribution of public resources, the implementation of social policies, and taxation, must be classified, without hesitation, as high risk. This classification imposes strict obligations on public authorities, including:

- a) Algorithmic Impact Assessment (EIA): obligation to conduct a prior and ongoing analysis of the risks and benefits of the AI system, including the assessment of biases and the impact on fundamental rights;
- b) Effective Human Supervision: maintaining mechanisms that guarantee human intervention at any point in the process;
- c) Transparency and Documentation: requirement for operational logs, technical documentation, and clear information about the purpose and operation of the system.

The adoption of a risk-based model by the AI legal framework is crucial, as it establishes a regulatory basis that obliges the State to treat AI in the budget not as a neutral tool, but as a technology with high decision-making power that requires caution and control (Façanha et al., 2024). Although not yet enacted, the bill provides an important normative reference for the future regulation of artificial intelligence in Brazil.

6. Final Remarks

The text analyzed the convergence between Zero-Based Budgeting (ZBB) and Artificial Intelligence (AI) as a structuring foundation for the reconstruction of the Brazilian budgetary process.

The starting point was the diagnosis that the current incremental model, foreseen by the 1988 Constitution, is exhausted in the face of structural inefficiencies, transparency challenges, and distortions in the allocation of public resources—a phenomenon exacerbated by the dynamics of parliamentary amendments and the absence of teleological rationality in the budgetary cycle.

In this scenario, Zero-Based Budgeting (ZBB) re-emerges as a technique capable of breaking institutional inertia by demanding full justification for each expenditure, redefining priorities, eliminating inefficient spending, and expanding the capacity to evaluate public policies.

AI is presented as the element capable of enabling this structural shift. Algorithmic tools expand the analytical capacity of the government, allowing for predictive modeling, risk identification, fraud detection, impact simulations, and evidence-based resource allocation.

The text demonstrated that AI transforms the budget into an active instrument for social development, integrating prediction, automation, and data analysis to improve public choice and reduce inequalities.

The study also outlined the historical evolution of the budget—from the Liberal State to the Algorithmic State—highlighting that the budget document has evolved from a mere legal authorization into a biopolitical instrument for managing life, dignity, and fundamental rights. Zero-based budgeting (ZBB), reinforced by AI, responds to this new paradigm, as it confers transparency, rationality, and accountability to the decision-making process.

The research also showed that AI applied to budgeting requires algorithmic governance, explainability (XAI), continuous auditing, and respect for the primacy of human judgment, in accordance with the guidelines of the LGPD (Brazilian General Data Protection Act) and international regulatory experiences. Thus, the public budget, when associated with explainable and auditable algorithmic mechanisms, can finally fulfill its constitutional function of promoting distributive justice, efficiency, and integrity of public policies.

Based on this text and the research undertaken, we propose, as developed in Section 3.2.4, that the implementation of AI-assisted Zero-Based Budgeting is structured in sequential institutional stages.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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