

**Nijmegen School of Management
Department of Economics and Business economics
Master's Thesis in Economics (MAN-MTHEC)**

**Framing of Returns vs. Stock Prices in Investor Perception: The Role
of Presentation in Decision-Making**

By Ismet Motika (1065052)

Nijmegen, 30 June 2025

Program: Financial economics
Supervisor: Kopányi-Peuker, A.G

Radboud Universiteit



Abstract

This thesis, building on Grosshans and Zeisberger (2018), explores how framing investment results as price changes or returns interacts with stock paths to influence investor perceptions and behavior. Grounded in behavioral finance and Prospect Theory, a mixed experimental design (framing between-subjects; paths within-subjects) was used with 163 participants. While framing had little effect on perceived risk, it significantly influenced satisfaction and trading intentions. Price framing led to higher satisfaction and a greater tendency to hold investments, especially in straight and rebound paths. Mediation analysis showed that perceived risk played a minor role, with return expectations and presentation format more strongly driving satisfaction. By integrating framing with path-dependent analysis, this study demonstrates that identical outcomes can produce different investor responses based solely on how they are presented. The findings offer practical insights for improving financial communication, digital advisory tools, and investor education.

Table of contents

1. Introduction.....	4
2. Literature review	8
2.1 Theoretical foundations of the framing effect.....	8
2.2 Framing effect in financial contexts	9
2.3 cognitive, emotional, and temporal moderators	10
2.4 Literacy, Experience, and Cross-Domain Generalizability.....	11
2.5 Hypothesis	12
2.6 Expectations.....	14
3. Methodology	15
3.1 Experimental design	15
3.2 Variables and measures	17
3.3 Data preparation and sample.....	22
3.4 Statistical Analysis	23
3.5 Robustness Checks and Extensions.....	26
4. Results	28
4.1 Simple two-sided T-test.....	28
4.2 Mixed effects model for satisfaction	29
4.3 Base Model: Predicting Satisfaction.....	30
4.4 Mediation: Risk as a Psychological Mechanism.....	32
4.5 Moderated Mediation via SEM.....	33
4.6 Robustness and Diagnostics.....	35
4.7 Unexpected or Non-Aligned Findings.....	35
4.8 Answering the hypothesis	37
5. Conclusion	38
6. References.....	41
7. Appendix.....	48
Appendix A:	47
Appendix B:.....	51

1. Introduction

Throughout their investment journeys, investors are repeatedly required to make decisions based on the available financial information. How they interpret this information is often shaped by the way it is framed. Past research has shown that the paths significantly influence individual risk perception and, by extension, impact investment behavior (Grosshans & Zeisberger, 2018). This paper tried to extend from that fact by incorporating framing as an added dimension. While financial reports often provide both returns and price movements, while there is there is established research based on simply framing, but there is very little when it comes to paths and framing. This thesis explored whether presenting investment performance as either price changes or returns combined with the given paths alters investor perceptions, including risk assessments, satisfaction levels, and decision-making behaviors. The goal was to contribute to the behavioral finance literature by better understanding cognitive biases and their role in the decision-making process.

Investors routinely encounter financial information presented in varying formats, yet the impact of these variations combined with the paths on their judgments, remains somewhat underexplored. If two investments yield identical returns but are expressed in different formats and different paths, one as price movements and the other as returns, do investors evaluate them equally? Or does the framing influence satisfaction and perceived risk? This thesis investigated: How does framing investment performance as price movements versus returns affect investor perceptions and behavior across different stock paths? Specifically, it sought to determine whether identical outcomes, framed differently with different paths, lead to different results, particularly when it came to affecting perceived risk, and ultimately influence satisfaction and behavioral intentions. The paper, also based on Grosshans and Zeisberger (2018), and from which you could from their result some anchoring behaviour, which this paper briefly looked at, discusses. This research directly contributes to the field of behavioral finance by addressing how presentation format (framing) interacts with outcome volatility (path dependency) to shape investor satisfaction, risk perception, and trading behavior. While framing effects are well-documented in decision theory (Tversky & Kahneman, 1981), and path-dependent preferences have been studied in market contexts (Grosshans & Zeisberger, 2018), the integration of these two concepts remains underexplored. By experimentally manipulating both factors within the same design, this study offers empirical insights into how investors process complex financial

information and form judgments based on reference points and visual patterns, key concerns in applied behavioral economics. In doing so, it bridges two important strands of literature and informs real-world financial communication strategies used by digital advisors, educators, and regulators.

Grounded in theories of behavioral finance such as Prospect Theory (Kahneman & Tversky, 1979) and framing effects (Tversky & Kahneman, 1981), this study addressed notable research gaps. While past studies have explored framing generally, few have based framing on stock paths and how that influences the risk perception or the satisfaction of individuals. Grosshans and Zeisberger (2018) found that volatile versus smooth return paths shape investor judgments, but they did not focus on framing. Similarly, Glaser et al. (2007) showed that predictions differ when decisions are based on prices rather than returns, though they did not explore risk perception or satisfaction, and also no stock paths were included. Diacon and Hasseldine (2007) analyzed how visual formats like graphs affect risk perception but did not examine price framing. This study shifted the focus to the cognitive processing of quantitative information and tests whether such framing with paths alters perception and behavior.

Further, Glaser et al. (2019) illuminated how framing alters forecast accuracy but did not investigate its effects on satisfaction, risk perception, or trading behavior. This study also build on those insights by having introduced a causal pathway via mediation analysis and a hybrid experimental design. Thus, it adds depth and methodological rigor to a previously underexplored domain in framing research.

To address these gaps, this study examined how price changes and returns paired with their given paths had affected three primary outcomes: risk perception, satisfaction, and trading decisions. The question that was addressed was whether paths expressed in prices are more satisfying than those expressed in returns? Do these formats influence perceived risk? And do they affect sell/hold decisions? In addition to identifying these effects, the study explored further underlying mechanisms. Mediation analysis tests whether perceived risk explains why one framing format influences satisfaction more than the other. A hybrid design (within- and between-subjects) improved upon past research by enabling both between-group comparisons and within-participant contrasts.

This research provided a crucial contribution by focusing on behavioral outcomes, such as satisfaction and risk perception, rather than solely on forecast accuracy or preference ratings. The dual experimental design allowed for nuanced insights: the between-subject component captures "first impression" effects, while the within-subject component simulates real-world portfolio management where investors evaluate multiple options framed differently. This

methodology reflected real investment environments where framing effects are dynamic and context-sensitive.

The study also offered practical implications. Personalized financial communications could be informed by these findings, tailoring formats to enhance clarity and support better decisions. Unlike Hung et al. (2012), who studied framing broadly, this thesis delved into how the format with stock path impacted specific investor outcomes such as satisfaction and trading behavior. The results can guide financial education programs and user interface designs on platforms and robo-advisors. Policy-makers may also find value in empirical evidence on which formats, when working with certain stock paths, are most likely to lead to misinterpretation, informing targeted regulation.

Using a survey-experimental design, participants were presented with investment scenarios that yield the same outcome, but the stock paths were framed either in prices or returns. The hybrid design ensures internal validity by preventing carryover effects while enabling individual-level comparison because the study was designed so that participants only see one type of framing (to avoid bias), but they rate several different scenarios (to analyze their responses across conditions). This combination improves the accuracy and credibility of the findings. In the study, 163 participants participated in this analysis, of which 82 came from return framing and 81 from price framing. Key dependent variables included satisfaction, perceived risk, return forecast, and trading decisions, measured through Likert scales and open-ended responses.

The analytical method that was used in the research went through multiple phases to examine the impact of framing and stock trajectory on investor reactions. Welch's independent samples t-tests were first used to assess if there were significant differences in satisfaction, trading intention, and perceived risk between the two framing conditions (price vs. return). These first comparisons offered a preliminary evaluation of framing effects before the element of the stock trajectory was included. Then, the linear mixed-effects models (LMMs) were used to account for the structure of the various stock trajectories. This approach helped in the examination of satisfaction across all path trajectories while keeping repeated measures within participants and considering both between-subject and within-subject variability.

Afterwards, mediation analysis was performed to explore underlying psychological mechanisms by evaluating if the impact of framing on satisfaction was mediated through perceived risk. Using the method of Baron and Kenny (1986), two linear models were analyzed: one that forecasts the mediator (risk) based on the independent variables, and another that predicts satisfaction, incorporating both the independent variables and the mediator. The importance of the indirect route was evaluated through bootstrapped confidence intervals.

Furthering on this, a moderated mediation model was used through structural equation modeling (SEM), using the concurrent estimation of both direct and indirect effects and examining if the mediating pathway differed among varying levels of reference-based predictors like deviation from the accurate return or price.

Lastly, to investigate anchoring effects, the variable RefDiff (Reference Deviation), which was created through the variable of return forecast, was incorporated into all predictive models. This variable measured the gap between the estimated outcome of participants and the accurate reference value given in the scenario.

The structure of this paper is the following: the paper starts with an overview explaining the research's motivations and goals, then proceeds to assess the available literature regarding framing, path dependency, risk perception, and anchoring in financial choices. The following methodology chapter outlines the experimental setup, variables measured, and statistical approaches used, such as t-tests, linear mixed-effects model, as well as mediation and moderated mediation analyses. The chapter on empirical results showcases the findings in an organized manner, starting with descriptive and inferential statistics and moving on to multivariate models. The concluding segments present concluding remarks on the theoretical and practical significance of the findings, consider constraints, and suggest directions for upcoming studies.

2. Literature review

2.1 Theoretical foundations of the framing effect

When examining the study of how framing influences investment decisions, this is inherently rooted in the study of behavioural economics. Behavioural economics is a subject of economics that challenges the more traditional economics assumptions of rational decision-making (Kao & Velupillai, 2015). The cornerstone of this field is prospect theory, which was initially developed by Kahneman and Tversky (1979) in who showed that individuals evaluate potential outcomes relative to a reference point rather than in absolute terms. This reference-dependent evaluation leads to several cognitive biases that systematically affect financial choices (Barbaris, 2013).

The key insight from prospect theory is loss aversion, which is the finding that losses psychologically impact individuals strongly than equivalent gains (Schmidt & Zank, 2005). This notion has profound implications when it comes to the idea of investment behaviour, for it alludes that investors might reject positive trades if framed in terms of potential losses, even when the expected value is positive. This theory then leads to the concept of value function, which is concave for gains, which shows risk-averse behaviour, and convex for losses, which shows risk-seeking behaviour (Schroeder, 2008). This explains why investors often hold losing positions long while selling winners too early (Shefrin & Statman, 1985).

Building on this prospect theory, Thaler (1985) developed mental accounting, which explains how people create several separate mental accounts for different financial decisions, which can lead to irrational outcomes. Thaler, therefore, showed that the reference point is of relevance when it comes to making financial decisions.

All mentioned previously lead to the framing effects, which were early on demonstrated by the previously mentioned Tversky and Kahneman (1981), who showed that identical choices framed differently can lead to systematically different choices. They did this by framing the context in terms of lives saved versus lives lost. Translated to a financial context, this implies that presenting identical investment outcomes either as returns or as price changes may lead to significantly different perceptions of risk and satisfaction.

This relates to dual-system thinking, which was refined by Kahneman and Frederick (2002), who suggested that framing changes the accessibility and salience of specific features during judgment. Given that the mind gravitates toward intuitive, emotionally charged cues, this idea helps explain why numeric representations such as price versus returns have a different effect on investor cognition.

Additionally, Bordalo, Gennaioli, and Shleifer (2012) created the Saliency Theory of Choice, which asserts that people overemphasize salient characteristics when making decisions. In this case, a €50 loss might have a greater psychological impact than a -10% return because it is more tangible and vivid.

2.2 Framing effect in financial contexts

The framing effect has also been extensively examined in financial choice settings, with several landmark papers providing crucial observations on how formats of presentation influence investor behavior.

Research by Glaser et al. (2019) demonstrated that returns, when well-presented, can mitigate some of these biases by inducing more systematic comparisons between investment options. Their study established that the performance metric utilized to present performance (price vs. return) actually has the ability to alter the perception and reaction of investors to the same underlying economic fact (Liao et al., 2024).

Glaser et al. (2007) investigated how framing stock market forecasts either as price changes or returns affects investor expectations and decisions. The study found that investors provided price-based forecasts that made different expectations from those provided with return-based forecasts, even where the underlying financial implications were the same. Specifically, return forecasts for increasing stocks were greater and forecasts for decreasing stocks were smaller when people were explicitly questioned about returns compared to prices. This "framing effect" resulted in the conclusion that investors do not consider financial information in a narrowly rational manner but are influenced by the way that information is presented (Cantarella et al., 2023). In addition, the study found a bias to overestimating stock return volatility, with a pattern of overconfidence being observed when investors were asked to predict returns rather than prices. Notably, the study also determined that financial education reduced framing effect and overconfidence bias (Pitthan, F., & De Witte, 2025). These findings contribute to the body of knowledge in finance of behavioural bias that framing influences investor expectations, albeit that the research did not assess it directly on asset allocation decisions.

Grosshans and Zeisberger (2018) added another level of insight by examining how investors evaluate performance in terms of path dependency. By investigating how investors assess performance based on the temporal trajectory of price changes, Grosshans and Zeisberger (2018) provided yet another level of insight. Their research examined the form of the return path, contrasting smooth and volatile trajectories, and how these patterns affect investor

satisfaction and risk perception rather than the framing or format of returns (Roundtree & Allayannis, 2008). Monteiro and Bressan (2021) also added by explaining how satisfaction scales capture subtle psychological changes in investor sentiment across different presentation methods. Further works suggest that sequencing and over-time delivery of performance information interacts with the underlying framing effect, which can strengthen or mitigate biases based on context (Nadkarni et al., 2018.; Cantarella et al., 2023).

2.3 cognitive, emotional, and temporal moderators

The role of investor characteristics in moderating framing effects has been a central research question. Peters et al. (2006) demonstrated that numeracy skill is central to investor processing of alternative performance measures. Their study proved that less numerate investors utilized the price changes more because they are simpler to process, hence making the group particularly vulnerable to framing effects. More advanced financial investors, however, use returns because these enable more accurate cross-asset comparisons (Landete et al., 2020).

The way that investors view risk is further complicated by financial communication practices. Diacon and Hasseldine (2007) looked into how investor perception is affected by various visual formats used in mutual fund disclosures. They discovered that while line charts of prices appeared more stable, bar charts of returns made risk appear higher. This suggests that visual framing significantly changes how volatility is perceived and, in turn, how investors make decisions. Furthermore, there is research noted that investors give excessive attention to the presentation of information in assessing risk, and they would make choices based on the manner in which previous performance is framed, rather than on the actual returns themselves. Their findings highlight the necessity to consider presentation effects in financial reporting so that investors accurately perceive risk and return trade-offs (Bateman et al., 2016).

Lastly, adding strength to the importance of scaling in financial decision-making, Huber and Huber (2019) examined how changes in the scale of presenting financial data influence perception of risk, expected return, and investment desire. Based on their study, when financial metrics were scaled to be unlike each other, investors were disposed to exhibit levels of risk aversion and investment probability, even where there was no real change in financial information (Diacon & Hasseldine, 2007). This means that cognitive processing of financial information is highly responsive to the scaling of data presented, which can reinforce or diminish framing effects (Tian & Zhou, 2015). Their findings provide additional evidence that presentation formats, other than mere framing, are important in shaping investor behaviour.

To build on this analysis further, Reyna et al. (2009) introduced Fuzzy-Trace Theory, which posits that people use the "gist" of numerical information instead of literal quantification. This is highly relevant to this study of price versus returns formats when it is paired up with path dependency, for a sequence of up-down or down-up may impact the gist impression, which may influence whether the journey the price took felt risky, so it can affect risk perception. This is why the same results explained differently still lead to different impressions.

Lipkus et al. (2001) further observe that even educated individuals struggle to understand returns and probabilities. Such an observation increases the strength of the thesis's hypothesis that less numerate individuals may find less complex absolute forms more comprehensible or credible and thereby overestimate framing effects.

Besides cognitive load, emotional response also affects investors' processing of framed information. Lerner et al. (2015) found that some emotions, like fear and anger, alter risk perception and decision confidence. The research adds to Loewenstein et al. (2001), whose Risk-as-Feelings Hypothesis demonstrated that people's feeling responses towards risk often overwhelm rational evaluations. This is to explain why framing (i.e., showing a fluctuating loss curve in prices) could create higher dissatisfaction or trading forces than a smoother return presentation, even though it is economically identical.

The combination with time perception is a second necessary point of view. Read, Loewenstein, and Kalyanaraman (1999) investigated how time discounting impacts gain and loss valuation, showing that immediate frames are over-weighted relative to long-term judgments. Zauberman & Lynch (2005) extended this, demonstrating how subjective time perception influences value judgments. This is very relevant to the analysis, since the way returns are spread out over time might interact with how they're presented (as prices or returns) to affect how satisfied investors feel and how risky they think the investment is.

2.4 Literacy, Experience, and Cross-Domain Generalizability

A variation across-domains perspective to include is from environmental and health economics. Levin, Schneider, and Gaeth (1998) showed that framing effects differ by context, like whether it's about money, health, or product features. But they also found that framing influences decisions across all these areas. This supports the idea that the effects seen in this study could also apply in other areas outside finance. Similarly, Rothman & Salovey (1997) examined whether framing threats to health as gains versus losses impacts decisions and revealed that even purely abstract danger is very susceptible to emotional and linguistic frames.

Based on what Peters et al. (2006) found, this shows how people's ability with numbers (numeracy) affects how well they handle complex information. Less complicated formats (€ changes) reduce mental effort and are more accessible for low-literacy investors (Lipkus et al., 2001; Reyna et al., 2009). This aided this study in framing prices and returns can have differences in difficulty in comprehension and therefore different effects. Furthermore, framing also interacts with affective systems when information is effortful cognitively or affectively, investors resort to heuristics or get exposed to framing biases (Loewenstein et al., 2001; Kahneman & Frederick, 2002). Therefore, framing cannot be viewed as a value-free presentation but rather as an active probable influence on decision confidence, satisfaction, and perceived volatility.

Given this particular study, it is important to know the size of the effect framing effects have. More educated individuals in financial markets or institutional investors might be less affected than retail investors or non-informed investors

The role of investor sophistication and cognitive bias in framing effects has been well documented in the behavioural finance literature (Maheshwari et al., 2023). For instance, more sophisticated investors such as institutional traders, finance professionals, or long-term investors would be predicted to be more systematic in processing information and less susceptible to presentation biases. For example, Cheng, Raina, and Xiong (2014) examined mortgage choices of financial experts within the housing bubble and determined that despite training, they were not entirely immune to speculative activity, showing professional training doesn't necessarily eliminate biases. Similarly, Dhar and Zhu (2006) demonstrated that investors who had more than 10 years' market experience exhibited a significantly weaker disposition effect (selling winners too soon and retaining losers), which indicates experience eliminates some of these behavioural biases. Individual investors, particularly less financially sophisticated ones, however, use heuristics and are more vulnerable to information framing. Hung, Yoong, and Brown (2012) found that those who were less financially literate struggled with returns and tended to over-weight price changes (e.g., to put more faith in "a \$100 gain" than in "a 5% return"). This is echoed in the results of Lusardi and Mitchell (2014), which linked low numeracy to poorer financial decisions, especially when return presentations were more complex.

2.5 Hypothesis

Now, given the introduction of the topic and the accompanying literature review, the null and alternative hypotheses for this study are the following:

Null Hypothesis (H_0): There is no difference in perceived risk between investors who see performance framed as returns versus price changes when the underlying financial outcome is identical.

Alternative Hypothesis (H_1): Investors will perceive higher risk when performance is presented as returns compared to price changes, even when the underlying financial outcome is identical.

Null Hypothesis (H_{01}): There is no difference in satisfaction ratings between return-framed and price-framed presentations of identical investment outcomes.

Alternative Hypothesis (H_{11}): Investors report lower satisfaction when performance is framed as returns versus price changes, despite identical outcomes.

Null Hypothesis (H_{02}): Framing (returns vs. price) has no effect on investors' stated intention to hold versus sell a stock.

Alternative Hypothesis (H_{12}): Return framing leads to a higher tendency to sell (i.e., lower "hold" intention) than price framing

The subsequent hypotheses are based on the previously mentioned literature, indicating that the way financial outcomes are displayed returns as opposed to price fluctuations can influence investor perception, satisfaction, and behavior, despite the outcomes being economically the same.

Framing theory (Tversky & Kahneman, 1981) and prospect theory (Kahneman & Tversky, 1979) indicate that people are very responsive to the way information is conveyed, particularly in situations related to gains, losses, and ambiguity. Research by Diacon and Hasseldine (2007) and Huber and Huber (2019) indicates that return formats, which are relative and frequently more abstract, generally enhance the perception of volatility and risk compared to more tangible price-based formats. This reinforces the initial hypothesis (H_1), predicting greater perceived risk in the return-framed scenario.

Expanding on this, value function theory (Schroeder, 2008; Shefrin & Statman, 1985) and path-dependency studies (Grosshans & Zeisberger, 2018) indicate that emotionally impactful displays, like erratic return trends, may diminish investor satisfaction, despite identical overall performance. In addition, Reyna et al. (2009) and Lipkus et al. (2001) demonstrate that investors with lower numerical skills depend on straightforward, gist-oriented evaluations. Because price changes are simpler to understand, they could provide more clarity and emotional ease, reinforcing the second hypothesis (H_{11}): diminished satisfaction is anticipated in return-framed scenarios.

Lastly, these perceptual and emotional variations are anticipated to affect behavioral intentions. The risk-as-feelings hypothesis (Loewenstein et al., 2001) suggests that emotionally charged

situations, like variable returns, can trigger fear-based responses such as hasty selling. This is backed by framing studies (Glaser et al., 2007) and the evident effects of salience (Bordalo et al., 2012), resulting in the third hypothesis (H_{12}): return framing will enhance the probability of selling relative to price framing.

2.6 Expectations

Based on previous research in behavioral finance and information framing, it is expected that the way performance information is presented, either as returns or price changes, will significantly influence investors' perceptions and behavioral responses, even when the underlying financial outcomes are identical.

Initially, it is expected that participants will view increased risk when investment performance is shown as returns instead of price fluctuations. This expectation is based on findings by Diacon and Hasseldine (2007), who demonstrated that return-based formats highlight volatility more prominently than price line graphs. In a similar vein, Huber and Huber (2019) showed that varying scales and formats can enhance risk perceptions, even when the actual values do not change. These findings are also backed by the Risk-as-Feelings hypothesis (Loewenstein et al., 2001), indicating that emotionally charged displays like variable returns can increase perceived uncertainty.

Secondly, because of the heightened awareness of volatility in return-framed situations, it is anticipated that investors will express lower satisfaction with similarly performing investments when performance is presented as returns rather than price. This is based on Prospect Theory (Kahneman & Tversky, 1979), which suggests that losses or uncertainty, even when presented abstractly, diminish experienced utility. Research conducted by Grosshans and Zeisberger (2018) indicates that the perception of instability in the return path diminishes satisfaction, even when end values are the same.

Third, return-framing is anticipated to result in a decreased intention to retain investments, that is, investors will be more inclined to indicate a wish to sell when contrasted with price-framed presentations. Loewenstein et al. (2001) and Bordalo et al. (2012) predict this change in behavior, suggesting that more noticeable or emotionally charged signals (like perceived return volatility) can lead to faster avoidance or exit choices. This corresponds with studies on framing-induced overreactions and mental accounting (Thaler, 1985), indicating that more unstable presentations cause individuals to perceive losses as more likely, resulting in heightened selling urges.

3. Methodology

This research employed a controlled experimental framework to investigate how the presentation of investment outcomes as either price path or comparative returns path affects investor perceptions and behavioral intentions. Utilizing the model proposed by Grosshans and Zeisberger (2018), the study examined framing effects by showing participants the same financial results in two different presentations with paths. The objective was to assess if the presentation format by itself influences perceived risk, satisfaction, trading intention, reference points, and return expectations.

Participants were randomly allocated to one of two framing conditions: a return-framed condition or a price-framed condition. In every group, participants evaluate a range of investment situations that exhibit three types of price patterns (Straight, Down-Up, and Up-Down), all resulting in a +10% return. This mixed approach, between-subjects for framing and within-subjects for price trajectory, enhances internal validity and realism significantly.

The research utilized a series of statistical models to examine the data. Welch t-tests evaluate initial variances in perceived risk, satisfaction, and trading choices among framing groups. Linear mixed-effects models (LMM) consider repeated measures and analyze the interaction between framing and price trajectories. The mediation analysis investigates whether perceived risk mediates the impact of framing on satisfaction. Ultimately, a structural equation model (SEM) is employed to examine a moderated mediation model that combines reference points, expectations, and cognitive pathways in influencing investor outcomes.

Together, this methodological strategy facilitated a detailed examination of how framing influences psychological perceptions and behavioral reactions, despite the stability of financial fundamentals.

3.1 Experimental design

This research utilized a mixed experimental design, integrating a between-subjects manipulation of framing alongside a within-subjects manipulation of return paths. Participants were randomly allocated to one of two framing conditions: a price-framed group, where stock results are displayed as numerical prices, or a return-framed group, where the same performance is illustrated as percentage returns. This between-subjects design prevented contamination that could have happened if participants experienced both formats.

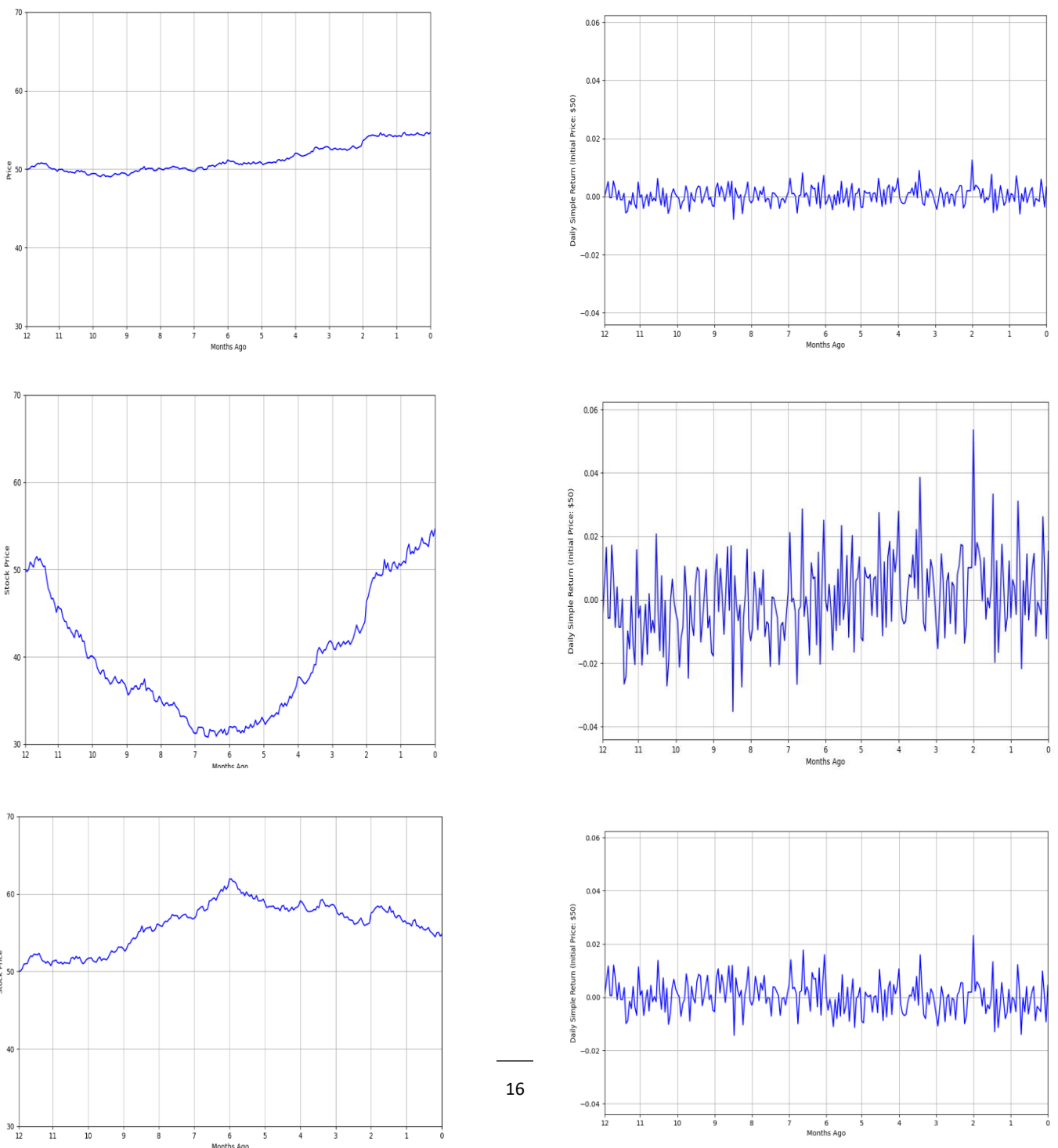
Under each framing condition, participants assessed three different investment paths. These paths are founded on the return path scenarios created by Grosshans and Zeisberger (2018), and consist of: a linear growth, a down-up path, and an up-down path. In the price framing group,

participants observed stock prices change from an initial figure (e.g., 50), drop to 35, then rise back to 50, and conclude at 55. In the return group, the price changes are represented in returns also for the paths of (straight, up-down, down-up)

This blend of framing format (between-subject) and path pattern (within-subject) allowed the research to distinguish the psychological impacts of framing while examining how the order of returns influences investor perception. The design guarantees that every participant evaluates the identical underlying financial data, thus regulating performance fundamentals while examining how presentation style impacts satisfaction, perceived risk, and investment actions.

Below are the paths and their corresponding return next to them.

Figure 1: Price and return trajectories under different simulated paths.



3.2 Variables and measures

This research assessed the psychological and behavioral effects of how investment performance is framed by utilizing a range of dependent variables grounded in behavioral finance studies. Every variable reflects a distinct part of the investor's experience emotional evaluation, cognitive assessment, decision-making, and anticipations for the future. The variables were assessed using Likert-type scales or open-ended responses, allowing for both detailed interpretation and statistical analysis. The variables of satisfaction, perceived risk, and trading decision came from Grosshand and Zeisberger (2018), and the variables of reference point and return forecast were added to this study. Below, these variables are given, including the question on how it was captured.

1. Satisfaction

"How satisfied are you with this investment's performance?"

Scale: -4 (Very unsatisfied) to +4 (Very satisfied).

The Satisfaction variable is central to this thesis, captured by its measure of: "Most satisfied or most unsatisfied," which is placed on a -4 to +4 Likert scale running from Very Unsatisfied through Very Satisfied. This bipolar scale measures both negative and positive aspects of investor attitudes through specific valences that surpass unidirectional and neutral-oriented scales.

This variable aimed to measure investors' subjective evaluations of investment success, going beyond objective financial indicators such as return percentages or volatility. Satisfaction here is understood as a psychological and emotional response to investment outcomes, shaped not just by performance but also by how that performance is presented. Rather than focusing solely on figures such as prices or returns, this evaluation captures how investors feel about their experience. Prior research (Vohra, 2023) indicated that such satisfaction plays a central role in investor retention, risk tolerance, and behavioral biases. The variable functions as an indicator for behavioral finance theory's cognitive-affective appraisal process. Research examined the effects of performance presentation methods on investor interpretation through its dependent variable approach to satisfaction measurement. The research method for measuring satisfaction follows established behavioral research procedures. Grosshans and Zeisberger (2018) measured investor satisfaction using comparable scales for their study on investor learning and sentiment. Monteiro and Bressan (2021) explained how satisfaction scales capture subtle psychological changes in investor sentiment across different presentation methods. The 9-point Likert scale

provides detailed information that enables statistical modeling to detect small sentiment variations in participant responses. The satisfaction measure functions as a mediator that connects framing effects and their impact on trading behavior. The positive presentation of identical results would generate elevated satisfaction levels, which could affect participants' stock selling or holding decisions. Satisfaction serves both as an outcome measure and a potential mediator within the complete cognitive-behavioral process.

The satisfaction variable served as an essential element because it helped the study to understand investment subjectivity and how framing effects transform into actual investor actions.

2. Perceived Risk

"How risky did this investment feel?"

Scale: 1 (Not risky) to 7 (Extremely risky).

The assessment of Perceived Risk uses the question "How risky did this investment feel?" which presents a 7-point Likert scale from 1 (Not risky) to 7 (Extremely risky). The variable measured subjective risk perception of investors, although this perception does not match actual volatility levels because it effectively predicts their investment choices.

Behavioral finance relies on perceived risk as its basic concept to identify irrational investor behaviors, including loss aversion and disposition effect, and herding. Investors make investment decisions based on perceived risk levels rather than mathematical risk assessments because their perception of risk depends on recent experiences and presentation methods as well as cognitive shortcuts. The measure directly supported the research because it evaluated how risky investors perceive financial data when price and return investment returns are used as framing tools. A zero-point or midpoint-free rating scale ensures directional responses, which will produce distinct data points for analysis. Grosshans and Zeisberger (2018) support this measurement method because they emphasize how psychological perception determines financial volatility assessment. Monteiro and Bressan (2021) demonstrate that framing plays a critical role in determining perceived risk even when the fundamental return remains unchanged. The present study used perceived risk both as an outcome variable and as a possible intervening factor to explain how framing impacts satisfaction and trading choices. The employment of a 7-point scale enables precise interpretation without compromising methodological consistency with prior studies. The results become more robust while their external validity increases through this approach. Risk perception required a broad answer collection because individual perspectives tend to differ strongly during experiments that modify investment information presentation. Perceived risk serves as a vital link between

financial data and investor response because it combines measurable market data with unpredictable investor behavior. The existence of perceived risk enabled the study to better understand how investors make uncertain inferences through superficial presentation styles. The variable enhances the research knowledge of investor psychology while strengthening the theoretical value of this research.

3. Trading Decision

"Would you hold or sell this stock today?"

Scale: 1 (Very likely sell) to 6 (Very likely hold).

This manipulation was critical to this thesis because it translated internal beliefs such as satisfaction and perceived risk into a public behavioral intention. In contrast to attitude variables, trading decisions are a proximate measure of actual investor behavior and thereby a critical bridge between cognition and action.

Midpoint neutrality was intentionally avoided. It forces respondents to take a position either for buying or for selling, thereby increasing the discriminative power of the scale. Such a decision format has the purpose of reducing ambivalence and allowing for unambiguousness of respondents' replies, as per proposals by Trang and Tho (2017). This is important in the experimental arrangement where framing effects are required to be quantified exactly. If the question allowed neutrality, the observable impact of the framing manipulation on actual investment intentions would be diluted.

The variable was also of interest to the analyst since it captured how internal variables like satisfaction and perceived risk are translated into action. For instance, even if the investor is fairly satisfied, a high perception of risk would still lead to selling. Conversely, a positive attitude towards the future could lead to a hold decision irrespective of dissatisfaction. Including these trading decisions, the study could assess how far subjective attitudes actually determine action often under-emphasized in behavioral finance theory.

While the majority of research (Glaser et al., 2007) is concerned with performance and expectations in the past, it does not necessarily pick up on what people will do in a genuine situation. This study filled the gap with a dependent variable based on behavior. Moreover, it can be tested to see whether the framing effect not only impinges on perceptions but also decisions, which has implications for the way investment sites and reports are put together.

Overall, the trading decision variable is a way to identify the behavioral termination point of the affective-cognitive process under the influence of framing. It enhanced the applied significance of the study by linking psychological assessment with real-world financial conduct.

4. Reference Point

"What's the lowest price you'd accept to sell this stock?"

Open-ended: \$[input].

This open-ended question allowed respondents to give a specific numeric value (e.g., \$25), which is their internalized performance benchmark or tolerable loss/profit threshold. A fundamental tenet of behavioral finance is that reference points serve as cognitive anchors for risk tolerance and decision framing.

Anchor points are extremely personal and are determined by previous expectations, experience, and biases. By asking participants to provide the actual euro figure rather than select from a range, this measure captures the subjective and often non-linear way that investors think about acceptable outcomes. This was particularly applicable to the present thesis, which looked at whether different framing conditions (price of return) affect the way investors mentally anchor their acceptable boundaries.

This openness also facilitated comparative analysis across experimental conditions. For example, if framing in price terms generates more conservative (lower) reference points than return framing, this would suggest that surface presentation cues have a pronounced impact on basic investment judgments. Monteiro and Bressan (2022) emphasize the diagnostic value of open-ended measures in revealing cognitive heuristics that would otherwise be dormant in fixed-scale items.

Furthermore, the reference point variable can be used to infer loss aversion behavior. If the investor sets a minimum acceptable selling price, even in circumstances of losses, it may be an indication of resistance towards realizing losses, a known behavioral bias. For the price group, the prices are more apparent, but this is more difficult in the return group. Conversely, a lower reference point might suggest either a risk-seeking attitude or a resignation to the poor performance. This bidirectional diagnostic utility makes the variable highly valuable for accounting for individual differences in investor psychology.

The open-ended section in the thesis design merges with Likert-scale items across other sections because of its open nature.

This variable provides deeper insights into decision-making criteria because it reveals implicit factors that enhance understanding of how framing affects investor judgments.

5. Return Forecasts

The Return Forecasts consist of two separate measurement tools.

How do you estimate the probability of this stock price rising during the following twelve months, at what level? The scale ranges from 1 Extremely Unlikely to 6 Extremely Likely.

Your level of confidence regarding this forecast stands at what level? (1 = Not confident at all to 6 = Extremely confident)

These items together measured the direction of expected returns as well as the level of certainty behind those predictions. The dual measurement system strengthens investor sentiment assessment through the disclosure of both positive and negative outlooks and the strength of these beliefs.

The differentiation between forecast confidence and probability proved important because these two factors normally produce opposing effects on investor decisions. A stock investor who predicts a rise in the stock market value can hold a strong belief in this prediction, yet still maintain cautious behavior. The thesis benefited from analyzing both factors to separate affective and cognitive components in forward thinking because these elements usually merge in basic forecasting metrics.

The value of this variable lies in its ability to assess whether framing techniques modify retrospective evaluations (e.g., satisfaction or risk perceptions) and simultaneously influence forward-looking mental states. Research indicated that satisfaction and perceived risk influence future return expectations while framing methods modify both the magnitude and direction of those expectations (Demirgüneş, 2015; Monteiro & Bressan, 2021).. The presentation of stock performance using returns instead of prices creates more optimistic outcomes, which builds confidence among investors who have limited financial experience.

The Likert scale, consisting of six points, does not contain a central point, so respondents must select either a positive or a negative answer. The measure achieves better sensitivity to detect framing effects because experimental manipulations tend to produce these effects most strongly. Behavioral science best practices are followed through this method because neutral responses from respondents represent indecision rather than neutrality.

The Return Forecast variable functions as an anticipatory measure that strengthens analysis by integrating with more immediate evaluative and behavioral data. The assessment enabled the study to understand whether framing effects extend beyond current satisfaction and decisions to influence investors' future outcome forecasts and their self-assessed confidence levels.

3.2 Data Preparation and Coding

Several steps were implemented during dataset preparation to maintain both consistency and interpretability of the results. All responses from Likert-scale items about satisfaction and perceived risk and trading intentions and expected returns, and confidence in those expectations were converted into numerical values. The conversion enabled statistical modeling and comparison of patterns between different experimental groups. The study encoded categorical

variables through recoding the framing condition into a binary variable (0 for return and 1 for price) and dummy coding the price path variable to represent Down-Up and Up-Down trajectories with the Straight path as the reference.

The study had multiple derived variables to better understand psychological responses from participants. The `return_forecast` variable combines return likelihood and confidence scores after standardization through z-score transformation to measure investors' expectations according to De Bondt and Thaler (1995). The study determined two deviation metrics for the reference point variable through calculations: `ref_diff` which displays the absolute difference between reference points and final stock prices, and `ref_pct_diff`, which presents this difference as a percentage of the final value. The procedure functions optimally for identifying behavioral phenomena like anchoring and loss aversion according to Furnham and Boo (2011).

All participants who did not complete all necessary survey questions were excluded before any analysis began. All variables underwent screening procedures to detect outliers and verify normality, and then received appropriate transformations when needed to meet the normality assumptions. The method ensures proper psychological examination of framing effects and price path volatility based on a clean dataset, which is suitable for analysis. During screening, most variables, such as satisfaction, risk, and trading decision, exhibited satisfactory distributional characteristics without significant skewness. Although certain outliers were noted in the reference point estimates (notably in the return-framing condition), they were kept to maintain real-world variability unless they were evidently unreasonable (e.g., reference points 1,000 times the final value). Variables utilized in regression analyses were assigned numerical codes and checked for normality, with transformations (such as standardization for prediction and confidence) carried out only as necessary for interaction or moderation variables. No transformations were required to satisfy the fundamental assumptions for t-tests or linear models, and residuals conformed to normality assumptions according to visual evaluation and model diagnostics.

3.3 Data preparation and sample

All participants who did not complete all necessary survey questions were excluded before any analysis began. All variables underwent screening procedures to detect outliers and verify normality, and then received appropriate transformations when needed to meet the normality assumptions. The method ensures proper psychological examination of framing effects and price path volatility based on a clean dataset, which is suitable for analysis.

The experimental group consisted of 163 subjects whereby 82 were in the return framing group and 81 of which in the price framing group.

The study applied both facility-based and targeted sampling techniques. The recruitment methods for this study will use university student groups alongside online communities of investors.

The study's selection process maintained balance to separate framing effects while producing strong contrasts between study groups. The presentation mode evaluation of investor perception results in enhanced internal validity while ensuring accurate interpretation of presentation effects.

3.4 Statistical Analysis

The research employed advanced statistical models grounded in psychological theory and econometric practice to systematically evaluate how path dependency and framing influence investor attitudes and behaviors. The analysis focuses on three key questions: Framing together with path dependency influence satisfaction individually or collectively. The risk perception serves as the channel through which these effects occur. The research investigated whether these effects are moderated by individual differences or reference-based heuristics.

Simple two-way t-test

In the initial phase of the analysis, this research performed a set of Welch independent samples t-tests to examine group means between the price and return framing conditions concerning important dependent variables. This method was employed to evaluate whether the framing manipulation had an instant and statistically significant impact on participants' satisfaction, perceived risk, and trading intention.

The Welch t-test was chosen instead of the standard Student's t-test because of its resilience to violations of homogeneity of variances, which is a frequent problem in experimental data with unequal group sizes or heteroscedasticity (Ruxton, 2006). This enabled a more cautious and dependable comparison of group averages across framing conditions.

Three distinct models were analyzed for the outcome variables: satisfaction, perceived risk, and trading intention. These tests aimed to determine if a basic between-subject framing effect existed before adding control variables or interaction terms in the regression models. For each scenario, the framing variable was classified as a binary between-subject condition (price versus return), and group averages were compared for every result. The model will follow the next expression:

$$Y_i = \beta_0 + \beta_1 \cdot \text{Framing}_i + \varepsilon_i$$

Whereby framing is different from framing groups

Linear Mixed-Effects Modeling (LMM)

The study applied a linear mixed-effects modeling (LMM) for data analysis through the lme4 package in R (Bates et al., 2015). The LMM proved to be an appropriate choice for the research because it included elements from both within-subject and between-subject aspects. Multiple investment scenarios were evaluated by participants while they received only one framing condition, which resulted in framing being a between-subject variable due to their repeated evaluations.

The LMM provides statistical adjustments to control framing and price path effects alongside individual baseline response differences. The model follows this expression:

$$\text{Satisfaction}_{ij} = \beta_0 + \beta_1 \cdot \text{Framing}_i + \beta_2 \cdot \text{Path}_{ij} + \beta_3 \cdot (\text{Framing}_i \times \text{Path}_{ij}) + \beta_4 \cdot \text{Trade}_{ij} + \beta_5 \cdot \text{RefDiff}_{ij} + \beta_6 \cdot \text{Forecast}_{ij} + u_i + \varepsilon_{ij}$$

Where:

n_i indexes participants

j indexes the scenario (within-participant)

The participant-specific random intercept v_i follows a distribution of $N(0, \sigma_v^2)$.

The residual error ε_{ij} follows a distribution of $N(0, \sigma^2)$.

This design incorporates participant-specific baseline satisfaction and allows measurement of different investment contexts across scenarios. The use of random intercepts removes participant-specific effects, which results in improved model accuracy and decreased Type I error risk (Gelman & Hill, 2007). The model design enables the elimination of fixed effects that include the interaction between framing and price path, which enhances internal validity (Barr et al., 2013).

Linear Models for Dependent Variables

The study used a standard linear regression model (LMs) to analyze secondary results, including perceived risk and trading behavior. The models provide straightforward methods to evaluate how participants react to independent variables in their cognitive and behavioral responses (Fox, 2016). Two different regression models were used for prediction: one for perceived risk assessment and another for trading intention analysis.

The risk prediction model includes the following variables:

$$\text{Risk} = \alpha_0 + \alpha_1 \cdot \text{Framing} + \alpha_2 \cdot \text{Path} + \alpha_3 \cdot \text{Trade} + \alpha_4 \cdot \text{RefDiff} + \alpha_5 \cdot \text{Forecast} + \varepsilon$$

Trading Decision:

$$\text{Trade} = \gamma_0 + \gamma_1 \cdot \text{Framing} + \gamma_2 \cdot \text{Path} + \gamma_3 \cdot \text{Satisfaction} + \gamma_4 \cdot \text{Risk} + \gamma_5 \cdot \text{Forecast} + \varepsilon$$

The models enable the study to analyze how affective responses (satisfaction) together with cognitive assessments (risk perception) shape trading decisions that are fundamental to behavioral finance (Lo, 2005). Moreover, RefDiff and Forecast act as behavioral economics variables which correspond to anchoring effects and expectation-based reasoning (Bordalo et al., 2020). The models integrate these predictors to determine how investors behave systematically when their expectations are not rational.

A linear mixed-effects model (LMM) was employed for satisfaction since each participant evaluated several scenarios, enabling the model to consider personal variations. Yet, for perceived risk and trading intention, a more straightforward linear regression sufficed. These results exhibited reduced variability among individuals, and analyses indicated that the mixed model produced almost identical outcomes to the simpler model. As increasing complexity did not significantly enhance the outcomes, the standard model was employed to maintain clarity and ease of interpretation in the analysis.

Mediation analysis

The study applied the mediation analysis with the Baron and Kenny traditional technique (1986) to explore the psychological mechanisms between framing effects and investor satisfaction. The approach requires two separate OLS regression models for mediator prediction and outcome prediction.

$$\text{Risk} = a_0 + a_1 \cdot \text{Framing} + a_2 \cdot \text{Path} + \varepsilon$$

$$\text{Satisfaction} = b_0 + b_1 \cdot \text{Framing} + b_2 \cdot \text{Path} + b_3 \cdot \text{Risk} + \varepsilon$$

The calculated indirect effect of framing on satisfaction, which passes through risk, equals the product of coefficients $a_1 \times b_3$. The Baron and Kenny method establishes a basic framework for mediation, but modern practice recommends avoiding the exclusive use of normality assumptions for indirect effect identification (Hayes, 2013; MacKinnon et al., 2004). The study resolved this issue by running 5,000 non-parametric bootstrap simulations through the mediation package in R (Tingley et al., 2014) to generate the analysis. The method delivers robust confidence intervals together with significance tests for indirect effects while making no assumptions about parameters.

Structural Equation Modeling (SEM) analysis of Moderated Mediation

The study then employed Structural Equation Modeling (SEM) through the lavaan package in R (Rosseel, 2012) to examine the interaction between framing effects and cognitive judgments in a moderated mediation analysis. The modeling capability of SEM allows simultaneous estimation of multiple regression relationships to analyze both direct and indirect effects in one

framework (Kline, 2016). The method proves useful when studying complex psychological mechanisms that occur in decision-making situations.

The SEM model is represented as:

$$\text{Risk} = a_1 \cdot \text{RefDiff} + a_2 \cdot \text{Forecast} + a_3 \cdot \text{Framing} \quad \text{Satisfaction} = b_1 \cdot \text{Risk} + b_2 \cdot \text{RefDiff} + b_3 \cdot \text{Forecast} + b_4 \cdot \text{Framing}$$

This model generates two important indirect effects through its equations.

$\text{Indirect}_1 = a_1 \times b_1$ (reference deviation mediated effect on satisfaction through risk)

$\text{Indirect}_2 = a_2 \times b_1$ (forecast strength mediated effect on satisfaction through risk)

Traditional SEM fit measures, RMSEA, CFI, and TLI, serve to assess model fit according to Hu and Bentler (1999). The results include standardized path coefficients, which simplify effect comparison and improve interpretation. The modeling approach helps the study better understand how anchoring expectations and perceptual components affect investor behavior through framing effects (Bagozzi & Yi, 2012).

3.5 Robustness Checks and Extensions

The study conducted multiple methodological robustness checks alongside extensions to validate the empirical findings. The established methodology helps the study confirm that modeling results remain unaffected by different assumptions while demonstrating robustness against alternative specifications (Athey & Imbens, 2017).

1. Tests of Moderation with Interaction Terms: The study added interaction terms such as Framing \times RefDiff and Path \times RefDiff to determine if investor reference point distance affects framing or price path effects. The behavioral finance theory predicts that anchoring works to change how investors perceive numbers in different formats (Returns vs. prices). Robust Standard Errors and Clustered Inference: As the study had repeated measurements within participants, the study ran clustered robust standard errors by participant ID using the `modelsummary` package. It handles within-subjects correlation while providing more cautious but reliable confidence intervals (Cameron & Miller, 2015).

3. The `car` package was used to calculate Variance Inflation Factors (VIFs) for determining the level of multicollinearity between predictors. The VIFs were all below the conventional threshold of 5, which indicates no issues with coefficient stability or interpretability (Fox, 2016).

4. Nonparametric bootstrapping with 5,000 iterations was used for regression and mediation coefficients to make confidence intervals more robust against non-normality. This method,

implemented through the boot package, provides more reliable inference, especially for small or skewed samples (Efron & Tibshirani, 1993).

5. Sensitivity tests were conducted; for instance, Leave-one-out diagnostics were also used to check if the outcomes were being driven by individual-level outliers (Cook & Weisberg, 1982). These methods are used in order to build both the statistical evidence and the theoretical credibility of the study. The observed framing effects among investors are not only statistically significant but also meaningfully large and analytically robust under varying methods, as with best practice in behavioral finance research (Lo, 2005).

4. Results

This section demonstrates the experimental evidence of path dependency and framing effects on investment choices. The analysis evaluates participant satisfaction levels and risk perceptions and their trading choices while studying the effects of outcome presentations in prices versus returns and tracking the development of results through straight and down-up and up-down sequences. Through the study research design, the paper has gained an understanding of how people interpret numeric information and return sequences through psychological processes.

The research employed regression models together with mediation analysis and structural equation modeling, as well as several robustness checks to test our hypotheses while ensuring the accuracy of the results. The study combined statistical research with visual illustrations, which demonstrate the effects of reference setting and pleasure modification across different conditions.

The research demonstrates that satisfaction depends heavily on both the path of returns and the way returns are presented. The participants displayed higher satisfaction for price-based scenarios than for return-based scenarios, while perceived risk acted as a partial mediator for satisfaction levels. The research provided vital information for better financial communication tools and investor support while revealing typical biases that occur during investment choices.

4.1 Simple two-sided T-test

Prior to the regression analyses, initial comparisons were performed to assess whether the framing condition (price versus return) affected participants' satisfaction, perceived risk, and intention to trade. Welch two-sample t-tests were employed to address possible variance discrepancies among the groups.

The findings can be found in Table 1, and they indicate a distinct and statistically meaningful variation in satisfaction between the two framing situations. Participants subjected to price framing indicated significantly greater satisfaction with the investment result ($\beta = 0.63$) in contrast to those who experienced return-based framing ($\beta = -0.94$). This variation indicates that showing performance in price terms enhances the perceived positivity of the result, even when the base situation remains unchanged.

A comparable trend appeared for trading intent. Individuals in the price framing condition reported a higher probability of holding or selling the investment ($\beta = 3.85$) compared to those in the return framing group ($\beta = 3.37$). This indicates that framing not only affects evaluative assessments but can also impact hypothetical actions concerning financial choices.

In contrast, the perceived risk did not show significant differences between the conditions. Participants in the price frame viewed the investment as marginally more risky ($\beta = 3.26$) compared to those in the return frame ($\beta = 2.98$), though this disparity lacked statistical significance. Consequently, although framing significantly affected satisfaction and decision-making intentions, it seemed not to significantly change participants' evaluations of investment risk.

Together, these findings suggest that price framing significantly impacts subjective satisfaction and behavioral intention, whereas its effect on perceived risk is minimal. These results indicate that the presentation of performance information can influence individuals' emotions and reactions to financial situations, highlighting the significance of framing in decisions related to investments. In the next phase, these associations are analyzed through multivariate models that incorporate extra covariates and interactions.

Table 1: T-tests Comparing Framing Conditions

Variable	estimate	estimate1	estimate2	statistic	p.value	parameter	conf.low	conf.high
Satisfaction	1.569	0.630	-0.939	8.490	0.000	486.988	1.206	1.932
Perceived Risk	0.271	3.255	2.984	1.713	0.087	476.689	-0.040	0.583
Trading Intention	0.486	3.852	3.366	3.768	0.000	485.343	0.233	0.739

4.2 Mixed effects model for satisfaction

A linear mixed-effects model (LMM) was utilized to address the repeated-measures aspect of the data, as each participant assessed several investment scenarios. This model featured a random intercept for each participant, allowing the analysis to account for individual-level baseline variations in satisfaction that could otherwise skew estimates.

The fixed effects consisted of the framing condition (price versus return), the investment's price trajectory (straight, up-down, or down-up), along with their interaction. The model also accounted for the participants' trading intentions, the difference between their reference value and the actual outcome (ref_diff), and a return forecast variable generated by merging price predictions with confidence levels. All findings are presented in Table 2.

The findings reveal that trade intention was a robust and statistically significant indicator of satisfaction ($\beta = 0.450$, $p < .001$), validating that those participants more likely to retain or sell their investment also expressed higher satisfaction. The return forecast additionally indicated

satisfaction positively ($\beta = 0.148, p = .033$), implying that participants with assured expectations of favorable outcomes experienced greater satisfaction.

Importantly, the relationship between framing and price trajectory was noteworthy. In the “straight” path scenario, those in the return framing group indicated notably reduced satisfaction relative to participants in the price framing group ($\beta = -1.944, p < .001$). A comparable interaction arose in the “up-down” pathway ($\beta = -1.561, p < .001$). These results indicate that the adverse impact of return framing is particularly pronounced in straightforward or rebound-style situations, where the final outcome can seem more unclear or personally unsatisfactory when conveyed in return values.

In comparison, the primary effects of framing and path individually were not statistically significant, suggesting that their influence on satisfaction relies on their interaction. These interaction effects highlight that the psychological influence of financial results relies not.

Table 2: Mixed effects model

effect	term	estimate	std.error	statistic	df	p.value
fixed	(Intercept)	-1.186	0.287	-4.133	458.567	0.000
fixed	framingreturn	-0.185	0.288	-0.644	416.225	0.520
fixed	pathstraight	0.243	0.260	0.934	349.085	0.351
fixed	pathup_down	0.050	0.246	0.203	327.383	0.839
fixed	trade	0.450	0.063	7.121	479.392	0.000
fixed	ref_diff	0.006	0.006	0.995	257.874	0.321
fixed	return_forecast	0.148	0.069	2.138	479.228	0.033
fixed	framingreturn:pathstraight	-1.944	0.367	-5.304	350.276	0.000
fixed	framingreturn:pathup_down	-1.561	0.349	-4.479	329.011	0.000

4.3 Base Model: Predicting Satisfaction

A multiple linear regression model determined how investors experience happiness based on return framing and sequence order. The model contained three essential variables, which were participant trading choices between selling and holding, as well as their reference error and their predicted return forecast. The model included interaction terms between the return path

(straight, up-down, or down-up) and the framing format (returns vs. price) to detect refined path-dependent framing effects.

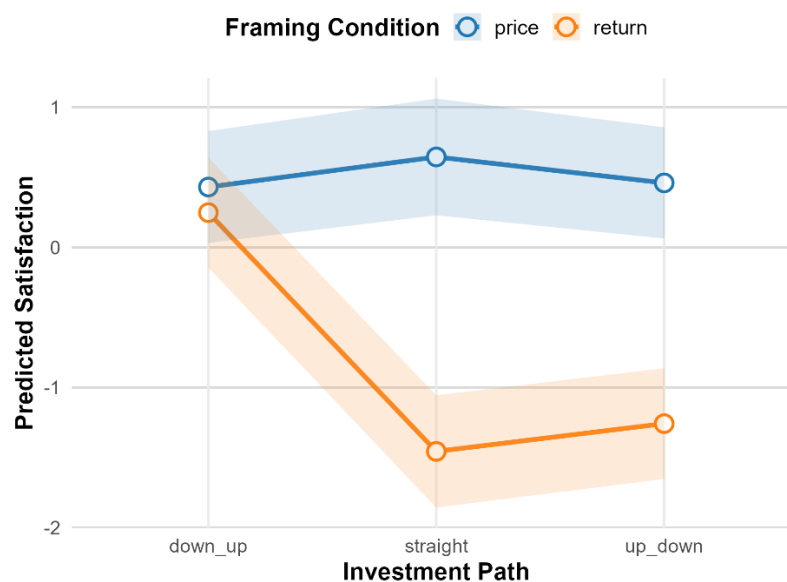
The research demonstrated that participant happiness depends heavily on their trading decisions. The results can be found in Table 3, where people who maintained their stock ownership displayed much higher satisfaction levels ($\beta = 0.48$, $p < .001$), which reflects the common investor behavior of defending their choices after making a decision.

The analysis revealed significant joint effects between the return sequence and presentation method. The participants who received straight-line return data in return format demonstrated the lowest satisfaction levels ($\beta = -1.92$, $p < .001$). The satisfaction levels of participants declined equally when they experienced an up-down return path under return framing ($\beta = -1.53$, $p < .001$). The price-framing condition showed no such patterns, thus revealing that return-based information makes participants more sensitive to return sequence order. This can be seen in Figure 2 whereby price framing has a significant effect on satisfaction but sees little difference among in that satisfaction among which paths taken.

Figure 2: Satisfaction of price versus return across paths

Effect of Price vs Return Framing Across Investment Path:

Model-based predictions with 95% confidence intervals



Return sequencing with framing produces a stronger effect on satisfaction than framing alone does. People show greater emotional responses to the sequence of gains followed by losses when returns are presented in return terms. Returns framing produces intensified emotional responses because it makes participants more sensitive to initial gains followed by losses and flat returns in straight paths.

The manner and sequence of result presentation, along with trading decisions, influence satisfaction levels. Behavioral tendencies like mental accounting and loss aversion become apparent through the observed interaction between framing and path. Financial data presentation should consider both the information content and the visual and mathematical methods of delivery according to the research findings.

Table 3: Linear Regression Model Summary

Term	estimate	std.error	statistic	p.value
(Intercept)	-1.288	0.286	-4.508	0.000
Framingreturn	-0.183	0.287	-0.638	0.524
Pathstraight	0.215	0.298	0.721	0.471
pathup_down	0.029	0.286	0.103	0.918
Trade	0.478	0.064	7.522	0.000
ref_diff	0.004	0.005	0.784	0.433
return_forecast	0.117	0.070	1.677	0.094
framingreturn:pathstraight	-1.918	0.420	-4.567	0.000
framingreturn:pathup_down	-1.535	0.404	-3.794	0.000

4.4 Mediation: Risk as a Psychological Mechanism

To establish the role of perceived risk in explaining how framing affects investor satisfaction, the study conducted a causal mediation study. The study used the `mediate()` function in R for bootstrapped simulations following the Baron and Kenny framework. The study separated the total effect of framing on satisfaction into two components, which included the direct effect that represents the framing influence on satisfaction regardless of risk and the indirect effect that shows how risk mediates the effect. In Table 4, the research findings demonstrated that perceived risk establishes a relationship between framing and satisfaction through a statistically significant indirect effect (ACME) amounting to 0.051 ($p = 0.0388$). The direct effect (ADE) of -1.62 ($p < .001$) remained substantial and robust after accounting for the influence of perceived risk on satisfaction. The mediated proportion was minimal (about -3.2%) yet statistically significant.

People's risk perceptions of investments change when returns are presented as returns, leading to different emotional responses. Return framing leads to an abstract sense of volatility or increased risk even when the actual results remain constant. The mediation effect shows that risk perception plays a role in how people understand and react to financial information, even though it does not dominate the relationship. The findings demonstrate the importance of emotional and cognitive aspects when evaluating investor behavior.

Table 4: Mediation Analysis Summary with 95% CI and P-values

Effect	Estimate	P.value	CI.Lower	CI.Upper
ACME (indirect)	0.051	0.039	0.002	0.123
ADE (direct)	-1.620	0.000	-1.975	-1.264
Total Effect	-1.569	0.000	-1.932	-1.217
Prop. Mediated	-0.032	0.039	-0.085	-0.001

4.5 Moderated Mediation via SEM

The Structural Equation Modeling (SEM) method enabled the study to conduct a moderated mediation analysis to study psychological mechanisms between reference points and perceived risk, and satisfaction. The method helped the study to understand how perceived risk acts as a mediator between reference deviations and return expectations and framing effects on investor satisfaction by allowing simultaneous assessment of multiple relationships, including direct and indirect effects. The model confirmed that framing produces a meaningful direct influence on satisfaction levels. In Table 5, the satisfaction ratings of participants who viewed paths in return format were significantly lower than those who received the identical information presented in price terms ($\beta = -1.53$, $p < .001$). The second significant factor that influenced satisfaction was the predicted returns because people who thought their investments would perform better showed increased satisfaction with their investments ($\beta = 0.34$, $p < .001$).

The analysis found that reference deviations together with return projections did not produce any significant effects on satisfaction through perceived risk ($\beta = -0.042$, not significant). Risk perception remains theoretically important, but it does not appear to be the main factor influencing satisfaction in this situation since the indirect paths from reference error and return forecast to perceived risk are statistically insignificant.

This finding challenges some fundamental assumptions. The SEM results indicate that investor satisfaction depends more on their comprehension of projections together with framing than on their risk perception, although previous research showed a minimal effect of risk perception. Cognitive assessments of danger seem to impact satisfaction more than emotional evaluations do.

Table 5: SEM Moderated Mediation Model Summary with P-values

Predictor	Estimate	Std. Error	Z value	P value	Std. Estimate
risk ~ ref_diff	-0.002	0.005	-0.342	0.732	-0.016
risk ~ return_forecast	0.009	0.064	0.143	0.887	0.007
risk ~ framing	-0.253	0.166	-1.526	0.127	-0.072
sat ~ risk	-0.042	0.051	-0.822	0.411	-0.034
sat ~ ref_diff	0.008	0.006	1.336	0.181	0.057
sat ~ return_forecast	0.342	0.073	4.685	0.000	0.195
sat ~ framing	-1.534	0.189	-8.106	0.000	-0.351
risk ~~ risk	3.051	0.195	15.636	0.000	0.994
sat ~~ sat	3.949	0.253	15.636	0.000	0.828
ref_diff ~~ ref_diff	241.753	0.000			1.000
ref_diff ~~ return_forecast	0.950	0.000			0.049
ref_diff ~~ framing	2.092	0.000			0.269
return_forecast ~~ return_forecast	1.553	0.000			1.000
return_forecast ~~ framing	-0.083	0.000			-0.133
framing ~~ framing	0.250	0.000			1.000
indirect1 := a1*b1	0.000	0.000	0.316	0.752	0.001
indirect2 := a2*b1	0.000	0.003	-0.141	0.888	0.000

4.6 Robustness and Diagnostics

The study performed various robustness and diagnostic tests to validate the regression findings. The study first tested for multicollinearity by using variance inflation factors (VIFs). The VIF values were all below 2 and well within acceptable limits, which indicates that the estimated coefficients remained stable and the predictors in the model were not strongly related to each other (can be found in the appendix).

It applied both clustered standard errors per participant and HC1 heteroskedasticity-consistent standard errors for analysis. The adjustments made to the primary findings were validated through statistical tests, which confirmed the significance of crucial interactions and were particularly useful for examining framing and return pathway interactions.

The stability of regression coefficients was tested through non-parametric bootstrapping with 1,000 resamples. Additional confidence that sample-specific estimates remain unaffected comes from how well the generated confidence intervals match the original OLS model estimates. The analysis of different impact effects was conducted by performing subgroup evaluations for each framing category. The study developed different models to evaluate participants who received price-framed and return-framed scenarios. The reaction to the return sequence was stronger among participants in the return-framed group compared to participants in the price-framed group, which indicates that return displays create more pronounced sequencing effects than price value displays.

Multiple diagnostic procedures confirm that the observed framing effects remain consistent and validate the internal validity of the results. The results establish a robust foundation to interpret findings about the effects of return patterns and presentation formats on investor choices.

4.7 Unexpected or Non-Aligned Findings

The main research results confirm that investor satisfaction and perception result from return order sequences and quantitative presentation styles, yet not all findings match theoretical expectations. The SEM analysis of moderated mediation produced one substantial departure from expected outcomes. The SEM model showed no meaningful relationship between risk perception and satisfaction, although the previous causal mediation method indicated a small but substantial indirect effect through risk perception. The risk factor did not play a crucial role in this study since the results showed that framing and return expectations produced more direct effects than emotional responses, including risk perception.

The participants who received straight return information reported an average reference point that exceeded the actual final value by 1876% which can be seen in Table 6. It could be from

difficulty in interpretation and scaling challenges that arise when working with very small return results. The extreme result could stem from task confusion or anchoring effects that occurred. Participants did not experience this problem in the price-framed situations, which might indicate their difficulty understanding small or abstract returns when compared to actual price values.

The base model showed that framing had no statistically significant effect on the results when the return path was not considered. This contradicts previous findings, which showed that investment decisions can depend heavily on the numerical presentation format. This showed that framing only became significant when participants received returns in a particular order. The findings indicate that information delivery methods and perception sequences create intricate connections. Researching investor psychology proves to be an extremely difficult task because of these unexpected findings. The differences in results may stem from three possible factors, including numerical skills, previous investment knowledge, or exhaustion from taking surveys. The observed variations deliver valuable insights that guide further research about improving risk perception quantification and studying how financial literacy affects return statistics among people.

The research findings highlight the importance of framing effects in understanding investment behavior and satisfaction levels of investors. This study evaluated the effects of return sequence and presentation format on investor satisfaction, as well as perceived risk and reference setting, and trading behavior.

Table 6: Reference Anchoring Effects by Framing and Path

framing	path	n	mean_ref	final_value	avg_relative_error	sd_relative_error
price	down_up	81	46.88	55.00	-14.77	37.50
price	straight	81	46.83	55.00	-14.86	38.85
price	up_down	81	46.24	55.00	-15.92	40.19
return	down_up	82	0.05	0.04	0.35	81.37
return	straight	82	0.02	0.005	1,876.10	11,888.45
return	up_down	82	0.04	0.01	295.01	369.18

4.8 Answering the hypothesis

This research aimed to explore whether the framing of investment results as either price variations or returns impacts investor perceptions and choices, even with the same financial outcomes. Three main hypotheses were suggested, focusing on risk perception, satisfaction, and trading behavior.

The initial hypothesis investigated whether framing returns would increase perceived risk. Although theory and previous research indicated that returns based on percentages could highlight volatility more prominently, the findings did not back this belief. Participants in the return framing condition rated investments as somewhat riskier, but the difference was not statistically significant ($p = 0.087$). Consequently, the null hypothesis was not rejected, suggesting that framing by itself does not significantly alter perceived risk in this situation.

Nonetheless, a contrasting trend appeared regarding satisfaction. The findings clearly indicated that context is important. Participants who perceived investment performance in price terms consistently expressed greater satisfaction than those who viewed the same performance as returns. This influence was particularly intense in straight and vertical paths, indicating that the order of returns enhances the framing effect. Even when the results were the same, the way returns were presented decreased subjective satisfaction, consistent with Prospect Theory's predictions regarding the psychological weighting of losses and volatility. Both t-tests and mixed-effects models provided strong support for this hypothesis, leading to the rejection of the null hypothesis.

Lastly, the third hypothesis concentrated on behavioral intent: whether framing returns would increase the likelihood of investors selling their investments. Once more, the evidence proved to be conclusive. Participants presented with return-oriented information exhibited a notably reduced inclination to hold, in contrast to those shown price-focused data. This indicates that emotional reactions related to return framing, possibly triggering increased worry or perceived uncertainty, can motivate action, rather than merely influencing perception. The null hypothesis was once more dismissed.

Interestingly, while perceived risk was expected to mediate the relationship between framing and satisfaction, its actual role was limited. A small but statistically significant indirect effect was found, yet further analysis via Structural Equation Modeling revealed that risk perception was not a major driver. Instead, future return expectations and the framing itself were the strongest predictors of satisfaction

5. Conclusion

The research examined the effects of investment information presentation on satisfaction and perceived risk and reference setting, and trading behavior while investigating the combined effects of presentation style and return sequence on these factors. The results demonstrate that investor assessments are influenced by presentation style and timing of results, together with the results themselves, through a mixed experimental design.

The main finding reveals that satisfaction depends on both return path and framing effects. Participants who experienced different or reversed return paths, which used return-based returns, showed less satisfaction when the final result was identical. The use of return-based framing makes volatility's psychological effects more pronounced because it makes short-term gains and losses more impactful. Price-framed participants showed little anchoring behavior according to the study by choosing reference points that were lower than actual asset values.

Cognitive factors such as return forecast and reference deviation proved stronger than perceived risk in affecting satisfaction levels according to the research findings. Decision making for investments occurs through an intricate system that combines rational assessments with emotional processing and mental efficiency. The research observations produce multiple useful implications. Financial data presentation methods significantly affect how users feel about their experiences and their decisions through digital platforms, including investment dashboards and robo-advisors. The way facts are presented can lead users to base their choices on knowledge rather than emotions. This research also adds a nice dimension to the research of Grosshans and Zeisberger (2018).

Multiple promising research directions emerge for the future. The research should explore how interactive charts affect framing and sequencing effects in comparison to plain text presentations. Risk perception, along with framing effects in humans, will be studied through research that investigates cultural and demographic influences in the next step. Research conducted over time using longitudinal methods can evaluate whether the effects become stronger or weaker with increased experience. A combination of behavioral data with physiological measurements through eye tracking and biometric feedback would enhance the comprehension of emotional variables affecting investor choices.

The study establishes how investment information sequencing and structural design elements shape investor behavior. The research proves that these effects operate in meaningful ways between emotional reactions and cognitive processes, and behavioral responses. Financial experts and platform designers can develop better solutions that serve users by understanding

their decision-making patterns during uncertainty through the identification and management of these trends.

Nevertheless, a number of limitations must be acknowledged. Initially, the research did not account for individual-level factors like financial literacy, risk tolerance, or previous investment experience. These elements may interact with framing effects and affect how participants comprehend or respond to information. Secondly, although the sample size was sufficient for the statistical techniques employed, the broader applicability of the results may be restricted due to the reliance on a convenience sample, which might be biased towards specific demographics. Third, the research emphasized theoretical situations rather than actual financial results, which might restrict ecological validity. Subsequent studies may improve by including control variables, diverse participant groups, and tangible incentives to more accurately reflect how framing works in realistic financial decision-making scenarios.

6. References

Athey, S., & Imbens, G. W. (2017). The state of applied econometrics: Causality and policy evaluation. *Journal of Economic perspectives*, 31(2), 3-32

Bagozzi, R. P., & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the academy of marketing science*, 40, 8-34

Barberis, N. C. (2013). Thirty years of prospect theory in economics: A review and assessment. *Journal of Economic Perspectives*, 27(1), 173-196.

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of memory and language*, 68(3), 255-278

Bateman, H., Eckert, C., Geweke, J., Louviere, J., Satchell, S., & Thorp, S. (2016). Risk presentation and portfolio choice. *Review of Finance*, 20(1), 201-229.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of statistical software*, 67, 1-48

Bordalo, P., Gennaioli, N., & Shleifer, A. (2012). Salience theory of choice under risk. *The Quarterly journal of economics*, 127(3), 1243-1285

Bordalo, P., Gennaioli, N., & Shleifer, A. (2020). Memory, attention, and choice. *The Quarterly journal of economics*, 135(3), 1399-1442

Cameron, A. C., & Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of human resources*, 50(2), 317-372

Cantarella, S., Hillenbrand, C., & Brooks, C. (2023). Do you follow your head or your heart? The simultaneous impact of framing effects and incidental emotions on investment decisions. *Journal of Behavioral and Experimental Economics*, 107, 102124.

Chen, G., Kim, K. A., Nofsinger, J. R., & Rui, O. M. (2007). Trading performance, disposition effect, overconfidence, representativeness bias, and experience of emerging market investors. *Journal of Behavioral Decision Making*, 20(4), 425-451.

Cook, R. D. W. S. (1982). Residuals and influence in regression

De Bondt, W. F., & Thaler, R. H. (1995). Financial decision-making in markets and firms: A behavioral perspective. In R. Jarrow, V. Maksimovic, & W. T. Ziemba (Eds.), *Handbooks in Operations Research and Management Science: Finance* (Vol. 9, pp. 385–410).

Demirgüneş, B. K. (2015). Relative importance of perceived value, satisfaction and perceived risk on willingness to pay more. *International Review of Management and Marketing*, 5(4), 211-220

Diacon, S., & Hasseldine, J. (2007). Framing effects and risk perception: The effect of prior performance presentation format on investment fund choice. *Journal of Economic Psychology*, 28(1), 31-52.

Fox, J. (2015). *Applied regression analysis and generalized linear models*. Sage publications

Furnham, A., & Boo, H. C. (2011). A literature review of the anchoring effect. *The journal of socio-economics*, 40(1), 35-42

Glaser, M., Iliewa, Z., & Weber, M. (2019). Thinking about prices versus thinking about returns in financial markets. *The Journal of Finance*, 74(6), 2997-3039.

Glaser, M., Langer, T., Reynders, J., & Weber, M. (2007). Framing effects in stock market forecasts: The difference between asking for prices and asking for returns. *Review of Finance*, 11(2), 325-357.

Gelman, A., & Hill, J. (2007). *Data analysis using regression and multilevel/hierarchical models*. Cambridge University Press.

Grosshans, D., & Zeisberger, S. (2018). All's well that ends well? On the importance of how returns are achieved. *Journal of Banking & Finance*, 87, 397-410.

Hayes, A. F. (2013). Mediation, moderation, and conditional process analysis. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*, 1(6), 12-20

- Hsee, C. K., & Weber, E. U. (1999). Cross-national differences in risk preference and lay predictions. *Journal of Behavioral Decision Making*, 12(2), 165-179.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal*, 6(1), 1-55
- Huber, C., & Huber, J. (2019). Scale matters: risk perception, return expectations, and investment propensity under different scalings. *Experimental Economics*, 22(1), 76-100.
- Hung, A., Yoong, J., & Brown, E. (2012). Empowering women through financial awareness and education.
- Jain, J., Walia, N., Singla, H., Singh, S., Sood, K., & Grima, S. (2023). Heuristic biases as mental shortcuts to investment decision-making: a mediation analysis of risk perception. *Risks*, 11(4), 72
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263-291.
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. *Heuristics and biases: The psychology of intuitive judgment*, 49(49-81), 74
- Kao, Y. F., & Velupillai, K. V. (2015). Behavioural economics: Classical and modern. *The European Journal of the History of Economic Thought*, 22(2), 236-271.
- Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford publications
- Landete, M., Monge, J. F., Ruiz, J. L., & Segura, J. V. (2020). Sharpe portfolio using a cross-efficiency evaluation. *Data Science and Productivity Analytics*, 415-439.
- Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual review of psychology*, 66(1), 799-823
- Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: A

typology and critical analysis of framing effects. *Organizational behavior and human decision processes*, 76(2), 149-188

Liao, G., Wang, J., & Xue, J. (2024). Relative performance evaluation and investment efficiency. *Pacific-Basin Finance Journal*, 83, 102261.

Lipkus, I. M., Samsa, G., & Rimer, B. K. (2001). General performance on a numeracy scale among highly educated samples. *Medical decision making*, 21(1), 37-44

Lusardi, A. (2012). *Numeracy, financial literacy, and financial decision-making* (No. w17821). National Bureau of Economic Research

Madaan, G., & Singh, S. (2019). An analysis of behavioral biases in investment decision-making. *International Journal of Financial Research*, 10(4), 55-67.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate behavioral research*, 39(1), 99-128

Maheshwari, H., Samantaray, A. K., & Jena, J. R. (2023). Unravelling behavioural biases in individual and institutional investors investment decision-making: Intersection of bibliometric and systematic literature review. *South Asian Journal of Business and Management Cases*, 12(3), 275-299.

Monteiro, B. A., & Bressan, A. A. (2021). Framing effects of information on investment risk perception. *Revista Contabilidade & Finanças*, 32(86), 285-300

Nadkarni, S., Pan, L., & Chen, T. (2019). Only timeline will tell: Temporal framing of competitive announcements and rivals' responses. *Academy of Management Journal*, 62(1), 117-143

Pitthan, F., & De Witte, K. (2025). How learning about behavioural biases can improve financial literacy?. *International Review of Economics & Finance*, 103989.

Read, D., Loewenstein, G., & Kalyanaraman, S. (1999). Mixing virtue and vice: Combining the immediacy effect and the diversification heuristic. *Journal of Behavioral Decision Making*, 12(4), 257-273

- Reyna, V. F. (2008). A theory of medical decision making and health: fuzzy trace theory. *Medical decision making*, 28(6), 850-865
- Rm, B. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*, 51, 1173-1182
- Rothman, A. J., & Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: the role of message framing. *Psychological bulletin*, 121(1), 3
- Rountree, B., Weston, J. P., & Allayannis, G. (2008). Do investors value smooth performance?. *Journal of Financial Economics*, 90(3), 237-251.
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of statistical software*, 48, 1-36
- Ruxton, G. D. (2006). The unequal variance t-test is an underused alternative to Student's t-test and the Mann–Whitney U test. *Behavioral Ecology*, 17(4), 688-690
- Schmidt, U., & Zank, H. (2005). What is loss aversion?. *Journal of Risk and Uncertainty*, 30, 157-167.
- Schroeder, M. (2008). Value theory.
- Shefrin, H., & Statman, M. (1985). The disposition to sell winners too early and ride losers too long: Theory and evidence. *The Journal of Finance*, 40(3), 777-790.
- Thaler, R. (1985). Mental accounting and consumer choice. *Marketing science*, 4(3), 199-214.
- Tian, Y., & Zhou, H. (2015). From bottom line to consumers' mind: The framing effects of accounting information. *Accounting, Organizations and Society*, 43, 56-66.
- Tibshirani, R. J., & Efron, B. (1993). An introduction to the bootstrap. *Monographs on statistics and applied probability*, 57(1), 1-436
- Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). Mediation: R package for causal mediation analysis. *Journal of statistical software*, 59, 1-38

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, 211(4481), 453-458.

Trang, P. T. M., & Tho, N. H. (2017). Perceived risk, investment performance and intentions in emerging stock markets. *International Journal of Economics and Financial Issues*, 7(1), 269-278

Vohra, T. (2023). Measuring Investors' Experience about Stock Market: Scale Development and Validation. *Abhigyan*, 41(1), 24-34

Zauberman, G., & Lynch Jr, J. G. (2005). Resource slack and propensity to discount delayed investments of time versus money. *Journal of Experimental Psychology: General*, 134(1), 23

AI-Statement

The only AI that was used was Grammarly, which corrects grammar mistakes while writing, so the refining of the language, but no generative AI was used in the process of making this thesis proposal.

7. Appendix

Appendix A:

This appendix presents the results of alternative model specifications that were estimated to test the robustness of the main findings. These include interaction terms and condition-specific regressions, ensuring that the observed effects are not model-dependent and hold across analytical variations

Table 7: Interaction between Framing and Reference Deviation

Term	estimate	std.error	statistic	p.value
(Intercept)	-1.295	0.285	-4.542	0.000
Framingreturn	-0.184	0.286	-0.644	0.520
Pathstraight	0.210	0.297	0.706	0.480
pathup_down	0.028	0.285	0.097	0.923
Trade	0.480	0.063	7.568	0.000
ref_diff	0.004	0.005	0.771	0.441
return_forecast	0.121	0.070	1.733	0.084
framingreturn:pathstraight	-1.961	0.420	-4.674	0.000
framingreturn:pathup_down	-1.613	0.406	-3.973	0.000
framingreturn:ref_diff	2.772	1.536	1.805	0.072

Table 7: Tested whether the effect of reference deviation (anchor distance) on satisfaction is moderated by framing condition.

Table 8: Interaction between Path and Reference Deviation

Term	estimate	std.error	statistic	p.value
(Intercept)	-1.302	0.293	-4.451	0.000
Framingreturn	-0.167	0.295	-0.568	0.570

Term	estimate	std.error	statistic	p.value
Pathstraight	0.225	0.320	0.704	0.482
pathup_down	0.063	0.308	0.206	0.837
Trade	0.478	0.064	7.498	0.000
ref_diff	0.002	0.010	0.249	0.803
return_forecast	0.118	0.070	1.682	0.093
framingreturn:pathstraight	-1.928	0.437	-4.412	0.000
framingreturn:pathup_down	-1.569	0.421	-3.726	0.000
pathstraight:ref_diff	0.001	0.014	0.096	0.923
pathup_down:ref_diff	0.004	0.013	0.299	0.765

Table 8: Evaluated whether anchoring effects differ by investment path rather than framing

Table 9: Condition-Specific Models (only return)

term	estimate	std.error	statistic	p.value
(Intercept)	-1.436	0.367	-3.918	0.000
pathstraight	-1.814	0.277	-6.550	0.000
pathup_down	-1.606	0.276	-5.823	0.000
trade	0.474	0.086	5.507	0.000
ref_diff	2.685	1.484	1.809	0.072
return_forecast	0.011	0.086	0.131	0.896

Table 9: Isolated results for participants in the return framing group.

Table 10: Table 9: Condition-Specific Models (only price)

term	estimate	std.error	statistic	p.value
(Intercept)	-1.393	0.360	-3.865	0.000
pathstraight	0.069	0.324	0.214	0.830
pathup_down	-0.005	0.297	-0.016	0.987
trade	0.502	0.093	5.402	0.000
ref_diff	0.002	0.006	0.431	0.667
return_forecast	0.326	0.119	2.749	0.006

Table 10: Isolated results for participants in the price framing group.

Table 11: Model Comparison (AIC Scores)

Model	AIC
model	1,971.38
model_interact1	1,970.07
model_interact2	1,975.29
model_return	976.07
model_price	993.67
mixed_model	1,966.97

Table 11: Slight improvements in AIC suggest interaction terms provide a marginally better fit. The mixed model remains competitive.

Table 12: VIF Diagnostics

Variable	VIF	Df	$GVIF^{1/(2 \cdot Df)}$	Interacts With	Other Predictors
framing	1.29	5	1.026181	path	trade, ref_diff, return_forecast
path	1.29	5	1.026181	framing	trade, ref_diff, return_forecast
trade	1.28	1	1.129333	--	framing, path, ref_diff, return_forecast
ref_diff	1.10	1	1.048687	--	framing, path, trade, return_forecast
return_forecast	1.15	1	1.072766	--	framing, path, trade, ref_diff

Table 12: Included for multicollinearity assessment. All values < 2 , indicating no concern.

Appendix B:

This appendix contains the full survey used in the experimental study. The survey was administered online and consisted of investment scenarios varying by framing condition (price vs. return) and stock path (straight, up-down, down-up). Each participant received six scenarios framed consistently within their assigned condition and was asked to rate each on perceived risk, satisfaction, reference estimation, confidence, forecast, and trading intention.

Default Question Block

Dear participant,

My name is Ismet Motika, and I am currently working on my Master's thesis at Radboud University. As part of my research, I am conducting a survey to gather insights on people's investment decisions, and with this, it would be greatly appreciated to get your input on this topic.

Your participation in this survey is completely voluntary, and your responses will remain anonymous and confidential. The data will only be used for scientific purposes and will not be shared with any third party. This survey has no right or wrong answers, and the survey will take approximately 5 minutes to complete.

Thank you for your time and support.

Before this survey can begin, I must be given your consent to this survey. So by selecting "**Yes, I agree to participate,**" you confirm that you have read this information, understand the purpose of the study, and voluntarily agree to take part. If you select "**No, I do not agree to participate,**" you will not be included in the

survey, and no data will be collected from you

Here is survey consent: select "Yes, I agree to participate"
to

participate in this study or select "No, I do not agree to
participate

to be excluded from this survey

Yes, I agree to participate

No, I do not agree to participate

Identification

What is your age?

What is your gender?

Male

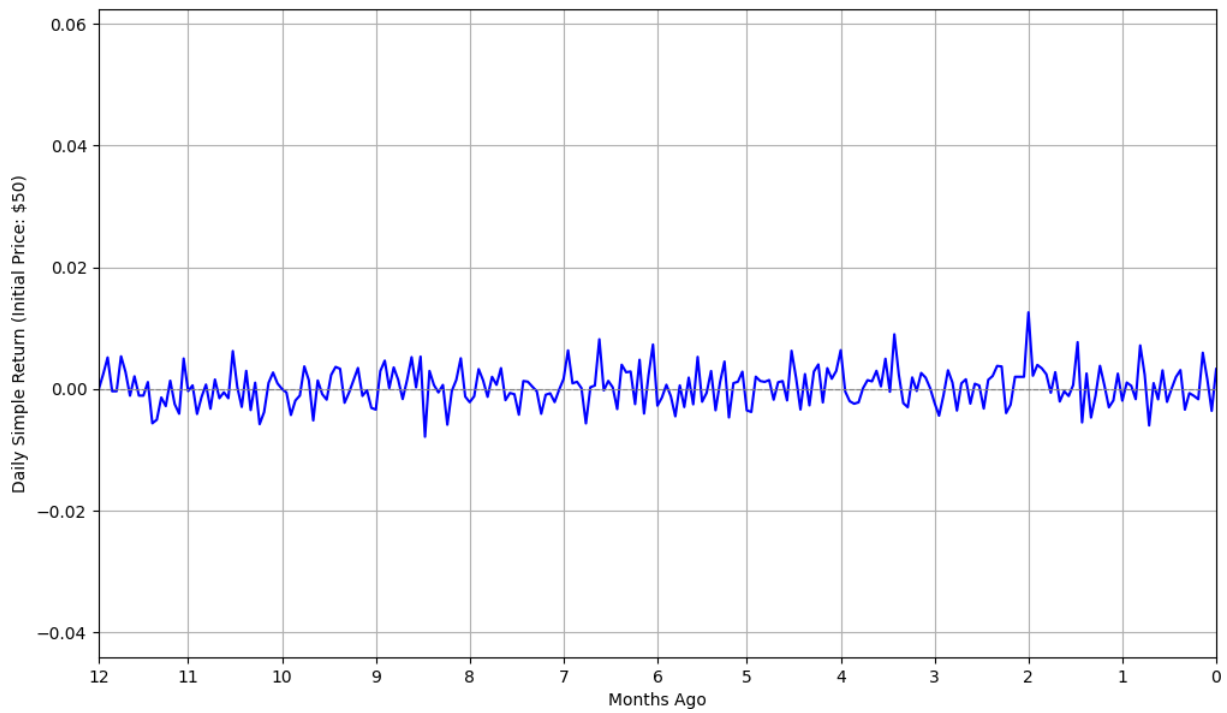
Female

Non-binary/third gender

Prefer not to say

return path (straight)

Presented below is a detailed overview of the stock's monthly return performance over the past 12 months, now keep in mind this shows the returns of a stock that had a starting price of 50. For the purpose of this exercise, envision that you made an investment in this stock exactly one year ago. Now, after this one-year holding period, you are being asked to assess and reflect upon the outcome of that investment decision



How satisfied are you with this investment's performance?

very unsatisfied

unsatisfied

somewhat unsatisfied

slightly unsatisfied

neutral

slightly satisfied

somewhat satisfied

satisfied

very satisfied

How risky did this investment feel?

- not risky at all
- slightly risky
- somewhat risky
- moderately risky
- quite risky
- very risky
- extremely risky

Would you hold or sell this stock today?

- Definitely sell
- very likely sell
- somewhat likely sell
- somewhat likely hold
- very likely hold
- definitely hold

Given the stocks last returns, what is the lowest return you'd accept to sell this stock? (Give me only the number, no explanation is needed along side it)

How likely do you think is that this stock price's will increase over the next 12 months?

Extremely unlikely

very unlikely

somewhat unlikely

Somewhat likely very

likely extremely

likely

How confident are you in this estimate? (regarding the one question before)

Not confident at all

slightly confident

moderately confident

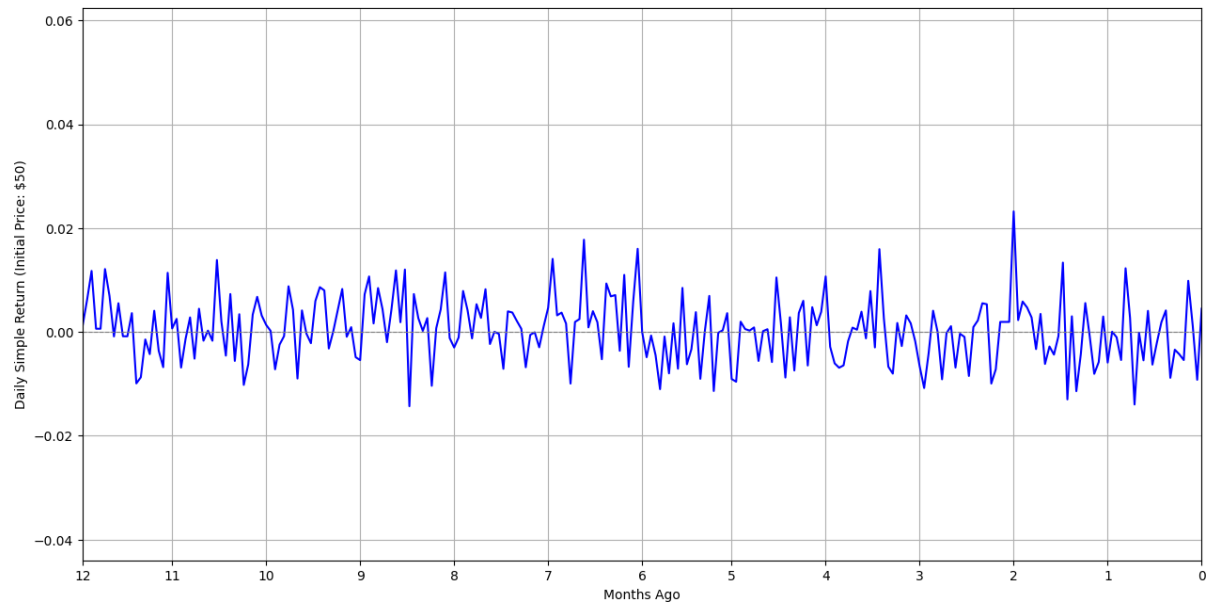
confident

very confident extremely

confident

return path (up-down)

Presented below is a detailed overview of the stock's monthly return performance over the past 12 months, now keep in mind this shows the returns of a stock that had a starting price of 50. For the purpose of this exercise, envision that you made an investment in this stock exactly one year ago. Now, after this one-year holding period, you are being asked to assess and reflect upon the outcome of that investment decision



How satisfied are you with this investment's performance?

- very unsatisfied
- unsatisfied
- somewhat unsatisfied
- slightly unsatisfied
- neutral
- slightly satisfied
- somewhat satisfied
- satisfied
- very satisfied

How risky did this investment feel?

- not risky at all
- slightly risky
- somewhat risky
- moderately risky
- quite risky
- very risky
- extremely risky

Would you hold or sell this stock today?

- Definitely sell very
- likely sell
- somewhat likely sell
- somewhat likely hold
- very likely hold
- definitely hold

Given the stocks last return, what is the lowest return you'd accept to sell this stock? (Give me only the number, no explanation is needed along side it)

How likely do you think is that this stock price's will increase over the next 12 months?

- Extremely unlikely
- very unlikely
- somewhat unlikely
- Somewhat likely very
- likely extremely
- likely

How confident are you in this estimate? (regarding the one question before)

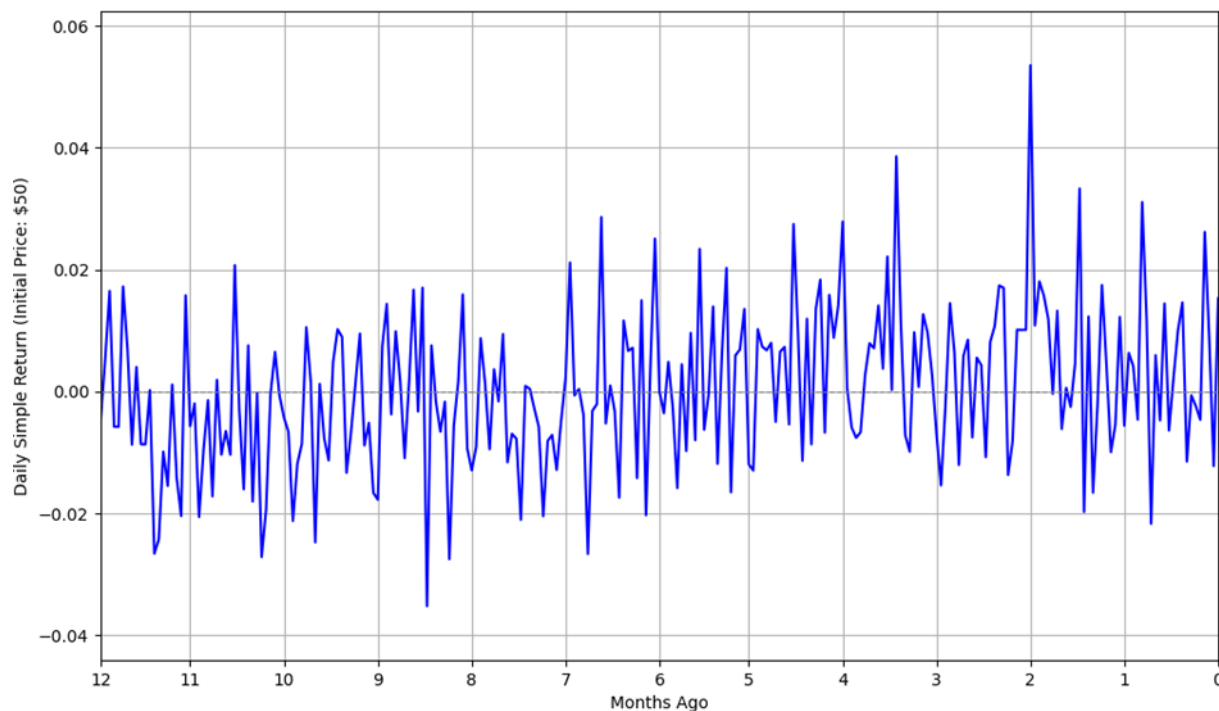
- Not confident at all
- slightly confident
- moderately confident
- confident

very confident

extremely confident

return path (down-up)

Presented below is a detailed overview of the stock's monthly return performance over the past 12 months, now keep in mind this shows the returns of a stock that had a starting price of 50. For the purpose of this exercise, envision that you made an investment in this stock exactly one year ago. Now, after this one-year holding period, you are being asked to assess and reflect upon the outcome of that investment decision



How satisfied are you with this investment's performance?

very unsatisfied

unsatisfied

somewhat unsatisfied

slightly unsatisfied

neutral

slightly satisfied

somewhat satisfied

satisfied

very satisfied

How risky did this investment feel?

not risky at all

slightly risky

somewhat risky

moderately risky

quite risky

very risky

extremely risky

Would you hold or sell this stock today?

Definitely sell very

likely sell

somewhat likely sell

somewhat likely hold

very likely hold

definitely hold

Given the stocks last return, what is the lowest return you'd accept to sell this stock? (Give me only the number, no explanation is needed along side it)

How likely do you think is that this stock price's will increase over the next 12 months?

Extremely unlikely

very unlikely

somewhat unlikely

Somewhat likely very

likely extremely

likely

How confident are you in this estimate? (regarding the one question before)

Not confident at all

slightly confident

moderately confident

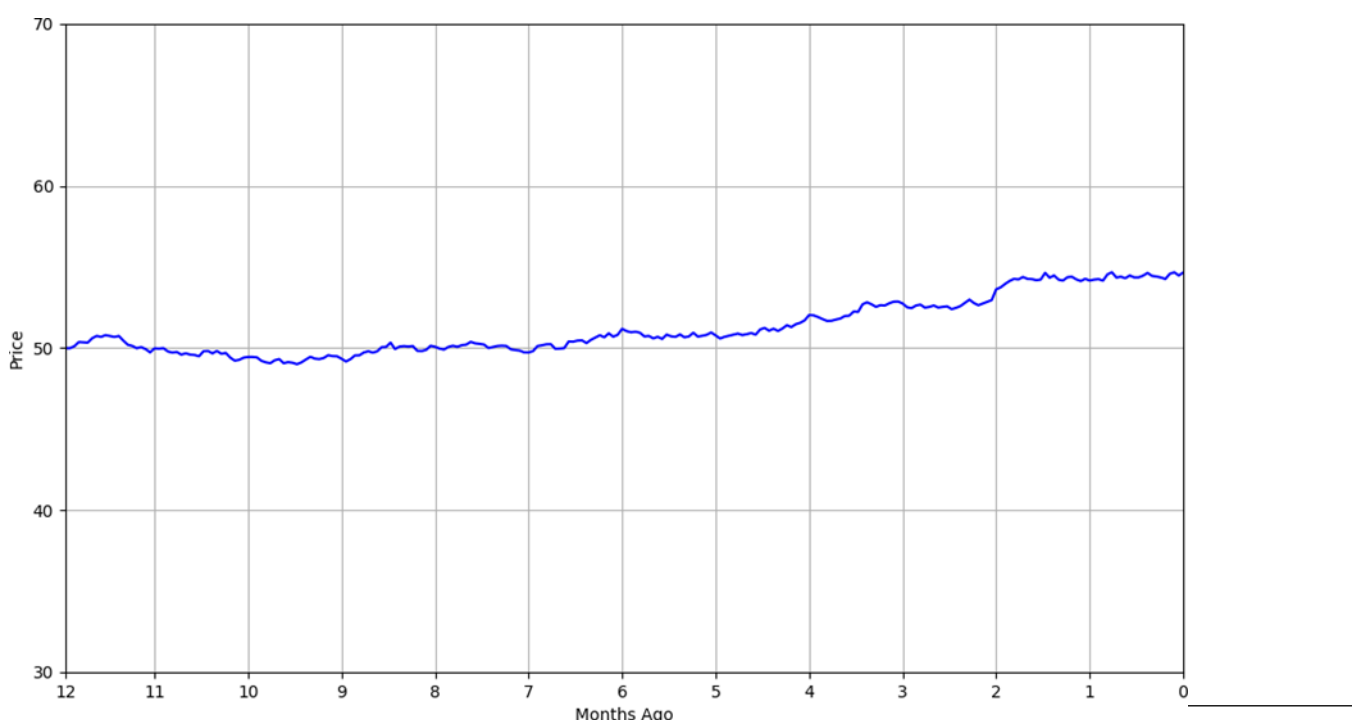
confident

very confident

extremely confident

price path (straight)

Presented below is a detailed overview of the stock's price movements over the last 12 months. For the purpose of this exercise, envision that you made an investment in this stock exactly one year ago. Now, after this one-year holding period, you are being asked to assess and reflect upon the outcome of that investment decision.



How satisfied are you with this investment's performance?

- very unsatisfied
- unsatisfied
- somewhat unsatisfied
- slightly unsatisfied
- neutral
- slightly satisfied
- somewhat satisfied
- satisfied
- very satisfied

How risky did this investment feel?

- not risky at all
- slightly risky
- somewhat risky
- moderately risky
- quite risky
- very risky
- extremely risky

Would you hold or sell this stock today?

- Definitely sell very
- likely sell
- somewhat likely sell
- somewhat likely hold
- very likely hold
- definitely hold

Given the stocks last return, what is the lowest return you'd accept to

sell this stock? (Give me only the number, no explanation is needed along side it)

How likely do you think is that this stock price's will increase over the next 12 months?

Extremely unlikely

very unlikely

somewhat unlikely

Somewhat likely very

likely extremely

likely

How confident are you in this estimate? (regarding the one question before)

Not confident at all

slightly confident

moderately confident

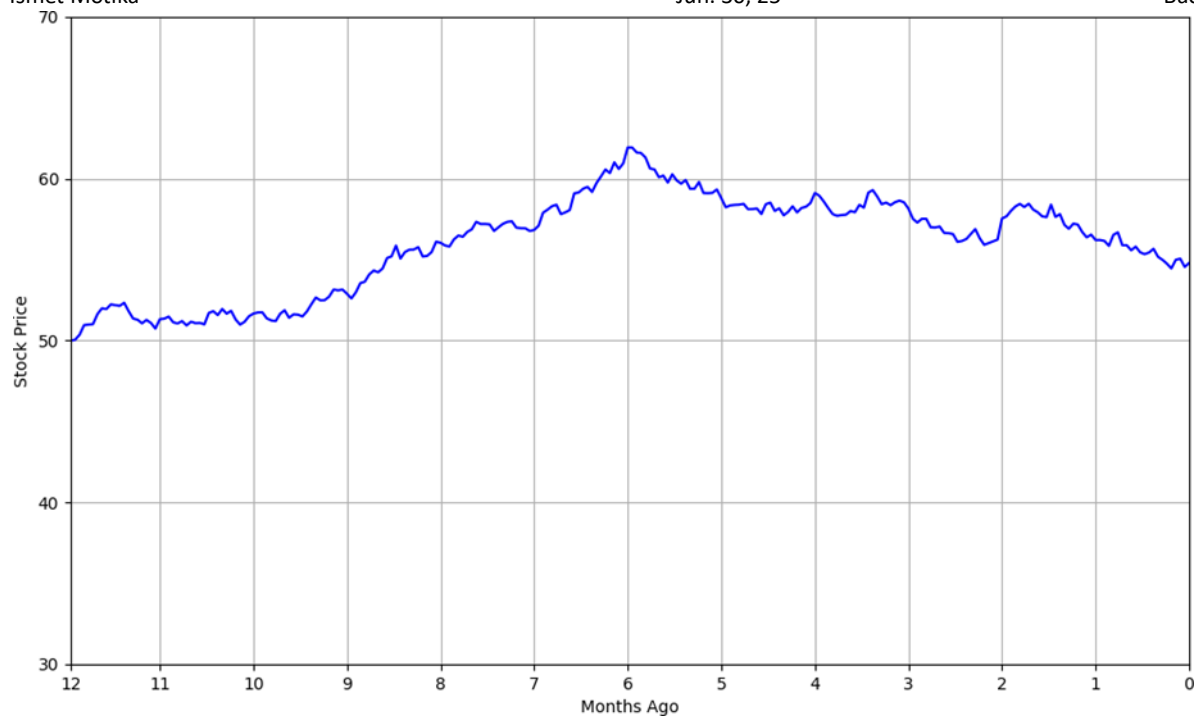
confident

very confident

extremely confident

price path (up-down)

Presented below is a detailed overview of the stock's price movements over the last 12 months. For the purpose of this exercise, envision that you made an investment in this stock exactly one year ago. Now, after this one-year holding period, you are being asked to assess and reflect upon the outcome of that investment decision.



How satisfied are you with this investment's performance?

- very unsatisfied
- unsatisfied
- somewhat unsatisfied
- slightly unsatisfied
- neutral
- slightly satisfied
- somewhat satisfied
- satisfied
- very satisfied

How risky did this investment feel?

- not risky at all
- slightly risky
- somewhat risky
- moderately risky
- quite risky
- very risky
- extremely risky

Would you hold or sell this stock today?

- Definitely sell very
- likely sell
- somewhat likely sell
- somewhat likely hold
- very likely hold
- definitely hold

Given the stocks last return, what is the lowest return you'd accept to sell this stock? (Give me only the number, no explanation is needed along side it)

How likely do you think is that this stock price's will increase over the next 12 months?

- Extremely unlikely
- very unlikely
- somewhat unlikely
- Somewhat likely very
- likely extremely
- likely

How confident are you in this estimate? (regarding the one question before)

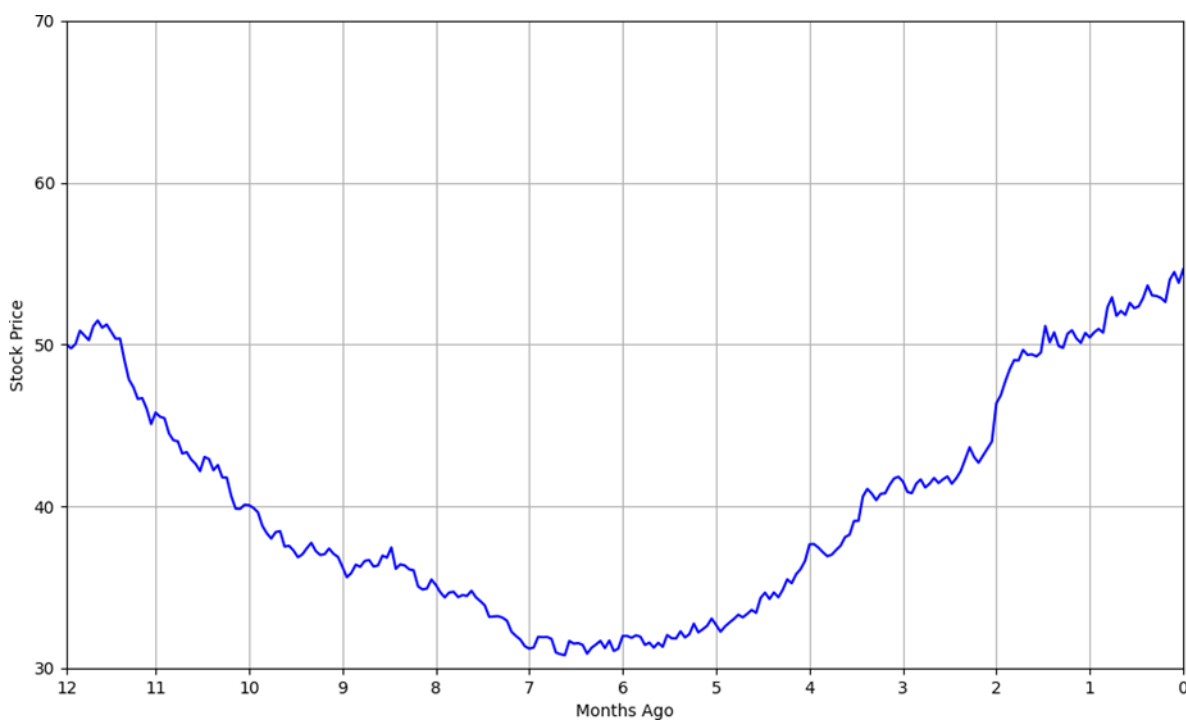
- Not confident at all
- slightly confident
- moderately confident
- confident

very confident

extremely confident

price path (down-up)

Presented below is a detailed overview of the stock's price movements over the last 12 months. For the purpose of this exercise, envision that you made an investment in this stock exactly one year ago. Now, after this one-year holding period, you are being asked to assess and reflect upon the outcome of that investment decision.



How satisfied are you with this investment's performance?

very unsatisfied

unsatisfied

somewhat unsatisfied

slightly unsatisfied

neutral

slightly satisfied

somewhat satisfied

satisfied

very satisfied

How risky did this investment feel?

not risky at all

slightly risky

somewhat risky

moderately risky

quite risky

very risky

extremely risky

Would you hold or sell this stock today?

Definitely sell very

likely sell

somewhat likely sell

somewhat likely hold

very likely hold

definitely hold

Given the stocks last return, what is the lowest return you'd accept to sell this stock? (Give me only the number, no explanation is needed along side it)

How likely do you think is that this stock price's will increase over the next 12 months?

Extremely unlikely

very unlikely

somewhat unlikely

Somewhat likely very

likely extremely

likely

How confident are you in this estimate? (regarding the one question before)

Not confident at all

slightly confident

moderately confident

confident

very confident

extremely confident

