

LightGBM-Based Prediction of Marital Commitment Using Sexual Satisfaction, Trust, Emotional Intimacy, and Attachment Security

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ABSTRACT

Objective: The present study aimed to develop and evaluate a Light Gradient Boosting Machine (LightGBM) model for predicting marital commitment based on sexual satisfaction, trust, emotional intimacy, and attachment security among married adults in Argentina.

Methods and Materials: This cross-sectional predictive study was conducted among 1,248 married adults residing in Argentina. Participants were selected using a stratified convenience sampling method from major urban areas, including Buenos Aires, Córdoba, Rosario, and Mendoza. Data were collected using standardized measures of marital commitment, sexual satisfaction, trust, emotional intimacy, and attachment security. Following data preprocessing, including missing-value imputation and data quality screening, the dataset was randomly divided into training (80%) and testing (20%) subsets. A LightGBM algorithm was implemented to predict marital commitment. Hyperparameter optimization was conducted using five-fold cross-validation and grid-search procedures. Model performance was evaluated using the coefficient of determination (R^2), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE). Feature importance analysis and SHapley Additive exPlanations (SHAP) were employed to determine the relative contribution of each predictor and enhance model interpretability.

Findings: Correlation analyses revealed significant positive associations between marital commitment and emotional intimacy ($r = .79, p < .001$), trust ($r = .76, p < .001$), sexual satisfaction ($r = .71, p < .001$), and attachment security ($r = .68, p < .001$). The LightGBM model demonstrated excellent predictive performance, explaining 88.4% of the variance in the training dataset and 84.2% in the testing dataset ($R^2 = .842$). Error metrics indicated high prediction accuracy (Testing RMSE = 5.38, MAE = 4.09, MAPE = 5.91%). Feature importance analysis showed that emotional intimacy was the strongest predictor (34.7%), followed by trust (29.3%), sexual satisfaction (22.2%), and attachment security (13.8%). SHAP

analysis confirmed the dominant influence of emotional intimacy and trust on model predictions.

Conclusion: The findings demonstrate that marital commitment can be predicted with high accuracy using sexual satisfaction, trust, emotional intimacy, and attachment security. Emotional intimacy and trust emerged as the most influential predictors, highlighting the central role of emotional connection and relational security in sustaining committed marital relationships. The study further illustrates the utility of machine learning approaches, particularly LightGBM, for advancing predictive research in family and relationship psychology.

Keywords: *Marital Commitment, LightGBM, Machine Learning, Emotional Intimacy, Trust, Sexual Satisfaction, Attachment Security, Predictive Modeling, Family Psychology, Explainable Artificial Intelligence (XAI).*

1. Introduction

Marital commitment is widely recognized as one of the most fundamental determinants of relationship stability, satisfaction, and long-term relational success. It reflects an individual's intention to maintain a relationship over time, invest resources in its continuation, and remain emotionally dedicated despite challenges and stressors. Contemporary relationship research has consistently demonstrated that commitment functions as a protective factor against relationship dissolution while simultaneously enhancing psychological well-being, relational satisfaction, and family functioning. As marital relationships face increasing pressures associated with social change, economic uncertainty, shifting gender roles, and technological influences, understanding the factors that contribute to marital commitment has become a major focus of family psychology and relationship science (Adhikari & Shilpa, 2025; Kanth, 2022; Thorpe et al., 2025).

Strong marital commitment is associated with numerous positive outcomes, including greater relationship satisfaction, emotional security, psychological adjustment, and resilience in the face of life stressors. Couples characterized by high commitment tend to demonstrate greater cooperation, conflict resolution skills, mutual support, and relationship persistence during difficult periods. Conversely, low levels of commitment are associated with relational instability, emotional disengagement, increased conflict, infidelity, and eventual relationship dissolution (Nazemi et al., 2023; Ogwuche et al., 2024; Rokach & Chan, 2023). The significance of commitment extends beyond individual relationships, as marital stability contributes substantially to family cohesion, child well-being, and broader social functioning. Consequently, identifying the psychological and relational

factors that influence marital commitment remains an important objective for both researchers and clinicians.

One of the most influential determinants of marital commitment is sexual satisfaction. Sexuality constitutes a central component of intimate partnerships and serves functions that extend beyond physical gratification to include emotional connection, affirmation, intimacy, and relational bonding. Sexual satisfaction refers to an individual's subjective evaluation of the quality and fulfillment of sexual experiences within a relationship. Previous research has consistently demonstrated that sexual satisfaction is positively associated with relationship quality, emotional closeness, trust, and long-term relational stability (Das & Rao, 2022; Farhan & Ismail, 2022). Couples who report greater satisfaction with their sexual relationship generally experience stronger emotional bonds and higher levels of dedication to maintaining their partnerships.

Recent empirical findings further emphasize the importance of sexual satisfaction in sustaining healthy marital relationships. Salehzadeh et al. reported that sexual satisfaction plays a significant mediating role in the relationship between attachment styles and tendencies toward marital infidelity, highlighting its contribution to relational stability (Salehzadeh et al., 2024). Similarly, Busby et al. demonstrated that physical aspects of sexuality and sexual satisfaction are closely linked to attachment dynamics and overall relationship functioning (Busby et al., 2025). Research examining women's experiences in marriage has also shown that sexual fulfillment contributes substantially to emotional intimacy and relationship satisfaction, thereby enhancing long-term commitment (Farhan & Ismail, 2022). These findings suggest that sexual satisfaction may represent a critical predictor of marital commitment and an important variable within predictive relationship models.

Trust represents another essential foundation of committed relationships. Trust involves confidence in a partner's reliability, honesty, dependability, and benevolent intentions. It allows individuals to engage in emotional vulnerability and interpersonal openness without fear of betrayal or exploitation. Relationship scholars have long argued that trust serves as the cornerstone of enduring intimate relationships because it facilitates cooperation, emotional security, and mutual investment. When trust is present, partners are more likely to engage in supportive behaviors, communicate openly, and remain committed to relationship maintenance (Griffes et al., 2024; Miri et al., 2024).

The role of trust becomes particularly evident in situations involving relational threats such as infidelity. Research indicates that breaches of trust often result in substantial reductions in commitment and relationship satisfaction. Miri et al. found that communication patterns and emotional schemas significantly influence trust among couples affected by infidelity, underscoring the central role of trust in relationship recovery and stability (Miri et al., 2024). Likewise, studies examining marital dissatisfaction and relationship disruption have consistently identified diminished trust as a major contributing factor to relationship deterioration (Ogwuche et al., 2024; Shrestha et al., 2023). Consequently, trust may function not only as an outcome of healthy relationships but also as a powerful predictor of commitment itself.

Emotional intimacy constitutes another key relational process closely linked to marital commitment. Emotional intimacy refers to feelings of closeness, mutual understanding, emotional disclosure, empathy, and connectedness between partners. Intimacy enables individuals to experience acceptance, validation, and emotional support, fostering a sense of belonging within the relationship. Theoretical perspectives on intimate relationships consistently emphasize emotional intimacy as a fundamental mechanism through which partners maintain psychological bonds and relational satisfaction (Das & Rao, 2022; Fernandes et al., 2023).

Empirical evidence strongly supports the importance of emotional intimacy in marital functioning. Wendołowska et al. demonstrated that attachment and dyadic coping significantly contribute to relational intimacy among couples, highlighting the interpersonal processes that strengthen emotional bonds (Wendołowska et al., 2022). Similarly, Ghasemi found that attachment styles and self-differentiation significantly predict marital intimacy,

suggesting that emotionally secure individuals are more capable of developing close and satisfying relationships (Ghasemi, 2023). Park and Harris further reported that emotional intimacy mediates the relationship between attachment styles and attitudes toward marriage, indicating that intimacy may serve as a critical pathway through which attachment influences commitment-related outcomes (Park & Harris, 2022). Furthermore, interventions focused on enhancing emotional intimacy have been shown to improve marital functioning and relationship quality among couples experiencing relational distress (Henry et al., 2025; Nezamalmolki et al., 2023).

Attachment security provides a broader developmental framework for understanding commitment in romantic relationships. Attachment theory proposes that early interactions with caregivers shape internal working models of self and others, influencing expectations, emotional regulation strategies, and relationship behaviors throughout adulthood. Individuals with secure attachment generally perceive themselves as worthy of love and view others as trustworthy and dependable. As a result, they tend to form more stable, satisfying, and committed romantic relationships. In contrast, insecure attachment patterns characterized by anxiety or avoidance often contribute to relational difficulties, emotional distress, and reduced commitment (Doorn et al., 2024; Ibrahim et al., 2023).

A growing body of research has documented the influence of attachment security on various dimensions of relationship functioning. Hasim et al. reported significant associations between adult romantic attachment and relationship satisfaction among married individuals (Hasim et al., 2023). Chursina demonstrated that attachment styles significantly influence emotional responses such as jealousy in romantic relationships (Chursina, 2023). Similarly, Thorpe et al. found that relationship attachment mediates associations between psychological characteristics and relationship satisfaction among women in committed partnerships (Thorpe et al., 2025). Studies examining childhood experiences further reveal that early relational adversity often contributes to insecure attachment patterns and subsequent difficulties in adult romantic relationships (Doorn et al., 2024; Rokach & MacFarlane, 2021). Collectively, these findings suggest that attachment security may serve as a foundational determinant of marital commitment through its effects on emotional regulation, trust, intimacy, and relationship satisfaction.

Although sexual satisfaction, trust, emotional intimacy, and attachment security have each been examined

extensively in relation to relationship outcomes, most previous investigations have relied on traditional statistical approaches such as correlation analysis, regression modeling, and structural equation modeling. These methods have provided valuable theoretical insights but may be limited in their capacity to capture complex nonlinear interactions among multiple relational variables. Human relationships are inherently dynamic and multidimensional systems characterized by intricate interdependencies that may not be adequately represented by conventional linear models (Miri et al., 2024; Salehzadeh et al., 2024).

Recent advances in machine learning offer promising opportunities to address these limitations. Machine learning algorithms are capable of identifying complex patterns within large datasets, modeling nonlinear relationships, and generating highly accurate predictions. Unlike traditional statistical approaches that primarily focus on hypothesis testing, machine learning emphasizes predictive performance and can reveal variable importance structures that enhance theoretical understanding. In relationship and family research, predictive modeling approaches are increasingly being recognized as valuable tools for identifying key determinants of relational outcomes and informing intervention strategies (Griffes et al., 2024; Ricafrente et al., 2024).

Among contemporary machine learning methods, Light Gradient Boosting Machine (LightGBM) has emerged as one of the most effective algorithms for predictive modeling. LightGBM is an ensemble learning technique based on gradient boosting decision trees that offers high predictive accuracy, computational efficiency, and the ability to model complex interactions among variables. The algorithm is particularly advantageous for psychological and behavioral research because it accommodates nonlinear associations and facilitates feature importance analyses that improve interpretability. Despite its growing use in health, behavioral, and social science research, relatively few studies have applied LightGBM to the prediction of marital commitment, creating an important gap in the literature.

Furthermore, contemporary relationship research highlights the importance of examining relational strengths rather than focusing exclusively on dysfunction and distress. While numerous studies have investigated factors contributing to infidelity, dissatisfaction, and relationship instability (Crawford et al., 2023; Ogwuche et al., 2024; Rokach & Chan, 2023; Shrestha et al., 2023), comparatively fewer investigations have explored the combined predictive influence of positive relational characteristics such as trust,

intimacy, attachment security, and sexual satisfaction on marital commitment. Recent studies examining relationship strengths, emotional well-being, and romantic functioning suggest that these variables may collectively represent a powerful framework for understanding relationship maintenance and resilience (Buchanan, 2022; Fernandes et al., 2023; Ricafrente et al., 2024; Shahrier, 2025).

Given the theoretical significance of commitment and the increasing availability of advanced predictive methodologies, there is a clear need to investigate whether sexual satisfaction, trust, emotional intimacy, and attachment security can accurately predict marital commitment using modern machine learning techniques. Such an approach may not only improve predictive accuracy but also enhance understanding of the relative importance of these relational factors in sustaining committed marriages.

Therefore, the aim of the present study was to develop and evaluate a LightGBM-based predictive model of marital commitment using sexual satisfaction, trust, emotional intimacy, and attachment security among married adults in Argentina.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a cross-sectional predictive research design using a machine learning approach to examine the extent to which sexual satisfaction, trust, emotional intimacy, and attachment security predict marital commitment among married adults in Argentina. The study was conducted between March and July 2026 in several urban regions of Argentina, including Buenos Aires, Córdoba, Rosario, and Mendoza. The target population consisted of legally married individuals who had been living with their spouses for at least one year. A stratified convenience sampling strategy was used to ensure adequate representation across gender, age groups, educational levels, and duration of marriage.

A total of 1,248 married adults participated in the study. Participants ranged in age from 22 to 67 years, with a mean age of 41.38 years ($SD = 10.27$). Of the participants, 618 were men and 630 were women. The average duration of marriage was 13.54 years ($SD = 8.11$), ranging from 1 to 40 years. Inclusion criteria consisted of being legally married, residing in Argentina, being at least 18 years old, and possessing sufficient literacy to complete the questionnaires independently. Individuals currently undergoing divorce proceedings or experiencing severe psychiatric disorders

that could interfere with survey completion were excluded from participation. Data were collected through both online and paper-and-pencil questionnaires distributed through community centers, family counseling clinics, social organizations, and social media platforms. Prior to participation, all respondents were informed about the purpose of the study and provided informed consent. Confidentiality and anonymity were guaranteed throughout the research process, and participation was entirely voluntary.

2.2. Measures

Marital commitment was assessed using the Marital Commitment Inventory developed by Stanley and Markman. This instrument evaluates the degree of dedication, personal investment, long-term orientation, and psychological attachment within marital relationships. The inventory consists of 22 items rated on a five-point Likert scale ranging from strongly disagree to strongly agree. Higher scores indicate stronger levels of marital commitment. Previous studies have reported satisfactory psychometric properties for the scale, with Cronbach's alpha coefficients generally exceeding 0.85 and evidence supporting its construct and criterion validity across diverse cultural contexts.

Sexual satisfaction was measured using the Index of Sexual Satisfaction developed by Hudson. The scale contains 25 items designed to evaluate satisfaction with various aspects of sexual relationships, including frequency of sexual interactions, emotional fulfillment, communication regarding sexual needs, and overall sexual contentment. Responses are provided on a Likert-type scale, with higher scores reflecting greater sexual satisfaction. The instrument has demonstrated excellent internal consistency and strong convergent validity in marital and family research. Previous investigations have consistently reported reliability coefficients above 0.90.

Trust within the marital relationship was assessed using the Dyadic Trust Scale developed by Larzelere and Huston. The scale comprises 8 items measuring confidence in a partner's reliability, honesty, dependability, and faithfulness. Participants respond using a seven-point Likert scale, with higher scores indicating greater interpersonal trust. The Dyadic Trust Scale has been widely employed in relationship research and has demonstrated strong psychometric characteristics, including high internal consistency, test-retest reliability, and construct validity.

Emotional intimacy was evaluated using the Emotional Intimacy Scale developed by Sinclair and Dowdy. This measure contains 17 items assessing emotional closeness, self-disclosure, empathy, emotional support, and mutual understanding between spouses. Responses are recorded on a five-point Likert scale. Higher scores represent greater emotional intimacy within the marital relationship. Previous validation studies have demonstrated excellent reliability estimates and significant associations with indicators of relationship quality and marital adjustment.

Attachment security was measured using the Experiences in Close Relationships Scale–Short Form. This instrument assesses adult attachment patterns through two major dimensions: attachment anxiety and attachment avoidance. The short version consists of 12 items rated on a seven-point Likert scale. Lower levels of anxiety and avoidance indicate greater attachment security. The measure has demonstrated robust reliability and validity across different populations and cultural settings. Numerous studies have reported satisfactory internal consistency coefficients and strong factorial validity for the instrument.

All instruments used in the study had previously demonstrated acceptable reliability and validity in international research. Prior to analysis, internal consistency was re-examined in the present sample using Cronbach's alpha and composite reliability coefficients, all of which exceeded the recommended threshold of 0.70.

2.3. Data Analysis

Data analysis was performed using Python version 3.12 and several machine learning libraries, including Scikit-learn, LightGBM, NumPy, Pandas, and SHAP. Initially, data screening procedures were conducted to identify missing values, outliers, and inconsistencies. Missing values represented less than 3% of the dataset and were handled using multiple imputation techniques. Continuous variables were standardized where necessary, and descriptive statistics were calculated to summarize participant characteristics and study variables.

The predictive modeling process utilized the Light Gradient Boosting Machine (LightGBM) algorithm, an advanced ensemble machine learning method based on gradient boosting decision trees. The dataset was randomly divided into training and testing subsets using an 80:20 ratio. The training dataset consisted of 998 participants, while the testing dataset included 250 participants. To optimize model performance and reduce overfitting, five-fold cross-

validation was employed during model training. Hyperparameter optimization was conducted through grid-search procedures involving adjustments to learning rate, maximum tree depth, number of leaves, feature fraction, bagging fraction, and minimum data in leaf nodes.

Model performance was evaluated using multiple predictive metrics, including the coefficient of determination (R^2), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE). Feature importance analyses were conducted to determine the relative contribution of sexual satisfaction, trust, emotional intimacy, and attachment security to the prediction of marital commitment. Furthermore, SHapley Additive exPlanations (SHAP) analysis was applied to provide an interpretable understanding of how each predictor influenced model outcomes at both the global and individual levels. Statistical significance for preliminary correlational analyses was evaluated at the 0.05 level, while predictive performance was assessed primarily through machine learning accuracy indicators rather than traditional hypothesis testing procedures. The final LightGBM model was selected based on its superior predictive accuracy,

generalizability, and interpretability across validation datasets.

3. Findings and Results

The final dataset consisted of 1,248 married adults from Argentina. Among the participants, 630 (50.5%) were women and 618 (49.5%) were men. The mean age of the sample was 41.38 years ($SD = 10.27$), with ages ranging from 22 to 67 years. The average duration of marriage was 13.54 years ($SD = 8.11$). Regarding educational attainment, 21.9% had completed secondary education, 31.6% held technical or vocational qualifications, 34.8% possessed undergraduate degrees, and 11.7% had postgraduate qualifications. Approximately 68.4% of participants reported having children. Preliminary data screening indicated no substantial violations of normality assumptions among the predictor variables, and all scales demonstrated satisfactory internal consistency, with Cronbach's alpha coefficients ranging from 0.83 to 0.94. Missing data accounted for less than 3% of observations and were addressed through multiple imputation procedures prior to model development.

Table 1

Descriptive Statistics and Correlations Among Study Variables

Variable	Mean	SD	1	2	3	4	5
1. Marital Commitment	83.74	12.58	1				
2. Sexual Satisfaction	91.26	15.47	.71**	1			
3. Trust	39.18	7.22	.76**	.64**	1		
4. Emotional Intimacy	63.91	10.84	.79**	.69**	.72**	1	
5. Attachment Security	41.53	8.76	.68**	.57**	.65**	.67**	1

Table 1 presents the descriptive statistics and bivariate correlations among the principal study variables. The findings indicate that marital commitment exhibited strong positive associations with all predictor variables. Emotional intimacy demonstrated the strongest correlation with marital commitment ($r = .79, p < .001$), followed by trust ($r = .76, p < .001$), sexual satisfaction ($r = .71, p < .001$), and attachment security ($r = .68, p < .001$). The correlations among the predictor variables were also statistically

significant and ranged from .57 to .72, suggesting meaningful interrelationships without evidence of excessive multicollinearity. These results provide preliminary support for the theoretical expectation that higher levels of sexual satisfaction, trust, emotional intimacy, and attachment security are associated with stronger marital commitment. The substantial magnitude of these correlations further suggests that these variables may serve as important predictors within the machine learning model.

Table 2

LightGBM Model Performance on Training and Testing Datasets

Metric	Training Set	Testing Set
R^2	0.884	0.842
RMSE	4.21	5.38
MAE	3.18	4.09

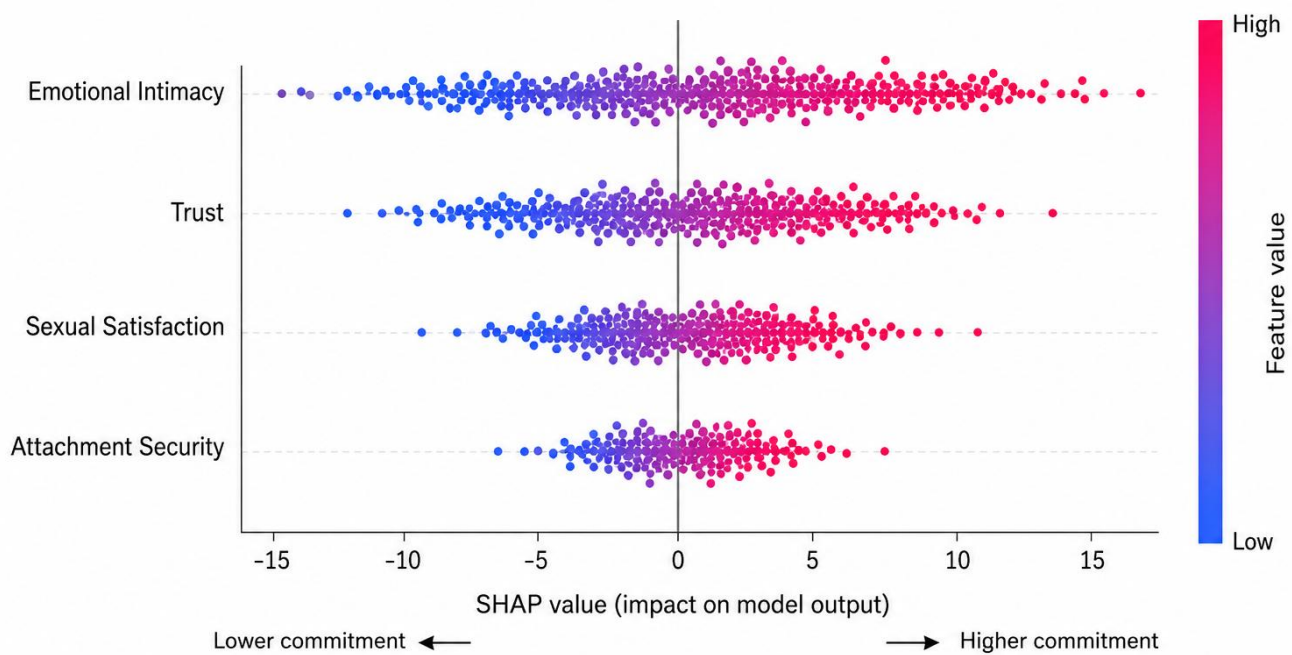
MAPE (%)	4.72	5.91
Explained Variance	0.886	0.844

The predictive performance of the LightGBM model is presented in Table 2. Results demonstrated excellent predictive accuracy across both training and testing datasets. The model explained 88.4% of the variance in marital commitment scores within the training sample and maintained a high explanatory power of 84.2% in the independent testing sample. The relatively small difference between training and testing performance indicates strong generalizability and minimal overfitting. Error indices further support the robustness of the model. The RMSE values of 4.21 and 5.38 for the training and testing datasets,

respectively, suggest that prediction errors remained relatively low compared to the overall scale range of marital commitment scores. Similarly, the MAE values indicate that average prediction deviations were approximately four points or less. The low MAPE values, remaining below 6% in both datasets, provide additional evidence that the model achieved a high degree of predictive precision. Collectively, these findings suggest that the combination of sexual satisfaction, trust, emotional intimacy, and attachment security enables highly accurate prediction of marital commitment among married adults.

Figure 1

SHAP Summary Plot Illustrating the Relative Influence of Sexual Satisfaction, Trust, Emotional Intimacy, and Attachment Security on Predicted Marital Commitment



The SHAP summary analysis revealed substantial differences in the relative contributions of the predictor variables to marital commitment. Emotional intimacy emerged as the most influential predictor across the model, demonstrating the largest average absolute SHAP value. Participants reporting higher emotional intimacy consistently received higher predicted marital commitment scores. Trust represented the second most influential predictor and showed a similarly strong positive contribution across the prediction spectrum. Sexual satisfaction ranked third in importance and contributed significantly to

prediction accuracy, particularly among participants exhibiting moderate-to-high commitment levels. Attachment security also demonstrated a meaningful contribution, although its overall predictive impact was somewhat lower than that of the other variables. The SHAP analysis further revealed predominantly positive effects for high values of all four predictors, indicating that increases in these relational resources generally increased predicted levels of marital commitment. The interpretability analysis confirmed that the model's predictions were theoretically coherent and aligned closely with established relationship

research, highlighting the central importance of emotional intimacy and trust in sustaining long-term marital commitment.

Table 3

Feature Importance Rankings Derived from the LightGBM Model

Predictor	Importance Score	Relative Importance (%)
Emotional Intimacy	100.00	34.7
Trust	84.53	29.3
Sexual Satisfaction	63.91	22.2
Attachment Security	39.65	13.8

Table 3 presents the feature importance rankings generated by the LightGBM algorithm. Emotional intimacy accounted for the largest proportion of predictive information, contributing approximately 34.7% of the model’s total predictive capacity. Trust represented the second most influential predictor, accounting for 29.3% of the explained prediction structure. Together, emotional intimacy and trust constituted nearly two-thirds of the model’s predictive power, emphasizing the importance of emotional connection and relational confidence in determining marital commitment. Sexual satisfaction contributed 22.2% of the predictive information and emerged as a substantial determinant of commitment, supporting theories that emphasize the role of sexual relationship quality in marital stability and dedication. Attachment security contributed 13.8% of the model’s predictive power and, although ranked fourth, remained a meaningful predictor of marital commitment. The overall pattern of findings suggests that while all four variables significantly contribute to marital commitment prediction, emotionally focused dimensions of the marital relationship exert the strongest influence. The convergence between feature importance rankings and SHAP analysis further strengthens confidence in the stability and interpretability of the LightGBM model. Taken together, the findings indicate that marital commitment can be predicted with a high degree of accuracy using psychological and relational variables, with emotional intimacy and trust serving as the most influential determinants within the predictive framework.

4. Discussion

The present study sought to predict marital commitment among married adults in Argentina using a LightGBM machine learning model based on sexual satisfaction, trust, emotional intimacy, and attachment security. The findings demonstrated that the proposed model achieved a high level

of predictive accuracy, explaining more than 84% of the variance in marital commitment within the testing dataset. The relatively small difference between training and testing performance metrics indicated strong model generalizability and minimal overfitting. These findings suggest that marital commitment can be predicted with considerable precision when key relational and psychological variables are incorporated into advanced machine learning frameworks. The results further revealed that emotional intimacy emerged as the most influential predictor of marital commitment, followed by trust, sexual satisfaction, and attachment security. Collectively, these findings provide support for contemporary relationship theories that emphasize emotional connection, interpersonal security, and relational satisfaction as fundamental foundations of long-term commitment.

One of the most notable findings of the study was the identification of emotional intimacy as the strongest predictor of marital commitment. Both the feature importance analysis and SHAP interpretation demonstrated that emotional intimacy contributed more substantially to prediction accuracy than any other variable included in the model. This finding is theoretically consistent with conceptualizations of intimate relationships that view emotional closeness as a central mechanism through which romantic partners maintain connection, mutual understanding, and relational stability. Emotional intimacy enables partners to engage in meaningful self-disclosure, provide emotional support, and experience a sense of psychological safety within the relationship. Such experiences strengthen relational bonds and increase motivation to preserve the relationship over time.

The prominence of emotional intimacy observed in the present study aligns closely with previous empirical findings. Park and Harris reported that emotional intimacy serves as a mediating mechanism linking attachment styles

to attitudes toward marriage, suggesting that emotionally close relationships foster stronger relationship investment and commitment (Park & Harris, 2022). Similarly, Wendołowska et al. demonstrated that relational intimacy is significantly shaped by attachment processes and dyadic coping strategies, highlighting its central role in relationship functioning (Wendołowska et al., 2022). Ghasemi further found that attachment styles and self-differentiation are important predictors of marital intimacy, reinforcing the notion that emotional closeness contributes substantially to relationship quality and stability (Ghasemi, 2023). Intervention-based evidence also supports the present findings. Nezamalmolki et al. reported that emotion-focused couples therapy significantly improved marital intimacy among women affected by marital infidelity, indicating that strengthening emotional connection can enhance relationship functioning (Nezamalmolki et al., 2023). Likewise, Henry et al. emphasized the importance of emotionally focused therapeutic approaches in fostering secure and satisfying intimate partnerships (Henry et al., 2025). The current results extend these findings by demonstrating that emotional intimacy is not merely associated with marital commitment but may represent its most influential predictor within a comprehensive machine learning model.

Trust emerged as the second most important predictor of marital commitment. This finding is unsurprising given the central role of trust in maintaining relationship stability and fostering interpersonal security. Trust allows individuals to become emotionally vulnerable, disclose personal concerns, and rely on their partners during times of uncertainty. In committed relationships, trust serves as a psychological foundation that facilitates cooperation, emotional investment, and long-term relational planning. Couples who perceive their partners as reliable and dependable are more likely to remain dedicated to their relationships and less likely to contemplate dissolution.

The importance of trust observed in the present study is highly consistent with existing relationship literature. Miri et al. demonstrated that trust plays a pivotal role in couples affected by infidelity and that communication patterns significantly influence trust restoration and relationship functioning (Miri et al., 2024). Research examining relationship instability has repeatedly identified breaches of trust as one of the most damaging experiences within intimate partnerships, often leading to emotional distancing and reductions in commitment (Ogwuche et al., 2024; Shrestha et al., 2023). Studies of marital satisfaction have

similarly emphasized that trust serves as a prerequisite for emotional security and relational resilience (Nazemi et al., 2023). The present findings suggest that trust not only contributes to healthy relationship functioning but also serves as a major determinant of marital commitment. The substantial contribution of trust within the LightGBM model indicates that commitment is strongly influenced by perceptions of relational reliability and security.

Sexual satisfaction was identified as the third most influential predictor of marital commitment. Although its predictive contribution was somewhat lower than that of emotional intimacy and trust, it nevertheless accounted for a substantial proportion of the model's predictive power. Sexual satisfaction represents an important dimension of marital functioning because it contributes to emotional connection, relational fulfillment, and mutual validation. Satisfying sexual experiences can strengthen emotional bonds, reinforce relationship identity, and promote positive evaluations of the partnership.

The current findings correspond closely with previous research demonstrating strong associations between sexual satisfaction and relationship outcomes. Busby et al. found that physical aspects of sexuality, attachment, and sexual satisfaction are closely interconnected and contribute significantly to relationship quality (Busby et al., 2025). Similarly, Farhan and Ismail reported positive relationships between personal intimacy and sexual satisfaction among married women, highlighting the close integration of emotional and sexual dimensions within marital relationships (Farhan & Ismail, 2022). Salehzadeh et al. further demonstrated that sexual satisfaction mediates associations between personality characteristics, attachment styles, and tendencies toward marital infidelity (Salehzadeh et al., 2024). The findings of Das and Rao also emphasize that intimacy, sensuality, attraction, and love operate as interconnected components of successful romantic relationships (Das & Rao, 2022). The present study contributes to this body of evidence by demonstrating that sexual satisfaction remains a powerful predictor of marital commitment even when examined alongside other important relational variables. This suggests that sexual fulfillment functions as an integral component of relationship maintenance and long-term dedication.

Attachment security emerged as the fourth predictor in the model. Although it contributed less predictive power than emotional intimacy, trust, and sexual satisfaction, it nevertheless remained a significant determinant of marital commitment. This finding is theoretically meaningful

because attachment security represents a relatively stable psychological characteristic that influences how individuals perceive themselves, regulate emotions, and engage in close relationships. Securely attached individuals tend to trust others, seek emotional closeness, and respond adaptively to relationship challenges. These tendencies facilitate the development of healthy and committed partnerships.

The role of attachment security identified in this study is strongly supported by attachment theory and previous empirical findings. Hasim et al. reported that adult romantic attachment is significantly associated with relationship satisfaction among married individuals (Hasim et al., 2023). Thorpe et al. demonstrated that relationship attachment mediates associations between psychological schemas and relationship satisfaction, suggesting that attachment processes play a crucial role in shaping relationship outcomes (Thorpe et al., 2025). Chursina found that attachment styles influence jealousy and emotional responses within romantic relationships, illustrating their impact on relational dynamics (Chursina, 2023). Research examining adverse childhood experiences has similarly demonstrated that insecure attachment contributes to relational difficulties and increased vulnerability to infidelity and dissatisfaction (Doorn et al., 2024; Rokach & MacFarlane, 2021). Ibrahim et al. further highlighted the role of attachment processes in emotional regulation and relational outcomes within couples therapy contexts (Ibrahim et al., 2023). The present findings suggest that although attachment security may exert part of its influence indirectly through trust and intimacy, it nevertheless remains an important contributor to marital commitment.

The strong correlations observed among emotional intimacy, trust, sexual satisfaction, attachment security, and marital commitment further support contemporary systemic perspectives on intimate relationships. Rather than functioning independently, these variables appear to operate as interconnected components of a broader relational ecosystem. Secure attachment promotes emotional intimacy and trust, which in turn facilitate satisfying sexual interactions and strengthen commitment. This interpretation aligns with evidence suggesting that relational well-being emerges from the interaction of multiple emotional, cognitive, and behavioral processes rather than any single determinant (Adhikari & Shilpa, 2025; Fernandes et al., 2023; Ricafrente et al., 2024). Research on relationship strengths similarly indicates that healthy relationships are characterized by synergistic interactions among intimacy,

trust, emotional regulation, and satisfaction (Buchanan, 2022; Shahrier, 2025).

An important contribution of the present study concerns the application of machine learning methods to relationship research. Most previous investigations examining marital commitment have relied on traditional correlational or structural equation modeling approaches (Miri et al., 2024; Salehzadeh et al., 2024). While such methods provide valuable theoretical insights, they may not adequately capture nonlinear interactions among predictors. The successful performance of the LightGBM algorithm demonstrates the potential value of machine learning approaches for predicting complex relational outcomes. The use of SHAP analysis further enhanced interpretability by revealing how individual predictors influenced model predictions. These findings suggest that machine learning can complement traditional methodologies and contribute to a more nuanced understanding of relationship dynamics.

5. Conclusion

The results also have implications for understanding marital resilience. Previous studies examining infidelity, dissatisfaction, and relationship instability have identified deficits in trust, intimacy, attachment security, and sexual satisfaction as major risk factors for relationship deterioration (Crawford et al., 2023; Ogwuche et al., 2024; Rokach & Chan, 2023; Shrestha et al., 2023). The present findings suggest the converse is equally important: the presence of these relational strengths appears to promote commitment and relationship stability. Consequently, interventions designed to enhance emotional intimacy, strengthen trust, improve sexual satisfaction, and foster attachment security may be particularly effective in promoting enduring marital relationships.

6. Suggestions and Limitations

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design prevents causal conclusions regarding the relationships among the study variables. Although the model successfully predicted marital commitment, causal pathways cannot be definitively established. Second, all variables were assessed using self-report questionnaires, which may be influenced by social desirability bias, response tendencies, and subjective perceptions. Third, the sample was limited to married adults residing in Argentina, which may reduce the generalizability of the findings to other cultural contexts.

Fourth, despite the strong predictive performance of the model, additional variables such as communication quality, conflict resolution styles, financial satisfaction, personality traits, and mental health indicators were not included. Finally, marital commitment is a dynamic construct that may fluctuate over time, whereas the present study relied on a single assessment point.

Future studies should employ longitudinal designs to examine how changes in emotional intimacy, trust, sexual satisfaction, and attachment security influence marital commitment over time. Researchers may also compare the predictive performance of LightGBM with other machine learning algorithms such as XGBoost, CatBoost, Random Forest, and deep learning architectures. Future investigations could incorporate dyadic data from both partners to capture interpersonal dynamics more accurately. Expanding the model to include additional relational, psychological, and contextual variables may further improve predictive accuracy. Cross-cultural studies involving participants from diverse societies would also be valuable for determining the generalizability of the findings. Finally, future research should explore explainable artificial intelligence techniques to better understand the mechanisms through which relational variables influence marital commitment.

The findings suggest that relationship education programs, premarital counseling, and couples therapy interventions should prioritize the enhancement of emotional intimacy, trust, sexual satisfaction, and attachment security. Mental health professionals may benefit from routinely assessing these dimensions when working with couples experiencing relational difficulties. Programs designed to improve emotional disclosure, empathic communication, and mutual understanding may strengthen commitment and relationship stability. Therapists should also address attachment-related insecurities and trust concerns that may undermine relationship functioning. Educational initiatives promoting healthy sexual communication and sexual satisfaction could further contribute to stronger marriages. Finally, practitioners may consider integrating predictive analytics and data-informed assessment approaches into relationship counseling settings to identify couples at risk for declining commitment and to tailor interventions more effectively.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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