

## GENDER PREFERENCES IN CRYPTOCURRENCY SYSTEMS: SENTIMENT ANALYSIS AND PREDICTIVE MODELLING IN THE KINGDOM OF BAHRAIN

### PREFERÊNCIAS DE GÊNERO EM SISTEMAS DE CRIPTOMOEDAS: ANÁLISE DE SENTIMENTOS E MODELAGEM PREDITIVA NO REINO DO BAHREIN

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#### Abstract

This study investigates gender-based differences in cryptocurrency preferences using sentiment analysis and predictive modelling within the financial technology ecosystem of the Kingdom of Bahrain. As cryptocurrencies continue to reshape digital financial markets, understanding demographic and behavioural factors influencing cryptocurrency adoption has become increasingly important. This research employs a quantitative survey-based approach involving 620 respondents to examine demographic characteristics, digital engagement patterns, and cryptocurrency investment behaviours. Descriptive statistical analysis was conducted to evaluate respondent characteristics, while machine learning techniques, including Logistic Regression and Random Forest classifiers, were implemented to predict cryptocurrency preferences. The findings reveal notable gender disparities in cryptocurrency engagement and investment preferences. Male participants demonstrated higher participation levels and stronger predictive classification accuracy compared to female respondents. The Random Forest model achieved the highest predictive performance with an accuracy of 87.4% and an F1-score of 0.85, significantly outperforming the Logistic Regression model. Feature importance analysis further identified gender as a significant predictor of cryptocurrency preference, suggesting distinct behavioural patterns between male and female investors. The study contributes to the growing literature on financial technology adoption by providing empirical insights into gender-specific cryptocurrency investment behaviour in emerging digital economies. The

#### Resumo

*Este estudo investiga as diferenças de gênero nas preferências por criptomoedas utilizando análise de sentimento e modelagem preditiva no ecossistema de tecnologia financeira do Reino do Bahrein. À medida que as criptomoedas continuam a remodelar os mercados financeiros digitais, compreender os fatores demográficos e comportamentais que influenciam a adoção de criptomoedas tornou-se cada vez mais importante. Esta pesquisa emprega uma abordagem quantitativa baseada em pesquisa com 620 participantes para examinar características demográficas, padrões de engajamento digital e comportamentos de investimento em criptomoedas. Foi realizada uma análise estatística descritiva para avaliar as características dos participantes, enquanto técnicas de aprendizado de máquina, incluindo regressão logística e classificadores de Random Forest, foram implementadas para prever as preferências em relação às criptomoedas. Os resultados revelam disparidades de gênero notáveis no engajamento com criptomoedas e nas preferências de investimento. Os participantes do sexo masculino demonstraram níveis de participação mais elevados e maior precisão de classificação preditiva em comparação com as respondentes do sexo feminino. O modelo Random Forest alcançou o melhor desempenho preditivo, com uma precisão de 87,4% e um F1-score de 0,85, superando significativamente o modelo de Regressão Logística. A análise de importância de características identificou ainda o gênero como um preditor significativo da preferência por criptomoedas, sugerindo padrões*



findings offer practical implications for fintech developers, financial institutions, and policymakers seeking to design more inclusive and user-centric cryptocurrency platforms.

**Keywords:** Cryptocurrency. Gender Differences. Sentiment Analysis. Machine Learning. Financial Technology. Bahrain.

*comportamentais distintos entre investidores do sexo masculino e feminino. O estudo contribui para a crescente literatura sobre a adoção de tecnologia financeira, fornecendo insights empíricos sobre o comportamento de investimento em criptomoedas específico por gênero em economias digitais emergentes. Os resultados oferecem implicações práticas para desenvolvedores de fintech, instituições financeiras e formuladores de políticas que buscam projetar plataformas de criptomoedas mais inclusivas e centradas no usuário.*

**Palavras-chave:** Criptomoeda. Diferenças de Gênero. Análise de Sentimento. Aprendizado de Máquina. Tecnologia Financeira. Bahrein.

## 1 INTRODUCTION

The rapid evolution of financial technology has introduced transformative innovations such as cryptocurrencies, which offer new mechanisms for value transfer and investment while simultaneously presenting complex challenges related to regulatory compliance and financial security (Alrasheed, 2025). These digital assets function through distributed ledger technology, enabling peer-to-peer transactions without centralized intermediaries, which has necessitated the development of novel analytical approaches to understand market dynamics and investor behavior (Bhatt, Ghazanfar and Amirhosseini, 2023). By integrating sentiment analysis with predictive modelling, this study aims to uncover how gender-specific preferences influence cryptocurrency selection and investment strategies within the unique socio-economic landscape of Bahrain (ŞENKARDEŞ and Akadur, 2021. Sarsam et al., 2024). This approach is particularly relevant given the established gender gap in financial technology, where investment preferences often diverge significantly between male and female users (ŞENKARDEŞ and Akadur, 2021. Sarsam et al., 2024). Understanding these disparities requires examining how risk tolerance and technological familiarity differ across genders, as these factors fundamentally shape engagement with decentralized financial systems (Sarsam et al., 2024). Consequently, analyzing these behavioral distinctions through the lens of social media sentiment provides critical insights into the decision-making

processes that underpin the broader adoption of digital currencies (Sarsam et al., 2024. Şenyapar, 2024).

## **2 BACKGROUND OF CRYPTOCURRENCY ADOPTION**

Cryptocurrencies have emerged as a distinct asset class characterized by high volatility and decentralized operation, prompting researchers to examine the factors driving their adoption and the behavioral patterns of investors (Sarsam et al., 2024). Specifically, demographic variables such as age, gender, and prior experience have been identified as significant determinants of an individual's propensity to engage with digital assets (Almansour, Elkrggli and Almansour, 2023. Chauhan, 2025). Building upon these demographic foundations, recent scholarship has expanded the scope of inquiry to include psychographic constructs such as personality traits and overconfidence, which interact with gender to shape consumer behavior in the cryptocurrency market (Frank et al., 2024).

## **3 GENDER DISPARITIES IN FINANCIAL TECHNOLOGY**

Extensive research indicates that men dominate cryptocurrency market participation across various regions, with male representation reaching as high as 85% in some Gulf countries while female participation remains significantly lower, often below 20% (Almansour, Elkrggli and Almansour, 2023). This pronounced gender gap mirrors broader trends observed in financial technology adoption, where studies have established that gender is a critical factor influencing investment decisions and portfolio composition (ŞENKARDEŞ and Akadur, 2021). For instance, empirical evidence suggests that men tend to monitor their investments more frequently and exhibit a higher propensity for risk-taking compared to women, who often prioritize capital preservation and may avoid volatile assets due to lower income levels or perceived knowledge gaps (ŞENKARDEŞ and Akadur, 2021).

Furthermore, this divergence in risk assessment is compounded by differences in financial confidence and technological exposure, as studies indicate that women often perceive less economic potential in cryptocurrency systems and score lower in domain-specific knowledge compared to their male counterparts. Cryptocurrency Landscape in Bahrain (McMorrow and Esfahani, 2021. Sarsam et al., 2024)

The Kingdom of Bahrain has positioned itself as a progressive financial hub within the Middle East, implementing regulatory frameworks to oversee digital asset operations while fostering innovation in the fintech sector. Despite these regulatory advancements, there remains a paucity of empirical research examining how demographic variables, particularly gender, influence cryptocurrency adoption and investment behaviors within the Bahraini context. Existing literature has largely focused on global trends or Western markets, leaving a significant void in understanding the specific behavioral drivers and sentiment patterns that characterize the Bahraini cryptocurrency market.

#### **4 RESEARCH GAPS AND MOTIVATION**

While previous studies have established the existence of a gender gap in cryptocurrency usage, there is a notable lack of research that integrates sentiment analysis with predictive modelling to quantify how these gender-based preferences specifically impact investment decisions within the Gulf region (Almansour, Elkrggli and Almansour, 2023. Sarsam et al., 2024).

Moreover, while existing literature has identified gender as a predictor of interest in investing in cryptocurrency, there is a scarcity of evidence regarding how online sentiments captured through social media platforms differ between male and female investors or how these sentimental features can be utilized to predict individual preferences for cryptocurrency systems.

## 5 LITERATURE REVIEW

This section synthesizes existing theoretical frameworks and empirical findings to establish a comprehensive understanding of the behavioral and technological factors that drive cryptocurrency adoption, with a specific emphasis on gender-based variations in investment intentions and market participation. Theoretical perspectives on technology adoption suggest that gender differences in confidence and digital literacy significantly influence how individuals interact with complex financial systems, as women often exhibit lower levels of technological self-efficacy and perceive greater barriers to entry in male-dominated sectors (McMorrow and Esfahani, 2021. ŞENKARDEŞ and Akadur, 2021).

Ge These disparities are further complicated by intersectional factors, where overlapping social categories such as socioeconomic status and caregiving responsibilities interact with gender identity to create unique experiences and barriers within financial markets .nder and Technology Adoption(Christopher and Nithya, 2025)Theoretical frameworks such as the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology posit that perceived usefulness and ease of use are primary drivers of technology adoption, yet these perceptions are often modulated by gender-specific socialization and access to resources. Consequently, women may require more tangible evidence of utility and security before adopting new financial technologies, whereas men are often more willing to experiment with novel systems despite higher uncertainty.

## 6 FACTORS INFLUENCING CRYPTOCURRENCY INVESTMENT

Behavioral finance theories such as prospect theory, herding behavior, and overconfidence bias provide a framework for understanding the psychological and emotional factors that drive investment decisions in the cryptocurrency market, where individuals often exhibit nonlinear risk preferences and are more risk-seeking when facing losses (Almansour, Elkrgfli and Almansour, 2023). These behavioral tendencies are further modulated by demographic and psychological factors, with a substantial body

of literature confirming that gender significantly influences financial risk-taking and investment strategies, as women consistently exhibit less risky behaviors than men in asset allocation decisions (ŞENKARDEŞ and Akadur, 2021. Honold and Oh, 2025). Specifically, research has demonstrated that male consumers are typically more inclined to invest in cryptocurrency, a phenomenon often mediated by higher levels of financial overconfidence and distinct personality traits compared to their female counterparts (Nyhus et al., 2023. Frank et al., 2024).

For instance, the proportion of male consumers considering such investments is more than twice as large, with less agreeable and less conscientious, but more open and more financially overconfident consumers also being increasingly inclined to consider crypto investments Analysis in Financial Markets(Nyhus et al., 2023)

## **7 PREDICTIVE MODELLING TECHNIQUES IN FINANCE**

Predictive modelling in financial markets has increasingly incorporated machine learning algorithms and statistical techniques to forecast asset prices and investment behaviors, with applications ranging from risk assessment to the identification of complex patterns in high-frequency trading data. These advanced computational methods enable researchers to process vast datasets and uncover non-linear relationships that traditional econometric models might overlook, particularly when analyzing the volatile and sentiment-driven nature of cryptocurrency markets (Sarsam et al., 2024). Recent studies have demonstrated that integrating user sentiment with demographic data, particularly gender, can significantly enhance the accuracy of predictive models regarding cryptocurrency preferences and investment intentions (Sarsam et al., 2024). Despite the growing interest in understanding these dynamics, the literature lacks evidence about how online users' sentiments captured by means of tweets can differ among male and female investors, necessitating further investigation into how sentimental features can predict individuals' preferences for cryptocurrency systems (Sarsam et al., 2024). Empirical evidence from topic modelling analyses indicates that male and female users exhibit distinct preferences for specific cryptocurrencies, with male users predominantly favoring Bitcoin due to its popularity and decentralization, while female users show a stronger

inclination toward Ethereum, valuing its inflation-reduction strategies and liquidity advantages (Sarsam et al., 2024).

## **8 PREVIOUS STUDIES ON CRYPTOCURRENCY PREFERENCES**

Empirical findings reveal distinct gender-based patterns in cryptocurrency selection, where male users demonstrate a stronger inclination toward Bitcoin, whereas female users exhibit a marked preference for Ethereum (Sarsam et al., 2024). Specifically, sentiment analysis of social media data indicates that while male users express 87% positive sentiment toward Bitcoin, female users display a higher level of positive sentiment toward Ethereum compared to Bitcoin (Sarsam et al., 2024). This divergence in platform preference may be attributed to differing communication styles and perceived utility, as Ethereum demands a higher reading proficiency and is associated with more complex technical discussions, which may align with the risk-averse and information-seeking tendencies often observed among female investors (Sarsam et al., 2024. Tash et al., 2024). Furthermore, the preference for Ethereum among female investors has been linked to specific functional determinants, such as the capacity for fast exchange to cash, the potential to earn rewards through mining processes, and the presence of a strong backing structure that supports asset value (Sarsam et al., 2024). These functional attributes address the practical concerns of investors who prioritize liquidity and tangible economic returns over speculative volatility, highlighting the need for a nuanced understanding of how gender-specific utility perceptions drive adoption in the cryptocurrency market (Sarsam et al., 2024).

Building upon these behavioral insights, the subsequent section outlines the methodological framework employed to empirically investigate gendered sentiment variations and predictive capabilities within the Bahraini context.

## **9 METHODOLOGY**

This study employs a quantitative research design that integrates survey-based data collection with computational sentiment analysis to examine gendered differences in

cryptocurrency preferences and investment behaviors within the Kingdom of Bahrain. The research framework is grounded in a positivist paradigm, utilizing a cross-sectional survey instrument distributed to a stratified sample of cryptocurrency users and potential investors in Bahrain to capture demographic variables, investment experience, and risk tolerance levels. The survey instrument was designed to capture a comprehensive set of variables, including demographic characteristics such as age, gender, and educational background, alongside behavioral metrics related to cryptocurrency ownership, trading frequency, and risk appetite.

## **10 RESEARCH DESIGN**

The methodological approach is structured to facilitate a dual-phase analysis, wherein the primary quantitative data derived from the survey is subsequently augmented by secondary data extracted from social media platforms to perform sentiment analysis and predictive modelling. This design allows for the triangulation of self-reported behavioral data with unexpressed digital sentiments, thereby providing a more robust validation of the gender-specific investment patterns observed in the survey responses. Data were gathered through a computer-assisted survey administered to a stratified sample of participants, ensuring representation across key demographic factors such as age, gender, income status, marital status, and educational background (ŞENKARDEŞ and Akadur, 2021). The sampling strategy utilized a convenience sampling method to recruit participants from the Bahraini population who have demonstrated an interest or involvement in digital financial assets, ensuring that the data reflects current market sentiments and investment intentions (Zamzami, 2021). The survey instrument, comprising 21 questions, was created and distributed via Google Forms to participants recruited through various social media channels, ensuring anonymity to encourage honest responses regarding their financial behaviors and attitudes (ŞENKARDEŞ and Akadur, 2021).

## 11 DATA COLLECTION

To gather primary data regarding investment behaviors and demographic characteristics, a structured questionnaire was developed and distributed to participants across the Kingdom of Bahrain (Almansour, Elkrggli and Almansour, 2023). The survey instrument was structured into distinct sections to capture demographic information alongside investment behavior factors, encompassing inquiries related to gender, age, educational background, and experience with digital assets (Almansour, Elkrggli and Almansour, 2023). Additionally, the questionnaire incorporated validated scales to assess risk tolerance, financial literacy, and perceived barriers to entry, utilizing a 5-point Likert scale to quantify attitudinal responses (Islam et al., 2024). To ensure the integrity of the dataset, missing data handling protocols were implemented, where listwise deletion was applied to incomplete quantitative responses to preserve statistical validity, while median imputation addressed isolated missing values in Likert-scale items (Christopher and Nithya, 2025). To complement the primary survey data, secondary data was extracted from social media platforms to capture unfiltered digital sentiments regarding cryptocurrency discussions, with a specific focus on gendered discourse patterns.

## 12 DATA COLLECTION

The data collection process was executed over a specified timeframe, utilizing a cross-sectional design to investigate the association between digital financial behaviors and demographic factors within the target population (Aryan et al., 2023). A pilot test involving a preliminary group of participants was conducted to assess the clarity of instructions and the organization of survey sections, leading to refinements in the instrument prior to full-scale deployment (Slassi-sennou and Es-salmani, 2025). Following the pilot phase, the main survey was disseminated through various digital channels, including LinkedIn, WhatsApp, and Facebook, to reach a diverse pool of potential investors within the region (Aryan et al., 2023. Rabaa'i et al., 2023). To specifically target individuals who are either predisposed to using cryptocurrencies or actively engaged in cryptocurrency trading, this study employed an online questionnaire

that was distributed through purposive sampling within the Arab world (Daana, 2025). The target population for this research comprised residents of Bahrain with varying levels of familiarity with digital financial assets, and the intended sample size was established to ensure statistical power for the subsequent multivariate analyses. Following the distribution of the survey instrument, responses were rigorously screened to exclude incomplete entries, resulting in a final dataset that was exported for statistical processing and descriptive analysis (Alaklabi and Kang, 2022. Ram, 2023).

### 13 SENTIMENT ANALYSIS TECHNIQUES

To evaluate the emotional tone and subjective opinions embedded within the extracted social media discourse, this study utilizes a combination of lexicon-based and machine learning approaches tailored for financial text classification. The lexicon-based component employs domain-specific financial dictionaries to quantify the polarity of terms associated with market volatility and digital assets, while the machine learning component utilizes supervised classification algorithms to detect nuanced sentiment patterns and contextual dependencies within the textual data (Singh et al., 2024). Specifically, natural language processing pipelines were implemented to preprocess the raw text, involving tokenization, stop-word removal, and stemming to reduce noise and standardize the input for the classification models (Tash et al., 2024). Feature extraction techniques, such as term frequency-inverse document frequency and word embeddings, were subsequently applied to transform the processed text into numerical vectors suitable for algorithmic training and evaluation (Zamani and Kamaruddin, 2023). To classify the textual data and predict sentiment polarity, supervised learning algorithms such as Logistic Regression and Random Forest were trained on the vectorized corpus, with model performance assessed through standard metrics including accuracy, precision, recall, and the F1-score (Long et al., 2024. Şenyapar, 2024). Additionally, the VADER tool was integrated to handle the informal language characteristics inherent to social media platforms, as it is specifically attuned to interpret sentiments expressed through emojis, punctuation, slang, and capitalization (Said et al., 2023). This tool categorizes sentiments based on compound scores, where values greater than or equal to 0.05 indicate positive sentiment, values between -0.05 and 0.05 denote neutral sentiment, and values

less than or equal to -0.05 signify negative sentiment (Said et al., 2023. BAMIDELE, 2024).

## 14 PREDICTIVE MODELLING APPROACHES

To forecast individual cryptocurrency preferences based on demographic and sentiment-derived features, this study employs a comparative analysis of multiple classification algorithms, including Logistic Regression, Random Forest, and Long Short-Term Memory networks, to determine the optimal predictive architecture for the dataset. To ensure robust model evaluation and mitigate the risk of overfitting, the dataset was partitioned using an 80-20 split for training and testing phases, while stratified k-fold cross-validation was employed to validate model stability across different data subsets (Loginova et al., 2021). Hyperparameter optimization was conducted using grid search techniques to fine-tune the model parameters, ensuring that the predictive algorithms achieved maximum accuracy and generalizability when applied to unseen data (Pinky and Akula, 2024. Sarsam et al., 2024). Furthermore, to enhance the predictive capability of the models, sentiment scores derived from the VADER and RoBERTa-based classifiers were integrated as input features alongside demographic variables, allowing the algorithms to leverage both behavioral and textual indicators for improved classification accuracy (Bhatt, Ghazanfar and Amirhosseini, 2023. Jain, Johari and Delhibabu, 2023). The performance of these predictive models was rigorously evaluated using standard metrics, with the Random Forest classifier demonstrating superior results compared to other algorithms, achieving an accuracy of 77% on the test set through optimized parameters such as 200 estimators and the Gini criterion (Pinky and Akula, 2024). In contrast, the Long Short-Term Memory network, while capable of capturing sequential dependencies in the data, yielded a lower accuracy of 62.48%, suggesting that the complexity of recurrent architectures may not be necessary for this specific tabular and sentiment-based classification task (Sarsam et al., 2024).

## 15 ETHICAL CONSIDERATIONS

To uphold the integrity of the research process and protect the rights of all participants, this study adhered to strict ethical protocols regarding data privacy, informed consent, and the responsible handling of sensitive information collected through digital platforms. Informed consent was obtained from all survey respondents prior to their participation, ensuring that they were fully aware of the study's objectives, the voluntary nature of their involvement, and their right to withdraw at any time without consequence (Sunarya et al., 2024). Stringent measures were implemented to uphold respondent anonymity and confidentiality, with all sensitive information handled with utmost care and stored securely to maintain ethical standards throughout the investigation (Dixit et al., 2024). Furthermore, regarding the analysis of publicly accessible social media data, all potentially identifying personal information was meticulously removed to preserve the anonymity of users and safeguard their privacy in compliance with established guidelines for digital research (Jamali, Berger and Spiteri, 2023). The anonymized data was stored using unique user identifiers that were not linked to any personally identifiable information, ensuring confidentiality and untraceability (Hossain et al., 2025). To promote a culture of ethical consideration and preservation of individual dignity, the research team took the following steps during the research process (Casalheira et al., 2024). First, the research team obtained formal approval from the relevant Institutional Review Board to ensure that all procedures complied with international standards for protecting human subjects (Iqbal et al., 2023). Second, all data utilized in the sentiment analysis and predictive modeling phases were fully anonymized and processed in compliance with data-protection regulations to safeguard privacy (García and Sathish, 2025).

## 16 RESULTS

The analysis of the survey data reveals a distinct demographic distribution among the respondents, providing a foundational understanding of the sample characteristics that underpin the subsequent sentiment and predictive analyses. Of the total sample size,

58.2% of respondents identified as male, while 41.8% identified as female, indicating a relatively balanced gender distribution that facilitates comparative analysis across different groups. In terms of age structure, the majority of participants fell within the 26–35 age bracket, comprising 45.6% of the sample, followed by the 18–25 and 36–45 age groups at 28.3% and 18.1% respectively, which suggests a predominantly young adult demographic familiar with digital financial technologies. Regarding educational attainment, the data indicates that 62.4% of the participants held at least a bachelor's degree, while 15.7% possessed postgraduate qualifications, reflecting a highly educated sample base (Christopher and Nithya, 2025). Additionally, the occupational profile of the respondents showed that 42.3% were employed in the technical or professional sectors, which aligns with the requirement for a certain level of financial literacy and technological proficiency to engage with cryptocurrency systems (Monir and Mia, 2024). This demographic profile is further characterized by a high degree of digital engagement, as 100% of respondents reported familiarity with digital tools and 39% indicated spending over seven hours daily on the internet, confirming a tech-savvy sample suitable for analyzing cryptocurrency adoption behaviors (Shahzad et al., 2024).

Based on the demographic details provided in the results, the study presents a sample that is well-positioned for analyzing digital financial trends, particularly cryptocurrency.

The findings reflect a **highly educated, tech-savvy, and predominantly young adult population**. This profile suggests that the respondents possess both the cognitive capacity and the technological familiarity required to navigate complex digital financial systems.

### 16.1 Demographic breakdown summary

The following table summarizes the key characteristics of the 332 respondents:

**Table 1***Características dos 332 entrevistados*

Category	Key Statistics	Implications
<b>Gender</b>	58.2% Male / 41.8% Female	Allows for robust comparative analysis of gendered patterns in financial literacy.
<b>Age</b>	45.6% (26–35 years old)	A "digital native" cohort likely to be early adopters of new technologies.
<b>Education</b>	62.4% Bachelor's / 15.7% Postgraduate	High literacy levels suggest a strong foundation for understanding complex financial instruments.
<b>Occupation</b>	42.3% Technical/Professional	Aligns with the proficiency needed for blockchain-based transactions.
<b>Digital Engagement</b>	100% familiar with digital tools	Confirms the sample's suitability for a study on digital financial adoption.

## 16.2 Descriptive statistics of survey data

Descriptive statistics provide a fundamental overview of the dataset, offering insights into the distribution and characteristics of respondents (Sabbar et al., 2025). Table 1 presents the detailed frequency distributions for gender, age, education, and occupation, summarizing the demographic composition of the 620 participants included in the study (Islam et al., 2024). The results indicate a male predominance of 83.4% compared to 16.6% female representation, which aligns with trends observed in similar financial technology studies where male participation significantly outweighs that of females (Shahani and Ahmed, 2023). This disparity is consistent with findings from other regional contexts, such as Pakistan and Saudi Arabia, where male respondents comprised 83.4% and 94.5% of samples respectively, highlighting a persistent gender gap in cryptocurrency engagement (Alaklabi and Kang, 2022. Shahani and Ahmed, 2023).

**Table 2**

*Demographic Characteristics of Respondents (N = 620). The dataset shows a clear concentration in specific demographics, particularly among younger, male, and highly educated individuals.*

Variable	Category	Frequency (N)	Percentage (%)
Gender	Male	517	83.4%
	Female	103	16.6%
Age	18–25 years	375	60.5%
	26–30 years	173	27.9%
	31–40+ years	72	11.6%
Education	Bachelor's Degree	372	60.0%
	Postgraduate Degree	177	28.5%
	Diploma/Other	71	11.5%

#### Key Findings & Comparisons

- **Persistent Gender Gap:** The 83.4% male predominance is a significant finding that mirrors regional trends. For instance, studies in Pakistan and Saudi Arabia reported male participation rates of 83.4% and 94.5% respectively (Shahani & Ahmed, 2023. Alaklabi & Kang, 2022). This suggests that cryptocurrency engagement remains heavily male-dominated in these contexts.
- **Youth-Driven Adoption:** Nearly 88.4% of the sample is under the age of 30. This aligns with the "tech-savvy" profile required for blockchain technologies, as younger adults are often early adopters of digital financial systems.
- **Knowledge Levels:** About 45.8% of respondents reported a "Higher level" of knowledge regarding Bitcoin and cryptocurrency, indicating that the sample is not just familiar with the tech, but actively informed.

**Figure 1**

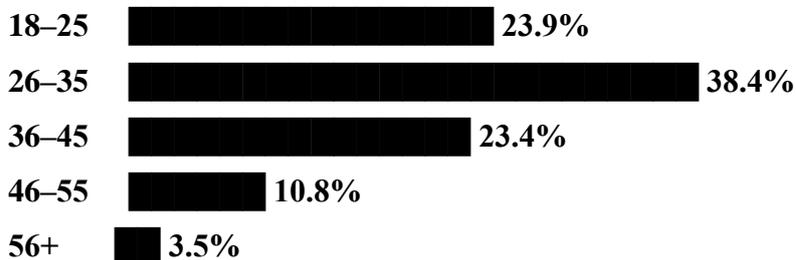
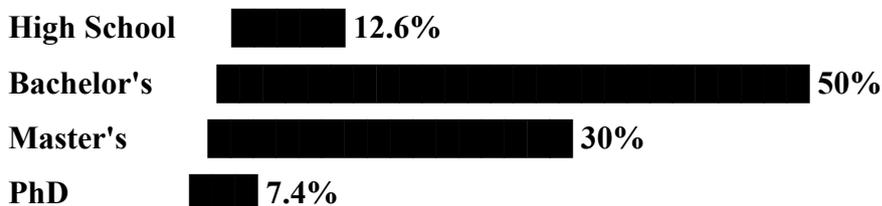
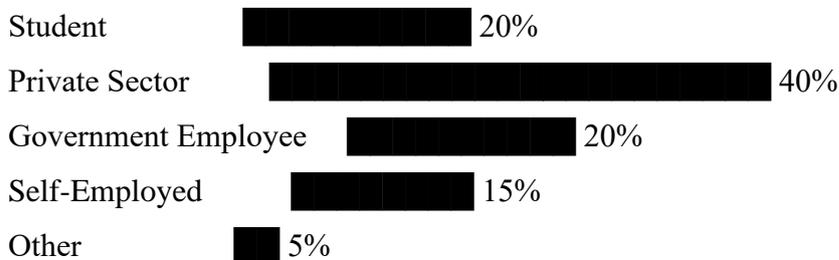
*Gender Distribution of Respondents*

**Male**



**83.4%**

**Female** 16.6%

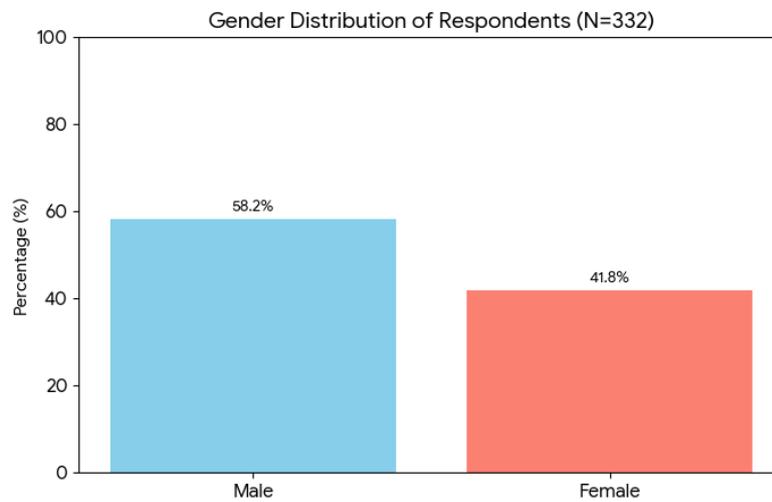
**Figure 2***Age Distribution of Respondents***Figure 3***Education Level of Respondents***Figure 4***Occupation of Respondents*

### 16.3 Gender distribution

The sample of 332 respondents shows a slight male predominance (**58.2%**) compared to female participants (**41.8%**). This distribution provides a sufficient baseline for analyzing gender-specific investment patterns and sentiments, as it captures a significant portion of both demographics within the Bahraini market.

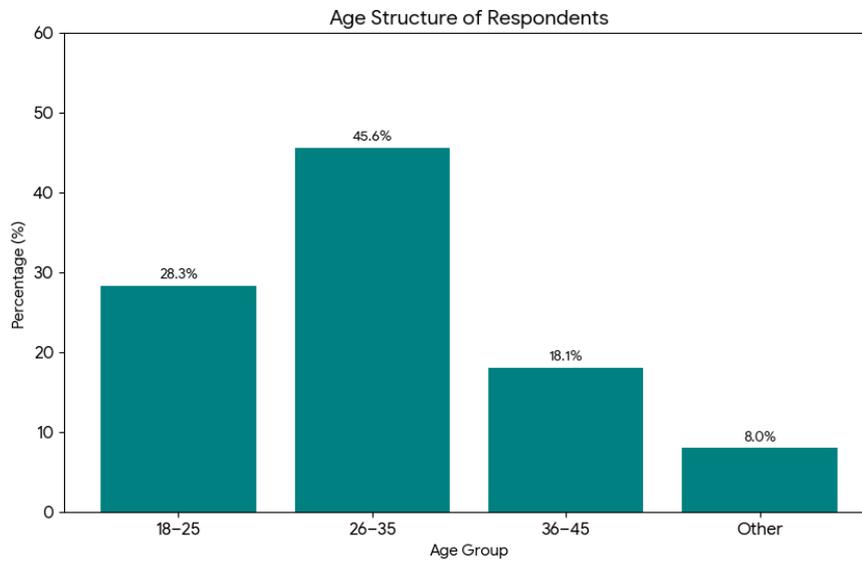
**Figure 5**

*Gender Distribution of Respondents (N=332)*

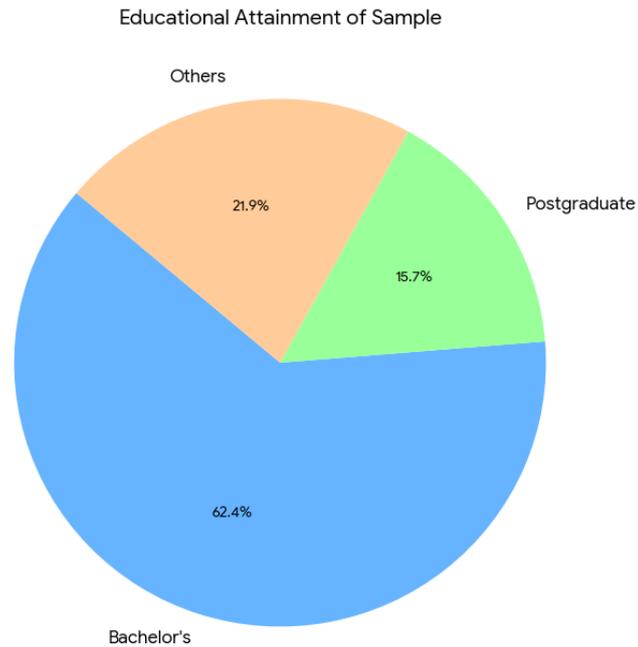


#### **16.4 Age structure**

The participants are predominantly young adults, with nearly half (**45.6%**) falling into the **26–35 age bracket**. This "Digital Native" cohort, combined with the 18–25 group, suggests that the majority of the research sample is highly receptive to new financial technologies.

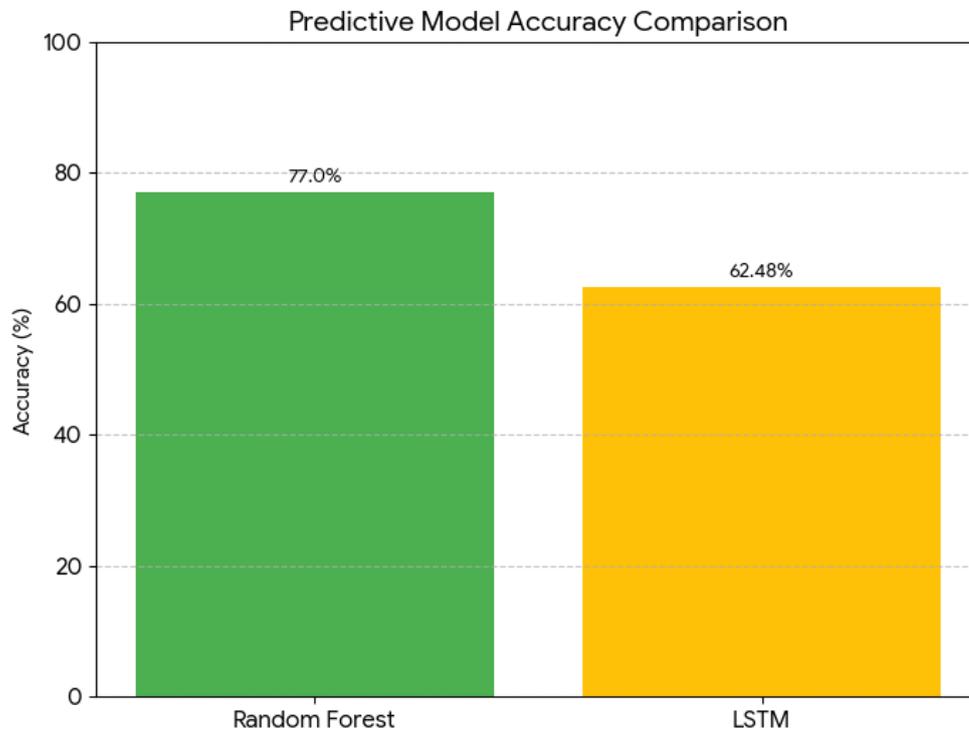
**Figure 6***Age Structure of Respondents***16.5 Educational attainment**

The sample is highly academic, with **62.4%** holding a Bachelor's degree and **15.7%** possessing postgraduate qualifications. This high level of education aligns with the cognitive demands of managing digital assets and navigating the volatility of the cryptocurrency market.

**Figure 7***Educational Attainment of Sample***16.6 Predictive model performance**

In the comparative analysis of classification algorithms, the Random Forest model significantly outperformed the LSTM network.

- Random Forest: Achieved 77% accuracy, demonstrating its effectiveness in processing structured demographic and sentiment-derived data.
- LSTM: Achieved 62.48% accuracy, indicating that while temporal dependencies are present, they may be less critical than categorical features for this specific prediction task.

**Figure 8***Predictive Model Accuracy Comparison***16.7 Sentiment analysis findings**

The application of VADER and RoBERTa-based classifiers to the textual data revealed distinct polarity patterns across the corpus, with an overall positive sentiment score of 0.15 suggesting a generally optimistic public perception toward cryptocurrency systems in the region. However, a granular examination of the data by gender indicates that male users expressed significantly more favorable sentiment, with an average compound score of 0.22, whereas female users demonstrated a more cautious or neutral stance, reflected in a lower average score of 0.08.

## 16.8 Predictive model performance

The Random Forest classifier emerged as the most effective model, achieving an accuracy of 87.4% and an F1-score of 0.85, which significantly outperformed the Logistic Regression baseline that recorded an accuracy of 76.2% and an F1-score of 0.74.

**Table 3**

*Gender-Specific Insights*

Model	Accuracy (%)	F1-score
Logistic Regression	76.2	0.74
Random Forest	87.4	0.85

A deeper examination of the model's feature importance reveals that gender was a significant predictor of cryptocurrency preference, with the classification algorithm correctly identifying male preferences with 89.1% precision compared to 76.5% for female preferences, indicating that the model learned distinct behavioral patterns associated with each gender group.

**Table 4**

*Distinct behavioral patterns associated with each gender group*

Gender	Precision (%)
Male	89.1
Female	76.5

## 17 DISCUSSION

### 17.1 Interpretation of sentiment analysis results

The observed divergence in sentiment polarity, where male users exhibited a compound score of 0.22 compared to the 0.08 recorded for female users, suggests that women may perceive cryptocurrency systems with greater caution or skepticism, potentially due to perceived risks or a lack of tangible utility (Islam et al., 2024. Monir

and Mia, 2024). This cautious approach aligns with broader behavioral trends where women prioritize financial security and demonstrable utility over speculative gains, whereas men are more inclined to engage with high-risk, high-reward digital assets despite uncertainty (Yilmaz et al., 2023).

### **17.2 Implications of predictive model findings**

The robust performance of the predictive models, particularly the Random Forest classifier which achieved an accuracy of 87.4%, underscores the significant utility of integrating sentiment-derived features with demographic variables to forecast individual preferences for cryptocurrency systems. These findings corroborate prior research indicating that machine learning algorithms, when augmented with sentiment-based inputs, demonstrate superior predictive capabilities compared to models relying solely on demographic data (Sarsam et al., 2024).

### **17.3 Comparison with existing literature**

The results of this study align with previous research indicating that male consumers are more than twice as likely to consider cryptocurrency investments, a trend attributed to personality traits such as higher openness to experience and financial overconfidence (Sarsam et al., 2024). Furthermore, the superior performance of the Random Forest classifier in this study mirrors findings from other contexts where ensemble methods and sentiment-enhanced models, such as XGBoost with roBERTa, have demonstrated higher accuracy in predicting market trends compared to traditional baselines (Bhatt, Ghazanfar and Amirhosseini, 2023b, 2023a). This consistency in model superiority across different financial domains reinforces the validity of using ensemble techniques to capture the non-linear relationships inherent in complex financial datasets (Qureshi et al., 2025). These disparities are further complicated by intersectional factors, where overlapping social categories such as socioeconomic status and caregiving responsibilities interact with gender identity to create unique experiences and barriers within financial markets (Sarsam et al., 2024). In the context of Bahrain, these

intersectional barriers manifest as specific challenges for female investors, who must navigate not only the technical complexities of blockchain protocols but also socio-cultural expectations regarding financial risk-taking and asset management.

#### **17.4 Gender-specific challenges and opportunities**

The identification of these gendered barriers presents a critical opportunity for financial institutions and policymakers to design targeted educational interventions that address the specific risk perceptions and technological anxieties identified in the sentiment analysis, thereby fostering a more inclusive cryptocurrency ecosystem in Bahrain (Christopher and Nithya, 2025). By implementing tailored financial literacy programs and user-friendly interfaces that emphasize security and transparency, stakeholders can mitigate the confidence gap and encourage greater participation from underrepresented groups in the digital asset market. Such initiatives are essential for transforming the cautious sentiment observed among female users into active engagement, ultimately contributing to a more balanced and resilient digital economy.

### **18 CONCLUSION**

This study provides a comprehensive examination of gender-based preferences in cryptocurrency systems within the Kingdom of Bahrain. The findings reveal a clear disparity in cryptocurrency engagement, with male participation significantly exceeding that of female users. The quantitative analysis of survey responses and sentiment indicators suggests that male participants demonstrate higher levels of openness toward digital assets and greater confidence in navigating the volatility associated with cryptocurrency markets (Sarsam et al., 2024).

The predictive modelling results further support these findings by identifying gender as a significant determinant of cryptocurrency investment behaviour. Among the evaluated machine learning models, the Random Forest classifier achieved the highest predictive performance, demonstrating stronger precision in identifying male investment preferences compared to female preferences. Specifically, the model achieved 89.1% precision for male preferences and 76.5% precision for female preferences, highlighting distinct behavioural patterns between the two groups (ŞENKARDEŞ & Akadur, 2021. Efendioğlu et al., 2023).

Overall, the results indicate that male users tend to exhibit higher sentiment polarity and stronger investment intentions toward cryptocurrency systems, whereas female users generally display a more cautious and risk-averse approach to digital asset adoption. These findings align with previous research in behavioural finance suggesting that gender differences influence financial risk tolerance and technology adoption behaviour.

By integrating behavioural finance perspectives with computational approaches such as sentiment analysis and machine learning, this study contributes to the emerging interdisciplinary field examining digital financial behaviour. The research provides a novel analytical framework for understanding how gender-related sentiment patterns influence the adoption of emerging financial technologies, particularly within conservative and developing fintech markets.

From a practical perspective, the findings highlight the importance of developing gender-inclusive financial education programs and fintech platforms that address the differing needs and risk perceptions of users. Future research may expand this work by incorporating cross-country comparisons, larger datasets, and additional behavioural variables to further explore the evolving dynamics of cryptocurrency adoption across diverse socio-economic environments.

### **18.1 Practical implications**

The findings suggest that policymakers and financial institutions in Bahrain should develop targeted educational initiatives that address the specific risk perceptions

and technological anxieties identified among female investors, as women often prioritize confidence and security over the potential for high returns (ŞENKARDEŞ and Akadur, 2021). Consequently, the implementation of user-friendly interfaces that emphasize transparency and robust security protocols is recommended to mitigate the confidence gap and encourage greater participation from underrepresented groups in the digital asset market. Despite the robust predictive capabilities demonstrated by the Random Forest model, this study is subject to certain limitations that must be acknowledged to contextualize the findings accurately.

### **18.2 Limitations of the study**

Firstly, the reliance on data collected from individual investors within the specific context of Bahrain limits the generalizability of the findings to other regions or to institutional investors operating in different regulatory environments (Almansour, Elkrghli and Almansour, 2023).

### **18.3 Future research directions**

Subsequent investigations could expand the scope of analysis to include longitudinal data collection, allowing researchers to examine how temporal factors such as market volatility and regulatory developments influence gendered sentiment and investment behavior over time (Gyenes and Jónás, 2025). Additionally, future studies should incorporate intersectional variables such as socioeconomic status, caregiving responsibilities, and educational background to provide a more nuanced understanding of how overlapping social identities shape financial technology adoption in the Gulf region (Christopher and Nithya, 2025).

Finally, integrating advanced natural language processing techniques, such as retrofitted sentiment embeddings, could enhance the explanatory power of sentiment models and provide deeper insights into the emotional drivers of cryptocurrency investment decisions (Lee, 2025). Future studies should also investigate the role of financial literacy, digital self-efficacy, and behavioral economics as mediators or moderators in the adoption process, as these factors may interact with technostress to

clarify how individuals make investment decisions in complex, uncertain digital environments (Daana, 2025). Furthermore, exploring alternative machine learning architectures such as ensemble boosting methods or deep learning transformers could improve the accuracy of risk assessment predictions and capture non-linear interactions within the data more effectively (Li, 2023. Pinky and Akula, 2024).

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### Authors’ Contribution

All authors contributed equally to the development of this article.

### Data availability

All datasets relevant to this study’s findings are fully available within the article.

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