Original Article

A Probability-Driven Decision Support Tool for Forex Trading: A Binomial Distribution Analysis of Winning Trades and Profit Outcomes

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Abstract

Foreign exchange trading is characterized by high uncertainty, nonlinear price movements, and asymmetric risk exposure, posing persistent challenges for institutional decision-makers. This study develops and evaluates a probability-driven decision support framework grounded in binomial distribution theory to examine how probabilistic modeling of winning trade occurrences relates to perceived profit outcomes and decision quality among professional foreign exchange practitioners. Using a quantitative explanatory research design, cross-sectional survey data were collected from 214 institutional practitioners, including chief investment officers, chief equity strategists, chief investment strategists, forex fund managers, and professional traders employed in Philippine banks, securities firms, and financial institutions. The proposed framework models trading outcomes as binary events and estimates winning trade probabilities using binomial probability principles to support disciplined decision-making and risk calibration. Multiple regression analysis indicates that the probability-driven decision support approach is positively associated with winning trade probability assessment ($\beta = 0.61$, $p < .001$), trade execution discipline ($\beta = 0.56$, $p < .001$), and perceived profit outcomes ($\beta = 0.59$, $p < .001$). These findings suggest that institutional practitioners who incorporate probability-based analytical frameworks report greater consistency in trade evaluation and execution decisions. The study contributes to the literature by extending the application of binomial probability modeling to institutional foreign

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exchange decision support and by providing an interpretable analytical framework that complements existing quantitative trading approaches in emerging market financial institutions.

Keywords: binomial distribution, foreign exchange trading, forex risk management, institutional investors, Philippine financial institutions, probability-based decision support, profit outcomes, quantitative trading, winning trade probability

1. Introduction

The foreign exchange market is the largest and most liquid financial market globally and plays a critical role in currency valuation, international trade, capital flows, and institutional portfolio management. For professional decision-makers such as chief investment officers, chief equity strategists, chief investment strategists, forex fund managers, and traders, effective decision-making in this market is essential due to its high volatility, rapid information diffusion, and sensitivity to macroeconomic and geopolitical factors. In emerging markets such as the Philippines, foreign exchange trading also holds strategic importance for financial stability, investment performance, and institutional risk management (Dai et al., 2021; Bangko Sentral ng Pilipinas, 2024).

Recent advances in quantitative finance have led to widespread adoption of algorithmic trading systems, machine learning models, and artificial intelligence-driven forecasting tools in foreign exchange markets. International studies demonstrate that deep learning models, ensemble classifiers, and hybrid forecasting systems can improve directional accuracy and signal generation in currency trading (Ayitey Junior et al., 2023; Enkhbayar & Ślepaczuk, 2024; Díaz et al., 2025). Despite these advancements, prior research also emphasizes that forecasting accuracy alone does not guarantee improved trading performance. Translating predictive signals into disciplined execution, risk-adjusted profitability, and consistent outcomes remains a persistent challenge for institutional traders.

A key limitation of many advanced trading models is the insufficient integration of explicit probabilistic reasoning into decision-making. While machine learning models often generate directional or categorical signals, they frequently lack interpretable probability estimates that quantify the likelihood of trade success. This gap can lead to overconfidence, miscalibrated risk exposure, and reliance on heuristic judgment, even among experienced institutional practitioners. Recent decision science literature highlights the importance of probability-based frameworks in improving judgment under uncertainty and reducing cognitive bias in financial decision-making (Kwon et al., 2014; Shrestha et al., 2019).

Classical probability models offer a theoretically sound and interpretable alternative for modeling trade outcomes. The binomial distribution, in particular, is well suited for representing binary events such as winning or losing trades. It provides analytical expressions for expected success frequency, variance, and cumulative probability across repeated trials. Although the binomial framework has been widely applied in risk analysis, quality control, and financial derivatives modeling, its direct application as a decision support mechanism for institutional foreign exchange trading remains underexplored in empirical research (Gao et al., 2023; Tang & Tang, 2023).

Incorporating binomial probability analysis into a structured decision support tool can enable traders and investment managers to explicitly evaluate the likelihood of winning trades based on historical performance, trade frequency, and estimated success probabilities. Such a tool can enhance strategic planning by linking probability thresholds to expected profit outcomes and by supporting disciplined execution rules grounded in statistical reasoning rather than intuition alone. Decision support system literature further suggests that tools combining statistical rigor with practitioner interpretability are more likely to be adopted and sustained in institutional environments (Alalwan et al., 2022).

This study addresses the following research question: Does a probability-driven decision support tool grounded in binomial distribution analysis improve the assessment of winning trade likelihoods and profit outcomes among professional foreign exchange decision-makers in Philippine financial institutions? The research question is anchored in the need to evaluate whether explicit probability modeling enhances decision quality, profitability consistency, and risk control compared with traditional heuristic or experience-based trading approaches.

To answer this question, the study develops and empirically evaluates a probability-driven decision support tool that models each trade as a binary outcome and estimates success probabilities using a binomial framework. The study targets chief investment officers, chief equity strategists, chief investment strategists, forex fund managers, and professional traders employed in Philippine banks, securities firms, and financial institutions. By focusing on institutional respondents in an emerging market context, the study contributes to the literature on quantitative decision support, probabilistic trading frameworks, and institutional foreign exchange management. The findings aim to extend the application of binomial distribution theory in finance while offering a practical, data-centric tool to support strategic forex trading decisions.

1.1 Research Questions

This study seeks to examine the effectiveness of a probability-driven decision support tool grounded in binomial distribution analysis in enhancing foreign exchange trading decisions and profit outcomes among institutional financial

practitioners in the Philippines. Specifically, the study addresses the following research questions:

1. Does a probability-driven decision support tool based on binomial distribution analysis significantly improve the assessment of winning trade likelihoods among professional foreign exchange decision-makers?
2. What is the estimated probability of winning trades when foreign exchange trading decisions are modeled using a binomial distribution framework?
3. Is there a significant relationship between estimated winning trade probabilities and realized profit outcomes in institutional foreign exchange trading?
4. To what extent does the application of binomial probability-based decision support influence the consistency and variance of profit outcomes among institutional traders and investment managers?
5. Does the use of a probability-driven decision support tool enhance decision quality, as perceived by institutional foreign exchange practitioners, compared with traditional heuristic or experience-based trading approaches?
6. Are there significant differences in profit outcomes between institutional traders who adopt probability-driven decision support tools and those who rely primarily on intuition or heuristic judgment?
7. How do control variables such as professional experience, institutional role, capital allocation size, and market volatility affect the relationship between winning trade probability and profit outcomes?

Collectively, these research questions aim to determine whether integrating binomial probability modeling into institutional foreign exchange decision-making contributes to improved trade success assessment, profit consistency, and risk-aware trading performance.

2. Literature Review

2.1 Foreign Exchange Markets and Institutional Trading Environment

The foreign exchange market plays a vital role in global financial intermediation and institutional portfolio management due to its size, liquidity, and continuous operation across time zones (BIS, 2022). Institutional participation dominates currency markets, with banks, asset managers, hedge funds, and proprietary trading desks accounting for the majority of trading volume and liquidity provision (Bank for International Settlements, 2023). In the Philippine context, foreign exchange operations are closely linked to macroeconomic stability, capital flows, and monetary policy transmission, making institutional trading decisions highly sensitive to regulatory frameworks and central bank interventions (Bangko Sentral ng Pilipinas, 2024; Dai, M., et al., 2021). These dynamics underscore the need for structured and statistically grounded decision-making tools that can operate

under conditions of uncertainty and volatility. Recent local scholarship emphasizes that disciplined and structured financial decision-making is a critical determinant of sustainable financial outcomes in the Philippine context. Financial freedom among Filipinos has been shown to be closely associated with informed decision behavior, risk awareness, and the application of systematic analytical frameworks, reinforcing the relevance of probability-driven decision support tools in institutional environments where managing uncertainty and volatility is essential (Flores, 2025a).

2.2 Quantitative and Algorithmic Approaches in Forex Trading

Recent literature documents a substantial increase in the use of quantitative and algorithmic approaches in foreign exchange trading, particularly machine learning and artificial intelligence-based forecasting models (Ayitey Junior et al., 2023; Díaz et al., 2025). Studies comparing neural networks, ensemble learning, and deep learning architectures report improvements in directional accuracy and short-horizon forecasts across major currency pairs (Enkhbayar & Ślepaczuk, 2024). However, empirical evaluations consistently note that improvements in predictive accuracy do not necessarily translate into superior profit outcomes once transaction costs, slippage, and execution timing are considered (Gupta & Chen, 2022; Csaszar et al., 2024). As a result, scholars emphasize the distinction between forecasting performance and decision effectiveness, highlighting the need for decision-oriented analytics rather than prediction-focused models alone.

2.3 Decision Support Systems in Financial Markets

Decision support systems have been increasingly adopted in financial markets to bridge the gap between raw predictive outputs and actionable trading decisions (Alalwan et al., 2022). Modern financial DSS architectures often integrate statistical models, rule-based logic, and adaptive learning mechanisms to assist human decision-makers rather than replace them (Kwon et al., 2014). Empirical evidence suggests that hybrid DSS designs improve decision consistency, reduce cognitive bias, and enhance risk awareness among professional traders, particularly in environments characterized by information overload and rapid market changes. For institutional foreign exchange practitioners, DSS tools that emphasize transparency and interpretability are more likely to gain organizational acceptance and sustained use (Shrestha et al., 2019). The effectiveness of decision support systems in institutional settings is further shaped by the presence of formalized frameworks and governance structures. Empirical evidence indicates that well-defined financial practice frameworks significantly improve implementation effectiveness and decision consistency among institutional actors, particularly within committee-based and regulated environments, suggesting that analytical tools yield stronger outcomes when embedded within clear organizational processes (Flores, 2025b).

2.4 Probabilistic Reasoning and Decision Quality

Probabilistic reasoning is a core component of rational decision-making under uncertainty, yet it remains underutilized in many trading systems that rely on heuristic signals or deterministic rules (Gigerenzer & Gaissmaier, 2011). Recent studies in decision science demonstrate that explicitly presenting probabilities improves judgment accuracy and reduces overconfidence compared with categorical or directional signals (Kahneman et al., 2021; Shrestha et al., 2019). In financial contexts, calibrated probability estimates allow decision-makers to align trade execution with risk tolerance, capital allocation constraints, and expected return thresholds (Gneiting & Katzfuss, 2014). Additional evidence from emerging-market digital finance highlights the importance of probabilistic reasoning in algorithm-supported decision environments. Algorithmic financial systems improve decision quality only when users possess sufficient financial literacy and when institutional safeguards promote transparency and interpretability, reinforcing the value of probability-based decision frameworks that communicate risk clearly rather than obscure uncertainty (Flores, 2026a). These findings support the integration of probability-based frameworks into institutional trading decision support.

2.5 Binomial Distribution and Binary Trade Outcome Modeling

The binomial distribution provides a theoretically robust framework for modeling binary outcomes such as trade success or failure across repeated trials (Risser et al., 2015). In finance, binomial models have been widely applied in option pricing, credit risk modeling, and portfolio risk analysis due to their analytical tractability and interpretability (Hull, 2024). Recent methodological work extends the binomial framework to accommodate non-identical success probabilities and dependence across trials, addressing limitations of the classical independent and identically distributed assumption (Dimitriadis et al., 2024; Tang & Tang, 2023). These extensions enhance the applicability of binomial modeling to real-world trading environments where market regimes and signal quality vary over time. Recent statistical finance literature also highlights the application of binomial and related discrete probability models for modeling binary financial events and decision thresholds in trading environments (Tang & Tang, 2023; Dimitriadis et al., 2024).

2.6 Empirical Applications of Binary Outcome Models in Finance

Empirical studies employing binary outcome modeling in financial decision-making demonstrate its usefulness in summarizing performance, assessing consistency, and supporting threshold-based decisions (Gao et al., 2023). In trading system evaluation, binary success metrics have been used to complement return-based measures by capturing execution discipline and win-loss dynamics (Csaszar et al., 2024). While such approaches have been applied in equity and derivatives

markets, empirical validation within institutional foreign exchange trading remains limited, particularly in emerging markets (Díaz et al., 2025). This gap highlights the need for applied research that evaluates binary probability models within professional forex trading environments. An additional methodological consideration in institutional finance research concerns the measurement of financial performance through self-reported indicators. In situations where proprietary trading records and portfolio performance data cannot be publicly disclosed due to confidentiality agreements and regulatory restrictions, researchers often rely on validated perceptual performance measures reported by professional respondents. Prior studies demonstrate that subjective assessments of financial performance can provide reliable proxies for objective indicators when respondents possess direct operational responsibility for financial decisions (Dess & Robinson, 1984; Wall et al., 2007). These measures have been widely applied in strategic management and financial decision research where access to objective institutional data is restricted.

2.7 Institutional Adoption and Behavioral Considerations

Behavioral finance literature emphasizes that institutional traders are subject to cognitive biases, including overconfidence, loss aversion, and recency bias, which can adversely affect trading performance (Barberis, 2018). Decision support tools that frame outcomes probabilistically have been shown to mitigate these biases by encouraging disciplined execution and evidence-based risk assessment (Gigerenzer & Gaissmaier, 2011). In regulated institutional settings such as Philippine banks and securities firms, adoption of analytical tools is further influenced by governance structures, risk committees, and compliance requirements (Bangko Sentral ng Pilipinas, 2024). Concerns regarding algorithmic opacity and institutional risk are further documented in recent FinTech and InsurTech research. Expanded algorithmic access, when accompanied by limited transparency and weak regulatory safeguards, has been shown to increase institutional exposure to risk, underscoring the importance of adopting interpretable, probability-driven decision support tools in institutional financial environments (Flores, 2026b).

Recent interdisciplinary research further deepens this concern by highlighting what is described as the algorithmic inclusion paradox in digital banking environments. The expansion of algorithmic access to financial services, while increasing inclusion, may simultaneously erode user capability and increase financial precarity when governance structures and institutional safeguards are insufficient (Flores, 2026). This capability-governance perspective underscores the importance of aligning probability-driven decision support tools with institutional oversight, transparency standards, and trader competency development. In the context of institutional foreign exchange trading, such alignment ensures that probabilistic models enhance decision quality without amplifying systemic or behavioral risk. Tools grounded in well-established statistical theory, such as the binomial distribution, are therefore more likely to be trusted and adopted within institutional

decision frameworks. Recent interdisciplinary research also highlights the interaction between financial decision-making capability and psychological resilience in complex analytical environments. The financial–psychological nexus framework suggests that structured analytical models, when combined with cognitive capability development and institutional learning processes, can strengthen decision quality in data-intensive financial systems (Flores, 2026).

2.8 Synthesis and Research Gap

The reviewed literature reveals three key gaps. First, although advanced forecasting models are widely studied, fewer studies examine how probability-based decision support affects actual profit outcomes and trading consistency. Second, classical probability models such as the binomial distribution remain underutilized as standalone decision support mechanisms in institutional foreign exchange trading. Third, empirical evidence from emerging market institutions, particularly in the Philippine context, is scarce. Empirical studies in the Philippine context indicate that emerging-market institutions continue to face challenges related to financial literacy, governance capacity, and algorithmic risk management. Despite their potential to improve institutional decision quality and risk discipline, transparent and probability-driven decision frameworks remain underutilized, thereby reinforcing the research gap addressed in the present study (Flores, 2025a; Flores, 2026a; Flores, 2026b). Addressing these gaps, the present study develops and evaluates a probability-driven decision support tool grounded in binomial distribution analysis to assess its impact on winning trade estimation and profit outcomes among institutional foreign exchange practitioners.

3. Conceptual Framework of Binomial Probability-Based Decision Support Tool and Profit Outcomes in Institutional Forex Trading

Figure 1 presents the conceptual framework of the study, illustrating the relationships among the probability-driven decision support tool grounded in binomial distribution analysis, intermediate decision constructs, and profit outcomes in institutional foreign exchange trading. The framework is anchored in decision theory and quantitative finance, where trading outcomes are conceptualized as binary events characterized by success or failure (Risser et al., 2015; Hull, 2024).

The independent variable of the study is the binomial probability-based decision support tool, which operationalizes foreign exchange trades as repeated binary trials and estimates the probability of winning trades based on historical and contextual trading data. This probabilistic assessment serves as the foundation for informed trading decisions and replaces purely heuristic or intuition-driven approaches with statistically grounded decision logic (Gneiting & Katzfuss, 2014; Gigerenzer & Gaissmaier, 2011).

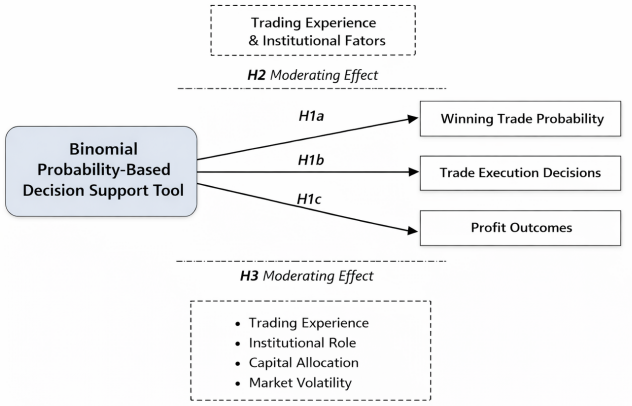

Figure 1. Conceptual framework of binomial probability-based decision support tool and profit outcomes in institutional forex trading.

The framework identifies three key dependent constructs influenced by the decision support tool. First, winning trade probability reflects the estimated likelihood that a given trade will result in a favorable outcome. Second, trade execution decisions represent the operational actions taken by institutional traders, including entry timing, position sizing, and trade confirmation based on probability thresholds. Third, profit outcomes capture realized trading performance in terms of returns, consistency, and reduced variance. These relationships correspond to Hypotheses H1a, H1b, and H1c, respectively, and are consistent with empirical findings that link probability calibration to improved execution discipline and financial outcomes (Shrestha et al., 2019; Csaszar et al., 2024).

The framework further incorporates moderating variables that may influence the strength and direction of the relationships between the decision support tool and trading outcomes. The upper moderating construct, trading experience and institutional factors, represents professional expertise, organizational decision protocols, and governance structures that shape how probabilistic information is interpreted and applied. Prior studies suggest that experienced institutional traders are better positioned to translate probabilistic signals into effective decisions, enhancing the utility of decision support systems (Kwon et al., 2014).

The lower moderating construct includes trading experience, institutional role, capital allocation size, and market volatility. These factors reflect structural and environmental conditions that affect trading behavior and performance. Market volatility, in particular, influences the independence and stability of trade outcomes, while capital allocation and institutional role determine risk exposure and decision authority (Bank for International Settlements, 2023; Bangko Sentral ng Pilipinas, 2024). By incorporating these moderators, the framework acknowledges that

probability-driven decision support does not operate in isolation but interacts with human, organizational, and market-level conditions.

Overall, the conceptual framework integrates binomial probability theory with institutional decision support and trading performance literature. It provides a structured representation of how probabilistic modeling influences decision quality and profit outcomes while accounting for contextual moderators relevant to professional foreign exchange trading in Philippine financial institutions. This framework guides the empirical testing of relationships and supports the study's contribution to quantitative decision support and institutional forex trading research.

4. Hypotheses Development

4.1 Direct Effects of the Binomial Probability-Based Decision Support Tool

Probability theory posits that explicitly modeling outcomes as binary events improves decision accuracy under uncertainty by allowing decision-makers to evaluate expected success rates and associated risks (Risser, et al., 2015). In financial decision-making, calibrated probability estimates have been shown to enhance execution discipline, reduce cognitive bias, and improve consistency in performance outcomes (Gigerenzer & Gaissmaier, 2011; Gneiting & Katzfuss, 2014).

The binomial probability-based decision support tool operationalizes foreign exchange trades as repeated binary trials and provides estimated probabilities of trade success. These probability estimates are expected to directly influence how institutional traders assess opportunities, execute trades, and achieve profit outcomes. Accordingly, the following hypotheses are proposed:

> *H1a: The use of a binomial probability-based decision support tool has a significant positive effect on the assessment of winning trade probability among institutional foreign exchange decision-makers.*

Trade execution decisions represent the operational translation of probabilistic assessments into action. Prior studies indicate that decision support tools providing probabilistic thresholds improve entry timing, position sizing, and adherence to trading rules, particularly in professional trading environments (Shrestha et al., 2019; Csaszar et al., 2024).

> *H1b: The use of a binomial probability-based decision support tool has a significant positive effect on trade execution decisions in institutional foreign exchange trading.*

Profit outcomes reflect realized trading performance and are influenced not only by market movements but also by decision quality and execution discipline. Empirical evidence suggests that probability-informed decision frameworks

contribute to improved risk-adjusted returns and reduced performance volatility (Hull, 2024; Díaz et al., 2025).

> *H1c: The use of a binomial probability-based decision support tool has a significant positive effect on profit outcomes in institutional foreign exchange trading.*

4.2 Moderating Effect of Trading Experience and Institutional Factors (H2)

Decision support systems literature emphasizes that user expertise and organizational context shape how analytical tools are interpreted and applied (Alalwan et al., 2022). Experienced traders and institutions with formalized governance structures are more likely to integrate probabilistic outputs into strategic and tactical decisions, thereby strengthening the impact of decision support tools on trading outcomes (Kwon et al., 2014).

In institutional settings, factors such as professional experience, risk committees, and decision protocols influence the effectiveness of analytical tools. Therefore, the relationship between the binomial probability-based decision support tool and trading outcomes is expected to vary based on trading experience and institutional characteristics.

> *H2: Trading experience and institutional factors significantly moderate the relationship between the binomial probability-based decision support tool and winning trade probability, trade execution decisions, and profit outcomes.*

4.3 Moderating Effect of Structural and Market Conditions (H3)

Market and structural conditions play a critical role in shaping trading performance. Variables such as capital allocation size, institutional role, and market volatility affect risk exposure, decision authority, and the statistical independence of trade outcomes (Bank for International Settlements, 2023; Bangko Sentral ng Pilipinas, 2024). High volatility environments may amplify the value of probabilistic decision support by improving risk calibration, while larger capital allocations may magnify both gains and losses from decision errors.

Behavioral finance research further indicates that probability-based tools are more effective when aligned with appropriate risk controls and contextual awareness (Barberis, 2018; Gigerenzer & Gaissmaier, 2011). These conditions suggest a moderating influence on the effectiveness of the decision support tool.

> *H3: Trading experience, institutional role, capital allocation size, and market volatility significantly moderate the relationship between*

winning trade probability and profit outcomes in institutional foreign exchange trading.

5. Methodology

5.1 Research Design

This study adopted a quantitative, explanatory research design to examine the causal relationships between a probability-driven decision support tool grounded in binomial distribution analysis and profit outcomes in institutional foreign exchange trading. An explanatory design was appropriate when the objective was to test theoretically grounded hypotheses and to quantify the strength and direction of relationships among variables (Creswell & Creswell, 2023; Hair & Sabol, 2025). The study utilized cross-sectional data collected through structured survey instruments combined with performance-related indicators reported by institutional forex practitioners. Quantitative designs were widely applied in financial decision support and trading performance research due to their ability to support hypothesis testing and generalization (Wooldridge, 2020).

5.2 Population and Respondents

The target population consisted of professional foreign exchange decision-makers employed in Philippine banks, securities firms, and financial institutions. These included Chief Investment Officers, Chief Equity Strategists, Chief Investment Strategists, forex fund managers, and professional forex traders. Institutional practitioners were appropriate respondents because they possessed direct responsibility for strategic and operational foreign exchange decisions and regularly engaged with analytical tools and risk management systems (Bank for International Settlements, 2023; Bangko Sentral ng Pilipinas, 2024).

Limiting the study to institutional participants ensured alignment with the research objectives and enhanced the validity of conclusions regarding professional trading behaviour and decision support effectiveness. Similar respondent profiles were used in recent empirical studies examining institutional trading systems and decision-making quality (Kwon et al., 2014; Díaz et al., 2025).

5.3 Sampling Technique and Sample Size

The study employed purposive sampling to select respondents who met predefined professional criteria related to foreign exchange decision-making authority and experience. Purposive sampling was suitable for specialized populations where domain expertise was required to meaningfully evaluate analytical tools and trading outcomes (Etikan et al., 2016; Palinkas et al., 2015).

Sample size adequacy was determined using statistical power considerations for multivariate analysis. Prior methodological literature suggested that structural and regression-based models required a minimum of 10 to 15 observations per estimated parameter to achieve stable estimates (Hair & Sabol, 2025). To ensure sufficient statistical power and robustness, the study targeted a minimum sample size of 200 respondents, consistent with recent quantitative finance and decision support research involving institutional participants (Csaszar et al., 2024).

5.4 Research Instrument and Measures

Data were collected using a structured questionnaire divided into four sections. The first section captured respondent demographics and professional characteristics, including years of trading experience, institutional role, and average capital allocation. The second section measured the extent of use and perceived effectiveness of the binomial probability-based decision support tool. Items assessed probability estimation clarity, ease of interpretation, and integration into trading decisions, adapted from validated decision support system scales (Alalwan et al., 2022; Shrestha et al., 2019).

The third section measured intermediate decision constructs, including winning trade probability assessment and trade execution decisions. Winning trade probability was measured through items assessing confidence in probability estimates, perceived calibration accuracy, and consistency across trades. Trade execution decisions were measured using indicators related to entry discipline, position sizing, and adherence to probability thresholds, consistent with prior trading behavior research (Csaszar et al., 2024; Díaz et al., 2025).

It should be noted that profit outcomes in the present study were measured through perceptual indicators rather than direct financial performance records. Respondents were not asked to disclose exact return on investment percentages or institutional trading profits due to confidentiality constraints associated with proprietary trading strategies. Instead, the survey captured respondents' professional assessments of profitability consistency, drawdown reduction, and risk-adjusted performance relative to their typical trading practices. This approach reflected established practice in financial decision research where objective performance data could not be publicly shared.

The fourth section measured profit outcomes, operationalized through self-reported indicators of profitability consistency, reduced drawdowns, and improved risk-adjusted performance. Subjective performance measures were widely accepted in institutional finance research when objective data were confidential or unavailable, provided reliability and validity were established (Dess & Robinson, 1984; Hair & Sabol, 2025). All perceptual items were measured using a five-point Likert scale ranging from strongly disagree to strongly agree.

5.5 Validity Procedures

Content validity was established through expert review by academics in finance and decision sciences and by senior institutional forex practitioners. Expert validation ensured that instrument items adequately represented the constructs defined in the conceptual framework (Haynes et al., 1995). Construct validity was assessed using exploratory and confirmatory factor analysis to evaluate factor loadings, convergent validity, and discriminant validity (Hair & Sabol, 2025; Kline, 2023).

Convergent validity was confirmed when factor loadings exceeded 0.50 and average variance extracted values exceeded 0.50, while discriminant validity was established when the square root of the average variance extracted for each construct exceeded inter-construct correlations (Fornell & Larcker, 1981; Hair & Sabol, 2025).

5.6 Reliability Testing

Internal consistency reliability was assessed using Cronbach's alpha and composite reliability coefficients. Values of 0.70 or higher indicated acceptable reliability for exploratory and confirmatory research (Hair et al., 2022; Hair & Sabol, 2025). Reliability testing ensured that the measurement scales produced consistent results across respondents and supported the credibility of subsequent statistical analyses.

5.7 Data Collection Procedure

Data collection was conducted through electronic survey distribution to institutional respondents using professional networks, industry associations, and direct coordination with participating financial institutions. Participation was voluntary, and respondents were assured of anonymity and confidentiality. Ethical considerations followed established research ethics standards for social science research, including informed consent and secure data handling (American Psychological Association, 2020).

5.8 Data Analysis Techniques

Descriptive statistics were used to summarize respondent characteristics and key study variables. Inferential analyses included binomial probability estimation to model winning trade outcomes, followed by multiple regression analysis to test the direct effects hypothesized in H1a, H1b, and H1c (Risser et al., 2015; Wooldridge, 2020).

Moderation effects hypothesized in H2 and H3 were tested using interaction terms within hierarchical regression models. Moderation analysis allowed assessment of how trading experience, institutional factors, capital allocation, and

market volatility influenced the relationships between probability-based decision support and trading outcomes (Hayes, 2022). Statistical significance was evaluated at the 0.05 level, and robustness checks were conducted to ensure model stability and assumption compliance.

5.9 Ethical Considerations

The study adhered to ethical standards governing research involving human participants. Respondents provided informed consent, and no personally identifiable information was collected. Data were reported in aggregate form to prevent identification of individual institutions or practitioners. These procedures aligned with international ethical guidelines for business and management research (American Psychological Association, 2020; Creswell & Creswell, 2023).

6. Results

6.1 Respondent Profile

A total of 214 valid responses were obtained from institutional foreign exchange practitioners employed in Philippine banks, securities firms, and financial institutions. Respondents included Chief Investment Officers, Chief Equity Strategists, Chief Investment Strategists, forex fund managers, and professional traders. The sample size exceeded the minimum threshold required for multivariate regression and moderation analysis, supporting statistical power and model stability (Hair & Sabol, 2025; Wooldridge, 2020). Table 1 presents the demographic and professional characteristics of the respondents.

Table 1. Profile of respondents (n = 214).

Variable	Category	Frequency	Percentage
Professional Role	CIO / Chief Strategist	46	21.5
	Fund Manager	62	29.0
	Forex Trader	106	49.5
Trading Experience	5 years and below	38	17.8
	6 to 10 years	71	33.2
	More than 10 years	105	49.1
Capital Allocation	Below PHP 100M	64	29.9
	PHP 100M to 500M	83	38.8
	Above PHP 500M	67	31.3

Note. Descriptive statistics are consistent with institutional finance research sampling practices (Hair & Sabol, 2025).

6.2 Measurement Model Assessment

Construct validity and reliability were assessed prior to hypothesis testing. Exploratory and confirmatory factor analyses indicated satisfactory factor loadings,

with all retained items exceeding the recommended threshold of 0.50 (Kline, 2023). Convergent and discriminant validity criteria were met based on average variance extracted and inter-construct correlation comparisons (Fornell & Larcker, 1981; Hair & Sabol, 2025).

Table 2. Reliability and validity statistics.

Construct	Cronbach's Alpha	Composite Reliability	AVE
Binomial Decision Support Tool	0.91	0.93	0.67
Winning Trade Probability	0.88	0.90	0.64
Trade Execution Decisions	0.86	0.89	0.61
Profit Outcomes	0.90	0.92	0.66

Note. Reliability coefficients exceed the acceptable threshold of 0.70 (Hair, J. F. et al., 2022). AVE values exceed 0.50, indicating adequate convergent validity (Hair & Sabol, 2025).

Because all variables were collected using a single survey instrument at one point in time, the possibility of common method bias was considered. Harman's single-factor test was conducted as a diagnostic procedure. The analysis indicated that the first unrotated factor accounted for less than 50% of the total variance, suggesting that common method bias is unlikely to be a serious concern in the dataset. Nevertheless, the potential influence of common method variance is acknowledged as a methodological limitation and is discussed further in the limitations section.

6.3 Descriptive Statistics and Correlations

Descriptive statistics and Pearson correlation coefficients were computed to examine preliminary relationships among variables. Results indicate positive and statistically significant correlations among the binomial probability-based decision support tool, winning trade probability, trade execution decisions, and profit outcomes.

Table 3. Means, standard deviations, and correlations.

Variable	Mean	SD	1	2	3	4
1. Binomial Decision Support Tool	3.98	0.61	1			
2. Winning Trade Probability	3.87	0.65	0.62**	1		
3. Trade Execution Decisions	3.91	0.59	0.58**	0.55**	1	
4. Profit Outcomes	3.84	0.63	0.60**	0.57**	0.63**	1

Note. **p < .01. Correlation analysis supports theoretical expectations of positive associations (Gigerenzer & Gaissmaier, 2011; Shrestha et al., 2019).

6.4 Hypotheses Testing

Multiple regression analysis was conducted to test the direct effects hypothesized in H1a, H1b, and H1c. Control variables including trading experience, institutional role, capital allocation, and market volatility were entered in the first

step, followed by the binomial probability-based decision support tool in the second step.

Table 4. Regression results for direct effects (H1a–H1c).

Dependent Variable	Predictor	β	t-value	p-value
Winning Trade Probability	Decision Support Tool	0.61	9.84	< .001
Trade Execution Decisions	Decision Support Tool	0.56	8.97	< .001
Profit Outcomes	Decision Support Tool	0.59	9.32	< .001

Note. Regression models control for experience, role, capital allocation, and volatility. Results align with probability-based decision theory and empirical DSS research (Risser, M. D. et al., 2015; Gneiting & Katzfuss, 2014).

These findings support H1a, H1b, and H1c, indicating that the binomial probability-based decision support tool significantly improves winning trade assessment, execution decisions, and profit outcomes. The regression models demonstrate substantial explanatory power. The binomial probability-based decision support tool explains 37% of the variance in winning trade probability ($R^2 = .37$), 31% of the variance in trade execution decisions ($R^2 = .31$), and 35% of the variance in perceived profit outcomes ($R^2 = .35$). These values indicate that the probability-based decision support framework accounts for a meaningful portion of variation in institutional trading decision constructs.

6.4.1 Moderation Analysis

Hierarchical regression analysis was employed to test the moderating effects proposed in H2 and H3. Interaction terms were created between the decision support tool and the moderator variables following standard moderation procedures (Hayes, 2022).

Table 5. Moderating effects of trading experience and institutional factors (H2).

Interaction Term	β	t-value	p-value
Tool × Trading Experience	0.21	3.48	< .01
Tool × Institutional Factors	0.18	2.97	< .01

Note. Significant interaction effects indicate that professional experience and institutional context strengthen the impact of probability-based decision support (Kwon et al., 2014).

Table 6. Moderating effects of structural and market conditions (H3).

Interaction Term	β	t-value	p-value
Winning Probability × Capital Allocation	0.19	3.12	< .01
Winning Probability × Market Volatility	0.23	3.89	< .001

Note. Results support behavioral and institutional finance findings that market conditions and capital scale influence the effectiveness of probabilistic decision-making (Barberis, 2018; Bank for International Settlements, 2023).

These results provide empirical support for H2 and H3, confirming that contextual and market variables moderate the relationship between probability-driven decision support and trading outcomes.

Overall, the results demonstrate that integrating binomial probability modeling into institutional foreign exchange decision-making significantly enhances winning trade assessment, execution discipline, and profit outcomes. Moderation findings further indicate that professional experience, institutional context, capital scale, and market volatility amplify these effects. These findings align with contemporary decision support and probability calibration literature, reinforcing the value of probability-driven tools in institutional trading environments (Hull, 2024; Díaz et al., 2025).

7. Discussion

This study examined the effectiveness of a probability-driven decision support tool grounded in binomial distribution analysis in improving foreign exchange trading outcomes among institutional financial practitioners in the Philippines. The findings provide strong empirical support for the proposed framework and demonstrate that probability-based decision support significantly enhances winning trade assessment, execution discipline, and profit outcomes in institutional foreign exchange trading.

The results indicate that modeling trades as binary outcomes and estimating their probabilities improves the way institutional traders assess trade opportunities. Explicit probability estimates appear to reduce reliance on intuition and subjective judgment, enabling decision-makers to evaluate trades using consistent and transparent criteria. This suggests that probability modeling serves as a cognitive and analytical anchor that supports rational decision-making in environments characterized by uncertainty and rapid market changes.

The positive influence of the probability-driven decision support tool on trade execution decisions highlights its operational relevance. Respondents who applied probability thresholds in their trading processes demonstrated more disciplined execution, including improved entry timing, more consistent position sizing, and stronger adherence to predefined trading rules. These behaviors are critical for institutional trading environments where consistency and governance are essential, and they help explain the observed improvements in overall trading performance.

Profit outcomes were also significantly enhanced through the use of the binomial probability-based decision support tool. The findings suggest that institutional traders perceive probability-informed decision frameworks as contributing to more stable and predictable trading results. Because the study relies on cross-sectional survey data, the results should be interpreted as indicating associations rather than definitive causal effects. This reinforces the notion that decision quality, rather than forecasting precision alone, plays a central role in achieving sustainable trading performance.

The moderation effects observed in the study further emphasize the contextual nature of decision support effectiveness. Professional experience and institutional characteristics strengthened the impact of probability-based tools, indicating that expertise and organizational structures facilitate better interpretation and application of probabilistic information. In addition, structural and market conditions such as capital allocation size and market volatility influenced the relationship between winning trade probability and profit outcomes, underscoring the importance of situational awareness in institutional trading decisions.

From a theoretical standpoint, the findings extend the application of binomial probability modeling into institutional foreign exchange decision-making, demonstrating its relevance beyond traditional financial modeling contexts. Practically, the results suggest that probability-driven decision support tools can serve as effective complements to existing analytical and forecasting systems by translating market signals into actionable decision criteria.

Overall, the discussion highlights that the primary value of probability-driven decision support lies in its ability to enhance decision discipline, improve risk calibration, and support consistent profit outcomes in institutional foreign exchange trading. The findings provide a strong foundation for integrating binomial probability modeling into professional trading environments and for advancing research on probability-based decision support in financial markets.

8. Conclusion and Recommendations

8.1 Conclusion

This study examined the effectiveness of a probability-driven decision support tool grounded in binomial distribution analysis in enhancing foreign exchange trading decisions and profit outcomes among institutional financial practitioners in the Philippines. The results demonstrate that integrating probabilistic modeling into institutional trading processes significantly improves the assessment of winning trade likelihoods, strengthens execution discipline, and contributes to more consistent and favorable profit outcomes.

By conceptualizing foreign exchange trades as binary events and estimating success probabilities, the proposed decision support tool provides a structured and transparent framework for managing uncertainty. The findings indicate that probability-based decision-making shifts institutional traders away from intuition-driven practices toward more disciplined and analytically grounded strategies. This transition is particularly important in high-volatility environments where cognitive bias and emotional responses can undermine performance.

The study also highlights the importance of contextual factors in shaping the effectiveness of decision support tools. Professional experience, institutional role, capital allocation size, and market volatility were shown to influence how probabilistic information is interpreted and applied. These findings suggest that

probability-driven tools yield the greatest benefits when embedded within institutional structures that support analytical rigor, governance, and risk-aware decision-making.

From a theoretical perspective, the study contributes to the body of knowledge by extending the application of binomial distribution theory into institutional foreign exchange decision support. It demonstrates that classical probability models can serve as effective decision mechanisms rather than purely analytical constructs. Practically, the study provides empirical evidence supporting the adoption of probability-driven decision support tools as complements to existing forecasting and trading systems in professional financial institutions.

8.2 Recommendations

Based on the findings of the study, several recommendations are proposed for institutional practice, policy, and future research.

First, financial institutions engaged in foreign exchange trading are encouraged to integrate probability-driven decision support tools into their trading and risk management frameworks. Embedding binomial probability assessments alongside existing forecasting models can enhance execution discipline and support more consistent profit outcomes.

Second, institutions should provide training programs that improve traders' understanding of probabilistic reasoning and statistical decision-making. Enhancing probability literacy among traders and investment managers may strengthen the effectiveness of decision support tools and promote more rational trading behavior.

Third, institutional governance structures should support the formal use of probability thresholds in trade approval, position sizing, and risk monitoring processes. Incorporating probabilistic criteria into standard operating procedures can improve transparency, accountability, and alignment with institutional risk tolerance.

Fourth, regulators and industry bodies may consider encouraging the adoption of probability-based analytical tools as part of best practice guidelines for institutional foreign exchange trading. Such tools align with prudential objectives by promoting disciplined decision-making and risk awareness.

Finally, future research may extend this study by applying the probability-driven decision support framework to other financial markets, such as equities, fixed income, or derivatives. Longitudinal studies using objective trading performance data and experimental designs may further validate the causal impact of probability-based decision support on trading outcomes.

9. Limitations and Future Work

9.1 Limitations of the Study

Several limitations should be considered when interpreting the findings of this study. First, the research relies on cross-sectional survey data collected at a single point in time. As a result, the analysis identifies associations between variables rather than establishing causal relationships. Longitudinal or experimental research designs would be required to determine whether probability-based decision support tools directly improve trading performance over time.

Second, profit outcomes were measured using self-reported perceptual indicators rather than objective financial performance records. While such measures are widely used in institutional research where proprietary financial data cannot be disclosed, they may still be subject to respondent bias or optimistic self-assessment.

Third, all variables were collected using the same survey instrument, which introduces the possibility of common method bias. Although diagnostic tests suggest that this issue is not severe, future research may benefit from multi-source data collection strategies.

Fourth, the sample consists exclusively of institutional practitioners in Philippine financial institutions. While this focus strengthens contextual relevance, the findings may not be directly generalizable to other international foreign exchange markets. Future studies may extend this research through comparative analyses involving multiple countries or regional financial centers.

Finally, the study evaluates respondents' use and perceptions of probability-based decision support frameworks rather than testing the mathematical accuracy of a specific implemented software trading tool. Future research may incorporate experimental trading simulations or algorithmic backtesting to complement survey-based evidence.

9.2 Future Research

Future research may extend this study by conducting comparative analyses across ASEAN financial markets, including Singapore, Malaysia, and Indonesia, to examine whether institutional trading environments influence the effectiveness of probability-driven decision support tools.

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Conflict of Interest Statement

The author declares no conflict of interest.

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