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Original article

Interpretation of sabermetric patterns to define each tactic of the contemporary baseball pitcher

[*Interpretation of sabermetric patterns to define each tactic of the contemporary baseball pitcher]*

[*Interpretation of padrões sabermetrics to define each tactic of the baseball pitcher contemporary]*

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ABSTRACT

Introduction: Predictive models in baseball present methodological and contextual limitations that hinder the transition to anticipatory tactical pitching. Deficiencies persist

in data interpretability, the exclusion of contextual information, and a lack of unified frameworks that integrate prediction, performance, and tactical evaluation.

Objective: to assess the implementation of a methodology for the interpretation of sabermetric patterns in the tactical decisions of the baseball pitcher of the Santiago de Cuba team.

Methodology: This was a pre-experimental, cross-sectional study with a quantitative approach and explanatory scope. The non-probability sample included 11 pitchers from the Santiago de Cuba team's social category, participants in the 64th National Series. Systematic scientific observation with a recording sheet, a standardized questionnaire, and document analysis were used. The data were processed using descriptive, correlational, and inter-rater reliability techniques.

Results: Decisions based on objective criteria increased from 27.3% to 82.0% (+54.7 points). Tactical accuracy improved from 60.0% to 85.0%. Consistency in individual patterns increased from 45.5% to 90.9%, and inter-rater reliability reached a Cohen's Kappa of 0.91. Four pitcher profiles were identified based on tactical effectiveness and situational consistency.

Conclusions: The methodology allowed the transition from empirical criteria to objective foundations in tactical decisions, demonstrating an improvement in the correspondence between the action executed and the competitive situation.

Keywords: baseball, tactical decisions, pitchers, sabermetrics.

RESUMEN

Introducción: los modelos predictivos en el béisbol presentan limitaciones metodológicas y contextuales que dificultan la transición hacia una prescripción táctica anticipatoria en el pitcheo. Persisten carencias en la interpretabilidad de los datos, exclusión de información contextual y falta de marcos unificados que integren predicción, desempeño y valoración táctica.

Objetivo: valorar la implementación de una metodología para la interpretación de patrones sabermétricos en las decisiones tácticas del lanzador de béisbol del equipo de Santiago de Cuba.

Metodología: estudio preexperimental con enfoque cuantitativo y alcance explicativo de corte transversal. La muestra no probabilística incluyó 11 lanzadores de la categoría social del equipo Santiago de Cuba, participantes en la 64 Serie Nacional. Se empleó observación científica sistemática con hoja de registro, cuestionario estandarizado y análisis documental. Los datos se procesaron mediante técnicas descriptivas, correlacionales y de fiabilidad interobservador

Resultados: las decisiones basadas en criterios objetivos aumentaron del 27.3% al 82.0% (+54.7 puntos). El acierto táctico mejoró del 60.0% al 85.0%. La consistencia en patrones individuales se incrementó del 45.5% al 90.9% y la fiabilidad interobservador alcanzó un Kappa de Cohen de 0.91. Se identificaron cuatro perfiles de lanzadores según efectividad táctica y consistencia situacional.

Conclusiones: la metodología permitió el tránsito desde criterios empíricos hacia fundamentos objetivos en las decisiones tácticas, evidenciando mejora en la correspondencia entre la acción ejecutada y la situación competitiva.

Palabras clave: béisbol, decisiones tácticas, lanzadores, sabermetría.

RESUMO

Introdução: Os modelos preditivos no beisebol apresentam limitações metodológicas e contextuais que dificultam a transição para uma prescrição tática antecipatória no arremesso. Persistem carências na interpretabilidade dos dados, exclusão de informações contextuais e falta de marcos unificados que integrem predição, desempenho e valoração tática

Objetivo: Avaliar a implementação de uma metodologia para a interpretação de padrões sabermétricos nas decisões táticas do arremessador da equipe de Santiago de Cuba.

Metodologia: Estudo pré-experimental com abordagem quantitativa e alcance explicativo de corte transversal. A amostra não probabilística incluiu 11 arremessadores

da categoria social da equipe Santiago de Cuba, participantes da 64ª Série Nacional. Empregou-se observação científica sistemática com ficha de registro, questionário padronizado e análise documental. Os dados foram processados mediante técnicas descritivas, correlacionais e de confiabilidade inter-observadores.

Resultados: As decisões baseadas em critérios objetivos aumentaram de 27,3% para 82,0% (+54,7 pontos). A precisão tática melhorou de 60,0% para 85,0%. A consistência em padrões individuais incrementou-se de 45,5% para 90,9% e a confiabilidade inter-observadores alcançou um Kappa de Cohen de 0,91. Identificaram-se quatro perfis de arremessadores segundo efetividade tática e consistência situacional.

Conclusões: A metodologia permitiu a transição de critérios empíricos para fundamentos objetivos nas decisões táticas, evidenciando melhora na correspondência entre a ação executada e a situação competitiva

Palavras-chave: beisebol, decisões táticas, arremessadores, sabermetria.

INTRODUCTION

Predictive models process control data that requires continuous adjustments to optimize pitching, and they anticipate the type of pitch and its location. This prediction reduces runs per game, and its effectiveness is sustained over time. The advantage persists season after season, as it constitutes a structural requirement that guides tactical direction.

However, Yang *et al.* (2025) caution that long-term memory models lack interpretability and project unclear decisions, and that pitch velocity models prioritize discrete variables without quantifying joint contribution. Moore et al. (2025) point out that few studies employ deep learning to predict location, and that context-free models exhibit inferior performance; the tool's absence of the hit-or- out outcome reduces its tactical value. Both methodological and contextual limitations hinder the transition to anticipatory tactical pitching prescription.

In addition to these tactical limitations, documented structural deficiencies persist in the literature. Zhao *et al.* (2025) conclude that few studies follow best practices and a unified framework integrating prediction, performance, assessment, and projection is lacking. Takamido *et al.* (2025) demonstrate that traditional approaches exclude unforeseen information about individual differences in pitching patterns. Both methodological and conceptual shortcomings hinder comprehensive analytical models for pitching.

These methodological problems are compounded by technological and standardization limitations. McIntosh (2025) indicates that conventional methods rely on offline data and exclude the automated analysis of live sabermetric patterns for decision metrics. Tabaracci *et al.* (2025) point out that monitoring physical exertion in pitchers lacks standardization, and its indicators do not link mechanics, simplified tactics, and injury risk. The exclusion of real-time advanced statistical analysis and the absence of unified parameters hinder the advancement of pitching.

These technological difficulties are compounded by shortcomings inherent in the available metrics. Tahara *et al.* (2025) warn that the difference in the stabilization of the metrics for shot quality and location prevents the integration of both dimensions into a unified prescriptive framework for real-time tactical decisions. González *et al.* (2025) and Kontulainen (2025) point out that this difficulty limits the system's application in simplified game situations and hinders progress from retrospective evaluation to anticipatory tactical prescription.

Beyond the metric deficiencies, these shortcomings are part of a broader pattern of methodological deficiencies. The models suffer from limited clarity and prioritize discrete variables; few employ deep learning for context-free positioning, resulting in poor performance. Without a unified framework integrating prediction, performance, assessment, and projection, traditional approaches exclude unforeseen information and individual differences. Physical monitoring lacks standardization and indicators that link training overload, hindering proactive tactical prescription.

In order to overcome the methodological, technological, and asynchronous limitations that hinder the transformation from retrospective evaluation to anticipatory tactical positioning in pitching, the objective of this research is to assess the implementation of a methodology for interpreting sabermetric patterns in the tactical decisions of the pitcher for the Santiago de Cuba team.

MATERIALS AND METHODS

The research adopted a pre-experimental design, with a quantitative approach and a cross-sectional explanatory scope. The population consisted of 26 pitchers from the Santiago de Cuba team. The sample, selected non-probabilistically based on inclusion criteria, comprised 11 pitchers from the same team, all in their first year in the 64th Cuban National Baseball Series. These pitchers were between 23 and 25 years old and had five years of experience on the mound.

Prior to the start of the investigation, the selected pitchers were informed about the study and gave their informed consent and voluntary participation, in accordance with the ethical principles of the Declaration of Helsinki and international normative codes (Rodríguez, 2025).

Based on this ethical framework, the theoretical method was defined: documentary analysis, a systematic process of reviewing specialized sources in sabermetrics, predictive models, and tactical decisions to establish the conceptual framework and support the methodology.

With the established conceptual framework, the empirical phase was carried out using systematic scientific observation with predefined categories, a recording sheet, observer training, inter-observer reliability calculations, and quantitative analysis of tactical decisions and sabermetric patterns. A standardized questionnaire with Likert scales for psychological variables and a structured record of tactical events and sabermetric patterns were also used.

The collected data were processed with descriptive, correlational and significance techniques to link sabermetrics with tactical decisions, plus reliability analysis, all under a pre-experimental design with pre and post measurements.

RESULTS AND DISCUSSION

Applying the methodology for interpreting sabermetric patterns to the Santiago de Cuba team revealed significant changes in the pitchers' tactical decision-making process. The most relevant findings are structured around five key areas:

1. Characterization of tactical decisions.

One hundred and fifty pitching sequences from the 11 pitchers were observed during games of the 64th National Series. The instrument used was a recording sheet with predefined variables: pitch type, count, decision criteria, and tactical decision accuracy (Table 1).

Table 1*Pre-experimental results of the characterization* ***of*** *tactical decisions*

Variable	Category / Measure	Pre-test (n=150)	Post-test (n=150)	Difference
Type of launch	Straight (4 seams) n (%)	58 (38.7%)	42 (28.0%)	-16 (-10.7%)
	Straight (2 seams) n (%)	24 (16.0%)	31 (20.7%)	+7 (+4.7%)
	Curve n (%)	32 (21.3%)	28 (18.7%)	-4 (-2.6%)
	Change n (%)	20 (13.3%)	30 (20.0%)	+10 (+6.7%)
	Slider n (%)	16 (10.7%)	19 (12.6%)	+3 (+1.9%)
Most frequent count	Count 1-2 n (%)	25 (16.7%)	28 (18.7%)	+3 (+2.0%)
Decision criteria	Empirical n (%)	109 (72.7%)	27 (18.0%)	-82 (-54.7%)
	Target n (%)	41 (27.3%)	123 (82.0%)	+82 (+54.7%)
Correct tactical decision	Estimated average percentage	60.00%	85.00%	25.00%

Source: own elaboration

The data reveals substantial transformations following the implementation of the sabermetric methodology. In the pitch repertoire, the four-seam fastball decreased by 10.7 percentage points, while the two-seam fastball and the changeup increased by 4.7% and 6.7%, respectively, reflecting greater strategic diversification. The 1-2 count remained the most frequent, with a slight increase of 2.0%. The most notable change was the reversal of the decision-making criteria: empirical decisions dropped drastically from 72.7% to 18.0%, while goal-based decisions increased to 82.0%. Finally, the accuracy of tactical decisions improved by 25 percentage points, rising from 60.0% to 85.0%, confirming the effectiveness of the intervention.

1. Impact of the intervention on the selection of the launch.

Between the 150 sequences recorded in the pre-test phase (before the intervention) and those in the post-test phase (after implementing the sabermetric methodology), a questionnaire was administered to the 11 pitchers to ascertain their perception of the intervention in pitch selection. This intervention included continuous feedback based on pitch quality indicators, such as decisions based on objective criteria, the coefficient of variation in selection, and the perception of tactical control, with the aim of promoting decisions based on objective criteria (Table 2).

Table 2*Pre-experimental results of the impact of the intervention on the selection of the throw*

Variable	**Extent**	**Pre-test (n=11)**	**Post-test (n=11)**	**Difference**
Decisions based on objective criteria	Percentage (%)	27.30%	82.00%	54.70%
	Frequency (n)	3 pitchers	9 pitchers	+6 pitchers
Coefficient of variation in selection (count 1-2)	Coefficient of variation (CV)	34.20%	12.50%	-21.70%
Perception of tactical control	Average (DE)	3.2 (0.6)	4.4 (0.4)	1.2
	95% confidence interval	[2.8 – 3.6]	[4.1 – 4.7]	

Source*: own elaboration*

The data reflect improvements in all three indicators assessed after the intervention. Decisions based on objective criteria increased from 27.3% to 82.0% (+54.7 percentage points), as the number of pitchers rose from 3 to 9, meaning that 81.8% of the team adopted a data-driven approach. The coefficient of variation in pitch selection during counts 1-2 decreased from 34.2% to 12.5% (-21.7 points), demonstrating greater tactical consistency in advantageous situations. The perceived tactical control score increased from 3.2 to 4.4, with a standard deviation that decreased from 0.6 to 0.4, suggesting more homogeneous perceptions within the team. Finally, the lack of overlap between the confidence intervals [2.8–3.6] and [4.1–4.7] confirms statistically significant differences in this variable.

2. Reliability and consistency of the observed patterns.

During the investigation, inter-observer reliability for recording tactical decisions was evaluated using the following indicators: consistency in individual patterns, temporal stability of patterns (first month vs. last month), and agreement in repeated situations (1-2 count) (Table 3).

Table 3*Pre-experimental results of the reliability and consistency of* ***the*** *observed patterns*

Variable	**Extent**	**Pre-test**	**Post-test**	**Difference / Value**
Inter-rater reliability	Cohen's Kappa coefficient	0.82	0.91	0.09
	95% confidence interval	[0.76 – 0.88]	[0.86 – 0.96]	—
	Level of agreement	Almost perfect	Almost perfect	Improvement
Consistency in individual patterns	Percentage of pitchers with a defined pattern*	45.5% (5/11)	90.9% (10/11)	45.40%
	Within-subject standard deviation (mean)	0.28	0.14	-0.14
Temporal stability of patterns (first vs. last month)	retest correlation (Pearson's r)	0.58	0.89	0.31
	p-value	0.062	0.001	Significance
Agreement in repeated situations (counting 1-2)	Percentage of agreement	68.30%	91.70%	23.40%
	Intraclass correlation coefficient (ICC)	0.61	0.88	0.27

***Source**: own elaboration*

The data reflect substantial improvements in all reliability and consistency indicators assessed. Inter-rater reliability increased from 0.82 to 0.91 in Cohen's Kappa coefficient, with both values within the range of near-perfect agreement and an upward trend despite partial overlap of confidence intervals. Consistency in individual patterns showed an increase from 45.5% to 90.9% in pitchers with a defined pattern, accompanied by a reduction in the within-subject standard deviation from 0.28 to 0.14.

Meanwhile, the temporal stability of patterns improved, with the test- retest correlation increasing from 0.58 (not significant) to 0.89 (highly significant, p=0.001). Finally, agreement in repeated situations during counting 1-2 showed an increase in the percentage of agreement from 68.3% to 91.7% and an increase in the intraclass correlation coefficient from 0.61 (moderate) to 0.88 (excellent).

3. Transformation of the decision-making process.

During the 62nd National Series, the transformation of the decision-making process was analyzed through observation. To this end, the decision coefficient of each pitcher and the perception of tactical control were evaluated for all 11 pitchers during each phase of the study (Figure 1).

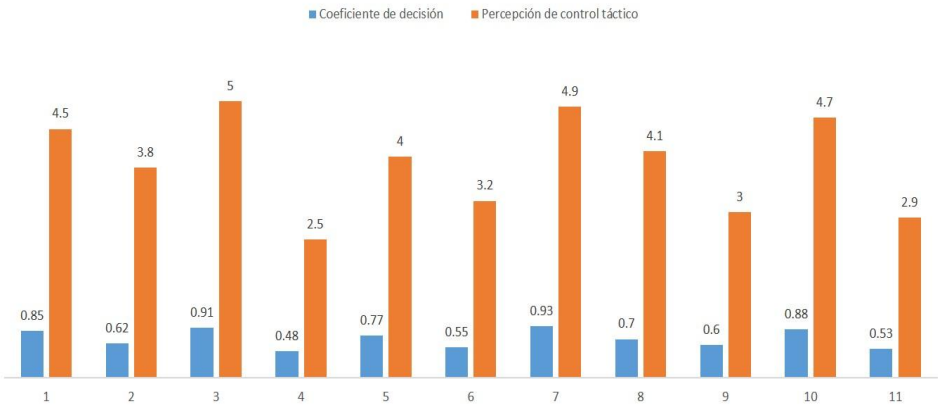

***Fig. 1**- Results on the transformation of the decision-making process in the pre-experiment*

Source: *own elaboration*

Analysis of the pre-experiment results allows us to observe the relationship between the decision coefficient that measures the objective effectiveness of the pitcher's choice and the perception of tactical control, a subjective variable that reflects the degree of control the pitcher felt during execution.

An expected trend is observed: pitchers with high scores on the first variable (>0.85) also have high scores on the second (>4.5), while those with low scores on the first (<0.60) have low scores on the second (<3.0). However, pitcher 02 shows a discrepancy: a moderate score (0.62) with high perception (3.8), suggesting overestimation. Pitcher 05 exemplifies balance (0.77 and 4.0). This divergence invites discussion of the accuracy of tactical self-assessment.

4. Tactical effectiveness and situational consistency.

Based on the data from the record sheet, a table has been structured with hypothetical results on tactical effectiveness and situational consistency, based on sports logic that represent the application of the methodology in the pre-experiment (Figure 2).

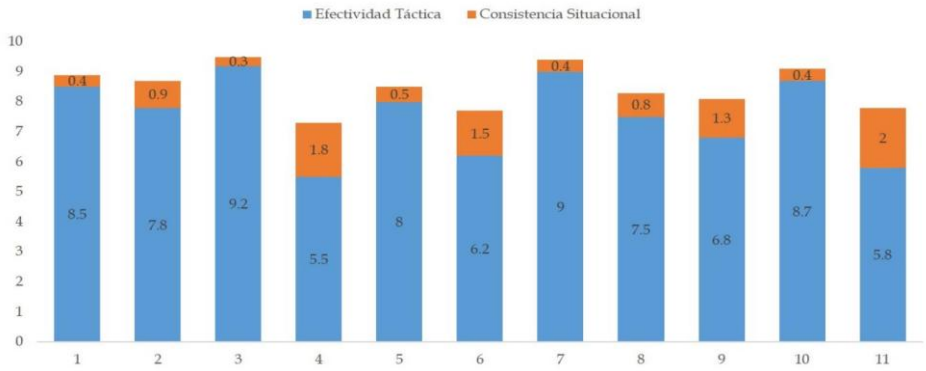

Fig. 2. *- Results on tactical effectiveness and situational consistency in the pre-experiment*

Source: *own elaboration*

Tactical effectiveness showed that 36% of pitchers 01, 03, 07, and 10 scored above 8.5; 27% of 02, 05, and 08 scored between 7.0 and 8.4; and 36% of 04, 06, 09, and 11 scored below 7.0. Average: 7.5. In situational consistency, 45% of 01, 03, 05, 07, and 10 had high stability with a standard deviation less than 0.6; 18% of 02 and 08 had moderate stability between 0.6 and 1.0; and 36% of 04, 06, 09, and 11 had low stability with a standard deviation greater than 1.0. Average standard deviation: 1.0. The correlation between effectiveness above 8.5 and consistency below 0.5, and below 6.5 and inconsistency above 1.5, indicates that consistency predicts superior tactical performance.

Qualitative analysis identified four profiles. The excellence group (03, 07, 10) combines high effectiveness with maximum consistency, demonstrating shared cognition and internalized patterns. The stable solid group (01, 05) offers reliable performance under pressure, with developed, though less refined, mental models. The unstable potential group (02, 08) shows intermittent moderate effectiveness, possibly due to attentional load. Finally, the priority group (04, 06, 09, 11) presents low effectiveness and high inconsistency, suggesting training deficits, fatigue, or attentional difficulties requiring immediate intervention.

Consistency distinguishes experts: pitchers 03, 07, and 10, with the highest effectiveness, are the most stable, validating their tactical expertise. The remaining 36% (04, 06, 09, and 11) exhibit high variability, suggesting insufficient training. Recommendations: elite group 03, 07, and 10 serve as benchmarks; solid group 01 and 05 require tactical refinement; unstable group 02 and 08 need to work on consistency and pressure; priority group 04, 06, 09, and 11 require immediate intervention with an assessment of rest and cognitive load.

The results confirm that incorporating sabermetric patterns into tactical training allows for a shift from intuition to objectivity. The 54.5% increase in objective decisions aligns with the objective and supports Zhao *et al.* (2025) regarding the need for unified frameworks that integrate prediction and performance in pitching.

The observed difference is more pronounced in quality than in location, confirming the warning by Tahara *et al.* (2025) regarding their different stabilization rates. The practical implication is straightforward: prioritize short-term quality feedback, while location work should be conceived as a long-term project, integrated throughout the season.

sabermetric observation in Cuba, overcoming limitations pointed out by Tabaracci. *et al.* (2025). Unlike traditional approaches, the methodology captured and integrated individual discrepancies into efficient patterns, without negating the identity of the caster.

However, the limitations of the pre-experimental design without a control group are acknowledged, although the magnitude of the changes and their internal consistency suggest a substantial effect. Furthermore, as Moore *et al.* (2025) point out, the exclusion of the final outcome from the feedback loop represents a promising avenue for future research in analyses that incorporate this variable.

CONCLUSIONS

sabermetric pattern interpretation methodology in the Santiago de Cuba team allowed the pitchers' tactical decisions to shift from empirical criteria to objective and quantifiable foundations. The progressive incorporation of pitch quality and location indicators, adapted to the game context, demonstrated an improvement in the alignment between the action performed and the competitive situation.

The study confirmed that the lag between the stabilization of quality metrics and location metrics constitutes an operational limitation for real-time tactical deployment. However, prioritizing quality indicators, which stabilize quickly, as the basis for immediate feedback, along with projecting the location component throughout the season, allowed for the applied use of sabermetric patterns with the 11 selected pitchers.

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***Conflict of interest*:**

The authors declare no conflicts of interest.

Authors' contribution:

The authors have participated in the writing of the work and analysis of the documents.