

OBSCURITY EFFECT: A VALUATION MATCH BETWEEN
BUYER AND SELLER OF TIME-SENSITIVE AND VALUE-
DEPRECIATING GOOD FOR THE SINGAPORE MILLENNIAL
CONSUMER MARKET

by

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Dedication

In Honor and In Memory of my late mother

MDM WONG LAI HAR

I made a promise to excel,
You chose to believe in me.
I took your trust seriously,
Now I have proven my worth to you.
You had shown unflinching love,
For that, I thank you.
Let it be remembered,
We will meet again one day.

To my children and their descendents, you can do it too!

“One generation passeth away, and another generation cometh: but the earth abideth for ever. The sun also ariseth, and the sun goeth down, and hasteth to his place where he arose.” ~ Ecclesiastes 1:9

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- Friends of the SSBM Circle - Dr. Alan, Jace, Kat and Tony the buddy - for providing advice and cheering me on to the finishing line.
- Friends in Facebook who had cheered me on during those very dark and difficult moments.
- And the last shall be the first: my extended family (by that I refer to the union of two separate families through marriage) and my beloved wife, Nobuko Nakagara, for the wonderful support in any way possible while I slaved through my education over the past many (countless, in fact) days, nights and years. All of you have supported my pursuit in many ways.

Preface

The study of marketing has been an adventurous journey for me. When I first started my tertiary education, I didn't know what area of focus I should embark on. Progressively as I took on more courses, I began to realize that I love three areas of studies: analytics, psychology and business. Analytics has been the core interest and it has defined my profession since day one of my career. Psychology is a fascinating topic as it looks into how people perceive nature. Business is a necessary topic for someone who is an entrepreneur and I'm glad my business education is helping me in my enterprise now. So what do you get when you blend all three together? You get consumer research. Back in the university days when I was a student at Singapore University of Social Sciences, consumer research was centered on the study of consumer behavior. Students were exposed to pertinent topics such as purchase and repurchase intention, needs and wants, and consumer psychology such as value perception and influences in pricing. I wanted more: and so I went on to be a post-graduate student at Nanyang Business School under the kind sponsorship of my relative. It was during my Masters' studies that I was exposed to behavioral economics. This topic fascinated me so much to the point that I searched for an appropriate DBA program all over the world. I did my search for 6 years, patiently looking through all the program brochures and online feedback from members of the public. Inevitably, cost was a key factor in my consideration. And I chanced upon SSBM which offered me the opportunity to complete my DBA through the dissertation track. I felt the dissertation track fitted squarely for me and it met my expectation too. I went on to be a doctoral student with SSBM, writing my thesis on the topic of behavioral economics. Right from the start of writing to the end, it has been a challenging but fulfilling journey. And it has been fulfilling because I know

the education I'm taking on is a fulfillment of a promise I made to my late mother. And love conquers all challenges.

Behavioral economics is a relatively new field of study as compared to other well-established studies. It looks into the behavioral patterns of consumers when it comes to econ – the study of behavior and interactions between economic agents. Increasingly, there have been many research articles focusing on the cognitive and social psychology of consumers' decision-making. And my e-mail is getting a lot of notices about new articles published in journals on a weekly basis.

The future of consumer research rests upon the ongoing research done in behavioral economics. I personally feel that we need more researchers from the business domain to bridge the gap between behavioral economics and marketing. This is exactly what I have done in this thesis: a behavioral economics research centered on a market that trades time-sensitive and value-depreciating products. It is not a psychology research or econometrics analysis, but an application of behavioral economics to explain real market behavior in the business world.

I sincerely hope you find my thesis helpful and insightful. To the end, I have achieved my objective which is to complete my formal education in Marketing at the highest level as a professional researcher.

Daniel Koh

DBA Candidate, SSBM

19th May 2023

ABSTRACT

OBSCURITY EFFECT: A VALUATION MATCH BETWEEN BUYER AND SELLER OF TIME-SENSITIVE AND VALUE- DEPRECIATING GOOD FOR THE SINGAPORE MILLENNIAL CONSUMER MARKET

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Behavioral economics is a study of decision-making from the perspective of individual's or institutions' behavior arising from a departure from the classical economic theory. One example would be the differences in setting buying price and selling price for the same product due to the attachment one has with it. In an uncertain environment where events change rapidly, consumers are not able to indicate their buying price and selling price of the same product rationally, leading to a disparity in prices. And this disparity can be noticeably huge. Over the past 50 years, researchers in the field of psychology, decision science, and economics have studied the varied nature of the irrationality of consumers,

and concluded that loss aversion remains the most credible explanation for the disparity. While buyers seek market valuation of products, sellers seek compensation for losing a product when it is sold. Researchers have named this phenomenon the endowment effect. In our research, we have shown that the endowment effect does not apply to a particular class of products - the time-sensitive and value-depreciating products or TSVD products. The selling price is determined by the loss in losing the chance to sell the TSVD products across different points in time, which is fundamentally expressed in the Loss Aversion Sensitivity function or LAS function. And we have shown that the selling price on average can be higher than the buying price on average when consumers' field of decision-making is obscured. We call this effect the obscurity effect. We researched the obscurity effect using a quantitative survey questionnaire and tested 6 hypotheses in within-subject and between-subject designs using non-parametric and parametric statistical methods. We concluded that the TSVD products follow the LAS function, and the behavioral pattern was disrupted when the obscurity effect is observed. In our discussion, we have provided some explanations for the obscurity effect. These explanations include concepts coming from cognitive psychology, social psychology, and emotions. Finally, we presented two use cases whereby businesses can benefit from curtailing the obscurity effect. Definitions used in this paper are defined by mathematical logic and reasoning.

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LIST OF DEFINITIONS

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LIST OF SCIENTIFIC NOTATIONS

The following list shows the scientific notations used in this thesis. It is sorted by alphabetical order, starting with the Greek letters, and then the English letters.

α – Alpha value to determine critical region of a distribution

β – Type II errors in hypothesis testing

Δ - The first order differential (taken from the LAS function)

η^2 - eta-squared or effect size of independent variable onto response variable

v – Values from sample

\hat{v} – Transformed values from sample

ρ - All kinds of customers

τ – A point in time within the start of ownership or possession to expiry or full depreciation

σ – Sample standard deviation

ϕ - LAS Function

χ^2 – Chi-Squared value for Kruskal-Wallis Test

ω - The maximal integer of the number of all kinds of customers

A – A good

a – Time in which the value is assessed minus the time in which the value is realized

B - A consumer who buy

b – b-parameter of LAS function

C – A service

D - A tangible product (by inference, $\sim D$ refers to intangible service)

E – Expectation

F - A consumer who is a buyer

f - A function ($f(D)$ refers to the exponential discounting function)

G – A consumer who has the rights to sell the product

H – A Hypothesis (H_0 : Null Hypothesis; H_1 : Alternative Hypothesis)

J – A consumer who is a seller

K - A consumer who performs the purchase

k - The market price of the product when the item was owned or received

M - Consumers who feels that his or her expectation is met

N – Sample size

n – Sample size (not relating to the study; general notation)

O - Consumer is satisfied

P - Probability of event

p – P-value of a test

PSE - Partial standard error at the respondent level

Q - An end-user of a product

R - An end-user of a service

S - The consumer who sells a product (in reference to the action of selling)

SE - Standard Error of a sample

T - Consumers who display emotions of satisfaction

t – The element of the LAS function

V - A consumer who is not a bulk purchase, trade purchaser, or donator

W – A customer who goes on a customer experience (journey)

X – Independent variable of the linear regression model of b-parameter estimate

x - A specific type of customer to be defined.

y - Dependent variable of the linear regression model of b-parameter estimate

Z – A proper definition of a consumer

CHAPTER I:
INTRODUCTION

1.1 Introduction

Singapore is a small country when measured by territory. (Abshire, 2011) Despite her size, her Gross Domestic Product (GDP) per capita based on Purchasing Power Parity¹ (PPP) was US\$95,603 in the year 2020 (IMF, 2020), ranking 2nd in place after Luxembourg. (World Bank, 2022) Gross Domestic Product is defined as the “standard measure of the value added and created through the production of goods and services in a country. As such, it also measures the income earned from that production or the total amount spent on final goods and services (less imports).” (OECD, 2022b)

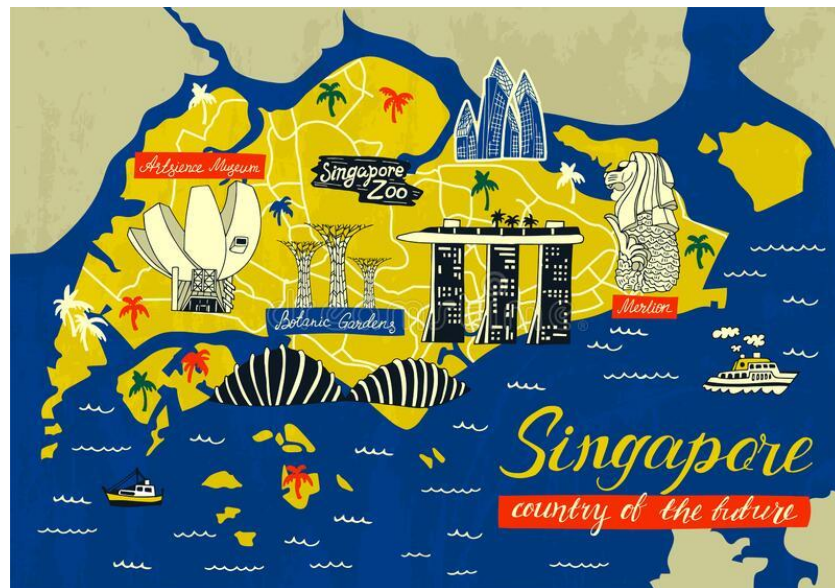


Figure 1 – Map of Singapore

As of the year 2022, there were 3.5 million citizens, 0.5 million permanent residents, and 1.6 million non-residents in Singapore. (“Overview of Singapore Population,” n.d.) That was equivalent to approximately 7 persons per meter square.

¹ Purchasing power parities (PPPs) refers to the national currency (in this research paper, Singaporean dollar) per US dollar. (OECD, 2022a)

Singaporean consumers with medium to high earnings based on income at the individual and household levels are expected to spend more. Monthly consumer spending in East Asia & Pacific was at US\$12 trillion, of which US\$122 billion (1.02%) was attributed to spending in Singapore. The per capita consumer spending in Singapore was at US\$19,765 per year. (“East Asia & Pacific Consumer Spending 1967-2022,” 2022; “Singapore Consumer Spending 1960-2022,” 2022) This figure translated to “a dollar” consumption in every US\$4.84 earnings or savings in a given year; spending was at a rate of 20.6% of earning on average at the national level.

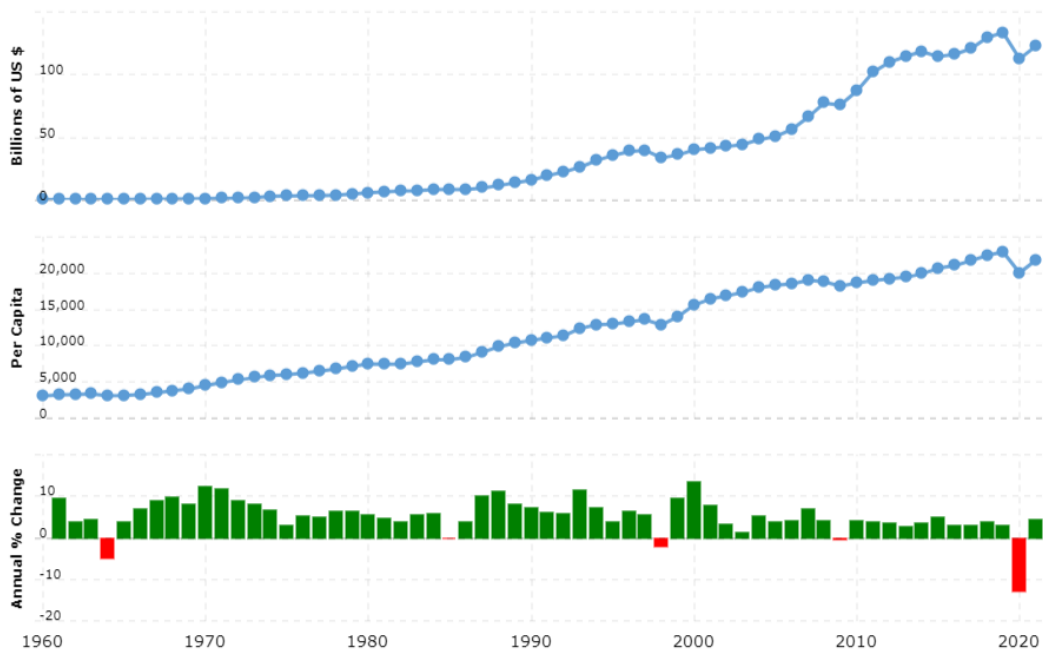


Figure 2 – Consumer Spending Trend of Singapore (“East Asia & Pacific Consumer Spending 1967-2022,” 2022)

Forecasting showed an optimistic outlook. An article by the Business Times in 2022 reported normalization in consumer spending from 2022, with medium-term expectations of household consumer spending at 2.5% a year. Real consumer spending was expected to grow by 3.6% in 2022, and the medium-term growth trajectory to grow

by 6.6% from 2022 to 2026. (Megan, 2022) While it is hardly a surprise that consumer spending normalized due to the recent COVID-19 pandemic, Singapore's consumer spending remains resilient despite several challenges posed by the pandemic.

With technological advancement progressing at a fast speed, more consumers were expected to enter the resale, second-hand, and auction market. (Simonson and Drolet, 2004) Hence, there is a need to study purchase intention for resale, second-hand items and food and beverages, and evaluate these items based on the sellers' expectations and buyers' expectations. For example, a seller may price a dining table of \$100-purchase-price at \$10 when they face the need to sell the furniture fast (i.e. for reasons such as relocation, liquidity, etc.). And buyers perceive the value of it as \$50. Such a disparity happens when buyers are not aware of the reasons for lowering the selling prices, and sellers are also not aware of buyers' perceptions of sellers' expectations. In this regard, there is a mismatch in both expectations. The seller sets it at \$10 but the buyer values it at \$50.

Studies have shown that buyers' valuation of a product depends on the market value of it at that point in time. And sellers' valuation of a product is primarily driven by the endowment effect. This explanation falls within the scenarios whereby the products involve ownership. However, this paper argues that the TSVD product is a different class of product that is not impacted by the endowment effect. While the endowment effect explains higher selling price, certain products such as the TSVD products may not necessarily possess any form of endowment. This is especially true for products that are mainly meant as disposable or use-and-throw.

In short, this dissertation aims to study the effect which impacts the disparity between the buyers' expectations and the sellers' expectations in a market that is characterized by high purchasing power, lowest spending per dollar per GDP capita, resilient spending habit, and steadfast readiness to enter into the resale, secondhand, or

auction market. The millennials aged 20 to 36 years old² in Singapore is studied: the millennial are the future of any society (Maiers, 2017) and it is very important to examine their spending pattern, behavior, and power to better understand the world that will evolve into the future.



Figure 3 – Millennials in Singapore (Meah, 2021)

In this research paper, we will conduct a quantitative research to understand buyer-seller behaviors. We will also offer some explanations for the mismatch of expectations.

1.2 Research Problem

² This age range is set in the year 2022.

Buyers indicate their choice prices³ instead of buying prices. (Kurt and Inman, 2013) They are first presented with several options, after which they choose a reference point as the start (usually the option with the least cost), and then decide their choice price. From the sellers' perspective, they indicate their selling price based on what they think the worth of the product is and their endowment with the product, and then seek a maximization rule to optimize monetary returns. We therefore observe the differences between sellers and buyers in their motivations; the sellers seek maximization motivation whereas buyers seek minimization motivation. (Kim and Srivastava, 2020)

In the scenario where the item of the trade is a time-sensitive and value-depreciating good, sellers seek maximization (or optimization) in return at the start of ownership, followed by a gradual decrease in this expectation, and finally a minimization in return when the expiry or full depreciation is near. (Koh, 2022)⁴ Unlike the conventional loss aversion explanation that shows a valuation based on one's endowment with the product, products that are TSVD in nature follows the loss aversion sensitivity function. However, the loss aversion sensitivity looks at the seller side of things (SSOT), which is an approximation and monotonic model⁵ that explains the loss aversion behavior arising from selling the TSVD product. There is still a need to consider the buyers' behavior in such scenarios, allowing us to match buyers' expectations with the sellers' expectations. By definition, the time-sensitive and value-depreciating product is defined

³ The choice prices are assessed by the available options at that moment of decision. It could be *ex-ante* such that the choices are assessed based on what the future would occur, or the choices are assessed based on the current market value inferring to the future.

⁴ This is the paper that was presented at the International Conference on Business and Integral Security 2022 in Zagreb, Croatia.

⁵ It is an approximation because individual consumers exhibit different behavior across time. For example, some consumers may be more sensitive at the end spectrum of the loss aversion sensitivity. But the proposition is that all consumers behave in an observable pattern as shown in the LAS function.

as “the non-unique and marketable product that has a time limit to its utility due to the depreciation of its value.” (*ibid.*)

In this paper, we outline several problem statements to be dealt with.

Buyers ascertain market valuation and not the expectation of sellers

Sellers are keen to know what buyers expect in terms of pricing, especially when time pressure is present. For example, due to the urgency in selling the product, sellers want to know what prices the buyers will expect, so as to sell it away rapidly. Conversely, buyers are ignorant of what sellers expect in monetary return for the sale of the product at the market level. In this regard, Yuan and Han (2011) proposed a Bayesian Nash equilibrium model⁶: they argued that setting high current prices drive buyers to search for options in a way that reaches a zero-sum game. For example, sellers set the selling price at \$50 and buyers search for more options to find cheaper alternatives, leading to a zero-sum game whereby the expectation in buying price matches with the expectation in selling price. From a rational perspective, the authors have derived a solution for buyer-seller expectations. However, from the behavioral perspective, the inclusion of behavioral patterns such as the obscurity effect is absent. Moreover, buyers and sellers do not interact comprehensively when there are too many sellers with an unknown number of buyers in the market. For example, buyers typically do not call up, or send an e-mail to all sellers asking how much they are willing to sell. They choose a seller that is the most reputable in the market with the lowest selling price. Conversely, sellers do not comprehensively provide a full explanation to the buyers for the valuation they make. This is true because a trade often starts with the sellers showcasing their

⁶ The BNE is a strategy that maximizes payoff based on a rational utility model.

products with a price to it⁷ and buyers are ignorant of the rationale behind the prices set by the sellers. This leads us to the possibility of an information gap impacting trade satisfaction in a market.

Buyers have information on the selling price across the market with the aid of technology but they do not have the information about the sellers' motivation. This is especially true when consumers expect high availability in the information provided for the options, so as to make decisions with ease without the need to perform any information search. However, buyers do not know the true expectation and perceptions of the sellers' valuation. For example, the buyers expected a higher selling price but in fact, the sellers are selling it at a lower price due to several personal reasons unknown to the buyers. While it is true that consumers search for information about the valuation of the product from a rational perspective and within the scope of high availability in the information given to them, this is unlikely true when time pressure and impulsive or instantaneous purchase is involved (i.e. online purchase of lower value good being an instantaneous purchase, time-sensitive trade with a time limit being time pressure). Hence, there is a need to conduct research into buyers' behavior *ex-ante*⁸ towards sellers' expectations at the behavioral level across time and the value of the good.

Sellers' behavioral pattern follows the loss aversion sensitivity model

Koh (2022) conducted a quantitative survey to ascertain buyers' and sellers' valuations of time-sensitive and value-depreciating products. The subjects undertook either the role of the buyer-then-seller or seller-then-buyer, and answered questions about

⁷ This may not necessarily be true in markets where price tag is not needed as a legal requirement. In Singapore, goods and services sold to consumers must have a price tag to them.

⁸ It is *ex ante* because consumers anticipate the sellers' expectation of the value of the good based on a forecast rather than the actual valuation of the seller. To assess the actual valuation would require high cognitive process into individual attributes, personal situation of the seller, intensive market comparison and trade-off.

the valuation of two types of good: marketable product which was the rare and unused Starbucks coffee mug⁹ and the time-sensitive and value-depreciating (TSVD) product which was the movie ticket. A loss aversion sensitivity model was built to represent the sellers' behavior in setting their selling price for the TSVD product.

There is one limitation in Koh's (2022) study¹⁰. The movie ticket served as a coupon that redeems the allowance to enter into a movie screening. While the movie ticket was also a TSVD product – albeit a proxy to an allowance to enter – it could be considered as a sub-class of the TSVD products. The endowment effect was not observed on the ownership of the ticket paper, but on the experience one could get. More studies can be done on this particular type of products.

Trade of goods with a lower obscurity effect leads to greater satisfaction

Marketing is not about making consumers buy at our whim and it may not necessarily lead to more consumption. (DiClemente and Hantula, 2005) It is understood as a set of practices that influence possible actions presented to the consumers. (Moisander et al., 2010) There is still a need to showcase marketing as a field of study that helps consumers in their decision-making process through the study of behavioral economics. Such is the case where consumers attribute their greater satisfaction to the success of marketing through a closer examination of the valuation match as advocated by behavioral economists. The obscurity effect impacts buyers' and sellers' valuation by making a decision within an obscured field for decision-making.

⁹ In that study, the rare and unused Starbucks collectible coffee mug is used to represent items that are unique and common in the market. A mug is easily found in the marketplace but the rareness and collectible nature makes it unique.

¹⁰ I want to thank Professor Nagaya from Yamaguchi University for his frank conversation with me over my 2022 paper presented in Zagreb.

1.3 Purpose of Research

The objective of this research paper is to develop a buyer-seller valuation match through the study of consumers' behavioral patterns. Consumers' behavioral patterns in decision making is defined as the varying behavior that consumers exhibit with respect to the time of valuation and the value of the product at the time of valuation. This study will supplement the long-term goal of achieving a valuation match across different groups of consumers and types of products. In this study, the box of chocolate is used as the TSVD product.

Conduct a comprehensive literature review

A comprehensive literature review¹¹ allows us to understand the theoretical landscape of this study. Over the past 60 years, economists, psychologists, behaviorists, and marketers have written hundreds of articles just on this topic of decision-making within the behavioral economics domain. This area of study has caught up with the academic flame¹² among researchers and students – including the author of this research paper. Étienne de Condillac¹³, the eminent French philosopher and epistemologist, as quoted in Lavoisier (1965) argued “*the art of reasoning is nothing more than a language well arranged.*” And a well-arranged literature review provides the foundation for the ensuing pursuit in the study of behavioral economics.

Build a mathematical explanation to arrive at definitions

¹¹ This literature review covers roughly 200 research papers. Some papers were not included due to the irrelevance of the outcome of the research, or we doubted the experimental method that leads to questionable results.

¹² The academic flame leads researchers to have continuous research effort for a particular domain of knowledge in a cascading effect across multiple application and nationalities.

¹³ Étienne de Condillac was an eminent French philosopher and epistemologist in the early 1700s. His contribution included “Le Commerce et le Gouvernement” in the area of economics and “Histoire ancienne and Histoire modern” in the area of history.

We will take on the task of laying out all the mathematical arguments in an *a priori* manner, such that whatever is to be researched is clearly shown in the mathematical model and logic. This is an *a priori* exercise as the formulation of math and logic is done *independently* of from any experiment. Hence, it will deal with logical arguments more than mathematical modeling of the data. This exercise will help us to lay out all the key definitions required in this research paper, and we strive to reduce ambiguity in definitions of terms and concepts as much as possible.

Create a valuation match between buyers' expectations and the sellers' expectation

Finally, there is a need to correlate the obscurity effect with the valuation match. Can we observe an increase in valuation mismatch due to the obscurity effect? While the rational perspective offers game theory to explain buyers and sellers in decision-making, the behavioral perspective offers a view of pricing behaviors impacted by psychological factors such as the obscurity effect exhibited by consumers at different points in time. Businesses may leverage the valuation match and identify which product within the vertical line extension satisfies the consumers the most. After all, no one strives to feel or become dissatisfied¹⁴: consumers want to feel satisfied with their purchase, and businesses want to feel satisfied with the compensation they get.

1.4 Significance of the Study

This research is important in two key aspects. First, it advances the current research effort done on behavioral economics. Over the years, behavioral economics study has focused on products that are not TSVD. For example, a coffee mug that does

¹⁴ Why bother to trade when the outcome is dissatisfaction?

not expire and the value in fact increases as the rarity of it in the market increases. Second, with this research, managers may embark on a new type of consumer research that allows them to understand their consumers better from a behavioral perspective in the market. In recent years, the resale and used products market is booming with more consumers selling their goods to other consumers – a marketplace commonly known as the Consumer to Consumer market. As such, businesses seek to understand what consumers truly perceive when it comes to selling their goods and buying from other consumers. Last, the results that we obtain from the NLS modeling of the Loss Aversion Sensitivity function can provide a stepping stone for further research. We will look into this modeling and provide a discussion for it.

1.5 Research Purpose and Questions

The research questions are formulated based on the research problem, objectives, and literature review. These three sections provide an overview of the motivation behind this dissertation paper.

The introduction of the Loss Aversion Sensitivity is a high-level introduction showcasing how consumers behave at different points in time in terms of selling prices for time-sensitive and value-depreciating products. At the start, consumers may not be willing to lower the selling price drastically, and gradually decrease the selling price as expiry and full depreciation gets nearer, and finally setting the selling price so low at the end, to the extent that it becomes very attractive to buyers. In this paper, we will prove the existence of the Loss Aversion Sensitivity function and also the applicability of the function by modeling the function to the respondents' data.

Oftentimes, what buyers expect to pay is quite different from what sellers expect to get in return from selling the good. Hence, there is a need to study this disparity from a behavioral standpoint across time.

The disparity can be widened due to the obscurity effect. And conventional loss aversion can be observed when sellers realize that their behavior is impacted by the obscurity effect. Can we truly attribute the irrational behavior to the obscurity effect? We embark on the journey of studying this potential attribution.

Among all these questions, we want to make sure that the respondents' first undertaken role and their demographic characteristics do not impact their answers in buying prices and selling prices. A significant impact from either test will result to poor statistical power and a review of the research scope.

CHAPTER II:
REVIEW OF LITERATURE

2.1 Introduction to Literature Review

Consumers do not make presumptions on the order of preference but build on choices by using selected attribute-based comparisons based on the available options on the spot (Bettman et al., 1998; Slovic, 1995; Tversky, 1996), or by conscious goal-oriented objective especially when consumers know what they exactly want. (Chartrand et al., 2008) Consumers make decision to maximize utility and minimize regrets with a goal hierarchy (Bettman, 1970), and observe changes in the choice situation or context and make adjustment to their inference. (Payne, 1976) Consumers make decision to purchase a product based on the options between that product and other alternatives that could be purchased. (Tversky and Kahneman, 1991)

Information presented to them has an impact on the overall impression of the choices, especially when online information is constantly updated or refreshed memory is utilized to base their impression on what they recall especially when there is a lack of available information. (Hastle and Park, 1986) Integrating information can be accomplished with effortful decision strategy or effortless by-product of memory representations. (Weber et al., 1995) However, consumers face difficulty in making decisions when the amount of information increases. (Bettman et al., 1998) When certain information on consumer choice is missing, whatever that is presented and inferred in the format of the choices is not used to describe these effects that arise from missing information. (Kivetz and Simonson, 2000) Above all, consumers are intelligent by taking a single facet of the choice task into account when it comes to information processing (Payne et al., 1996) instead of multiple facets that might confound the consumers, and

any further complexity in the choice task will render the consumers helpless. (Simon, 1957)

At the very high level, decision making is characterized by the satisficing¹⁵ strategy which is alternative-based, selective and noncompensatory (Frisch and Clemen, 1994) or the “elimination by aspects (EBA) strategy” which is attribute-based and noncompensatory. (Tversky, 1972) For example, consumers make a decision under the satisficing strategy either by compromising or selecting procedure such as trading-off a superior option and compromising an inferior option to reach a decision that reaches a level of adequacy. Under the EBA strategy, consumers make a decision based on various attributes of the options, and eliminate options that have important attributes but do not meet the expectations of the consumers. In the event that the correlation between attributes is negative (i.e. price versus quality), the alternative-based processing is preferred by the consumers in a less emotional decision tasks, whereas the attribute-based processing is preferred when the task is emotionally-laden. The philosophy behind the selection of strategy plays an important role in making a decision. The reason-based approach suggests that consumers focus on providing reasons as to why they choose an option over the others, whereas the problem-focused approach suggests that consumers direct their effort to solve problems at hand. (Bettman et al., 1998) When consumers are asked to explain the decisions they make, they sometimes are not aware of the factors that determine their choices which could lead to false explanations. (Shafir et al., 1993)

This literature review covers 5 major topics. First, we wish to explore the ‘generalizability’ of the existing research effort. It is very important to relate the

¹⁵ The term “satisficing” is a central term for spontaneous decision making. It refers to the strategy which aims to find a satisfactory or adequate solution. In an expert market, decisions are likely made by optimizing the solution or outcome instead.

literatures to our modern context. Second, we will then dive into prospect theory¹⁶, especially on the idea that consumers follow a reference point and make decision. Third, we will explore the endowment effect in explaining the valuation gap between the buyer and the seller, as understood in prospect theory. In addition to the endowment effect, we have also included attachment effect¹⁷. The combination of these two effects gives a good overview of why consumers act irrationally when uncertainty and risk are involved in making a choice. Fourth, we will expand the understanding of decision making by looking into uncertainty. Last, we will explore the explanation of valuation gap using loss aversion which is by far the most widely accepted explanation. The outcome of this literature review will give readers a clear picture of what exactly have been researched in the last 50 years from the date of this dissertation.

2.2 Experimental Incentives and the Applicability

In the late 80s, researchers used daily and practical items such as beer, television¹⁸, calculator, mouthwash and even calculator battery¹⁹ as stimuli in their research. Consumers were predominantly concerned with daily necessities and technological advancement more than egocentric products such as prestige and masstige²⁰ products. Pragmatism was the way of life. Back then, there was a series of research work

¹⁶ According to Richard Thaler, the initial name for this theory is Value Theory instead of Prospect Theory. Amos Tversky and Daniel Kahneman wanted to name this theory with a ‘completely meaningless term’ as the term ‘value theory’ was misleading. They hoped that by some lucky break the theory could become important. True enough, the theory became important and the term ‘prospect theory’ was set in stone. (Thaler, 2016, p.25)

¹⁷ The attachment effect is primarily taken from the attachment theory. It highlights the bond that a child has to his or her parent. In this paper, there is a slight twist to it and instead of a child and a parent, we would like to refer this attachment effect to the consumer and the physically endowed good.

¹⁸ In the 1980s, TV was the popular household equipment. (Seitz, 2016)

¹⁹ Batteries in the 80s were an essential accessory to a calculator. There was a constant stream of research on the longevity of the batteries. (Reddy et al., 2020)

²⁰ Masstige goods refer to the relatively inexpensive goods but are marketed to be luxurious or prestigious.

done in endowment effect and consumer choice. And in the early 90s, in addition to the pragmatism of the 80s, valuation of products became more probabilistic and arbitrary, which gave way for induced-value tokens and gambling²¹. More household items were used as stimuli in experiments too. In the late 90s, items such as travel packages and opportunistic stimuli such as job offerings were introduced. In the 2000s, items that were meant for consumption along with their accessories such as a mug became popular in experiments. And in the 2010s, lottery tickets became prominent as a stimulus for experiments relating to endowment effect and uncertainty effect.

Researchers adopted different incentives and stimuli for the past 50 years. Interestingly, among all the items in Appendix C²², there are only 16 items which are time-sensitive and value-depreciating out of 106. More importantly, these 16 items remain highly relevant in our modern context. Items such as CD player were not included as they are not highly relevant in our modern context. And only 1 out of those 16 items is related to the topic on consumer choice in the marketing domain. The rest of them are related to the topic on behavioral economics in other domain of studies.

It is evidently clear that behavioral economics have a greater impact on economics (or other domain of studies) instead of marketing. Yet, our society is gearing towards consumerism and consumers are becoming more empowered in making trade as compared to 10 years ago due to the rise of information availability and accessibility to trade via the internet. It is therefore very important that the study of behavioral economics be applied to marketing, which is a function that attracts and motivates customers to buy goods and services for their needs and wants through education or proper structuring of their purchase field.

²¹ Gambling in this paper refers to the small-scale, between-individual level gambling.

²² Appendix A contains a list of incentives and stimuli used in experiments in the last 50 years. It is a sample list.

There is a segment of products that closely relate to our daily lives. These products are the time-sensitive and value-depreciating products. Examples of these products include food, drinks, movie ticket and even furniture. Anything that decays and depreciates in value (with sensitivity toward time) falls within this category of products. Products that are attributed to a ‘time-pressure to sell’ also describe this category of product.

2.3 Reference Point and Status Quo Bias

Kahneman and Tversky (1979) introduced Prospect Theory which argued that “people evaluate gains and losses based on reference point.”²³ They further elaborated on this theory, stating that people evaluate gains and losses with a dependence on the reference point. The preference of choices in a decision making process depends on where this reference point lies. (Tversky and Kahneman, 1991)

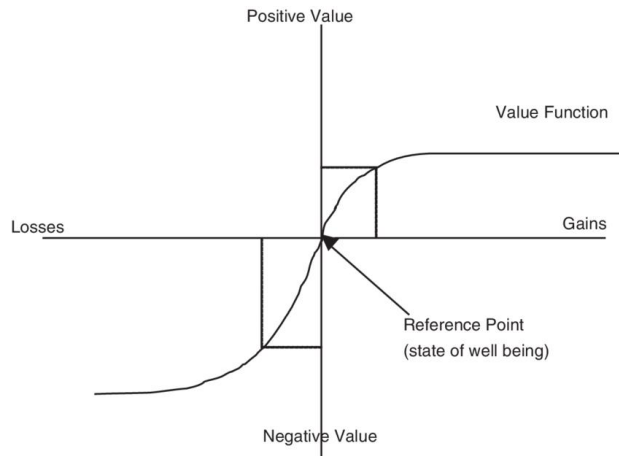


Figure 4 - Value Function in Prospect Theory²⁴

²³ The introduction of the shift from reference point was first introduced in Tversky and Kahneman (1975).

²⁴ The sensitivity in loss is reflected by the steeper convex up in the loss domain as compared to the concave down in the gain domain.

Prospect theory was originally developed to use a single attribute of low monetary value good to describe choice among risky options. (Hardie et al., 1993) Reference point theory suggests that buyers reduce their stated Willingness-to-Pay a good with certain amount of money and sellers inflate their stated Willingness-to-Accept compensation in selling the good with certain amount of money, so as to avoid ‘transaction disutility’. (Weaver and Frederick, 2012) Reference point theory looks into the outcomes that had happened and produce “rational expectations” (Kőszegi and Rabin, 2006), does not violate endowment effect (Van Boven et al., 2000), and is edited by ‘coding, combination and cancellation’²⁵, such that the reference point moves based on scenarios and context. (Kahneman and Tversky, 1979) For example, disutility arising from an outcome can be characterized as a loss and it can be greater when the outcome is characterized as a negation of the gain. (Knetsch and Thaler, 1986) Willingness-to-Pay is decreased in low reference point whereas Willingness-to-Accept is increased in high reference point. No valuation gap is found for scenarios where moderate reference point is utilized. (ibid.) Reference point is endogenous²⁶, and it can be adjusted rapidly to changes in endowment. For example, with an increase in endowment due to positive utility, reference point can be adjusted higher. And when reference point is increased such that the good becomes more valued, endowment is reportedly increased too. (Munro and Sugden, 2003) Reference point is also changed due to a comparison between the consumer and his or her peers who has more gains, resulting to a shift in valuation. (Wuthisatian et al., 2017) Affect also influences reference point for goods which are subsequently valued (Peters et al., 2003) but it can also cause erroneous choices such as “miswanting”. (Gilbert and

²⁵ The three Cs which the authors introduced were part of operationalization procedures in explaining the movement of the reference point.

²⁶ In statistical inference, endogeneity creates a major problem when the errors of the model are highly correlated with the dependent variable. This would suggest that the outcome impacts the error, in which the error explains the outcome.

Wilson, 2000) When consumers use extensive wealth-based rule as a way to form the decision frame, choice remains consistent. And when it comes to losses, they are to be avoided if possible. If they are unavoidable, losses should be combined. (Thaler, 1999)

Reference point is determined by the role of the status quo, the entitlements and expectations that locate the relevant reference levels. (Kahneman et al., 1991) Status Quo Bias is defined as “a preference for current state”²⁷ (ibid.), induced by loss aversion (Tversky and Kahneman, 1991), and “doing nothing or maintaining one’s current or previous decision.” (Samuelson and Zeckhauser, 1988) Status Quo Bias also prevents consumers in making good alternative choices (Samuelson and Zeckhauser, 1988), and having more options lead to a greater use of noncompensatory²⁸ choice strategies. (Johnson and Meyer, 1984) Consumers lack in motivation to choose other options if the status quo option proves reliable in subsequent decisions (Yang et al., 2013), take more time to make a decision which increases negative emotion to make a choice if the options prove challenging (Luce, 1998), evoke defensive avoidance²⁹ as a response to difficult choice (Beattie and Barlas, 2001), avoid making decisions when conflict between two or more alternatives is less evident or conflict between two or more attributes of the good is more evident especially when the amount of shared attributes of the options is small (Bettman et al., 1998; Dhar, 1997), feels ‘elated’ when the outcome of choosing the status quo bias is positive as compared to inaction in not choosing any option (Landman, 1987), gets more attracted to the status quo option that has a greater commonality with the alternatives (Dhar et al., 1999), and face problems in maintaining the status quo when

²⁷ In the context of the research done by the authors, they referred status quo as a state in which an individual is in. Nonetheless, they also inferred and stated that the status quo could also refer to the choice that the decision maker was most comfortable with.

²⁸ Noncompensatory is understood as the options that do not meet certain criterion and they are expected to be eliminated.

²⁹ Defensive avoidance motivates the consumers to avoid or postpone the stress of decision, not the responsibility in making the decision. Consumers may defer and wait due to stress and they recognize the need to make a decision. (Evans, 1990)

choices compete with each other. (Kuhl, 1986; Shafir et al., 1993) Status quo bias does not give consumers the time to adapt, as the decision to be made is straightforward (Kahneman et al., 1990) and this bias does reflect on the valuation gap when the sellers do not have a strong incentive to trade one's own possession. Fundamentally, sellers with strong attachment to the good usually exhibit the status quo bias due to the endowment effect, (Gal and Rucker, 2018) and consumers feel less blameworthy and responsibility if the outcome is negative. Similarly, Consumers tend to be more selective under time stress, (Wallsten, 1993; Zur and Breznitz, 1981) or under borderline time pressure (Payne et al., 1996, 1988) which can shift decision strategies. (Payne et al., 1993; Svenson et al., 1990) And under a severe time pressure, consumers switch to an attribute-based heuristic method in decision-making (Payne et al., 1988), focus on single alternative, and heuristically infer any missing attribute based on other-brand information with same attribute or same brand information with different attribute. (Huber and McCann, 1982; Payne et al., 1996; Ross Jr and Creyer, 1992) Consumers accelerate their choice processing under time pressure (Zur and Breznitz, 1981) which can lead to more mistakes when the decision is made too soon. (Eisenhardt, 1993) When consumers do not face stress and pressure due to time constraints, adopting the accuracy goal helps the consumers perform better in decision-making: consumers who are not facing pressure due to time constraints can perform better when they seek for accuracy in matching their expectation with the outcome. (Payne et al., 1996) Consumers are more likely to utilize categorical processing (i.e. goods that fall within the same category) in making a decision, especially when consumers have expertise in the category. (Bettman et al., 1998) And when effort is involved, relative weights applied to the accuracy of the match and the effort in making a choice can have an impact on consumers' selection of strategy

(Creyer et al., 1990), which varies in advantages and disadvantages when it comes to accomplishing different goals in a given situation³⁰. (Bettman, 1970) Unlike the “perceptual approach” which has much to say about the representation and saliency of the tasks and the available sensory information, effort-accuracy approach can explain how consumers use the information they receive to arrive at their decision with much time deliberation for the purpose of achieving accuracy. (Bettman et al., 1998)

Decision makers assess the benefits of the status quo option first, and then the benefits of the other options (Kahneman and Miller, 1986), and find that the addition of a competing alternative or attribute increases the popularity of the status quo option. (Biehal and Chakravarti, 1983; Shafir et al., 1993) Consumers determine what an offer can give in benefits, decide whether to purchase the good (Monroe, 1990), and pay little attention to the “global context”³¹ such as auction sites and fixed pricing of other products. (Simonson, 1999)

In choosing a brand, the value assigned in the brand choice is given by the experience one has with the brand (Tversky and Kahneman, 1991) and there is substantial advantage in choosing a brand early before consumers have to decide on a choice between two brands that are identical *ex ante* and offer uncertain utility. (Schmalensee, 1982) Status quo bias is more salient in choice making among a larger choice set. (Iyengar and Lepper, 2000) Samuelson and Zeckhauser (1988) draw a parallel attribution of this status quo bias with Thaler (1980) endowment effect: because consumers weigh potential losses more than potential gain, consumers also weigh losses in status quo – of which the comfort, habit and security exist – greater than the potential gain the consumers can get when alternatives are selected. Dean et al. (2014) provided three

³⁰ With respect to effort-based goal, consumers find that the strategy is evaluated to be the best in their decision-making process.

³¹ This is particularly true when the ‘global context’ involves humongous amount of information, in which the consumers are not able to assess the options effectively.

axioms that support their Limited Attention – Status Quo Bias (LA-SQB) model which is an extension of the Lleras et al. (2017) limited attention model with an “almost neutral” status quo added: 1) pairwise transitivity, 2) contraction and 3) consistency. The authors pointed out that “the introduction of the status quo option alters choices between alternatives that are not the status quo option”. The LA-SQB model is defined as a model that describes the limited attention consumers give when the status quo option is excluded from a choice set. (And thus, perplex selection of choice from alternatives)

There has been a foray of ‘encouragement’ coming from economists, asking behaviorists to reinterpret the application of prospect theory – or endowment effect in this context. (Knez et al., 1985) We are in the viewpoint that prospect theory and expected utility theory fill different gaps in the study of consumers. First, prospect theory fills the gap that exists in understanding consumers’ fast, non-repeated and inexperienced decision-making whereas the expected utility theory fills the gap that exists in the experienced, mature and transactional market. In the mid-1900s, decision making studies focused on the latter gap simply because the societies of those days heavily depended on professionals who believed in price or price-quality ratio being the “most important evaluative criterion” for rational consumers in the mature market and consumers were not as much empowered in decision making as compared to now. (Joergens, 2006) In today’s context, consumers are empowered in decision making and decision making studies shifted from the experienced market to the inexperienced market. (Shafir et al., 1993) Experienced market refers to the trade of goods among individuals who are well-versed with the mechanism of the trade, such that buying and selling behavior is predictable. One example would be the import and export market³². Inexperienced market refers to

³² Although the import and export market is weighed down with uncertainty arising from geopolitical and environmental impacts, there are a set of rules on how trade should be conducted. Hence, these rules create an experienced market.

the trade of goods among individuals who are new to the trade or the trade behavior is unpredictable³³. One example would be the retail market where consumers make decisions on the spot at a retail store.

Other ‘opponents’ of prospect theory include the effect of experience when decision makers repeat their choices, (Erev et al., 2008) and the introduction of 11 new paradoxes. (Birnbaum, 2008) Nonetheless, in general, mainstream economists are willing to accept certain facts arising from experiments done for psychology. (Hands, 2010)

2.4 Endowment and Attachment Theory as the Primary Drivers for Consumer Choices

Thaler (1980) sought to explain the gap arising from the disparity between the buying price and selling price using the Endowment Theory (ET), which is defined as the disparity between the selling prices exceeding buying prices, “a manifestation of loss aversion” (Kahneman and Tversky, 2013a; Tversky and Kahneman, 1991), a valuation gap (Zeiler, 2018), avoiding deals that are deemed as bad rather than avoiding the prospect of losing possessions (Weaver and Frederick, 2012), and a related theory to the Attachment Theory (AT), which is defined as “an individual’s attachment to an object”, leading to the perception of the object being reflecting self. (Belk, 1988)

Endowment effect – or as Zeiler (2018)³⁴ termed it as ‘valuation gap’ – arises from a greater weight being placed on past utility (Tsur, 2008), high value items such as housing (Genesove and Mayer, 2001), “an egocentric empathy gap” in which individuals largely overrate the similarity between themselves and others (Van Boven et al., 2000) but underrate when it comes to average selling price (Kurt and Inman, 2013),

³³ It is unpredictable because availability of information is not high at the market level, and often decision-making is made heuristically.

³⁴ Zeiler (2018) did a fantastic literature review on endowment effect and prospect theory. We would encourage readers to read and examine her paper.

environmental or consumer products (Knetsch, 1990; Viscusi et al., 1987), a lack of substitutability of available options (Hanemann, 1991), a mix of calculations and feelings (Hsee and Rottenstreich, 2004), an aversion to a bad deal (Isoni, 2011), a context effect (Walasek, 2014), inertia effect (Gal, 2006), and information processing³⁵. (Carmon and Ariely, 2000) Chapman (1998) argued that larger endowment effect is observed for dissimilar trades when subjects traded money for leisure time as compared to trading money for bookstore certificates. However, endowment effect does not emerge from trade of goods that are bought to be resold (Arlen et al., 2002; Kahneman et al., 1990), hypothetical possessions or substitutable (Masters et al., 2017), trade made by experienced or intense consumers that have substantial amount of experience and knowledge about the trade (Coursey et al., 1987; Knetsch and Sinden, 1984; Willig, 1976), trade with goods that are more ‘ordinary market good’ such that the goods are well known with less uncertainty (Tsur, 2008), valuation in ‘saving trees being destroyed’ by natural disaster instead of human factor such as road widening projects. (Walker et al., 1999), and disappears in repeated trials in experiments. (Boyce et al., 1992; Coursey et al., 1987; List, 2004a) Buyers have a preconceived³⁶ idea of how much a price should be instead of a real purchase price that represents action when the moment of purchase happens. (Kurt and Inman, 2013; Lerner et al., 2004) The difference in the amount of information given and the mental budget of the purchase may impact the buying price judgment, as well as moral responsibility which can impact judgment of both the buying price and the selling price. (Carmon and Ariely, 2000; Walker et al., 1999) Sellers indicate their selling price primarily based on the perceived demand of the buyers (Simonson and Drolet, 2004) or a price which is nearer to the market or retail price.

³⁵ Yet to be tested and proven empirically – the authors simply conjectured based on several observations.

³⁶ Consumers do not pre-compute choices (Tversky, 1996) but have a preconceived idea in memory about the choice they want.

(Achttypi et al., 2020; Weaver and Frederick, 2012) True valuation of different products has to be obtained through ‘building on existing knowledge’. (Ariely and Simonson, 2003)

Attachment to an object can lead to greater value or utility which subsequently influence Willingness-to-Accept or selling price to be higher. (Loewenstein and Issacharoff, 1994; Plott and Zeiler, 2005) Loss aversion can also jointly influence the valuation gap. (Masters et al., 2017) When it comes to emotions, ‘grief’ is greater when consumers experience detachment of ownership from goods that help to strengthen the self-identity and symbolization of self (Ferraro et al., 2011). Although removing a good is deemed as “a loss” and adding the same good is deemed as “a gain” (Thaler, 1980), there is a sense of ‘relief’ when consumers choose a ‘new bad’ in exchange for a ‘possessed bad’. (Brenner et al., 2007) In relation to the ‘new bad’, regret arising from a negative outcome can be mitigated by the use of institutions such as principle-agents and voting. (Arlen and Tontrup, 2014)

Endowment effect may not necessarily require consumers to have physical or legal ownership of the goods (Peck et al., 2009) but may be ‘contagious’, in the sense that the prior endowment of the goods may be carried over to other goods subsequently. (Pyo et al., 2021) Lerner et al. (2004) conducted two consecutive experiments in the context of disgust and sadness and found the absence of endowment effect when the first experiment is framed as disgust, and reversed when the first experiment is framed as sadness. Source-dependence effect also appears to be as strong as endowment effect, neutralize endowment effect when it is observed and operationalized, and impact valuation of owned goods more than those which are not owned. Source-independence is strongly rejected³⁷. Consumers value good higher when they perceive that they have

³⁷ This is strongly rejected because consumers do not make a decision “from nowhere” or “out of the air”.

received or owned the good due to personal skills as compared to chance. (Loewenstein and Issacharoff, 1994) ‘Preference reversal’ was first discovered by psychologists. (Lichtenstein and Slovic, 1971; Lindman, 1971; Slovic and Lichtenstein, 1968) and economists have since then made the ‘empiricist move’ to escape from psychology. (Giocoli, 2003) Preference reversal is mitigated by reducing preference for scenarios where matching choices are involved for more familiar products (Coupey et al., 1998), and providing incentives and feedback over repeated choices. (Bettman et al., 1998; Cox and Grether, 1996)

Even in the absent of ownership, pseudo-endowment effects exist (Ariely and Simonson, 2003) and consumers think more concretely about the possession of the item which makes them partially attached to it. (Ariely and Simonson, 2003) Nonetheless, the effect of physical ‘touch’ does impact the assessment of the goods too. (Brenner et al., 2007, 2007; Peck et al., 2009; Peck and Childers, 2003; Peck and Wiggins, 2006) When consumers own the good, there is a sense of attachment (Ariely et al., 2005) and endowment which leads to a higher valuation of the good. (List, 2004a) However, if the ownership is psychological or legal, there is only a sense of endowment to it as attachment requires physical or hypothetical-physical (i.e. dreaming of the ownership) ownership. Consumers are led to match the characteristics of the products with their own traits when they feel a certain level of psychological ownership of the goods. (Weiss and Johar, 2018, 2013) Endowment effect is pronounced when ownership of the goods is fully depleted (Schurr and Ritov, 2014), or when the deliberation time is longer to the extent that endowment becomes more salient. (Ashby et al., 2012) And the experienced consumers tend to lean on the neoclassical economics theory³⁸, whereas the casual consumers tend to lean more towards the endowment effect (List, 2004a), given that

³⁸ Such as the Expected Utility Theory or Utility Theory or Bounded Rational Theory.

expectations are formed rationally and the necessary ability and skill to perform computation to make a choice exists for the experienced consumers. (Bettman et al., 1998; Plott and Sunder, 1982)

The reasons behind this disparity are not due to how much the consumers have in monetary terms, or “strategic behavior” (Knetsch, 1989), and if income effect influence the consumers, it affects how much they are willing to pay to procure the good. (Grutters et al., 2008) Knetsch (1990) proposed that the gap is explained by the long-term endowment effects one has on the consumption. Pachur and Scheibehenne (2012) proposed that the termination of search after encountering high outcome for sellers and low outcomes for buyers contributes to the endowment effect which leads to the disparity.

When it comes to recall, sellers first recall the positive feature of a good and then the worse feature, whereas buyers exhibit an opposite behavior. The order of recall or query matters significantly in decision making. The order of queries as defined in the Query Theory suggests that the worth of goods is influenced by perspectives and may explain the endowment effect. (Johnson et al., 2007) Possession and framing have little impact on the endowment effect (Koh and Wong, 2013), although cultural variances do have a significant impact on endowment effect: Asians tend to be interdependent³⁹ in framing the options whereas Westerners tend to be independent. (Maddux et al., 2010)

A prediction of oneself in a particular role may not provide an accurate assessment of what others think. In recent years, consumers have become sellers; there is a shift in focus on consumers playing the role of a seller. (Simonson and Drolet, 2004)

One of the more popular models explaining the endowment effect is the Sequential Value Matching (SVM) model, which assumes that “persons compare the

³⁹ There is an ‘acute necessity’ to study cultural differences of the endowment effect to explain the disparity.

gamble against a set of possible prices in a dynamic stochastic process.” (Ashby et al., 2012) This model suggests that a different starting value impact price comparisons. (Johnson and Busemeyer, 2005) Kim and Srivastava (2020) proposed that the role initiates a “directionally distinct motivation”, such that sellers seek maximization motivation and buyers seek minimization motivation: multiple motivations dilute the amount of money consumers are willing to pay to procure the good and the amount of money consumers are willing to sell in compensation for selling the good. However, Van Boven et al. (2000) proposes that strategic misrepresentation alone does not explain the valuation gap and it is not premeditated. One of the reasons why such disagreement happens is because of the varying nature of different types of goods and services and there is a need to further study how endowment effect arising from different types of goods and services impact the valuation gap. (Ariely et al., 2005) The other explanation is the Equal Weight Strategy, which is defined as the greater emphasis on the varying attributes⁴⁰ of the goods rather than weighing these attributes (Dawes, 1979); this strategy falls under the Attribute Sampling Bias – a collective explanation of valuation gap in addition to loss aversion – advocated by Morewedge and Giblin (2015). Interattribute correlation also has an effect on consumers’ selection of strategy in making a decision. (Bettman et al., 1993)

2.5 Uncertainty Effect Impacting Decision Making

In the year 1947, Von Neumann and Morgenstern (1947) wrote “Theory of games and economic behavior – 2nd rev. edition” which led to the birth of game theory.⁴¹ And

⁴⁰ Consumers may be ‘star struck’ or too much in awe to the extent that the most important attribute becomes the only deciding factor; they miss out weighing other attributes too.

⁴¹ Starting from mid-1600s, mathematicians argued that decision-making is based on a utility model among the riskless options. Pascal and Huygen developed the concept of games of choice in the mid-1600s and in 1738, Daniel Bernoulli presented a utility model that explains decision-making within the context of riskless options.

over the years, decision science scholars and economists have leveraged on game theory to derive contemporary topics such as uncertainty effect. Prior to the 1947 paper, decision making was predominantly understood by Bernoulli's 1738 utility model in his *Theoriae Novae De Mensura Sortis Avctore* paper, where utility is maximized in the absence of uncertainty. Today, decision science has tremendously advanced forward in an unprecedented speed.

Uncertainty Effect is defined as “the condition in which individuals value a risky prospect less than its worst possible realization” (Gneezy et al., 2006; Machina, 1992; Starmer, 2000), and it characterizes the “actual moment of decisions” instead of the eventual event. (Shafir et al., 1993) Consumers face two types of uncertainties. First, consumers are uncertain about the future and what may happen as a result of their choice. Second, consumers are uncertain about what they prefer in the future if they make a choice now. (March, 1978) Uncertain and risky prospect involves a potential loss that the consumers might face if the uncertain risky prospect or option is chosen. For example, consumers choose the option of getting \$30 with 100% chance as compared to \$100 with 30% chance; consumers face the challenge in overcoming the uncertainty in getting \$100 with 30% of chance in getting it. If the risky prospect is chosen and it eventually offers negative utility, consumers feel regret in their choice unless the choice is not the ‘even worse outcome’ among the alternatives. (Ritov and Baron, 1995) Consumers evaluate alternatives that are associated with different level of regret and preferences shift when the likelihood of regret which is computed by prior probability of success is mitigated. When a better known good is selected, and the outcome is negative, consumers associate the decision as being less responsible for it but with greater regret (Simonson, 1992), especially when the decision is associated with repeating choice. (Inman and Zeelenberg, 2002)

Norm theory suggests that how consumers react and response to an outcome depends on the difference between what they expect the outcome to be and what the outcome actually is. (Kahneman and Miller, 1986) Uncertainty effect also impacts the value of products based on uncertain outcome and persists when the expected value of the offering is negative (Newman and Mochon, 2012), and increases in magnitude along with the disparity in the valuation gap. (Neilson et al., 2008)

When the utility of a good is negative (i.e. dissatisfaction from buying the good), there is uncertainty as to whether the good offers the expected utility that is beneficial and positive to the consumer. For example, due to the uncertainty in receiving the Starbucks mug (made in clay) in one piece after shipping, consumers may not value the mug – *ex-ante*⁴² – as much as one that is made in tin. The likelihood in purchasing products with uncertain incentive condition over those products with inferior reward condition increases aversion toward losses (Goldsmith and Amir, 2010) and also increases the desirability of gains in the loss/gain paradigm. (Kahneman and Tversky, 1979) When confronted with uncertainty, consumers find the inferior option between two or more options more attractive than the one that is supposedly a dominating alternative.⁴³ (Simonson and Tversky, 1992) Kahneman and Tversky (1979)’s editing operation curtails the dominance violations such as the violation of monotonicity in choices when they are detected. (Yang et al., 2013) When confronted with certainty, consumers find the dominating option more attractive with the addition of an inferior option – a phenomenon commonly known as the “attraction effect”. (Huber and McCann, 1982; Simonson and Tversky, 1992) Consumers also find the middle option sandwiched

⁴² It is *ex-ante* because it is a valuation of the arrived good before shipping.

⁴³ This explanation bears a similar understanding with the decoy effect, whereby a third option (similar to the high-price, low-value product) makes the similar product more attractive. Similar to the explanation in the paper, a form of uncertainty makes the inferior option more attractive. It is not known, at this moment, how uncertainty effect and decoy effect interacts with each other in the context of decision making within the domain of psychology.

between two polarizing options more attractive, which is commonly known as the ‘compromise effect’ (Simonson, 1989), with the potential of splitting the share of the nearest neighbor or option if it is placed too close in similarity – a phenomenon commonly known as the ‘similarity effect’. (Tversky, 1972) Adding an option to an offered set does not increase the market share of that option which is commonly known as the ‘regularity condition’ but reduces the market share of other extreme options when an extreme option is introduced (Shafir et al., 1993), and a larger choice sets often tend to yield lesser confidence in choices among the larger sets. (Chernev, 2006) Consumers may make a no-choice option (i.e. not selecting a choice) when there are only small differences in attractiveness among the alternatives (Dhar, 1997), and this no-choice option is more pronounced for unique bad within the alternatives than for unique goods. Consumers are more willing to switch to a new alternative if a choice with unique bad is made as compared to a choice with unique good. (Dhar and Sherman, 1996) The addition of a third alternative to the other two options in ways that are predictable from the saliency of unique features also impacts overall satisfaction with the choice. (Dhar and Sherman, 1996; Houston and Sherman, 1995) While there are many pessimistic outcomes potentially arising from uncertainty, “innate optimism”⁴⁴ leads people to interpret uncertainty positively; and some form and degree of uncertainty generates interest and motivational benefits among consumers. (Goldsmith and Amir, 2010) This is particularly true when uncertainty creates a form of game that challenges the consumers and in choosing an uncertain option, consumers feel excited as if they are gambling.

Under the influence of uncertainty, consumers tend to become susceptible to anchor effect; anchoring effect is more pronounced as uncertainty is made salient, “*may even diminish the susceptibility of WTP (Willingness-to-Pay) judgments*” (Simonson and

⁴⁴ This is an optimism that arises within the consumers themselves. A self-motivated psychological trait as a result of challenges imposed on them.

Drolet, 2004) and make errors especially when the salience of outcome is not the same when a choice is chosen as compared to the moment when a choice is experienced. (Kahneman and Thaler, 2006) Hence, consumers tend to place more weight on the outcomes that are certain with lesser pronounced anchoring effect as compared to mere probable outcomes (Kahneman and Tversky, 1979), as mere probability makes uncertainty more salient and uncertainty makes anchoring effect more pronounced, which leads to more errors.

Uncertainty effect arises when people misunderstood the task at hand, wrongly assessed hypothetical Willingness-to-Pay values, or seemingly shrouded in the decision making process by how valuation was gathered such as an unfamiliarity with the device that elicits a response. (Brown and Cohen, 2015; Simonsohn, 2009) Uncertainty effect is an exogenous external attribution⁴⁵. For example, consumers can't exert more 'uncertainty' to an option whereas the structure of options does change the degree of 'uncertainty'. Moreover, consumers who have low confidence in the given uncertainty may overrate the uncertainty, leading to 'false uncertainty' that could severely impact valuation of goods.

2.6 Loss Aversion as the Preferred Explanation for Valuation Gap

Loss Aversion is defined as “a manifestation of an asymmetry of value arising from the disutility of giving up an object and the utility associated with acquiring it”, (Kahneman et al., 1991) a trait that arises due to the mismatch between what consumers can receive in giving up a good and how much they are willing to pay to hold on to the good (Knetsch and Sinden, 1984), a “seemingly ubiquitous phenomenon” (Novemsky and Kahneman, 2005), and a result of a greater tendency to feel pain in perceived losses

⁴⁵ It is unlikely endogenous as the valuation gap impacts uncertainty but not the other way round.

than its equivalent gain. It is primarily driven by the urgency in addressing pain more than pleasure. (Kahneman et al., 1991; Tversky and Kahneman, 1991) Options are framed as either loss or gain and such framing effect was observed among the adolescents; the framing effect gets stronger as the adolescents grow up in childhood. (Williamson et al., 2019)⁴⁶

Loss Aversion is observed when the money used for necessities is greater in proportion as compared to the non-necessities (Wicker et al., 1995) and changes relative to the reference point is compared. (Mellers et al., 2021; Schurr and Ritov, 2014) Magnitude based on the similarity of the items in the exchange (Hanemann, 1991), goods with the same benefits (Novemsky and Kahneman, 2005), reject costs (Kahneman and Tversky, 2013b; Thaler, 1999), and small stake items such that these items do not impact on the wealth/circumstances of the consumers (Gal and Rucker, 2018) impact Loss Aversion. Loss Aversion is not found in one-to-one exchange such as an exchange of a \$20 bill with a new \$20 bill (Brenner et al., 2007; Novemsky and Kahneman, 2005), small value items (Harinck et al., 2008), decisions made by educated individuals (i.e. experts) who may be able to deal with all individual options in each noncomparable category⁴⁷ but not being able to deal with them if the set of options were formed recently (Aggarwal et al., 2006; Bettman and Sujan, 1987), decisions made with high moral responsibility such that people do not easily accept morally wrong actions (Boyce et al., 1992), and money outlays such as budgets to procure items or to start a project. (Bateman

⁴⁶ Interestingly, framing effect remains with us from childhood to adulthood. Does this suggest that our current decision-making in the inexperienced market is impacted by our upbringing? This is an interesting further study.

⁴⁷ If there are specific criteria in selecting a choice, the noncomparable choice scenario resembles more with those for comparable choice scenario. (Bettman and Sujan, 1987)

et al., 2005) However, List (2004b) argued that goods leaving endowment is treated as though the lost opportunity is treated as a cost rather than a loss.⁴⁸

Apart from valuation of goods, consumers' psychology plays an important role in understanding Loss Aversion. Consumers who are reminded of a lost possession that has a strong "self-link to self" face greater separation distress and negative emotions. (Ferraro et al., 2011) Consumers are more loss averse when they prefer not to calculate gains and losses (Aggarwal et al., 2006), and they make choices to reduce the anticipated negative emotions. (Anderson, 2003) Clark and Mils (1993) argued that consumers strive to balance net gains and losses from the social psychology perspective. Consumers also choose riskier option in investment to avoid potential loss in missing out the opportunity to earn more (Gal and Rucker, 2018). This is likely to happen when the options are consequentially ordered together rather than considering the option one at a time non-sequentially. (Thaler, 1999)

There are two types of loss aversion: 1) valence loss / valence gain (i.e. paying a fine is a loss and receiving a reward is a gain), and 2) possession loss / possession gains (Brenner et al., 2007; Tversky and Kahneman, 1991), and consumers evaluate gains and losses based on memory using some form of ordinal measurement. (Walasek, 2014): consumers use information in memory which is more accessible and more diagnostic (Bettman et al., 1998) but face difficulty in executing a decision making strategy due to failure in retrieving information from memory and computational difficulties in handling complex task scenarios or environmental stressors. (Payne et al., 1996) This difficulty may also arise from Hindsight Bias, which is a phenomenon known as the "knew-it-all-along" bias. (Hawkins and Hastie, 1990) The Hindsight Bias suggests that consumers often rely on the "knew-it-all-along" bias to make decisions. And when the choice

⁴⁸ In our opinion, there is an opportunity cost because the opportunity to own the good is lost. Hence, it is a loss arising from opportunity cost and also a loss in terms of the good leaving endowment.

situation gets highly complex, consumers generally use alternative-based processing (Creyer et al., 1990) and impact on preferences due to highly complex situation is larger as compared to actual magnitude of outcome. (Weber et al., 1995)

Most of the loss aversion research works are assumed to be universal and therefore there is a need to contextualize for application purpose. In fact, it was postulated that emotions and behaviors have an endogenous effect on the study of the differential in losses and gains – valuation gap. (Gal and Rucker, 2018) Researchers in the past have doubted the existence of loss aversion but the focus should be on understanding its boundary conditions. A group of researchers formulated a loss aversion scale (Li et al., 2021). However, this scale may not correlate well with the valuation gap clearly. There are limits to loss aversion (Novemsky and Kahneman, 2005), and researchers are encouraged to study the limits alongside with the benefits loss aversion explanation can offer. In an opposing view, Gal (2006) argued that the psychological law of inertia is a better explanation for the valuation gap instead of the loss aversion. We agree with Gal that the law of inertia may offer some explanation to the valuation gap, but we also believe that loss aversion should be retained. First, the unwillingness to change the reference point – in behavioral economics context, status quo – due to inertia and the knowledge about what one stands to loss or gain can work together to explain valuation gap. However, loss aversion impacts inertia more than inertia impacting loss aversion, simply because inertia is a form of psychological state that is not motivated by any outcome and loss aversion is impacted by the outcome of the choice to be made. Consumers can simply hold on to the status quo option and measure their affection for it even without any options presented to them. But loss aversion is nonexistent when there are no options.⁴⁹ Second, inertia can be used as a mediating explanation to loss aversion,

⁴⁹ Consumers do not know what is to be lost if there are no options. But inertia is a state that, in the absence of options, they know the value of the status quo based on past memory.

which finally impacts valuation gap. For example, due to the preference to hold on to status quo, when consumers are faced with several options, consumers encounter strong preference for an option due to loss aversion. And when the options are too many, consumers adopt the elimination strategies to identify the choice they want. (Johnson and Meyer, 1984)

Loss aversion suggests that the framing of the difference in the valuation gap has an impact on the valuation of choices. (Tversky and Kahneman, 1991) The authors argued that a gain is characterized by a concave curve, whereas a loss is characterized by a convex curve. In a riskless choice scenario where options are evaluated as balancing tradeoff (i.e. options with two attributes: one attribute is advantageous among the options, and the other attribute is disadvantageous among the options) that is expressed in a mathematical form such as the nonreversible indifference curves (Knetsch, 1989), the authors demonstrated that consumers place more weight on the difference in two options when the difference is viewed as not advantageous. Nonetheless, loss aversion for risky and riskless choices is positively correlated, although loss aversion for riskless choice is higher probably because it reflects loss aversion for money and the emotional attachment to the good. (Gächter et al., 2022) And when a risky choice is chosen, states of wealth or welfare do not explain the decision for risky choice but instead, the changes from the reference point explain the decision to choose risky choice. (Kahneman et al., 1991)

Finally, loss aversion is found to create impact on multiple attributes of the goods such as pricing and quality. For example, one product is salient in one attribute A and the other product in attribute B. While choosing attribute A is a gain, losing in Attribute B can be more painful than losing both attributes: after all, losing both attributes lead to a mindset of “it’s a lost after all”, whereas losing one attribute among two or more attributes lead to a mindset of “a dissatisfied gain – neither here nor there in utility”. (Hardie et al., 1993) This is a result of the Attribute Sampling Bias. (Morewedge and

Giblin, 2015) Consumers will likely use more abstract attributes criteria to evaluate options as noncomparability increases (Johnson, 1986, 1984), increase the use of concrete attributes (Bettman and Sujan, 1987), process more extensively using attributes of the options when the environments are more negatively emotional (Luce et al., 1997), switch from within-attribute to across-attribute strategies (Johnson, 1986), avoid uncomfortable trade-off which require extensive processing by picking an option that is best described by the most important attribute (Hogarth, 1987; Luce et al., 1997; Tetlock, 1992; Tversky, 1969; Tversky and Shafir, 1992), decide on choices based on a combination of attributes and available options (Ross Jr and Creyer, 1992), and place more weight on the more important attribute than having to match the different attributes, which is also known as the prominence hypothesis. (Tversky et al., 1988) The attribute-based processing is cognitively easier in making a decision. (Russo and Doshier, 1983)

Trade-off involves weighted additive computation which is extensive and compensatory. (Frisch and Clemen, 1994) And conflict which can defer choice by adding an alternative is an experience to be paid by one who chooses to be free in exercising their rights to choose an option. (Huber and McCann, 1982; Tversky and Shafir, 1992)

2.7 Summary

The very definition of marketing is oftentimes satisfaction of needs and wants and it involves finding out the needs of consumers and associate these needs with particular goods and utilization habits. (Miller and Rose, 1997) However, more study is required to understand the relationship between satisfaction and future behavior. (Neal, 1999) Having satisfaction may not necessarily be effective in describing a model that better explains consumer behavior both now and the future. And introspection in understanding satisfaction of people does not mean that individuals have the ability to measure what is going on in each other's mind. (Robbins, 2007)

Experimental economics correlates with experimental psychology very closely. (Guala, 2005; Sugden, 2005) And the commodity to be used for the experimental economics must include those which are not controllable such as coupon. (Coursey et al., 1987) Such intertwine of relationship between both experimental studies did not exist for the past 50 years or so. (Hands, 2010)

Consumer behavior studies may not necessarily lead to more consumption. It can also mean better education in choices and teaching consumers how to seek for information better. (DiClemente and Hantula, 2005) And in this literature review, we have undertaken a comprehensive search for the truth about consumer decision making from the psychology perspective.

The number of studies in classic social topic has decreased and the number of studies of cognitive topics has increased. (Simonson et al., 2001) There are many reasons for an increased connection between cognition and consumer choice (Bartels and Johnson, 2015) and the sophistry displayed in cognitive science is clearly salient in consumers' choice.

“Maybe it is time to move to cognitive economics away from behavioral economics. Cognitive economics refer to the intersection of cognitive science and economics. The intersection of how the brain works with economics.” (Chater, 2015)

Even more so, recent trend suggests that there is a shift from studying cognitive function to a study on “how can we help consumers make better decision?” (Sloman, 2015) Is behavioral economics a long-forgotten cousin in the study of decision making? We believe behavioral economics remains a relevant domain of study today simply because there are certain traits of behaviors that are observed among every single consumers, such as the Loss Aversion Sensitivity proposed by Koh (2022).

CHAPTER III:
MATHEMATICAL LOGIC, REASONING AND DEFINITIONS

3.1 Introduction

The objective of this exercise *Mathematical Logic, Reasoning, and Definitions* is to set out crystal clear definitions without any ambiguity. At the end, a layperson should be able to comprehend the topic and understand the importance of this research effort.

Mathematical reasoning and definitions has been the yardstick in measuring the effect of scientific inquiry. Albert Einstein once said, “It is my conviction that pure mathematical construction enables us to discover the concepts and the laws connecting them which give us the key to the understanding of the phenomena of Nature”. (Einstein, 1934) Immanuel Kant also once said that “that which grounds its cognition only on the construction of concepts, by means of the presentation of the object in an a priori intuition, is called mathematics”. (Kant, 2004) It is no surprise that academic research typically follows mathematics and its use is extensively encouraged⁵⁰.

In this chapter, the flow of the argument follows a top-down, deductive approach. It starts with the definition of a consumer by using an authoritative source from Oxford Publishing, and ends with formulas that clearly define key concepts for this research paper.

3.2 Consumer

⁵⁰ This is not to say that research effort without mathematics and logic is not research. The basis for math and logic is the proof of the ability to view the world from a more abstract perspective, such that any studies involved can more likely be generalized and hence, scientific. Thomas Kuhn once pointed out that “only when all the relevant conceptual categories (in the sense that math provides the avenue to categorize) are prepared in advance...can discovering that and discovering what occurs effortlessly together, and in an instant.” (*The Structure of Scientific Revolutions by Thomas S. Kuhn, Ian Hacking - Ebook | Scribd*, n.d.)

A consumer is defined as an end user of a product or service, and this user may or may not be the purchaser. (Doyle, 2016) A consumers $[x]$ is a subset of customer $\{\rho_1, \rho_2, \rho_3, \dots, \rho_\omega\}$, whereby a limited number of consumers exists within the list of customers. This is particularly true when customers are trade customer, bulk purchaser, donators, or consumers.

$$\text{Equation 1: } x \subset \{\rho_1, \rho_2, \rho_3, \dots, \rho_\omega\}; \omega \in \mathbb{R}; \omega > 0 \quad (1)$$

A consumer may buy and consume the product, and he or she may not necessarily be the buyer, and yet consume.

$$\text{Equation 2: } \forall \rho \exists x [B(x) \vee \sim B(x)] \quad (2)$$

$$\text{Equation 3: } \forall \rho \exists x [(Q(x) \vee R(x)) \wedge (B(x) \vee \sim B(x))] \quad (3)$$

In this equation, we are saying that in all $[\forall]$ customers $[\rho]$, there exists a type of customer $[x]$ which is defined as an end user of a product $[Q(x)]$ or $[\forall]$ an end user of a service $[R(x)]$, and this user may be purchaser $[B(x)]$ or may not be purchaser $[\sim B(x)]$. Notice that the sentence which is given by B is not directly related to the other sentences such as Q and R . This demonstrates asymmetry between the purpose of a consumer (i.e. an end user) and the method by which the consumer obtains the good or service. However, we are not implying that there's a causal relationship between the purposes of consumption and the method of gaining the product through buying or receiving. We are suggesting that the definition of a consumer is either an end user of a good or an end user of a service, and independently this consumer is either a buyer or not a buyer. In the case where the good is received, this individual is not a buyer.

We can further refine Equation 3. A consumer may not necessarily be an end user of a product **OR** a service only but potentially both at the same time. Hence:

$$\text{Equation 4: } \forall p \exists x \left[\left((Q(x) \vee R(x)) \vee (Q(x) \wedge R(x)) \right) \wedge (B(x) \vee \sim B(x)) \right] \quad (4)$$

We apply DeMorgan's Law to the first part of Equation 4 and arrive at the following:

$$\text{Equation 5: } \left((\sim Q(x) \wedge \sim R(x)) \wedge (\sim Q(x) \vee \sim R(x)) \right) \quad (5)$$

Equation 5 refers to a non-consumer being not an end user of a product and a service and also not an end user of a product or a service. We have arrived at the Law of Excluded Middle, which states that the positive in Equation 4 and the negation⁵¹ in Equation 5 form a logic that does not permit any middle ground (i.e. does not permit somewhat true or false). From this logical argument, we can infer that a trade buyer who is not a consumer, for example, is someone who is not the end user of a product and/or a service and the moment this individual fulfills either one of the condition, $[Q(x) \vee R(x)]$ or $[Q(x) \wedge R(x)]$, he or she becomes a consumer as understood in Equation 4. The negation applies not only to trade buyers but also bulk purchasers and donators who buy for reasons not relating to personal consumption or end-using.

During the Great Depression and World War II, consumer spending power was attenuated and competition for resources was very stiff. (*Principles of Marketing*, 2010)

⁵¹ This is a negation logic. And it has been argued that a theory is only proven when the positive and negative have been identified and tested, and that no middle ground as understood by the Law of Excluded Middle exists. This is an important note because an inverse reasoning that is not reflected by the negation is not a reliable logic.

This led to the rise of door-to-door sales, where men⁵² (mostly men) approached individual households to convince them to buy their products. Over the years since then, consumer spending power has increased, leading to stronger per-dollar spending. With the advent of technology, consumers began to rely on internet search and e-commerce to spend their dollars. (SPOTIO, 2023) In our modern context, consumer spending can also be found in social media where sellers introduce their products via video-conferencing or live feed – a practice commonly known as Social Selling.

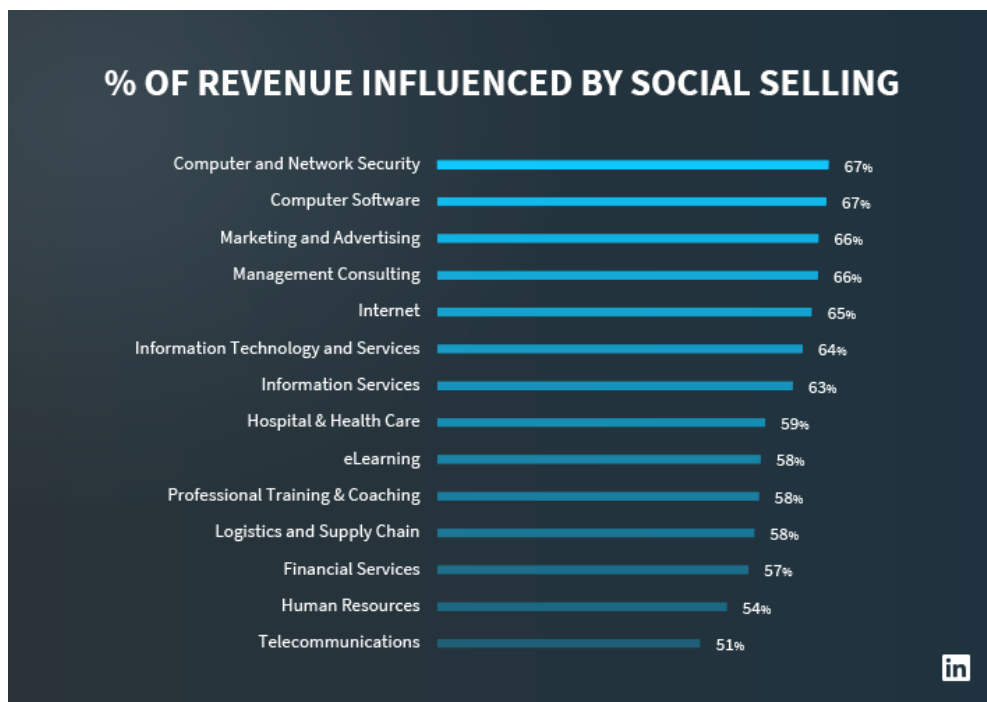


Figure 5 - % of Revenue Influenced by Social Selling (taken from Andrianos, 2017)

Hence, there's a shift in the understanding of spending power and power of consumption at the individual level⁵³.

⁵² People who lived through the 70s and 80s do remember the door-to-door salesmen who knocked on doors and sold toothbrushes across different neighborhoods.

⁵³ In this sense, the understanding of the definition of consumer is fast evolving and rapidly expanding too.

3.3 Product

University of Minnesota Libraries Publishing clarifies that the traditional way of understanding products includes both Goods and Services. However, the publishers also mentioned that this definition is ambiguous. In one example, they illustrated a scenario of a car purchase. Is a car purchase that includes services such as maintenance classified as a product? Or the product refers to the car itself? (*Principles of Marketing*, 2010) Microsoft Azure and Amazon Web Services use the term “Products” instead of Services for their range of offerings on their website. However, once a user signs up for an account with them, Microsoft Azure uses the term “Services” instead of “Products” in the administrator portal.

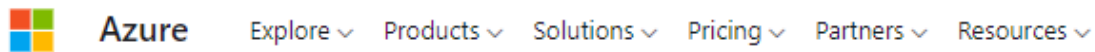


Figure 6 – Use of ‘Products’ before Logging into Azure Administrator Portal

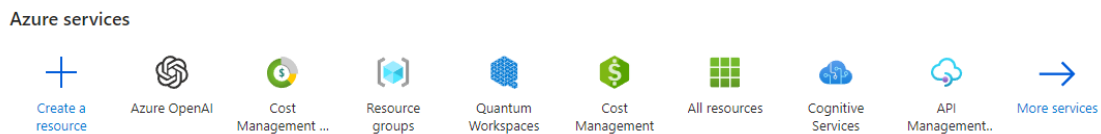


Figure 7 – Use of ‘Services’ after Logging into Azure Administrator Portal

There is ambiguity when it comes to the definition of product in our modern-day context. To clearly define a product, we define it as goods and services in the context of our modern society and businesses. And a customer cannot buy goods without service – even just placing the good on the e-commerce platform is a form of service. A product may or may not be tangible but a service is intangible and a good is tangible. Hence, a product is a good, a service, or both and it can be tangible or intangible⁵⁴.

⁵⁴ The understanding of tangibility of an item relates to the Law of the Excluded Middle. We do not classify items as half-tangible or half-intangible. It is either completely tangible or completely intangible. Hence, there’s no middle ground.

$$\text{Equation 6: } \forall P \exists p [(A(p) \vee C(p)) \vee (A(p) \wedge C(p)) \wedge (D(p) \vee \sim D(p))] \quad (6)$$

We can interpret Equation 6 in this manner. For all products $[P]$ in the market there exists a type of product $[p]$ which can be a good $[A(p)]$, or a service $[C(p)]$, or both good and service $[A(p) \wedge C(p)]$, and the product can be tangible $[D(p)]$ or not tangible (i.e. intangible) $[\sim D(p)]$. With the definition of a consumer and a product set out clearly, we can proceed to define a proper definition of a consumer for this paper.

3.4 Defining Consumer Proper

In Equation 4, we state that a consumer is an end user of a product and/or service. In Equation 6, we state that a product can be a tangible good or an intangible service. Using both equations, we refine the definition of a consumer:

$$\text{Equation 7: } Z(x, p) = \forall p \exists x [\forall P \exists p [(A(p) \vee C(p)) \vee (A(p) \wedge C(p)) \wedge (D(p) \vee \sim D(p))] \wedge (B(x) \vee \sim B(x))] \quad (7)$$

In all customers, there exists a kind of customer which is defined as the end user of a type of product that is either tangible good, or intangible service, or both, and this user may or may not be the purchaser. Notice that the definition uses two classes: a customer $[B(x)]$ and a product $[A(p) - \text{for example}]$. This definition is a result of the conjunctive logic formed by the definition of a customer and a product. A conjunctive logic is one that put two definitions together using the ‘and’ operator to create one definition. Hence, it narrows down to a specific group of customers (not business clients or traders). The following diagram shows the formation of conjunction logic. The shaded

area is the conjunct and the non-red or white areas are the constituents which is not part of the conjunction logic.

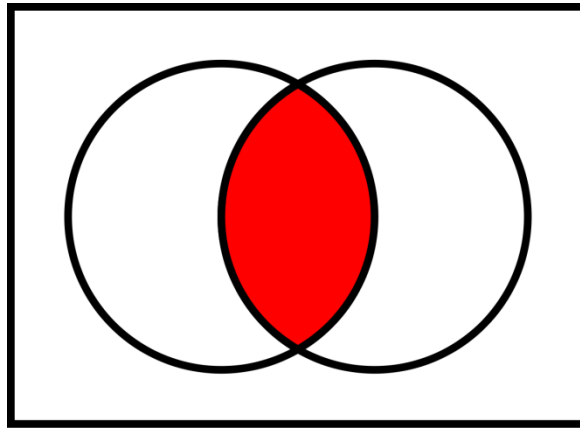


Figure 8 – A Venn Diagram showing Conjunction Logic

We can define consumers as such:

Definition 1: Consumer is defined as a specific type of customer who is an end user of a product that can come in a form of a tangible good, intangible service, or both, and he or she may or may not be the purchaser of that product but a person who consumes the product.

3.5 Buyer

At plain sight, it seems obvious when one asks what exactly a buyer is. However, a buyer can be understood as an individual person who performs trade procurement, purchasing of goods, subscription to services, bulk purchasing for distribution or even the activity of donation. In this research, a buyer is defined as the purchaser of a product from a consumption or end-using perspective. This essentially eliminates any definition relating to trade purchases, bulk purchases or donation. Take note that a buyer who is a

consumer may purchase products in bulk for personal consumption, although this paper does not look into this kind of purchase.

$$\text{Equation 8: } \forall Z(x, p) \exists x [K(x) \wedge V(x)] \Rightarrow F(x, p) \quad (8)$$

We are defining buyers who are consumers $[Z(x, p)]$ as understood in Equation 7 and they are not sellers. By this equation, we imply that a buyer $[F(x, p)]$ is a consumer that is defined as someone *who performs the purchase* $[K(x)]$ and he or she is not a bulk purchaser, trade purchaser, or donator $[V(x)]$. We have also considered the prospect of real outcome not matching the expected outcome and decided not to include purchases that are motivated by the real outcome of the purchase. Rather, we define buyer based on the expected outcome of the purchase. For example, the expected outcome of a purchase is to fulfill the purpose of consuming the product, even though the product may subsequently be donated away. In this aspect, the expected outcome of a product is consumption and the real outcome is donation.

In the original definition set out in Equation 3, a consumer is defined as an “end-user”. The term “end-user” is understood as the individual who uses the good or service or both. Meaning to say, this individual fulfills the purpose of the product by utilizing the service or consuming the good⁵⁵. We proceed to apply the Law of Contrapositive to Equation 8 as shown below.

⁵⁵ There is a difference between fulfilling the purpose of the product and fulfilling the purpose of consuming or utilizing the product. The former argues for the existence of the product, whereas the latter argues for the existence of the consumer. A consumer fulfills either purpose or both. For example, a consumer buys a box of chocolate to consume (fulfilling consumption). And by consuming it, the consumer fulfills the purpose of it. However, there are instances where the purpose of consumption is not fulfilled for the purpose of the product. For example, a consumer eats too much in a buffet. An individual fulfills the purpose of consuming food and drinks in the buffet and by that we refer this individual as consumer. However, the purpose of a buffet is not to make consumers to eat too much; it is to provide a spread of food with wide varieties of options for the consumers to choose and enjoy. In this sense, we say that the individual fulfills his or her purpose in overeating.

$$\text{Equation 9: } \sim F(x, p) \Rightarrow \forall Z(x, p) \exists x [\sim K(x) \vee \sim V(x)] \quad (9)$$

In Equation 9, we are stating the contrapositive of the definition of buyer. The consumer is not a buyer of the product $[\sim F(x, p)]$ and by that we imply that these consumers $[Z(x, p)]$ do not perform the purchase $[\sim K(x)]$ or he or she is a bulk purchaser, trade purchaser, or donator $[\sim V(x)]$. We then refine Equation 9 to better reflect the type of buyers for this research paper.

$$\text{Equation 10: } \sim F(x, p) \Rightarrow \forall Z(x, p) \exists x [\sim K(x) \vee \sim V(x)] \quad (10)$$

$$\text{Equation 11: } \forall Z(x, p) \exists x [K(x) \wedge V(x)] \Leftrightarrow F(x, p) \quad (11)$$

Equation 10 shows the refined version of Equation 9 which is the contrapositive of the definition of buyer. Equation 10 is then reverted back to the proper definition of buyer as shown in Equation 11. In this Equation 11, we are saying that in all consumers $[\forall Z(x, p)]$, there exist a type of consumers who perform the purchase of the product and he or she is not a bulk purchaser, trade purchaser, or donator, and by that we imply that the consumer is a buyer $[K(x)]$. Notice that the condition is an iff (if and only if). This condition refers to the bi-directional logic whereby a consumer is a buyer if he or she performs the purchase of the product, and he or she is not a bulk purchaser, trade purchaser, or donator. And by these descriptions we refer that consumer as a buyer.

Definition 2: A buyer who is a consumer is defined as a consumer who buys a product for consumption purpose and he or she does not buy in bulk, for trade purchase, or donation.

3.6 Seller

The definition of a seller is more comprehensive than a buyer. To sell, one must first own or have the rights to sell⁵⁶ the product. And to own or have the rights to sell the product, one must either buy, be given, take, or have the rights to sell the product. Buyers begin a new journey with the product when he owns or possesses it, and sellers had already begun the journey when the product or its rights to sell is owned. For this reason, the definition of a seller has to be narrowed down in this dissertation, so as to achieve clarity and focus on the topic. Consider John who is a consumer as defined in the consumer proper definition set out in definition 1. John may not be the purchaser (buyer), but he has a choice to either consume or sell it to others. Since the context of how John gets the good or service or both remains unknown, the understanding of John being a seller from an external perspective becomes very challenging.

$$\text{Equation 12: } \forall Z(x, p) \exists x [K(x) \wedge G(x)] \Rightarrow J(x, p) \quad (12)$$

In Equation 12, we are saying that for all consumer as defined in Equation 7, there exists a type of customer who is not a bulk purchaser, trade purchaser, or donator and has the rights to sell the product $[G(x)]$. We refer this person as the seller $[J(x, p)]$. Therefore, a buyer's definition starts when ownership or possession of the product begins, whereas a seller's definition starts when this customer sells and he or she may not necessarily be the purchaser but has the rights to sell. Similarly, the contrapositive of Equation 12 is shown below.

⁵⁶ Rights to own and rights to sell are different. The rights to own refer to the rights in which an individual is entitled to own but they may not necessarily have the entitlement to sell. And the rights to sell refer to the rights in which an individual is entitled to sell but they may not necessarily have the entitlement to own it. For example, in Singapore, some people have the rights to own a public housing, but do not have the rights to sell it. This is true when it comes to heavily subsidized public housing for low income earners.

$$\text{Equation 13: } \sim J(x, p) \Rightarrow \forall Z(x, p) \exists x [\sim K(x) \vee \sim G(x)] \quad (13)$$

In Equation 13, we are saying that an individual is not a seller if he or she is a consumer who is a bulk purchaser, trade purchaser, or donator, or does not have the rights to sell the product. Notice that the arrow is a unidirectional one: a bulk purchaser, trade purchaser, or donator may not necessarily be a non-seller. They can also be seller of bulk purchases and/or trade purchases. We observe that the positive in Equation 12 and contrapositive in Equation 13 are true. We then invert Equation 13.

$$\text{Equation 14: } \forall Z(x, p) \exists x [K(x) \wedge G(x)] \Rightarrow J(x, p) \quad (14)$$

In reference to the definition of consumer, a seller who is a consumer is an end-user of goods and/or services and he or she sells that product $S(x, p)$.

$$\text{Equation 15: } \forall Z(x, p) \exists x [(Q(x) \vee R(x)) \vee (Q(x) \wedge R(x)) \wedge S(x, p)] \Rightarrow J(x, p) \quad (15)$$

Using the Law of Transitivity, we arrived at the following equation.

$$\text{Equation 16: } \forall Z(x, p) \exists x [(Q(x) \vee R(x)) \vee (Q(x) \wedge R(x)) \wedge S(x, p)] \Rightarrow K(x) \wedge G(x) \quad (16)$$

Equation 16 states that for all consumer as defined in Equation 7, there exists a type of consumer who is end-users of goods and/or services and this customer sells the product, and by that we imply this type of consumer as an individual who is not a bulk purchaser, trade purchaser, or donator and he or she has the rights to sell the product. Equations 13 and 16 prove the definition of a seller by affirming the contrapositive and transitivity logic.

Following Equation 16, we have arrived at our third definition for this research paper.

Definition 3: A seller who is a consumer is defined as a consumer who is not a bulk purchaser, trade purchaser, or donator and he or she has the rights to sell the product.

It is important to take note that, unlike the definition of buyer, the definition of seller is a conjunctive logic of the status of the individual who is not a bulk purchaser, trade purchaser, or donator AND has the rights to sell the product. This individual may not necessarily have the product but he or she has the rights to sell it. For example, a property agent has the rights to sell a property that is owned by the client and the property is not owned by the agent. This definition of seller is only applicable to sellers who are consumers.

3.7 Time-Sensitive

The term time-sensitive is derived from two Latin words, “tempus”⁵⁷ and “sensitivo”⁵⁸. Time is understood as a dimension in which we count our existence in sequence. Time – or “Tempus” - likely comes from the root form of “tempos”, which means “stretch”. For example, we count 2000 years from 0 A.D. and perform this calculation by using days, or months or even seconds as a form of stretching. The term

⁵⁷ The word “tempus” can also mean ‘grammatical tense’ in the Finnish, Swedish and German language. A grammatical tense is a form of stretch from the past to the future and this stretch is expressed by the various tenses in the language.

⁵⁸ The nominative, singular, masculine form is ‘sensitivus’ which means pertaining to the senses. In English, sensitivity is the state whereby the senses are used and assessed. For example, we are sensitive to hot kettle when we touch it, but less sensitive if we wear a glove to prevent direct contact with the kettle.

“stretch” plays an important role in understanding time. To stretch something, there must be both ends in existence. In this aspect, time, as understood in ancient times, has an end from the start. In this paper, we can understand “time-sensitive” as a property of a TSVD product, and this property is characterized by both ends of time – start and end. The term “sensitive” illustrates “time” as a restricted stretch (i.e. limited period of life) from the start to the end. Due to the restriction in the stretch, time becomes more sensitive as the stretch becomes less extended.

$$\text{Equation 17: } F(p_\tau); 0 < \tau < \tau_u; \tau \in \mathbb{R}; \tau > 0 \quad (17)$$

Where τ_u refers to the time in the end (such as expiry date or full depreciation date), and p_τ refers to the state of the product at time τ , and the function of F refers to the utility of the product. Notice that the utility of the product at time t is bounded by 0 and t_u . The lower limit is 0 simply because there can be no ownership of the product before having it and the utility of the product can’t go beyond the date whereby the product is rendered null value.

Also notice that the understanding of time and its “sensitive” occurs by means of stretch. Hence, stretching time (i.e. making the expiration date longer or decreasing the value depreciation rate such that it depreciates slower) would make time less sensitive. In this regard, sensitivity to time becomes a function of time itself. This is true when sellers hop onto an extended warranty to experience less sensitivity toward time, in which time itself can be further stretched to a longer period if sensitivity becomes more heightened. This is the phenomenon we commonly observed when warranties are sold as a service

and consumers struggle to decide between multiple options that offer various lengths of warranty services.⁵⁹

Definition 4: A Time-Sensitive product is defined as a product which has an expiry date or a full depreciation date.

3.8 Value-Depreciating

The feature of value-depreciation in a product is one that follows the monotonicity⁶⁰ rule. This rule indicates that the function of time for a product results in a monotonic increase or decrease in value. As time increases, value is expected to decrease for products that have an end in shelf-life. Hence, a value-depreciating element of a product refers to the life – in terms of value and/or shelf-life – of the product. The value of a product may not necessarily have an end. Some products do not have a shelf-life and may eventually have a negative value. For example, financial instruments depreciate over time, resulting in a negative value which constitutes a loss. Together with the definition of time-sensitive, we arrive at the following definition for TSVD products:

Definition 5: A TSVD tangible good, intangible service or both is defined as a product which has its utility value depreciates over time, and the sensitivity toward the existence and value of the product in terms of monetary return increases as the end of the product in terms of expiration or full value depreciation approaches.

⁵⁹ The author bought a GPU-powered laptop and was given the option to choose 1, 3 or 5 year warranty. He is tempted to get a 5 year warranty as the incremental in cost is lesser than what is to be expected. Nonetheless, he bought the 3 year warranty, knowing that a desktop can last longer.

⁶⁰ In math, monotonicity is a fundamental rule for many underlying concepts. For example, to establish limits in a function, there must be upper and lower bounds. If the function is not monotonic, the upper and lower bound can become the same, as an increasing function with a subsequent decreasing rate may lead to a reverse back to the origin or the starting point.

3.9 Buyers and sellers not in equilibrium

In a customer journey, the purchase intention of buyers is influenced by the options available for decision-making. And sellers do not necessarily follow options in the market: they sell at a price that reflects their level of attachment to the product in their ownership – be it physical or psychological. This phenomenon creates a disparity between what the buyers expect to pay based on market information, and what the sellers expect to price based on their attachment to the product. Sellers must have some form of ownership *a priori* and buyers must have some form of mental evaluation *posterior* to the market offering. Inevitably, we arrive at the question “Is the expectation in the pricing of a seller impacted by their journey as a buyer?” And to compare buyers and sellers, we also arrive at the question “Is the expectation in the pricing of a buyer impacted by their journey as a seller?”

Buyers and sellers form expectations from past knowledge and experience. For buyers, the knowledge about the product can be formed in many ways such as past usage of a similar product, or friends’ recommendation of the product. However, sellers form their price expectations differently at a more intimate and personal level. Hence, it is likely to arrive at the conclusion of the expectation of buyers and sellers in terms of pricing not being in equilibrium.

$$\text{Equation 18: } E[F(x, p)] \neq E[J(x, p)] \quad (18)$$

Sellers may or may not necessarily be the buyer (i.e. gifting from friends) of the product to be sold and buyers *a priori* are not ‘sellers’ of the product they own.

$$\text{Equation 19: } F(x, p) \neq J(x, p)$$

$$\text{Equation 20: } [F(x, p) \neq J(x, p) \wedge J(x', p) \in F(x, p)] \vee [F(x, p) \neq J(x, p)] \Rightarrow E[F(x, p)] \neq E[J(x, p)] \quad (19)$$

(20)

In Equation 20, we are saying that the expectations between buyer and seller differ. And this is the result of the buyer not being the seller and the specific seller can be part of the buyer $[F(x, p) \neq J(x, p) \wedge J(x', p) \in F(x, p)]$ or simply the buyer is not the seller in any way (different persons). We restrict Equation 20 to a buy-then-sell scenario, whereby only the seller falls within the pool of buyers, but not buyers within the pool of sellers. This is fundamentally expressed in the same product in the logical expression, p . The expression for a specific seller refers to x' .

3.10 Reversal of loss aversion for TSVD product

In the previous subsection, we have argued for the proposition of sellers having an attachment to the product they own. In this sense, sellers become more emotionally and psychologically attached to the product they own – both physically and psychologically. The assignment of value to the product becomes more complex and it involves a form of compensation for the loss in attachment. This ‘compensation’ is usually understood as the need to compensate due to loss aversion.⁶¹

However, for TSVD products, the loss aversion is reversed. Instead of compensation for the attachment due to loss aversion, consumers seek compensation for the potential loss of the TSVD product when expiry or full depreciation arrives.

⁶¹ Compensation may not necessarily come in the form of money. Compensation is a representation of the reflection in loss, such that a heavier loss leads to larger compensation. Oftentimes, we express this representation in monetary terms.

$$\text{Equation 21: } \phi(Z(x, p), t) = \Delta \left(k_{t_0} * e^{-ek_{t_0} \frac{b}{\sqrt{t_1} * t_1}} \right) dt \forall k_{t_0} > k_{t_1} > k_{t_2}; k \in \mathbb{R}; t, b > 0 \quad (21)$$

Equation 21 is adapted from Koh (2022). The reversal of loss aversion for TSVD product $\phi(Z(x, p), t)$ is understood as the differential of a survival curve being controlled by a b-parameter b^{62} which is influenced by the initial value upon receiving or getting the product. At the high initial value, the sensitivity toward loss aversion is higher and hence a steeper gradient. And the end-tail of the loss aversion resembles a sudden taper off to a straight line, signifying the loss of hope due to the inability to regain monetary returns at near expiry or full depreciation.

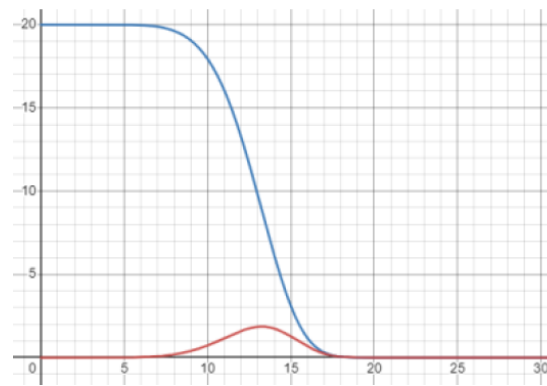


Figure 9 – Loss Aversion Sensitivity (LAS) function

3.11 Consumers' Satisfaction in Mismatch of Expectations

Consumers with different roles (i.e. buyers or sellers) form expectations in pricing differently. As mentioned before, sellers are concerned about the loss incurred should they avoid taking actions when expiry or full depreciation is near, and buyers are concerned about the right market value amidst comparison in choices. Sellers seek lower

⁶² The b-parameter is used instead of the beta-parameter as the use of beta is common in many statistical computations.

prices as expiry or full depreciation is near, and buyers seek market prices that justify their purchase at that point in time. Inevitably, this creates a disparity in expectation which impact satisfaction. In marketing, customer satisfaction is defined as “the feeling that a person experiences when an offering meets his or her expectations.” (*Principles of Marketing*, 2010) The key terms in this definition are “feeling”, “experience”, and “expectations”. Hence, we can express this definition in the following equation:

$$\text{Equation 22: } M(x) \subset W(\rho) \Rightarrow O(x) \quad (22)$$

This equation can be understood as a consumer who feels that his or her expectation is met $M(x)$ within the customer experience (journey) $W(\rho)$, which implies that the consumer is satisfied $O(x)$. Notice that the expectation falls within the customer experience journey. The term “customer experience” is preferred, as consumers do not feel satisfied simply from consumption, but also from other aspects such as intelligence gathering before consumption or after-sale service which is part of the customer journey. We have placed the word “journey” in parentheses to ease our reading and understanding. The definition provided by the authors included the key term “feeling”. Hence, equation 22 is further modified to fit into the framework of this paper.

$$\text{Equation 23: } ((T(x) \Rightarrow M(x)) \subset W(\rho)) \Rightarrow O(x) \quad (23)$$

Equation 23 refers to the following explanation. A consumer who displays emotion of satisfaction $[T(x)]$ is a consumer whose expectation is met $[M(x)]$ within the customer journey $[W(\rho)]$. As such, we can therefore imply that the consumer is satisfied $[O(x)]$.

We transform Equation 23 into its contrapositive.

$$\text{Equation 24: } \sim O(x) \Rightarrow ((\sim M(x) \Rightarrow \sim T(x)) \supset \sim W(\rho)) \quad (24)$$

The contrapositive states that if a consumer is not satisfied, we imply that the consumer's expectation is not met, and by that we imply that the consumer does not display emotion of satisfaction within the customer journey. Hence, we have our sixth definition:

Definition 6: When a consumer displays emotions that lead him or her to feel that the expectations are met in the customer experience journey, the consumer is satisfied.

3.12 Concluding Remarks

This dissertation studies the alignment of buyers: expectations as a consumer of the TSVD product with the sellers' expectations as a consumer of the same TSVD product. Every definition in this chapter is supported by mathematical logic and reasoning.

CHAPTER IV: METHODOLOGY

“By default, the method of hypothetical choices emerges as the simplest procedure by which a large number of theoretical questions can be investigated. The use of the method relies on the assumption that people often know how they would behave in actual situations of choice, and on the further assumption that the subjects have no special reason to disguise their true preferences”⁶³ (Kahneman and Tversky, 1979)

4.1 Overview of the Research Problem

The objective of this paper is to identify the obscurity effect by showing the disparity between buyers’ expectations and the sellers’ expectation in pricing for the TSVD product. We are expecting the obscurity effect to have a role in explaining higher selling prices.

The research problem comes with several assumptions. We expect the first undertaken role to have no significant impact on the differences in buying and selling prices. We also expect the demographic profiles split into subclasses of the sample to have no significant impact on the differences in loss aversion ratio. Last, we expect the respondents to follow the Loss Aversion Sensitivity function in explaining their loss aversion to the TSVD products.

4.2 Operationalization of Theoretical Constructs

The following theoretical constructs will be operationalized for this paper:

⁶³ There were questions raised by economists about hypothetical questions. The authors, Daniel Kahneman and Amos Tversky wrote this paragraph in defending their work. Eventually, the reviewers accepted their defense and published the paper. We hope that our reviewers favourably consider our research paper.

- Willingness-to-Pay; or rather, the buyers' price⁶⁴
- Willingness-to-Accept; or rather, the sellers' price⁶⁵
- Customer Satisfaction

4.3 Research Purpose

The purpose of this research is to quantify the theoretical constructs and provide statistical outputs to explain the disparity between the expectations of buyers and sellers. We hope to fill up the gaps in the literature, and also to provide more perspectives into the study of behavioral economics.

4.4 Research Design

A survey questionnaire will be given to the respondents to test the hypotheses. Full results together with a statistical explanation of the method and results will be given. We will adopt inductive reasoning to infer the results.⁶⁶ This study contributes to a larger part of the entire research effort and we acknowledge that this paper doesn't solve all problems. But it can provide reliable and scientific propositions for future considerations and study. R Studio⁶⁷ will be used to perform the data analysis, along with an implementation of a custom user-defined function to fit the data point to the LAS function.

Finally, a set of interpretations will be given from the social and cognitive psychology in the discussion chapter and a set of business recommendations will be

⁶⁴ The willingness-to-pay is a construct commonly known as WTP. It is the choice price set by buyers when it comes to making a decision.

⁶⁵ The willingness-to-accept is a construct commonly known as WTA. It is the asking price of sellers when it comes to making a decision.

⁶⁶ In the previous chapter 'Mathematical Logic, Reasoning and Definitions', we adopt a deductive approach, whereas in the 'Results' chapter, we follow an inductive approach.

⁶⁷ R Studio is 'a programming language for statistical computing and graphics'. ("RStudio," 2023)

given to marketers and entrepreneurs who are keen to adopt this valuation match. The set of interpretation will allow theoretical and applied researchers to leverage existing theories set out in the interpretation and continue the research work. The set of recommendations will allow businesses to apply these recommendations in their workplace (i.e. consultancy or marketing department), so as to create greater satisfaction for their customers – both current and new – and for the company they represent.⁶⁸

4.5 Population and Sample

This research paper studies a sample size of $n = 385$ which is taken from a population size of $N = 1.2$ million millennials in Singapore. This sampling method is taken from a 95% confidence level and the margin of error at 5%.

Sample size: **385**

This means 385 or more measurements/surveys are needed to have a confidence level of 95% that the real value is within $\pm 5\%$ of the measured/surveyed value.

Confidence Level: ?	95% ▾	
Margin of Error: ?	5%	
Population Proportion: ?	50%	Use 50% if not sure
Population Size: ?	1200000	Leave blank if unlimited population size.

Calculate ▶ **Clear**

Figure 10 – Sample size calculation using calculator.net

Although Singapore is a country with diverse groups of people, Koh (2022) concluded that the diversity in Singapore has no significant impact on his study. Simply put, regardless of the diversity, people in Singapore can be taken as a homogeneous group in the study of behavioral economics. Hence, there is no need to take more sample size from the largest ethnic group or a smaller sample size from the minority group. The

⁶⁸ This includes entrepreneurs: they represent the very company they created.

largest ethnic group in Singapore is the Chinese. (“The People of Singapore,” n.d.) We can treat all Singaporean millennials as one group.

4.6 Participant Selection

The participants were selected from a panel of respondents provided by pollfish.com⁶⁹. Their demographic description:

- Singaporean Citizen and Singaporean Permanent Resident⁷⁰
- Male and Female
- Residing in Singapore
- Chinese, Malay, Indian, Eurasian, and Others
- Age 25 – 36 years old

Participants are given an incentive provided by pollfish.com.

4.7 Instrumentation

The research instrument is a quantitative survey questionnaire hosted online on pollfish.com. The questionnaire was pre-tested by 2 male and female adult reviewers. They come from diverse backgrounds and domains of knowledge. Pretesting dates back to 1930s and early 1940s when researchers realized that there was a need to exclude questions that couldn’t be answered by respondents in a meaningful manner. (Hu, 2014)

The following observations were made from the outcome of pretesting:

1. Order of questions was wrong for one group of questions.
2. Changed the scale from Not Satisfied - Very Satisfied to Completely Not Satisfied - Completely Satisfied (with “does not bother me” as the neutral)

⁶⁹ Pollfish.com is ‘the only DIY market research provider with an end-to-end solution, focusing on a mobile-first approach and delivering real-time responses from 250 million+ real consumers around the world.’ (“Real Consumer Insights | Pollfish Survey Tools,” n.d.)

⁷⁰ This includes naturalized Singaporean citizens.

3. Changed the wording of the question on satisfaction level to reflect the magnitude of loss.
4. Changed the wording for the feedback question about their satisfaction rating.
5. Changed the wording for the matrix scale for selling price to include the instruction “write in dollars and cents”.
6. Changed the satisfaction answer type from gauge to multiple choice option.
7. Indicate how much they lose if they lower the price by 50% clearly.
8. The title of the pre-test survey includes the wording [Pre-Test] in the title - to clearly show that this is a pre-test and the purpose of it is to refine the survey.

These 8 changes were made to the draft questionnaire. Following the pre-test, a test was conducted by sending the mock questionnaire to 13 respondents that meet the screening criteria. The approach in maintaining anonymity is to send the questionnaire simultaneously to all 13 respondents, and then request their participation at a time convenient for them. As the data was collected without our knowledge of the completion time, we were not able to correlate their answers to their identity. On 16 March 2023, the test results were downloaded and analyzed. The results were found to be consistent and validated to be reliable.

The pre-test and test exercise are crucial to the success of implementing the quantitative survey. They serve as the proofreading and validation process for the finalized questionnaire.

Subsequently, the completed ethics application form, the informed consent form which is stated in the questionnaire’s terms and conditions, and the finalized

questionnaire were sent to the thesis supervisor. On 30th March 2023, full approval was granted to continue with the research.⁷¹

Respondents are expected to complete the questionnaire within 5 minutes from the start. Backend logic is robustly implemented to make sure that the respondents are directed to the correct set of questions based on their choice in the first question. Finally, this questionnaire serves as the instrument to reject the 6 null hypotheses⁷² through 3 studies⁷³.

4.8 Data Collection Procedures

Respondents first accept the terms and conditions by proceeding with the questionnaire on the first page. The terms and conditions page contains the participant information details and the informed consent. Once they proceed with the questionnaire, they will answer one screening question, “I am a Singaporean Citizen or Permanent Resident living in Singapore.” If they answer “no” to this screening question, they will exit the survey. If they answer “yes”, they will proceed to choose an option among 6 choices of flowers {*Rose, Tulip, Dandelion, Sunflower, Orchid, Jasmine*}. They also have the option to exit the survey by indicating “I do not want to participate in this survey.” The use of flowers as choices is to randomly assign the respondents to a particular set of questions without any ordinal relations. For example, respondents who chose the number 1 within a set of 6 numbers may compare 1 being the first and 2 being the second, whereas the choice of flower within a set of 6 flowers does not yield ordinal comparison.

⁷¹ The author would like to take this opportunity to thank his thesis supervisor, Dr. Andreja Rudančić, for her kind approval.

⁷² There were six hypotheses and two alternative hypotheses. If the null hypothesis is rejected, the alternative hypothesis is accepted.

⁷³ The author believes that the significance level is 10% for social science studies.

In choosing a flower, the respondents are then directed to a set of specified questions. The questions in different sets are similar, except that the expiry date of the box of chocolate varies. For the choice of Rose, respondents will answer questions in the buy-then-sell scenario for a box of chocolate that will expire in 1 year. For the choice of Tulip, the box of chocolate will expire in 6 months. For the choice of Dandelion, the box of chocolates will expire in 2 months. For choices of Sunflower, Orchid, and Jasmine, respondents will answer questions pertaining to the sell-then-buy scenario for a box of chocolates that will expire in 1 year, 6 months, and 2 months respectively. Each choice contains balanced responses of 64 or 65 responses which aggregate up to the sample size of 385.

In each set of questions after choosing a flower, in the buy-then-sell scenarios, the respondents provide their buying price, experience the obscurity effect by realizing that the actual day-to-expiry is halved, provide their buying price for that new expiry information, and then provide their selling price based on that new information. For the sell-then-buy scenarios, the respondents provide their selling price for the product they own and then their buying price for the product found in a supermarket; this product in the supermarket has half of the day to expiry as compared to the one that is owned by the respondent. They experience the obscurity effect by realizing that the actual day to expiry is two times: for example, 1 year to expiry instead of 6 months.

In between the scenarios, the respondents are asked about how satisfied they are if 50% of the e-commerce portal sells at 50% cheaper than the selling price they indicated in the previous question. This question primes the respondents to consider the obscurity effect more seriously. In the next question, they are asked to write a short description of why they choose their satisfaction level. The answers to this question will be used to interpret the results and provide some discussion on it too. Finally, the respondents

answer questions pertaining to their demographic profile such as their race, income brackets per annum, and latest education level.

Data is collected digitally and stored for at least 3 years. After which, the data will be disposed of following industry best practices. The questionnaire is completely anonymous and the respondents agree to provide the demographic information when they accept the terms and conditions by proceeding with the survey.

The data collection exercise started on 30th March 2023 and ended on 18th April 2023. A copy of the questionnaire and the terms and conditions provided by pollfish.com are found in Appendix D.

4.9 Data Analysis

Similar to Koh (2022), the research will undertake a quantitative, statistical analysis using non-parametric methods such as a rank-based approach and parametric analysis of variance, along with effect size analysis and qualitative approach using sentiment analysis.

For ease in reading, the detail about data analysis is found in the findings subsections.

4.10 Research Design Limitations

The research faces several limitations. First, each response is elicited *a priori*. We may not be able to ascertain whether the responses truly reflect the actual buying behavior when the action happens. However, the *a priori* response is a good estimation for modeling purposes. While it is a limitation, there is still merit in eliciting a response *a priori*. We can better approximate and gauge buyers' and sellers' behavior before the action happens.

Second, respondents do not have physical contact with the product under study. Respondents do not physically ‘feel’ the product. However, physical contact may not necessarily be needed in this research. The product is a popular item in the supermarket and the respondents would likely have eaten it before. The experience with the product is an important factor in making sure this limitation is mitigated as much as possible. Karl R Popper said “Even after the observation of the frequent or constant conjunction of objects, we have no reason to draw any inference concerning any object beyond those of which we have had experience.” (McGrew et al., 2009)

Third, the incentives for the respondents may not be appealing enough to elicit a reliable response. This research study is also impacted by the amount of available budget. Nonetheless, this limitation can be mitigated by making sure that the respondents are aware of the incentives *a priori*. Not only are the respondents agreeable to the research study, they are also agreeable to how much they are compensated through the incentives. However, respondents may choose to provide their responses based on how much they receive as an incentive. For example, given that the incentive is a 10-cent payment, respondents may hastily answer the question in the survey, whereas if the incentive is a \$10 payment, respondents may spend more time thinking before answering the question since they value their time spent as \$10 or approximately \$10. Based on the incentives provided by pollfish.com, the incentives are set to be within the range of \$1 to \$2 per completed survey per respondent. Hence, there is a very low chance that the respondents behave strategically in this manner.

4.11 Conclusion

The research methodology follows the Contingent Valuation Method⁷⁴ (CVM) closely. The CVM is defined as “an economical technique that helps determine the monetary value of a non-market resource.” (Team, 2023) This methodology allows the respondents to report their willingness to pay and willingness to accept a product directly instead of inferring their responses from observed behavior. In addition to the research method, the sample size is suitable for the homogenous population in Singapore. While diversity increases the probability of observing error, the population is characterized as diverse in personal value, but homogenous in terms of consumer behavior in the free and open market. This was seen in study conducted by Koh (2022). We are also aware that the demographic profiles of Singaporeans may change in the future, and we believe that the research method adopted in this research paper is replicable for future studies.

Finally, the research instrument is a calibrated instrument that specifically caters to the Singaporean audience. Reviewers that performed the pre-testing are aware that the survey instrument is specifically meant for the Singapore market in terms of the wordings, sense-making, and interpretations of words and meanings. A calibrated instrument allows the researchers to avoid expert-error and the respondents can complete the questionnaire without any challenge relating to semantics posed by the experts.

⁷⁴ The CVM was first proposed by Ciriacy-Wantrup (1947) and it was used to study the capital returns from soil-conservation practices.

CHAPTER V: RESULTS

5.1 Research Question One

Is the buying price different for consumers who first take on the role of seller or buyer? Imagine a buyer who has an intention to buy a piece of used furniture. This buyer then utilize experience with the same or similar product in the past and knowledge about the market to determine the buying price. Perhaps the furniture has deteriorated and it is framed as an item that comes with a much lower price. Will we observe a difference in buying prices if the consumer first undertakes the role of buyer and then seller? Conversely, when a consumer sold the used furniture, and subsequently buys the similar furniture which was bought (or to be bought) by the buyer, do we observe a difference in the buying prices when the consumer first undertake the role of a seller and then buyer? Similarly, is the selling price different for consumers who take on the role of buyer? And is it different from the consumers who take on the role of seller? Inevitably, consumers are always curious about how much difference between buyers' and sellers' prices can be observed based on their first undertaken role.

Buyers seek minimization in buying prices whereas sellers seek maximization (or in some cases, optimization⁷⁵) in selling prices. Can we assume that buyers who seek minimization in buying prices also seek minimization in selling prices? Conversely, do sellers who seek maximization in selling prices also seek maximization in buying prices? In a rational argument, prices should reflect the rational preference based on the market value of the good regardless of the first undertaken role. The rational argument suggests that the pricing set by the buyer should be the same as the pricing set by the seller if the

⁷⁵ For example, sellers in Non-Profit Organization seek to optimize prices such that it reflects the value of the item and not ripping off the buyers.

product is the same, *ceterus paribus*. However, the additional factor of the first undertaken role may confound the buying and selling prices. This first undertaken role refers to the first role in which the consumer is in. The consumer may potentially be a buyer in a buy-then-sell scenario, and subsequently be a seller in a sell-then-buy scenario. In this research paper, we are assuming that the same respondent does not switch their role rapidly. We posit that there is no statistical difference between buying prices and selling prices regardless of their first undertaken role as a buyer or a seller. In these two hypotheses, two groups of subjects in buy-then-sell and sell-then-buy scenarios⁷⁶ are studied. If the pricing they indicate differs, then there is a plausible explanation that the first undertaken roles impact pricing⁷⁷.

$H_{0,1} \leftarrow$ In between-subjects, subjects who take on the role of the buyer first (i.e. buy-then-sell) or later (i.e. sell-then-buy) do not exhibit a statistical difference in their buying price.

$H_{0,2} \leftarrow$ In between-subjects, subjects who take on the role of seller first (sell-then-buy) or later (buy-then-sell) do not exhibit statistical difference in their selling price.

These two hypotheses form the underlying basis for this research paper. If we obtain no statistical difference in the between-subject studies, we can then proceed with the research within the scope of prices.

5.2 Research Question Two

⁷⁶ This is similar to the cross-validation method whereby sampling is taken to be cross-validated with another sampling. In this research paper, a group of respondents is taken to be cross-validated with another group of respondents.

⁷⁷ We are not saying that roles have an impact on buying and selling prices. In this research paper, we are ruling out the possibility of such an impact, although most of the past literature has already suggested the insignificance of the impact.

Do sellers exhibit the behavioral pattern described by the Loss Aversion Sensitivity as introduced by Koh (2022)? Loss Aversion Sensitivity is a high-level introduction explaining how consumers behave at different points in time when it comes to indicating selling prices for time-sensitive and value-depreciating goods. At the start, consumers may not be willing to lower the selling price drastically. As the good approaches the expiry date or full depreciation, consumers then gradually decrease their selling price. And at the final moment when the expiry date or full depreciation is nearly reached (let's say, expiry is the next day), consumers set selling prices so low to the extent that it becomes very attractive to buyers. Inaction, when expiry or full depreciation is realized, leads to a total loss. And early action in the initial stage of ownership or possession of the good may lead to regret, especially when the selling price is lower than the expected price at the start. For this reason, consumers avoid decision-making by means of either delaying a decision or simply inaction (Anderson, 2003), depending on the context of the decision-making scenario. (Beattie et al., 1994) Decision avoidance is not the same as procrastination: procrastination involves an intention to act but stalls the act on the contrary to the intention to act, whereas decision avoidance is an act that is consistent with their intention to act. (Sabini and Silver, 1982) While inaction and delay in decision-making connote a negative outcome, on the contrary, a report shows that indecision can actually make us smarter. (Robson, 2022) We posit that consumers behave in accordance with the Loss Aversion Sensitivity function when it comes to selling time-sensitive and value-depreciating products. In addition to the first two hypotheses which test the difference in buying price and selling price regardless of their first undertaken role, we expect the behavior to follow the Loss Aversion Sensitivity function. We also expect the loss aversion ratio to be not statistically different across demographic groups.

$H_{0,3}$ ← In within-subjects, subjects do not exhibit reversal of loss aversion for time-sensitive and value-depreciating products.

$H_{1,3}$ ← In within-subjects, prices set by sellers across different time period follows the Loss Aversion Function.

$H_{0,4}$ ← In between-subjects, the reversal of loss aversion is not statistically different between different demographic groups.

Together with the first two hypotheses, these additional three hypotheses form the cradle⁷⁸ in which the main topic is focused on in this research. The explanation for the use of the word “cradle” is given in the discussion.

5.3 Research Question Three

Are buyers’ expectations of the buying price for a TSVD product before observing obscurity effect a match with the sellers’ selling price after observing the obscurity effect? Buyers have an expectation of how much they are willing to pay. And on the seller side, prices may differ depending on how much obscurity they face. This obscurity effect may arise from incomplete information, incorrect information, and misunderstanding of the information provided. We may also observe a spillover effect arising from the decision to set selling prices before the obscurity effect is observed. If respondents experience the obscurity effect due to the spillover effect from the prior question before the obscurity effect happens, the differences will be significantly observed due to the spillover effect. In other words, we want to rule out the probable effect of spillover. To isolate the spillover effect, a study of difference is required *a*

⁷⁸ The cradle holds the research topic. In this paper, the non-significance in the impact of first undertaken roles (buyer or seller role) and demographics (race, income, and most recent educational level) clears the doubt about whether there are confounding effects due to the intrinsic and assigned nature of the respondents.

*posteriori*⁷⁹ between the prices of the same good with the same day to the expiry date and the prior question in which the spillover effect may have happened. In the following diagram, we illustrate our explanation by showing the probable impact of the spillover effect arising from the prior question. We hope to isolate the influence from the prior question and focus our research on the scenario where obscurity effect is observed.

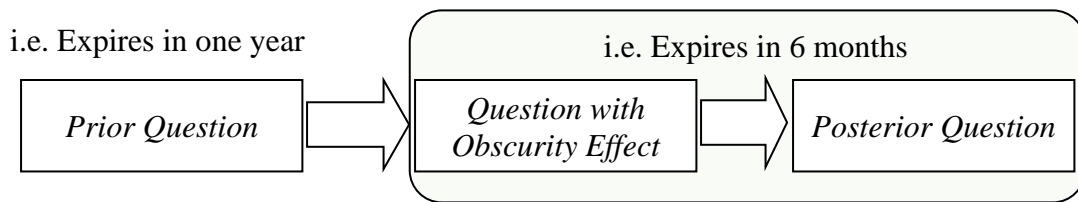


Figure 11 – Overview of Obscurity Effect Study

$H_{0,5}$ ← In within-subjects, subjects’ buying or selling price is not impacted by the spillover effect arising from the prior question.

5.4 Research Question Four

We want to know whether the selling price after observing the obscurity effect and the buying price before observing the obscurity effect remain the same for the same product and the same day to expiry. In a completely rational environment, the buying and selling price for the same product with the same expiry date should be the same. However, we posit that the buying price and selling price are different due to the obscurity effect. This final research question carries a huge impact on the existing behavioral economics literature⁸⁰.

⁷⁹ It’s *a posteriori* because it is based on past observations of the respondents. Respondents do observe the obscurity effect explicitly in the research.

⁸⁰ In the existing literature, the loss aversion ratio has been more than 1 in the WTA/WTP equation. For TSVD product, this loss aversion ratio is less than 1 with WTA being lesser than WTP. However, with the obscurity effect, this loss aversion ratio becomes more than 1 again.

$H_{0,6} \leftarrow$ In within-subjects, subjects' buying price is not statistically different from their selling price after observing the obscurity effect.

$H_{1,6} \leftarrow$ In within-subjects, subjects' selling price after observing the obscurity effect is statistically higher than buying price.

5.5 Summary of Findings – Study 1

Study 1 tests the third null hypothesis, $H_{0,3}$. RStudio (version 2022.12.0) hosting R (version 4.2.0) was used to test the hypothesis. First, the program declares the user-defined function (UDF) by constructing a mathematical function. This function is then modeled to the answers given by the individual respondent using the nonlinear least square method (NLS)⁸¹. The program then computes and predicts the b-parameter, and finally extracts the sum of errors to ascertain a working theoretical model that explains the reversal of loss aversion for TSVD products.

The NLS method first fits all observations into a linear fitting and subsequently adjusts the fit into a non-linear curve in an iterative approach. The algorithm will then seek the best non-linear fitting which optimally reduces the sum of squares of error. The b-parameter is adjusted to fit the data provided by the respondents. Hence, the b-parameter must start with a seed⁸². In terms of model validation, the interpretability of this model is judged subjectively and is not examined in the light of statistical methods. (Browne and Cudeck, 1992)

The LAS function which is modeled by the LOESS method shows the robustness of the NLS curve fitting. Ideally, we are seeking a normal curve as proposed by Koh

⁸¹ {stats::nls()}

⁸² In the R program, the seed is more than 0, as Koh (2022) proposes a positive real number for the b-parameter.

(2022) for the LAS function. If the b-parameter which controls the curve fitting at the minimal least sum of square of errors, and the normality of the LAS function resembles the Gaussian distribution using the Shapiro-Wilk Test⁸³, we have successfully created a theoretical model to explain the reversal of loss aversion for TSVD product. The script for study 1 and the graphs to illustrate the fitting of the LAS function onto the individual responses (20% of all responses were chosen at random, so to avoid cluttering the research paper with hundreds of charts) are found in Appendix E.

Result

The curve fitting using the NLS method with the LAS function yielded robust results. 74% of all respondents followed the theoretical model introduced by Koh (2022) with the b-parameter ranging from 1.05 – 7.12 and the Shapiro-Wilk Test p-value > 0.20. Partial standard error ranged from 0.0176 to 0.948, with the median value at 0.068 and the mean value at 0.0887⁸⁴.

⁸³ {stats::shapiro.test()}

⁸⁴ The partial standard error shows the deviation of points from the model and although the highest is 0.948 which is expected, most of the deviation centered on 0.068 for the median value and 0.0887 for the mean value. We should be concerned if the deviation centered around values that are close to 1.

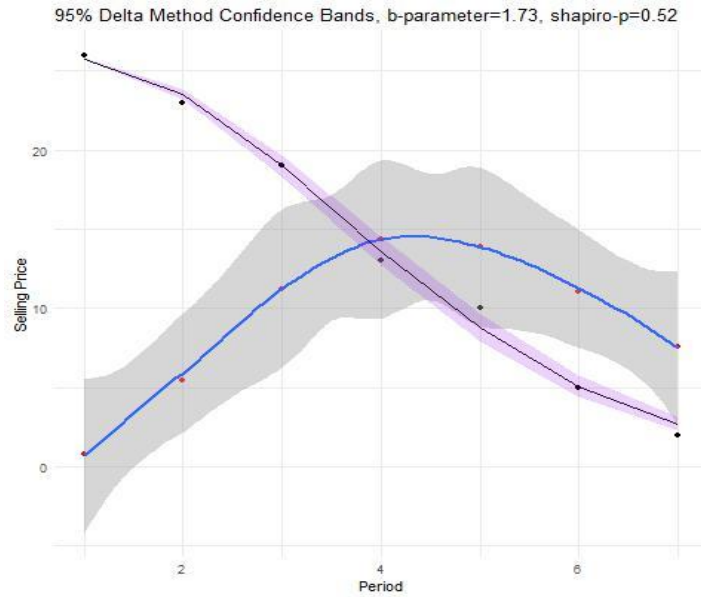


Figure 12 – NLS Modeling of LAS Function onto Data

The data points trending along the purple-shaded region are the selling price given by a respondent. The curve within the purple-shaded region is the integral of the LAS function⁸⁵. The purple-shaded region is the confidence level of the integral of the LAS function within 2.5% and 97.5%. The data points trending along the grey-shaded region are the gradient – also known as the LAS function – and the blue curve is a plot using the LOESS⁸⁶ method. The LOESS method is the Locally Estimated Scatterplot Smoothing method whereby the curve fits to the data using the weighted least squares approach. The grey-shaded region is the confidence level. The blue curve follows the Gaussian distribution. This is a significant conclusion because we are observing a mathematical function following nature, which is the primary purpose of science – the study of nature.

⁸⁵ The LAS function is a differential function. By integrating it, we transform the function back into the non-differential format.

⁸⁶ {stats::loess()}

A curve fitting method is just as good as the amount of partial standard error it gives. If the partial standard errors for the respondents are mostly high, we have a good curve fitting but low confidence.

Recall that the standard error of a sample is computed by the following formula:

$$\text{Equation 25: } SE \approx \frac{\sigma}{\sqrt{n}} \tag{25}$$

The standard error is the approximation of the sample standard deviation divided by the square root of the sample size. In the NLS output, the partial standard error (i.e. the standard error for each observation which will be aggregated to form the standard error of the sample) was computed to provide us with a better picture of the partial standard error of each respondent. If we create bins for the standard error by *break* = 0.1, we arrive at the following table:

Partial Standard Error	Count
(0,0.1)	220
(0.1,0.2)	55
(0.2,0.3)	5
(0.3,0.4)	1
(0.4,0.5)	1
(0.5,0.6)	0
(0.6,0.7)	2
(0.7,0.8)	1
(0.8,0.9)	1
(0.9,1)	1

Table 1 – Partial Standard Error of NLS Curve Fitting at Respondent Level

Based on this table, we have a good range of estimates among the 74% of respondents, with normality observed for the LAS function, and the partial standard error

mostly falls within the $0 < PSE < 0.1$ and $0.1 < PSE < 0.2$ bins. PSE refers to the partial standard error.

In addition to curve fitting, the b-parameter as described above was modeled into a linear model. Each period (i.e. each scenario of days to expiry; for example, 1 year, 6 months, 2 months, 15 days) was represented by the independent variables, and the estimate which was the b-parameter was the response variable. The following model achieved statistical significance at p-value < 0.05 and an adjusted R-squared value of 75%.

```
Call:
lm(formula = Estimate ~ poly(x1, 2) + x2 + exp(x3) + x4 + x5 +
    x6 + x7, data = h2)

Residuals:
    Min       1Q   Median       3Q      Max
-0.8963 -0.0701 -0.0057  0.0767  3.4054

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  8.921e-01  1.545e-01  5.773 2.18e-08 ***
poly(x1, 2)1 -1.392e+01  1.106e+00 -12.591 < 2e-16 ***
poly(x1, 2)2  4.002e+00  3.201e-01  12.503 < 2e-16 ***
x2            1.889e-02  8.343e-03  2.264  0.02440 *
exp(x3)      -2.782e-20  9.517e-21  -2.923  0.00377 **
x4            2.441e-02  7.803e-03  3.128  0.00196 **
x5            3.429e-02  8.594e-03  3.990  8.57e-05 ***
x6            2.583e-02  9.402e-03  2.747  0.00642 **
x7            1.828e-02  7.437e-03  2.458  0.01462 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.308 on 264 degrees of freedom
Multiple R-squared:  0.7516,    Adjusted R-squared:  0.7441
F-statistic: 99.86 on 8 and 264 DF,  p-value: < 2.2e-16
```

Figure 13 – Linear Regression Model of b-parameter Estimate

Mathematically, it is expressed as:

$$\text{Equation 26: } y = -13.92 X_1 + 4.00 X_1^2 + 0.02 X_2 + 0.02 X_4 + 0.03 X_5 + 0.03 X_6 + 0.02 X_7 + 0.89 \quad (26)$$

It is important to note that loss aversion for TSVD products was mostly impacted by the first period indicated in the study with a model parameter estimate (not the b-

parameter but the model term estimate) of 13.92 for the linear estimate and 4.00 for the polynomial estimate as compared to the rest (i.e. less than 1). This was an important result that suggested how consumers behaved due to loss and it was mainly impacted at the start of ownership or possession.

Relating to the b-parameter, a set of predicted estimates was computed. The following chart shows the scatter plot of actual b-estimates and predicted b-estimates:

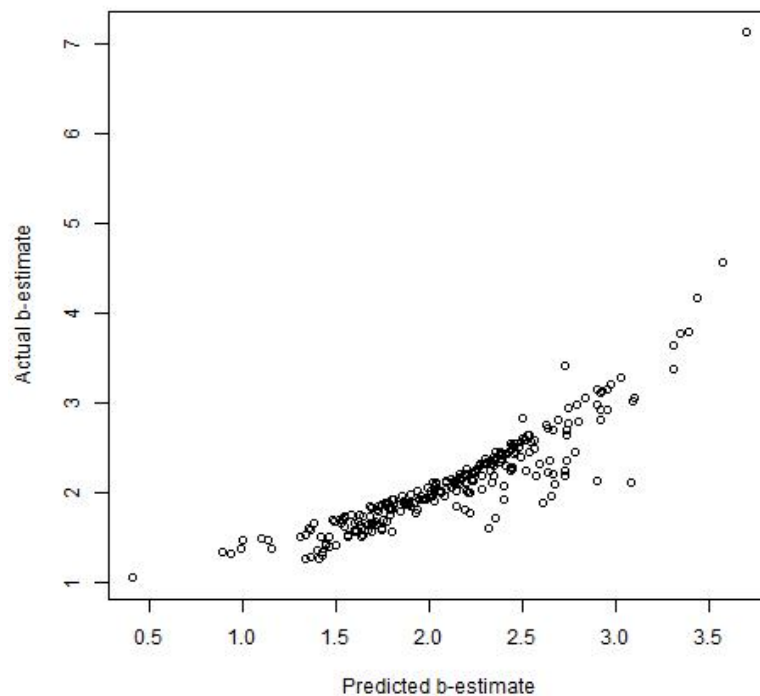


Figure 14 – Actual-Predicted Plot of b-parameter Estimate

With these results, we were able to conclude that the within-subject behavior exhibits a Gaussian-like distribution when it comes to the reversal of loss aversion for TSVD product. We also observed an exponential curve⁸⁷ when it comes to modeling the b-parameter which was the single parameter describing the loss aversion of the

⁸⁷ A curve is observed rather than a distribution.

respondents. In a similar vein to Granaas (1998), a model fitting was retained until a new and better one replaces it.

We reject the third null hypothesis, $H_{0,3}$, and proceed to accept the alternative hypothesis, $H_{1,3}$. The loss aversion (or the reversal of loss aversion as understood in this paper) for TSVD product follows the LAS function as proposed by Koh (2022). And the reason why we accept the alternative hypothesis is two-fold. First, we observed 74 out of 100 respondents following the LAS function in a random sample and the modeling of the b-parameter (i.e. the parameter which controls the curve that explains loss aversion behavior) to be normal. In light of this, we are observing the b-parameter following nature. Similar to earned income which follows a normal distribution in a country (i.e. not everyone is rich and not everyone is poor), we observe b-parameter to follow the same normality, even though the profile of it is different. Second, the differential of the NLS curve fitting which is an approximation of the LAS function follows normality. We observed the blue curve in the graph following normality.

As a summary, we observe normality of behavior represented by the values and b-parameter extracted from the LAS function in a within-subject and between-subject study. The within-subject study refers to the differential aspect of the LAS function (i.e. the loss aversion behavior of the individual respondent), whereas the between-subject study refers to the modeling of the b-parameter across all respondents.

5.6 Summary of Findings – Study 2

Study 2 tests the first ($H_{0,1}$), second ($H_{0,2}$), fourth ($H_{0,4}$), and fifth ($H_{0,5}$) hypotheses. RStudio (version 2022.12.0) hosting R (version 4.2.0) was used to test the hypotheses.

For the first hypothesis, an Unpaired Two-Samples Wilcoxon Test which is also known as the Mann-Whitney Test⁸⁸ was used to compare the difference of buying price in a buy-then-sell scenario and the buying price in a sell-then-buy scenario. The Mann-Whitney Test compares ranks in measurements and computes a statistic which is compared against the critical value. For the second hypothesis, the same method was used, except for the change in comparing the differences in selling price instead of buying price. Ideally, the role which the respondents first undertook should not impact their buying or selling price. The buying and selling price used in this test was pre-effect price: the prices that the buyers and sellers indicated before any obscurity effect is observed.

For the fourth hypothesis, the Non-Parametric Kruskal-Wallis test⁸⁹ was used. This approach was similarly used by Koh (2022). Ideally, loss aversion or reversal of it should not differ significantly across demographic groupings such as race, income brackets, and education. The Kruskal-Wallis Test compares ranks between three or more independent samples. In our research, we treat each sample within the demographic factor as independent, since they are independently sampled and between-subjects.

For the fifth hypothesis, the ANOVA method was used to compare the means of buying price and selling price in a within-subject scenario. The test was conducted on three buy-then-sell scenarios and three sell-then-buy scenarios. The former scenario looked at buying and selling prices when the box of chocolate had an expiry date that was 6 months away, 2 months away, and 15 days away. The latter scenario looked at buying and selling prices when the box of chocolate had an expiry date that was 1 year away, 6 months away, and 2 months away. In the buy-then-sell scenarios, the conventional method of asking buying price and then the selling price was used. In the rational theory,

⁸⁸ {stats::wilcox.test()}

⁸⁹ {stats::kruskal.test()}

the buying price and selling price should not have a significant difference in mean values across all scenarios if the day-to-expiry is the same. This is true because a product that is just bought and the consumer has undergone the obscurity effect should be sold at a similar price as compared to another similar item that has the same day-to-expiry date in the market⁹⁰. However, in this paper, we posit that they are different, and a statistical difference in mean value is observed due to the obscurity effect.

We will use Eta Squared⁹¹ (η^2) as the yardstick for assessing effect size as proposed by Kelley (1935) and the following interpretations⁹² are adopted as proposed by Rea and Parker (2005):

η^2	Interpretation
0.00 < 0.01	Negligible
0.01 < 0.04	Weak
0.04 < 0.16	Moderate
0.16 < 0.36	Relatively Strong
0.36 < 0.64	Strong
0.64 < 1.00	Very Strong

Table 2 – Interpretation of Effect Size

Ideally, the effect size of the question that carries the obscurity effect should be larger and stronger (relatively stronger) in Type II analysis. Type I refers to the sequential insertion of variables (or questions in this context) into the ANOVA model to assess the effect sizes. Type II refers to the complete insertion of all questions into the ANOVA model to assess the effect sizes. Type III is similar to Type II, except for the inclusion of

⁹⁰ From the rational theory perspective, the buying price and the selling price should be the same.

⁹¹ {effectsize::eta_squared() }

⁹² This interpretation follows the interpretations suggested by Rea and Parker (2005) for the Epsilon Square effect size interpretation.

the interaction effect. Due to a small sample size, Type III was not considered. Type I had an opposite partial effect size distribution as compared to Type II because Type I's first variable which was the question that did not have the obscurity effect explained most of the model, which could lead to an inaccurate effect size for the question with obscurity effect. If the second question which had the obscurity effect had a larger effect size as compared to the first question, then the question which had the obscurity effect could operate independently from the first question, which was not possible in the research as the respondents underwent treatment effect by answering the question without obscurity effect first, and then the question with obscurity effect. However, in the Type II model, the effect size was shared between both questions and the second question should drive the effect size in explaining the model.

Result

The Non-Parametric Unpaired Two-Samples Wilcoxon Test⁹³ was conducted on the buying price and selling price (based on the first undertaken role; before the obscurity effect is observed), $\alpha = 0.05$. The following table shows the statistical output for this test.

Role	Analysis	w	p-value
Buyer	6 months	1445	0.238
Buyer	2 months	1766	0.281
Seller	6 months	1157	0.351
Seller	2 months	974	0.112

Table 3 – Results from the Non-Parametric Unpaired Two-Samples Wilcoxon Test

⁹³ A T-Test analysis was conducted and results may differ quite differently from Wilcoxon Test. To acknowledge the non-normality of the data, the non-parametric Wilcoxon Test is used instead.

We have evidence to suggest that the first and second hypotheses are NOT rejected. We conclude that there is no statistical difference between the buying prices or between the selling prices regardless of the first untaken role. On the fourth hypothesis, the statistical output using Non-Parametric Kruskal-Wallis Rank Test is found below.

Demographic Variable	χ^2	p
Race	4.254	0.37
Income	9.900	0.11
Education	7.367	0.29

Table 4 – Results from the Non-Parametric Kruskal-Wallis Rank Test

We have evidence to suggest that the fourth hypothesis is NOT rejected. We can conclude that the demographic factors did not create any significant statistical difference in loss aversion. On the fifth hypothesis, dependent variables were transformed to normality by the following formula, so as to utilize the parametric test and then measure the effect sizes:

$$\text{Equation 27: } \hat{v} \leftarrow \sqrt{v} \tag{27}$$

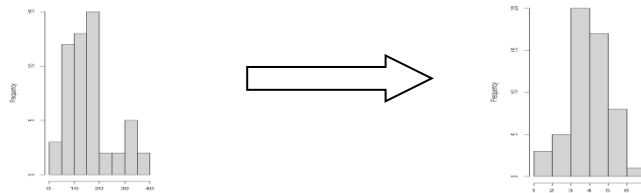


Figure 15 – Data Transformation for Parametric ANOVA

The statistical output using the ANOVA test⁹⁴ and Eta Squared is found in Table 5.

⁹⁴ We assume normality in this instance to assess effect sizes using the parametric method.

* The effect in η^2 (partial) refers to the obscurity effect. † obscurity effect observed \diamond after obscurity effect is observed

Class	Type	IV (SS)	DV (Resid)	p	η^2 (partial)
1 year - 6 months	I	1 year buying price (3065.54), 6 months buying price † (355.90)	6 months selling price \diamond (412.04)	< 0.0001	before effect (0.89), after effect (0.48)
	II	1 year buying price (89.85), 6 months buying price † (355.90)	6 months selling price \diamond (412.04)	< 0.0001	before effect (0.18), after effect (0.48)
	III	1 year buying price (15.72), 6 months buying price † (78.22), interaction (28.88)	6 months selling price \diamond (403.61)	< 0.0001 (intercept, interaction, <i>ns</i>)	before effect (0.03), after effect (0.17), interaction (0.06)
6 months - 2 months	I	6 months buying price (1259.58), 2 months buying price † (567.93)	2 months selling price \diamond (792.41)	< 0.0001	before effect (0.61), after effect (0.40)
	II	6 months buying price (44.53), 2 months buying price † (567.93)	2 months selling price \diamond (792.41)	< 0.0001	before effect (0.03), after effect (0.40)
	III	6 months buying price (117.45), 2 months buying price † (393.58), interaction (73.93)	2 months selling price \diamond (718.49)	< 0.0001 (intercept, <i>ns</i>)	before effect (0.12), after effect (0.34), interaction (0.07)
2 months – 15 days	I	2 months buying price (945.69), 15 days buying price † (357.28)	15 days selling price \diamond (837.71)	< 0.0001	before effect (0.52), after effect (0.29)
	II	2 months buying price (126.23), 15 days buying price † (357.28)	15 days selling price \diamond (837.71)	< 0.0001	before effect (0.12), after effect (0.29)
	III	2 months buying price (4.54), 15 days buying price † (128.36), interaction (26.49)	15 days selling price \diamond (811.22)	< 0.10 (intercept, interaction and pre-effect <i>ns</i>)	before effect (0.00), after effect (0.12), interaction (0.01)

Table 5 – Results from the ANOVA Test and Eta Squared

As observed in this result, the results for type III across all classes were not significant. This indicates the non-significance of the interaction term.

In type I and II across all cases, results showed statistical significance. In type I, all η^2 values for pre-effect questions were higher than the post-effect questions. This was fundamentally true as the first variable (the question *before* effect) accounted for most of the errors in the model. And when the second variable was inserted into the model (the question *with* effect), the amount of error to be explained became lesser. However, type II across all classes yielded very interesting results. The introduction of two variables in a full-term model (a model with all variables inserted) caused the pre-effect η^2 to drastically decrease. For example, in the first class (i.e. 1 year – 6 months), the introduction of full term decreases the η^2 of the first variable (pre-effect question) from 0.89 (Very Strong as understood from Table 2) for type I (sequential insertion of variables) to 0.18 (Relatively Strong as understood from Table 2) for type II (full term model). Evidently, the introduction of the obscurity effect had a huge impact on the selling price. This observation was consistent throughout all classes.

We can conclude that there is significant effect arising from the obscurity effect regardless of the role (i.e. buying or selling price), and there's no spillover effect from the pre-effect question over to the question with obscurity effect.

5.7 Summary of Findings – Study 3

We arrived at the point where we observed obscurity effect arising from selling price. In this third study, we will proceed to plot the valuation matrix between buying price and selling price after observing the obscurity effect. Plainly speaking, we extracted the buying prices from buyers who are ignorant of the obscurity effect, and the selling prices from sellers who faced the obscurity effect. The days to expiry were the same

across all buyers and sellers. In this final study, we hoped to show that our expectations in buying prices before experiencing obscurity effect do not exactly match up with the selling prices after observing the obscurity effect. Selling prices are expected to be lower because sellers are motivated to sell it at a value which attracts buyers, and buyers determine the buying price based on the market pricing. We will therefore observe irrationality in consumer decision-making and consumers are confounded by seemingly higher prices from the sellers due to obscurity effect when the selling prices are expected to be lower.

Results

For the sixth hypothesis which is the final hypothesis, we tested whether the buying price without the obscurity effect was statistically different from the selling price *after observing* the obscurity effect by using the Wilcoxon signed-rank test for the 6 months, 2 months, and 15 days to the expiry period.

Analysis	w	p	Median selling price from sellers (median)	Median buying Price from buyers
6 months to expiry	25823	< 0.0001	24.40	20.02
2 months to expiry	2001	< 0.0001	18.47	15.79
15 days to expiry	1718	< 0.0001	16.33	15.15

Table 6 – Results from Wilcoxon signed-rank Test

In this final hypothesis, we reject the null hypothesis and accept the alternative hypothesis. We conclude that we had sufficient evidence to suggest that the buying price without the obscurity effect and selling price *after observing the obscurity effect* statistically differed due to the obscurity effect. This was a departure from the rational understanding of having the same buying and selling price when the days to expiry are

the same for the same goods, *ceteris paribus*. We also note that although the products used in determining buying prices and selling prices are separate products (i.e. and by that we might assume they are different products), they are the same product but used in different context by the respondents.

One might ask where exactly the selling price is positioned in reference to all the buying prices indicated by the respondents. The following diagram provides the answer.

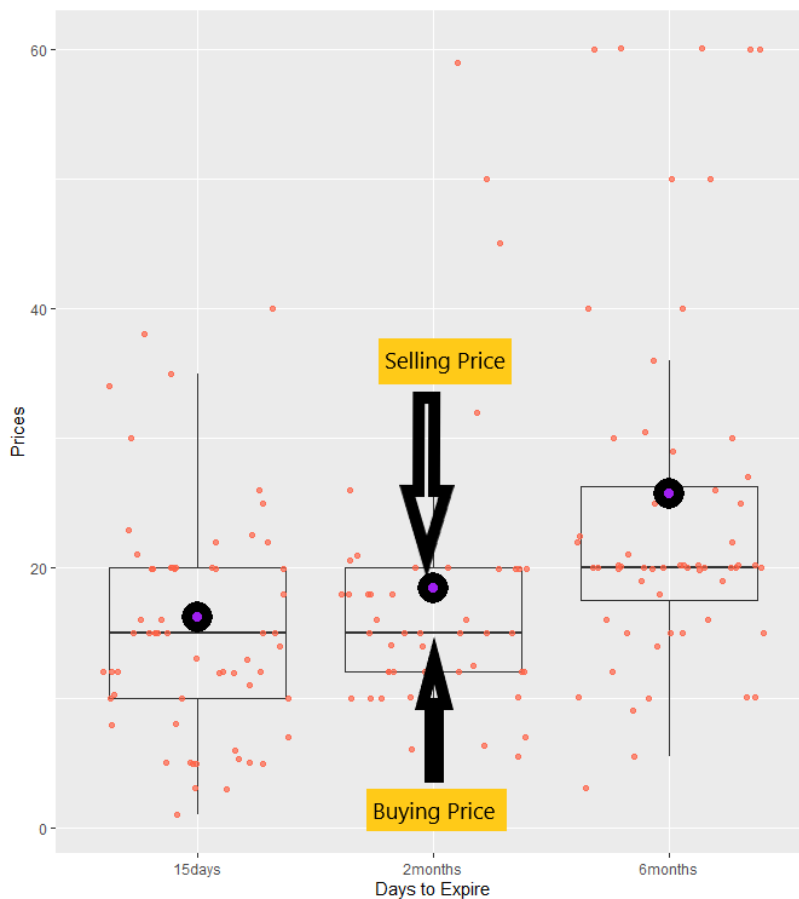


Figure 16 – Average Selling Price and Buying Price without Obscurity Effect

As observed in the chart above, the average selling price *post-effect* was higher than the average buying price *pre-effect* for the same days to expiry, *ceteris paribus*. The

disparity was drastic; the amount of confusion over pricing is certain when buyers perceive they know what the sellers set in the selling price.

5.8 Conclusion

In this chapter, we have observed the results as expected. The following table summarizes the results with the conclusion (rejected or not rejected hypotheses) and the comments which interpret the results:

Hypothesis	Results	Comments
$H_{0,1} \leftarrow$	NOT Rejected	Consumers are not impacted by the buyer role
$H_{0,2} \leftarrow$	NOT Rejected	Consumers are not impacted by the seller role
$H_{0,3} \leftarrow$	Rejected	Consumers exhibit loss aversion for TSVD products.
$H_{1,3} \leftarrow$	Accepted	Consumers exhibit loss aversion for TSVD products as characterized by the LAS function.
$H_{0,4} \leftarrow$	NOT Rejected	Consumers' loss aversion do not differ significantly based on race, income bracket per annum, and most recent educational level
$H_{0,5} \leftarrow$	NOT Rejected	Consumers are not impacted by the reference point (the pre-effect question) when they indicate their selling price after observing the obscurity effect. There is no spillover effect.
$H_{0,6} \leftarrow$	Rejected	Consumers selling price is statistically different between the moment they observe the obscurity effect and the post-effect (the question that is given after answering the question with the obscurity effect)
$H_{1,6} \leftarrow$	Accepted	Consumers selling price post-effect is mainly explained by the price indicated during the obscurity effect is observed and it's higher than buying price pre-effect when the respondents indicate their selling price post-effect.

Table 7 – Summary of the Hypotheses Testing

While it is a common practice to reject all null hypotheses in any scientific inquiry, we take the view of testing the hypotheses even if they are expected to be NOT rejected. This is to establish the foundation of the research and derive a better scope in

addition to the mathematical expression given in the previous chapter. To this end, we can conclude that consumers exhibit the loss aversion sensitivity function as proposed by Koh (2022), but the reverse of it (the conventional loss aversion as proposed by researchers) when they face the obscurity effect. The *pre-effect* expectations of the buyers is different from the *post-effect* expectations of the sellers. We gathered that the buyers' expectation can be quite different from the sellers' expectation in selling prices. Due to this disparity, respondents' feedback on their dissatisfaction in terms of expectations mismatch will be discussed in the next chapter. The following diagram summarizes the results chapter in a nutshell.

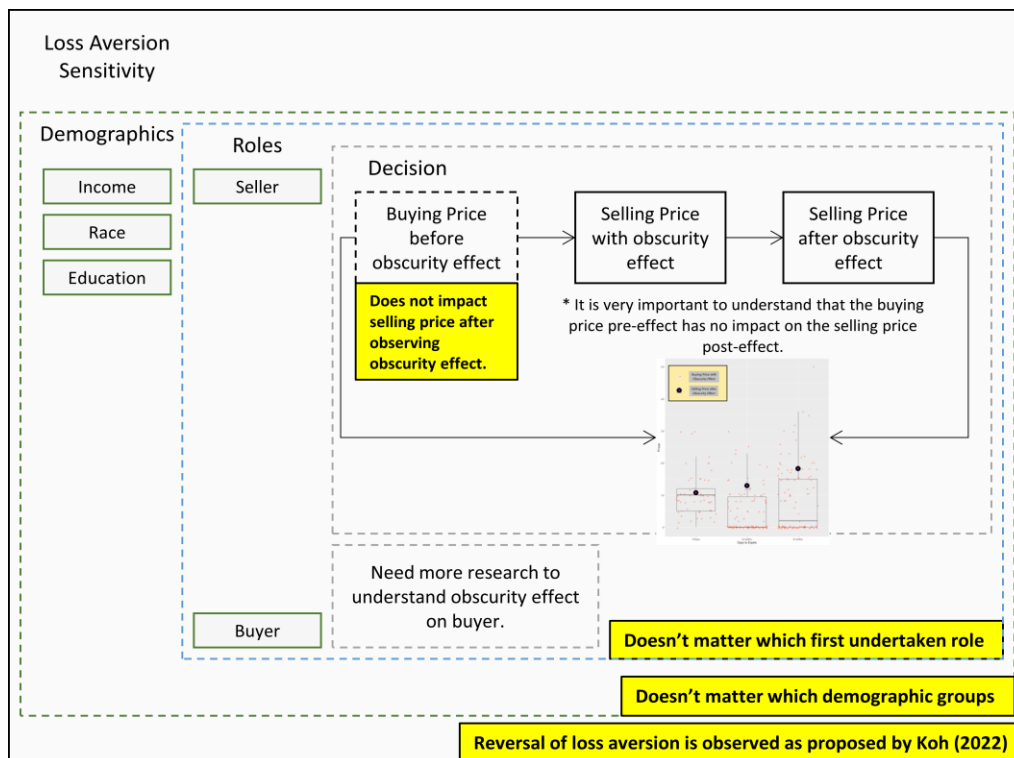


Figure 17 – An Overview of the Research Study

We make one conjecture: the respondents may have treated their trust in the product as a form of endowment and they set higher selling price when they lose the trust in the product. In this conjecture, we assume that trust in the product is a function of the

endowment. Having greater trust in the product leads to increase in endowment. We need to conduct more studies into this conjecture and determine the validity of it.

CHAPTER VI:

DISCUSSION

6.1 Null Hypothesis and Alternative Hypothesis

The approach in which this research was undertaken may be considered controversial. In a typical scientific inquiry⁹⁵, null hypotheses are expected to be rejected and if they are not rejected, a researcher is expected to review the scope of the study or the research design. To further complicate the matter, many academic journal reviewers favourably consider papers that reject the null hypothesis. (Kupfersmid and Fiala, 1991) However, we take the view that not all null hypotheses are to be rejected.

First, there are two kinds of null hypotheses in a research study. There are null hypotheses that test the ‘cradle’⁹⁶ of the study and there are null hypotheses that test the ‘candle’⁹⁷ of the study. The cradle is the object which holds the candle in place and collects the hardened wax once it is melted and cooled. In our context, the cradle is the foundation of the study, and it falls apart if the hypotheses are rejected. And the candle is the test hypotheses, and it fails to prove a point if the hypotheses are not rejected.



Figure 18 – The Candle and the Cradle

⁹⁵ The scientific inquiry refers to the ways in which scientists study nature and provide some explanations based on the evidence of a study. (MasterClass, 2022)

⁹⁶ This is usually referred to as the substantive hypothesis.

⁹⁷ This is usually referred to as the statistical hypothesis.

Consider this simple example. When COVID-19 became a pandemic⁹⁸, the null hypothesis that the world was very interested in was the following: the COVID-19 vaccine was not able to help subjects resist the virus. Rejecting this null hypothesis (candle) would mean that the vaccine helps the subjects resist the virus. However, underlying this null hypothesis, there are several other null hypotheses (cradle), of which they are expected not to be rejected. For example, the vaccine had no disparate effect on helping subjects to resist the virus across different demographic groups. If this null hypothesis is rejected, we would be facing a larger problem with the effectiveness of the vaccine. Moreover, there would likely be many types of vaccine for different age groups, if the age group proves to produce results of statistical difference in the disparate effect. In this simple example, we argue that the ‘candle’ must be rejected but the ‘cradle’ must not be rejected.

However, there’s the other side of the story. Consider the following example. When English physician Edward Jenner discovered vaccination by inoculating an 8-year-old James Phipps with ‘matter collected from a cowpox sore on the hand of a milkmaid’, he had to test the following null hypothesis (candle): the subject will not be reinfected by the same virus when the subject is inoculated with a matter of the virus earlier. This was the hypothesis that existed in the minds of everyone in those days. However, Edward would need to prove the effectiveness of the method by NOT rejecting the null hypothesis: by concluding that the subject will NOT be reinfected by the same virus. Hence, we have an example whereby the ‘candle’ must NOT be rejected. (Bartko, 1991; Frick, 1995)

Unfortunately, not rejecting the null hypothesis (candle) was deemed as ‘pure nonsense’. (Riedel, 2005) For this reason, vaccination was not widely accepted. Was it

⁹⁸ As of now, it is endemic with many countries removing the requirements for mask-wearing.

the part where Edward proved the wrong null hypothesis that caused the scientific committee back then to reject his findings? Or was the scientific committee side blinded by years, and even centuries, of research works that consistently reject null hypotheses as a scientific practice? Has the world arrived at a point where significance testing becomes ‘a kind of essential mindlessness in the conduct of research?’ (Bakan, 1966) Researchers argued that it is not always sensible to accept or reject a hypothesis ‘in a sharp sense’ (Good, 1981) and it has no meaning in interpreting a sharp p-value when the strength of evidence can be better understood by the distribution in which the p-value is assessed. (Rosnow and Rosenthal, 1992) The p-value is a statistic whereby we reject the null hypothesis if the p-value is within the critical region of a distribution. And if it does not fall within the critical region, we do not reject the null hypothesis.

At this point, it is important to differentiate rejecting the null hypothesis as a challenge⁹⁹ and not rejecting the null hypothesis as proof. The former calls for statistical methods to meet the challenge and establish the foundation of research, whereas the latter calls for statistical methods to validate and prove a point that interests us.

This research paper will not go into much detail about the validity of not rejecting null hypotheses. There are just too many research papers arguing against the use of significance testing. (Bakan, 1966; Brewer, 1985; Cronbach, 1975; Falk, 1986; Falk and Greenbaum, 1995; Folger, 1989; Gigerenzer and Murray, 2015; Grant, 1962; Meehl, 1967) By simple examples, we see that by not rejecting null hypotheses – such as the cradle, we can also produce results that lay the foundation of a research study and potentially welcome other researchers to falsify the claims. (Popper, 2005) And we

⁹⁹ We are not saying that hypotheses that pose a challenge are not statements to prove. Rather, the motivation to test the hypotheses comes from a challenge more than proof. For example, we know the sun rises from the east every day. There is no need for further proof. But we can challenge this truth for the sake of making a point!

expect to reject the null hypotheses – such as the candle – to prove *the point* in the scientific study.

In this research paper, the ‘cradle’ refers to the differences in loss aversion found between the demographic groups and undertaken roles. Ideally, we should observe no differences and if there are any differences observed, the entire study will fall apart, of which a more extensive study is required by including experimental research into how demographic variables impact the study.

One may argue that the null hypotheses are impacted by typology, taxonomy, or semantics. For example, the objects (typology), the type of objects (taxonomy), and the meaning attached to the objects by linguistics (semantics) impact null hypotheses. For this reason, many researchers cast a light of doubt on how well null hypotheses are designed to explain the research study. However, null hypotheses should be commonly understood and widely accepted in the current civilization. The understanding of the conjectures as laid out in the null hypotheses depends on the language of those days, (Estes, 1997) and the understanding of null hypotheses should remain consistent throughout all ages.

Probably the other argument we face is the understanding of the cradle. Some may argue that the cradle is essentially not part of the scientific study but a validation of the scope of the study. For example, before the actual research study by means of implementing the survey instrument, a researcher may perform the testing of null hypotheses (cradle) to ensure that the subsequent scientific study remains relevant and valid. We believe that the time in which the cradle is tested remains a preference for the researcher. In this research paper, all null hypotheses (cradle and candle) are put together in one chapter, so as to make it easier for readers to follow the research effort. Having the cradle placed in other chapters will require the readers to refer back and forth while

reading the results chapter. Nonetheless, the point remains the same, not all null hypotheses are to be rejected, depending on the type of null hypotheses they fall under (cradle or candle?).

About the definition of the null hypothesis, it is defined as “the proposition that there will not be a relationship between the variables you are looking at, i.e. any differences are due to chance.” (Crosier, n.d.) When it comes to chance, we usually examine and assess it using the p-value. If the p-value is 0.05 or less, we observe chance within the probability of 5% or less; a form of ‘odds-against-chance’ fantasy (Carver, 1978) or ‘illusion of attaining improbability’ (Falk and Greenbaum, 1995) Technically, we are saying that the null hypothesis is a proposition which shows that there is no relationship between the variables we are looking at, and even if there’s any relationship observed, they happen by chance with a probability of 5% or less. For null hypotheses that are ‘candle’ in our context, we want to make sure that the differences arising from the question with obscurity effect and question *post-effect* are subjected to 5% or less of the probability of chance. However, on the flip side, we do not want the differences in loss aversion as observed among the demographic groups attributed to a 5% or less probability of chance. The reason is because the conjecture in which the null hypothesis is based on is one which does not expect the differences to be attributed to 5% or less probability of chance. We are not saying that we want to observe chance. In fact, we want to observe non-chance: the fact that the null hypothesis can’t be rejected remains a long held truth about the event and by that, we see chance not having a significant role (non-chance). (Abelson, 1995)

Chance is a topic that deals with the unknown and it is often correlated with the conjunction fallacy whereby chance is attributed to the co-occurrence of events rather than its single constituents (Dagnall et al., 2007) and also to reasoning error when co-

occurring events are overestimated. (Tversky and Kahneman, 1983) We can say that chance and non-chance are mutually exclusive. An increase in chance does not necessarily mean a decrease in non-chance, and a chance in the sample generalized to the population is mainly directed by the intention of the researcher. For example, in a particular event that is entirely implausible, the odds ratio of 1 out of 10 is seemingly more significant than the odds ratio of 1 out of 100, and such differences in odds ratio is often attributed to how the researcher intends the study to be (1 out of 10 or 1 out of 100?). This is because the implausible event weighs on the probability of chance heavier, and the odds ratio is a reflection of individual events that the researcher observes with a probability of chance. Fixating on the $p\text{-value} < 0.05$ neglects the weightage on the probability of chance. Hypothetically, we can assume that weightage is equal across all probabilities of chance in every scenario, *ceteris paribus*. However, in real-life scenarios, this is impossible. An event is influenced by many factors, such that chance happens by mere randomness arising from an extremely complex environment. Can we ascertain the exact weightage of the probability of chance? Unfortunately, man do not have the capability to do so. Neither can machines nor artificial intelligence. No human or machine are capable of looking into the crystal ball, so to speak, and determine the weightage and value of the probability of chance for future events.

When a null hypothesis is rejected, if an alternative hypothesis is presented, we accept the alternative hypothesis. Since the null hypothesis tests for chance happening with a probability of 5% or less, researchers strive to explain the newly discovered (or rediscovered) phenomenon. The alternative hypothesis provides this information. Every null hypothesis should have one or more alternative hypotheses (Ranganathan and Pramesh, 2019) in classic statistics. An alternative hypothesis can be split into two – a left tail and a right tail. This is particularly true for parametric analysis where Gaussian

distribution is assumed for both the response variable and its error. However, an alternative hypothesis is simply just a conjecture to explain the unknown phenomenon and at times a highly probable one based on the frequentist view.

If an event has occurred, the definitive question is not “is this an event which would be rare if the null hypothesis is true?” but “is there an alternative hypothesis under which the event would be relatively frequent?” (Berkson, 1942, p.327)

There can be other explanations if the alternative hypothesis is transformed into a null hypothesis. For example, in this research paper, the alternative hypothesis for the third hypothesis is that the behavioral pattern of loss aversion for TSVD product follows the LAS function. However, we can transform this alternative hypothesis into a null hypothesis by stating the potential explanation of using other mathematical functions to explain the loss aversion behavior of consumers selling the TSVD product. The null hypothesis becomes “the behavioral pattern of loss aversion for TSVD is not only explained by the LAS function.” Such a transformation allows researchers to further develop the theory. Pruzek (2016) advocated for this transformation approach in the Bayesian inference framework, whereby the posterior probability of the rejected null hypothesis is used as the prior probability for the newly transformed null hypothesis from the previously accepted alternative hypothesis. But as Frick (1996) mentioned in his paper, specifying the prior probabilities becomes a great challenge when the research work is conducted in isolation, and the applicability of the posterior probabilities from an accepted alternative hypothesis may not necessarily translate quite fittingly to the prior

probabilities of a subsequent null hypothesis, especially when the environment or the respondents' state of mind changes.

However, the transformation of the alternative hypothesis to the null hypothesis must not be a translation of chance to probability. As described in Lindley's paradox, a 95% non-chance does not mean 95% posterior probability for the null hypothesis, and a high posterior probability does not mean a high likelihood for very small prior (i.e. 5%) in Bayesian analysis. Implying likelihood, in this case, is erroneous. It is very important to note that the 95% as described above is the probability of non-chance (Lindley, 1957) and not a 95% posterior probability.

The way how the hypotheses are formed matters in this research paper. The null hypothesis (cradle) follows the Acceptance-Support Null Hypothesis Significance Testing (AS-NHST) approach, which claims that the researcher believes in the null hypothesis to be true, and accepting it will lead to validation of what the researcher believes. The other null hypothesis (candle) follows the Rejection-Support Null Hypothesis Significance Testing (RS-NHST) approach, which claims that the researcher does not believe that the null hypothesis is true, and rejecting it will lead to validation of what the researcher believes. (Nickerson, 2000) Researchers need to know which approach should be adopted in a study.

In Hypothesis testing, reproducibility is paramount to the generalizability of the research. A small sample with a small p-value may be effective in the current research, but not generalizable to the population. And applicability to the population allows replicability or reproducibility. This brings us to the point about statistical power. A high reproducibility – being able to replicate the research and obtain similar results – requires high statistical power and a larger sample size (Schmidt and Hunter, 1997). However, in most social and psychology research, a large sample size is not an ideal option due to

budget constraints and logistical challenges. Nonetheless, a study that allocates sample sizes to subgroups that potentially represent the subgroups of the populations (within a reasonably large sample size based on the confidence level and margin of error) can produce strong statistical power. (*ibid.*) In this research paper, respondents were asked to choose a flower from a list of options. Each choice allocates one respondent to a subgroup. There are 64 or 65 respondents¹⁰⁰ in each sub-group that answers questions for a specific scenario. In total, the sample size in each group adds up to the total sample size, generalizable to the population.

As a final note, it is unfair to throw the entire hypothesis out of the window when the critical region determined by the critical value – commonly known as the α (alpha) – is 5% and the p-value is .051¹⁰¹. Can we truly not reject the null hypothesis simply because the p-value is 0.001 above the critical value? It becomes a contentious topic when we observe marginally significant results and yet we throw the entire hypothesis out of the window by not rejecting it when it is, in fact, false. This is often referred to the type II errors in hypothesis testing or “ β ”¹⁰².

At the end of the day, a p-value and the rejection of a hypothesis (or not rejecting it) truly depends on the researcher’s observation, data on hand, and experience. It also depends on auxiliary theories or the nature of the psyche in any form of experiments. (Meehl, 1990a, 1990b) Some researchers argue that the results arising from hypothesis testing by observing the probability of chance are imprecise and it gives little information about the event. And there’s a need to think statistically rather than ritually practice statistics. (Gigerenzer, 1998) But a common agreement that all researchers have arrived

¹⁰⁰ As the sample size is an odd number of $N = 385$, there will be one group which has 64 respondents.

¹⁰¹ This value is translated to 5.1% for the purpose of comparison.

¹⁰² This is the reason why the LAS function uses the b-parameter rather than the ‘beta’ Greek letter. There will be much confusion when the beta is used in both scenarios in a text.

at is that the Null Hypothesis Significance Testing should serve as a guide (Abelson, 1995; McDonald, 2016) rather than a rule, and a smart researcher should know when hypothesis testing makes sense in a given context and scenario rather than using hypothesis testing as a norm. (cf. Dar, 1998; Harlow et al., 1997) The use of the p-value to reject the null hypothesis depends on the planned manipulation designed by the researchers to observe the anticipated effect, and such practice should be made explicit before the start of research work. (Rogers et al., 1993)

There is a possibility to use the ‘good enough’ non-nil null hypothesis instead of the point null hypothesis to test for the existence of chance. The ‘good enough’ assessment comes from statistical outputs such as Cohen’s d^{103} or confidence level. In this approach, we can better determine not just the magnitude of the association but also the direction based on the variability of the data. It can give us a better picture of the relationship between variables. This method calls for the theory to be assessed using logic (conjoint or disjoint) rather than point (definitive and only one hypothesis to discover the truth). Refer to the paper written by Cohen (1994) for more information on the method of nil hypothesis.

Finally, evidence suggests that people do not take note of the contrapositive of likelihood ratio within the Bayesian framework. (Beyth-Marom and Fischhoff, 1983; Griffin and Tversky, 1992; Troutman and Shanteau, 1977) The likelihood ratio refers to the probability of observing the data given a true hypothesis $P(D|H)$ and the contrapositive refers to the probability of observing the data when the hypothesis is not true $P(D|\sim H)^{104}$. Popper (2005) suggested that a scientific theory is not proven to be

¹⁰³ Cohen’s d considers the variability of the data. It takes the difference between two mean values, and dividing by the data’s standard deviation. As you may have noticed, the variability of the data is considered.

¹⁰⁴ In this instance, we would like to highlight that the contrapositive means the probability of observing the data when the hypothesis is false. For example, John visits his mother at the hospital

scientific if falsification is not achieved. Plainly speaking, Popper argued that the contrapositive must be observed together with the positive for a scientific theory to be accepted¹⁰⁵. We tend to display confirmation bias by favoring a particular hypothesis with which we agree and neglect the contrapositive which can likewise provide a confirmatory outcome. Confirmation bias refers to the irrational favoring of a particular position or belief, such that the other positions or beliefs weigh lesser. In our research paper, we focus on the likelihood ratio of observing data (i.e. chance versus non-chance) that follows the hypothesis but have yet to compute the probability of observing the contrapositive. In subsequent research work, researchers may look into the contrapositive within the Bayesian framework.

6.2 Parametric and Non-Parametric Test

A parametric test is used when the assumption of normality for the population is held, the interval between values possesses meaningful explanation, and the variance is assumed to be equal across all groups. A non-parametric test is used when the variables in research follow an ordinal scale, such that ranking the values of the measurement provides meaningful explanation to the researcher. For example, a parametric measurement would be age, whereby a 30-year-old man is older than a 15-year-old man on a continuum. The values in a parametric measurement are assumed to follow a distribution that is normal (i.e. Gaussian distribution or bell-shaped distribution). A non-

every day. We assume – as a conjecture – that John cares for his mother. In this instance, it will be $P(D|H)$. However, the contrapositive would be John visits his mother at the hospital every day. We assume that John does not care for his mother. In this instance, the contrapositive will be $P(D|\sim H)$. Notice that visiting his mother may not necessarily mean John care for his mother. It could be done for other reasons. Hence, the results arising from the test of contrapositive may capture the probability of observing other reasons too.

¹⁰⁵ Popper argued his position with the possibility of other explanations that might exists in the contrapositive.

parametric measurement is rank-based, whereby the first position in a race is The Winner and the second position is The Runner-up. The interval between the first and second positions yields no meaning. Whenever normality is not assumed or the interval between values possesses no meaningful explanation, the non-parametric test is used. And vice versa: when normality is assumed and the interval between values yields meaningful explanation, the parametric test is used.

Theoretically, a non-parametric measurement can be transformed into a parametric measurement if normality is assumed but the measurement or values of the sample do not observe normality. In this research paper, the dependent variables for the fourth hypothesis were transformed by the squared-root function. In addition, the variances between either the independent variable (question before the obscurity effect and question with the obscurity effect) with the dependent variable (question after observing obscurity effect) are similar at a variance ratio of less than 4, and the observations are independently observed by simple random sampling. Outliers were removed by identifying anomalies in a boxplot. Therefore, we are confident in transforming the non-parametric measurement into a parametric measurement.

There is great value in using the parametric method. Many of the statistical tools rely on the parametric method which assumes normality for the population. A parametric method is preferred over a non-parametric analysis of variance, as the parametric method provides estimates and confidence intervals around the mean value. (Altman and Bland, 2009)

Regarding the non-parametric method, we transform data to meet the assumption of normality. This is a common practice when the population can be assumed to follow a normal distribution and the groups of observation in the sample have the same variance or standard deviation as the population. (Bland and Altman, 1996) However, researchers

often assume that the interval between values holds no meaningful explanation, but the data is forced-fed into a parametric analysis, or vice versa. While the first position and second position in a race can be considered rank 1 and 2 respectively, having a first-half position which is between the first and second position holds no meaning. We may end up having meaningless interval for the estimates and confidence interval, which holds no meaning in any form of interpretation. Although a 1.4 rank falls closer to 1 and 1.6 falls closer to 2 in basic arithmetic, a 1.4 has an equal chance to fall into rank 2 as compared to 1.6 falling into rank 1 since there is no distribution of the probability of chance to be observed for the interval between values in an ordinal scale. For example, a die that rolls to 1 has an equal chance of rolling to any value in the next roll, and a die is presumed not to have meaning in the interval between values. Yet, if we assign a probability of chance for the interval between the numbers of a die in a roll, we assume that we have prior knowledge about the bias of the die. For example, assuming there's meaning in the interval between numbers of a die in a roll, we assume that a 1.4 number is closer to 1, and therefore the next roll assigns the side with the number 1 with more weight in probability. This is erroneous as we do not have such information about this interval. Similarly, if we apply a parametric method to non-parametric measurement, we fall into this fallacy. Hence, researchers will need to ascertain whether the measurement is parametric and non-parametric in their form and the normality of distribution is correctly assumed in a given population. In this research paper, the non-parametric methods are the Unpaired Two-Samples Wilcoxon Test, Wilcoxon signed-rank test, and Kruskal-Wallis test by ranks.

The Unpaired Two-Samples Wilcoxon Test – also known as the Mann-Whitney Test – is a test procedure for two measurements that are assumed to come from different distributions. It employs the rank sum test whereby all values from both measurements

are put into ranks, and within each measurement, the ranks are summed up. The comparison is done between the two summed-up ranks.

The Wilcoxon signed-rank test is suitable for repeated measurements, or measurements whereby the values are taken within-subject repeatedly. Statistically, we are calculating the ranks in differences between measurements of the same subjects, compute the test statistic, and reject the null hypothesis if the test statistic is less than the critical value of a given sample. For example, an additive function of the ranks (either by the left or right tail; negative difference or positive difference) will yield a large test statistic when the positive differences are very huge as compared to the negative differences. Negative difference refers to the difference arising from larger values in the second set of measurements and positive difference refers to the difference arising from larger values in the first set of measurements.

The Kruskal-Wallis test by ranks is an extension of the Mann-Whitney U test which compares two or more independent samples and tests the assumption that the samples come from the same distribution. It is mainly used for groups of distributions that is assumed to come from the same distribution; but the measurement is non-parametric.

The Unpaired Two-Samples Wilcoxon Test is used to test the first and second hypotheses. In the first hypothesis, we are assuming that the distribution for buy-then-sell and sell-then-buy are different. Hence, we assumed the independency of samples. As the data do not meet the assumption of normality, we have decided to use the non-parametric method to test these two hypotheses. Although the measurement scale is parametric, we can treat each value as ranks rather than values in a continuum. Both measurements – buying price and selling price – came from different subjects and hence this is the unpaired analysis.

The Kruskal-Wallis Test is used to test the fourth hypothesis. We are assuming that the groups come from the same distribution by assessing the mean ranks of each group against each other. This method does not require the assumption of normality, and it is appropriate for a sample with three or more groups. In this research paper, race, household income bracket per annum, and most recent highest education level are considered nominal scale which has three or more level of factors. The dependent variable which is loss aversion (the ratio of Willingness-to-Accept or selling price and Willingness-to-Pay or buying price) is treated as ranks, since the interval of the ratio measurement may be accounted for by either the numerator, denominator, or both, and the interpretation of the intervals will be essentially impossible unless we have prior knowledge about the numerator or denominator.

The ANOVA method is used to test the fifth hypothesis. We are assuming that the population follows normality. However, the sample does not meet the requirement of normality assumption. For this reason, the sample is transformed by a function, so as to observe normality. The chosen transformation function is squared-root. We will not going into the full debate about the artificiality of using data transformation. In an ANOVA method, the statistical output provides a degree of association R^2 of the model, but not the partial degree of association or the effect size of the variables. Hence, there is a need to extract the effect sizes of the variables. The eta-squared is used in this aspect. Argumentatively, the Type II model is used to explain the amount of variance explained by the independent variables. In a Type I model, variables are sequentially inserted into the model and the Type III model acts as a similar model to the Type II, except for the extra additive which is the interaction term. In this research paper, the Type III model does not yield significant results with the interaction term. Using effect size measurements such as the eta-squared allows us to examine the main effects of the

independent variables (question before obscurity effect and question with obscurity effect). As the questions are designed to observe the ‘treatment’ effect (respondents provide pricing in a typical scenario without any obscurity effect, and subsequently answer the next question that is put in a different scenario that is impacted by the obscurity effect), the explanatory variable with the obscurity effect is expected to yield stronger effect size in explaining the dependent variable (question after observing obscurity effect). This approach will allow us to extract how much impact the independent variable with the obscurity effect has on the dependent variable.

Plainly speaking, we are expecting a stronger effect size due to the obscurity effect as compared to the scenario where the obscurity effect is not observed. But Cohen (1988) cautioned about the relative nature of the effect sizes: its applicability is confined within the area of study and particularly to the “content and research method being employed in any given investigation.” While it is comparable between the same or very similar studies as a form of replication, the effect size is also impacted by the study in any given experiment or research.

The Wilcoxon signed-rank test is used to test the sixth hypothesis, which is the final hypothesis. It is a signed test because it depends on the signs of the difference (negative difference or positive difference). For example, when the second set of measurements is larger, the net difference with the first set of measurements becomes negative, and vice versa. Consequently, the differences with directions are transformed into absolute differences. All the values are ranked, and all ranks from the negative difference are added together. Similarly, all ranks from the positive difference are added together. By taking the smaller value among the summed ranks of both the negative and the positive difference, we compare it with the critical value obtained from the Wilcoxon Signed Rank Test table. If the smaller value is lesser than the critical value, we reject the

null hypothesis. Notice that the null hypothesis is only rejected when the disparity in summed ranks within each negative difference and positive difference is significantly different. For example, if the summed ranks of negative difference is 4 and the summed ranks of positive difference is 13, there is a wide disparity between the negative difference and positive difference based on rankings. The sixth hypothesis tests for the obscurity effect and we are arguing that the obscurity effect exists when the disparity in differences in summed ranks between the negative difference and positive difference is significantly different. Conversely, if the disparity is not significantly different¹⁰⁶, we do not observe a statistical impact of the obscurity effect.

Each method is carefully chosen for specific scenarios and measurements. Undoubtedly, in the course of analyzing the data, the difference in the test statistics (w , p , η , etc) do not differ much if a parametric method is used on a study that was designed for a non-parametric method, and vice versa. This is possibly due to the sample size that provides sufficient power to each group. In typical social science and psychology research, a small statistical power will yield ‘swinging’ results as reflected in their p -values. However, in this research paper, we do not observe such an outcome.

6.3 Limitations and Challenges

Every research comes with limitations and challenges. This research paper is not spared from this truth. A research paper that is presented without limitations and challenges and watching a staged performance without flaws akin: while the stage is flawless, the amount of challenges and limitations at the backstage is immensely huge,

¹⁰⁶ Assuming that the sum of rankings in negative difference and positive difference is similar, a rank of one in a negative difference is not very different from a rank of two in a positive difference. But the disparity is significant when a negative difference has a rank of one but the positive difference has a rank of, for example, one hundred. Obviously they are ranked very far apart. Hence, there’s a statistical significance in the different between measurements.

and at times depressing. But the real essence of research is in unveiling the curtain that divides the stage and backstage, showing the truth about the performance and its preparation to everyone. In such a manner, we appeal to the audience for greater appreciation for the labor and determination needed to create a flawless performance.

First, respondents may experience cognitive dissonance when it comes to answering the questions. Cognitive dissonance is understood as the mental state in which the action does not match the belief. And it's a self-defeating limitation, as the research requires some form of complexity but the respondents are not able to rationally cope with the complexity. (Chapanis and Chapanis, 1964) Bem (1967) proposed an alternative explanation for cognitive dissonance: self-perception in which the judgments in decision-making are made by interpersonal judgments. In this research paper, the structure in which the questions were asked was carefully designed to answer the research problems. However, it remains a real challenge for respondents to answer the carefully crafted questions in a single sitting, without prior background about the research topic. Nonetheless, in the series of pre-testing and testing stages of drafting the research instrument, not a single reviewer brought up the potential experience of cognitive dissonance. This was likely because the way how the questions were asked was straightforward, using the direct voice in English grammar. Moreover, each question flowed seamlessly to the next, such that the respondents were led 'by the hand' carefully.

Second, while the sample size is representative of the population as described in the previous chapter, there remains a limitation in terms of forming higher-level factors in demographic consideration. For example, we need to ascertain the fourth hypothesis with additional demographic groupings such as the occupation type of the respondents. However, the difficulty in using higher-level factors such as the occupation type (even though the sampling is well-scoped based on heuristics) of the respondents remains a real

challenge, as they require more sample size to provide statistical power for the sample. This has an impact on the timeline of the research, the applicability of the work, and the limited financial budget a researcher has. In this aspect, the researchers' observation of nature and reality aid and guide the research work in a direction that does not jeopardize the scientific inquiry of the study, and yet produces meaningful results. Researchers will need to know, based on observations, what demographic variables will likely cause a disparate effect before the research.

Third, the approach in which the research instrument was administered was entirely online. The survey was drafted virtually, and respondents answer them virtually too. There is still a need to conduct more empirical research in a laboratory setting. Nonetheless, the current research presents a good approximation of the theoretical effort. It is not possible to prove a model fitting that completely reflects reality. Instead, it is considered an approximation that provides a credible alternative to the understanding of reality (Browne and Cudeck, 1992), which is highly applicable, impactful, and sufficiently reliable to the business world. While the virtual instrument is a meaningful questionnaire which then gathers impactful results, there could be more extraneous factors that might influence the respondents in making decisions while completing the questionnaire and these extraneous factors remained unknown to the researcher.

Fourth, the introduction of a new construct – the obscurity effect – poses a new challenge to researchers both in the academic and business domain. To effectively explain a new construct requires more research and theoretical proof. This is not a limitation, but an ensuing challenge to prove the construct through scientific inquiry.

Finally, the Loss Aversion Sensitivity function remains a difficult theory to prove for researchers. While this research paper has theoretically proven the LAS function through gathered data, there is still a need to further fine-tune the model to fit various

aspects of the behavior. For example, the function can be extended to include the modification of the lower tail¹⁰⁷ of the function, such that the behavior exhibited near the expiry of the product can be modified differently from the behavior exhibited at the start of the ownership or possession of the product.

6.4 Impact of roles on prices

Kim and Srivastava (2020) argued that the role which the consumer was in had an impact on their decision-making when it comes to pricing. For example, when the consumer is a seller, he or she seeks maximization in the selling price. This is undoubtedly true as consumers are setting their reference point and expectation around the minimized allowable value that they are willing to compromise. However, there is a difference between the first undertaken role impacting subsequent decisions, and the current taken role in which the consumers are in. Especially in a CVM approach where respondents are asked for their buying and selling price, a respondent with the buyer as the first undertaken role may have different expectations and reference points when it comes to indicating the selling price as compared to one whose first undertaken role is a seller. Hypothetically, when we purchase a product (buyer), we have some form of ownership with the product. And when we sell, we set the selling price higher due to affinity with it. However, when we sell a product (seller) and especially in the scenario where the product is a time-sensitive and value-depreciating one, we may assume that the first undertaken role doesn't matter as the potential loss is so overwhelming to the extent that salvage valuation comes into mind. The first research problem tackles this assumption.

¹⁰⁷ The lower tail of the function refers to the time period in which the expiry is very near.

In the null hypothesis, we conjecture the difference in summed ranks between selling prices and buying prices regardless of the first undertaken role to be non-significant. Hence, right from the start, we are expecting the null hypothesis not to be rejected. This is also applicable to the scenario whereby the product is not time-sensitive and value-depreciating: such goods are usually endowed goods with some form of attachment to them and regardless of their first undertaken roles, the buying price and selling price should remain the same. In this scenario, the potential loss is so overwhelming to the extent that the loss in affinity is reflected by the higher selling price.

In our results, we did not reject the null hypothesis simply because we did not have sufficient evidence to conclude that the differences in summed ranks for buying prices or selling prices, regardless of the first undertaken role, were attributed to a probability of chance at 5%. Plainly speaking, we leaned toward the probability of observing non-chance. We are not saying that chance is not a significant factor, but there is no evidence to suggest that we observe a 5% probability of chance happening. This is an important conclusion because the conjecture underlies the study and having significant differences in prices based on the first undertaken role will lead to a paradigm shift. Will we observe such a difference in the future? At this moment, we did not observe it.

In the previous section, we discussed the use of NHST. And we argued that not all null hypotheses must be rejected simply because they played different roles in research work. While null hypotheses are mainly used to affirm or validate a point, the invalidation of a point can also provide vital information to the theory. So in this case, we are using the invalidation of a point to help us lay the foundation of the work.

6.5 Application of Loss Aversion Sensitivity

When the LAS function (Loss Aversion Sensitivity) was first introduced, the intention was to set the loss aversion explanation apart from the conventional explanation of loss aversion. While consumers feel more pain in losing than pleasure in equivalent gain, this is a fundamental overarching truth about human behavior regardless of scenarios. Even individuals who feel pleasure in getting more pain know that losing pleasure (in feeling pain) is more painful than gaining it. We do not enjoy pain and we avoid pain as much as possible. However, in the conventional loss aversion study, the aversion of loss (and by this we mean pain) is typically reflected in the higher selling price of the product. For this reason, the LAS function was created to explain loss aversion for time-sensitive and value-depreciating products, and the selling price is lower when expiry or full depreciation is realized.

In our results, we rejected the third hypothesis and accepted the alternative hypothesis. This is a crucial hypothesis because the third hypothesis (and by rejecting it) differentiates the studies from the others and fills up a gap that is often overlooked by researchers.

The LAS function is described as the tendency not to sell too low at the start of having the product, followed by the gradual decrease in selling price, and finally, a greater tendency to sell very low at near expiry. Such behavior is commonly observed among all humans as no one wants to lose all when there's a chance to avoid complete loss in selling unless the selling stems from other purposes such as non-profit donation or religious offerings.

In this research paper, we focus on the buying and selling activity in an open commercial market for time-sensitive and value-depreciating good, the box of chocolate.

There is merit in creating a mathematical model to approximate behavior using one parameter only. We can assign meaningful interpretations to the parameter, and

further cross-examine this parameter with other studies such as cognitive psychology and social psychology. In an explanatory model, the unobserved construct which is the b-parameter can potentially be used to explain the observed phenomenon such as psychological traits and states. Moreover, social constructs can also be explained if the study is well-defined and designed. For example, can we correlate the b-parameter with Maslow's Hierarchy of Needs? Maslow's Hierarchy of Needs is understood as the level of human motivation from the bottom to the top in a pyramidal shape, starting with the most fundamental needs of humans such as food and water, to the top ending with self-actualization such as morality and acceptance. (Maslow and Lewis, 1987) Or can we correlate the b-parameter with the social psychology surveys, so as to derive a meaningful explanation for the b-parameter? We foresee there are endless opportunities to utilize the Loss Aversion Sensitivity function. Most importantly, we may be able to predict consumers' behavior in making decisions for purchases if we study their psychological state – both cognitive and social.

In this research problem, the fourth hypothesis tests the mean difference between the summed rankings of loss aversion between groups of demographic variables using the Non-Parametric Kruskal-Wallis Rank Test. The intention is to identify potential disparity that might arise from different subclasses of people based on their demographic profile. This hypothesis was not rejected, and similar to the first two hypotheses, it is meant to prove a point by not rejecting the null hypothesis.

Interpreting Results from LAS Model

The b-parameter reflects the tendency to sell at near expiry and also the drag to sell at the start. Higher b-value refers to the long drag to a lower price at the start (less

steep concave down; decreasing gradient) and a steep plateau at the near expiry (concave up; decreasing gradient). The following table summarizes the pattern of the curve.

Group	b-value	Pattern	Left Tail	Right Tail	Interpretation	% accounted in sample
Altruistic	$0 < b < 1$	Extremely steep left-tailed concave down curve at the start in decreasing fashion; Early plateau right-tailed concave up curve at the end in decreasing fashion.	Extremely Steep	Least Steep	Consumers are totally adverse to loss at the start but least adverse to loss at near expiry.	0%
Measured	$1 < b < 2$	Steep left-tailed concave down curve at the start and less steep right-tailed concave up near expiry in decreasing fashion	Steep	Less Steep	Consumers are more sensitive to loss at the start and less sensitive to loss at near expiry.	45.2%
Adventurous	$2 < b < 3$	Lesser steep concave down curve at the start in decreasing fashion; Steep right-tailed concave up near expiry in decreasing fashion	Less Steep	Steep	Consumers are less adverse to loss at the start but more adverse to loss at near expiry.	47.9%
Parsimonious	$b > 3$	Least steep concave down curve at the start in decreasing fashion; Extremely steep right-tailed concave up curve at near expiry in decreasing fashion.	Least Steep	Extremely Steep	Consumers are least adverse to loss at the start but totally adverse to loss at near expiry	6.9%

Table 8 – Interpretation of the Results obtained from the NLS Curve Fitting

Consumers generally feel greater pain in opportunistic loss when expiry is near and lesser pleasure in strategic gain at the start for TSVD products. For this reason, none of the respondents exhibit the characteristics of the Altruistic group.

The following histogram shows the distribution of the b-parameter at the respondent level, with a positive skew (right skew):

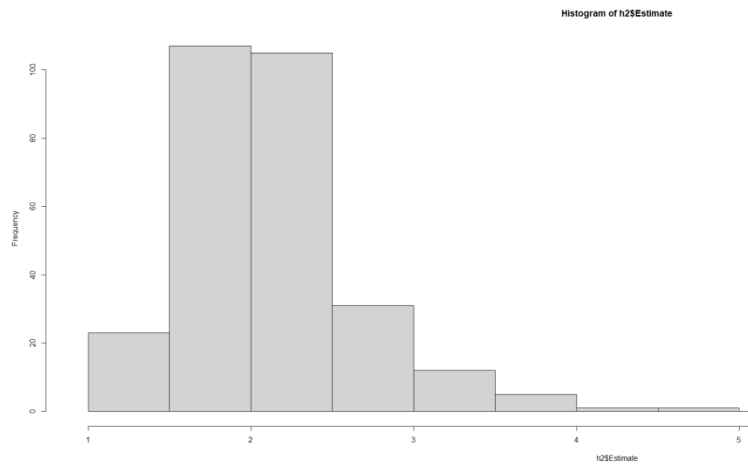


Figure 19 – Distribution of b-parameter at the Respondent Level

Altruistic Group

The Altruistic Group refers to individuals who know the consistent depreciation of the product. However, these individuals know the impact of gaining nothing when full depreciation is realized, and hence they set the selling price much lower when approaching (not near) the full depreciation of the product. Take note that these individuals have sensible and clear understanding of the loss in value at an earlier stage as compared to other groups.

Measured Group

The Measured Group refers to individuals who are more sensitive to loss at the start of having the product as compared to the end or near expiry of the product. They perceive the loss in value of a product as an adventure. Similar to the Altruistic group, they have a clear understanding of the loss in value at an earlier stage, but they prefer to moderate this loss over a longer period of time, such that the pain of losing is more cushioned at the start and end of the product. And compared to the Altruistic group, they are less sensible toward loss in value at an earlier stage.

Adventurous Group

The Adventurous Group refers to individuals who are more conscientious about their actions and prefer to sell at the purchase value as long as possible, even though the product is depreciating in value. Unlike the Measured group, they perceive the loss in value of a good as a justified means to reflect the true value of the good. However, such conscientious effort only happens at the start of having the good. When approaching (near) full value depreciation of the product, they are more adverse to loss and subsequently sell at a much lower price.

Parsimonious Group

The Parsimonious Group refers to individuals who wait on opportunities to come and set their selling price as high as possible at the earlier stage of having the product. And when the product is approaching full depreciation in value, they will not wait on opportunities anymore and sell the product as a form of riddance.

In addition to the LAS study, mean differences by ranks for loss aversion among different subclasses of the demographics are not statistically significant. This is an important conclusion as it impacts the statistical power of the sample. When the sample size is small due to the allocation of the sample size to various demographic groupings, we observe lower statistical power for inversed Type II Error, which is commonly known as the true positives. To increase the likelihood of true positives, we need a larger sample size for each demographic group if the mean differences in ranks between each demographic group are statistically significant. We did *not* reject the null hypothesis as loss aversion did not significantly differ across demographic groupings.

6.6 Hyperbolic Discounting & Exponential Discounting versus Loss Aversion Sensitivity¹⁰⁸

Hyperbolic discounting refers to the stronger preference for immediate gratification over long-term larger rewards, even though the shorter-term reward is much smaller. For example, consumers may choose immediate gratification by receiving \$50 now as compared to delayed gratification of \$500 after 3 years of waiting. Other examples include cigarette smoking, whereby the smokers seek immediate ‘release’ or gratification over long-term health.

The LAS differs from hyperbolic discounting in several aspects. First, hyperbolic discounting assumes that the value of the good or reward increases over time, whereas LAS assumes that the value of the good or reward decreases over time. Having said that, hyperbolic discounting may extend ad infinitum, whereas LAS function exists within the opposite whereby the start and end of the good or reward are certain: a TSVD product

¹⁰⁸ We would like to thank Dr. Kazuhisa Nagaya from Yamaguchi University, Japan, for bringing up hyperbolic discounting and exponential discounting.

starts with the ownership (both psychological and physiological) and ends with the full depreciation of the item.

Second, hyperbolic discounting does not account for concavity arising from the loss aversion behavior. LAS accounts for the initial concavity downward. This is an important distinction as the primary objective of the LAS explanation is to explain the initial concavity and final concavity using a single parameter.

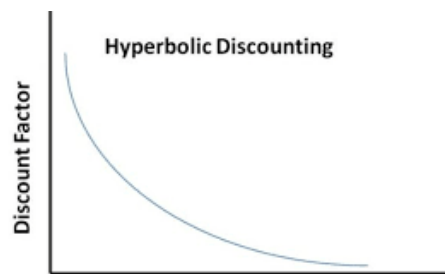


Figure 20 – Hyperbolic Discounting

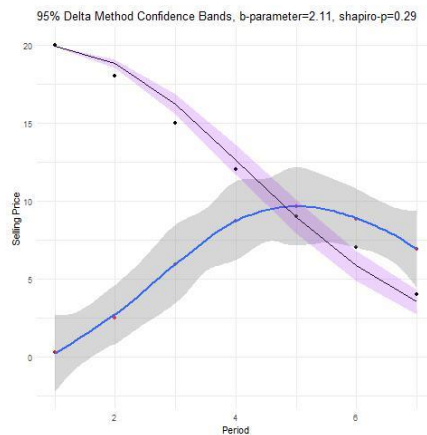


Figure 21 – Curve Fitting of LAS Function

Last, the delay parameter (which is also the only time element involved) in the hyperbolic discounting is part of a multiplicative factor, k , governing the degree of discounting, whereas the time parameter in the LAS is a multiplicative factor of the initial value of the product and time to expiration. Instead of resembling the hyperbolic

discounting function, we can say that the LAS function resembles exponential discounting more:

$$\text{Equation 28: } f(D) = e^{-ka} \tag{28}$$

The difference between the exponential discounting and LAS lies in the modifier, $-ek_{t_0} \frac{b}{\sqrt{t_1}}$. In Equation 28 which is the exponential discounting, this is expressed as $-k$. However, in the LAS function, t_1 and k_{t_0} are also involved in computing the parameter. Let's take $-k$ to be the interest rate of an investment as an example. In the LAS function, the modifier is the interest rate, which takes into account the initial value in investment and time to maturity. When the initial value of the investment is higher, the gradient in the drop of interest rate is higher. And when the period of maturity is longer, the gradient in the drop of interest rate is lower. You can imagine the LAS curve being pulled longer vertically in the graph if the initial value is higher and wider horizontally in the graph if the time to maturity is further out. Loosely speaking, this is a variable interest rate dependent on two factors - the initial value of the investment and time to maturity.

In exponential discounting, the parameter governing the discounting is purely a fixed interest rate across time. Regardless of the initial value of the investment and time to maturity, the interest rate is fixed.

6.7 Isolating obscurity effect

There is a need to isolate the obscurity effect. At times, we may assume that the question before observing the obscurity effect may have a spillover effect on the question with the obscurity effect. This is true when the initial question has such a strong influence on the study, to the extent that the obscurity effect becomes too correlated with the initial

question, of which we have a confounding effect between the spillover effect and the obscurity effect. To isolate the obscurity effect from the spillover effect, we observe the effect size of the questions on the response variable. For example, if the initial question has a similar or equal effect size with the question with the obscurity effect, we then come to question the impact of the spillover effect on the response variable through the question with obscurity effect. In this research paper, the question with the obscurity effect has a larger effect size for the Type II model across different types of scenarios.

What exactly is effect size? Effect size measures the strength of the relationship between two variables in a population. In our research paper, we are controlling one variable, and then measuring the effect size between the other variable with the response variable. The effect size shows the split in the strength of the relationship with the response variable.

The obscurity effect is context-based. The question of which the respondents answer follows the trail designed by the researcher. Hence, one question leading to the other is a normative approach in psychological science. We did not consider other effects in play and assumed *ceteris paribus*. Ideally, we hoped to conduct a broader survey by including more assessments on different types of effects that might potentially explain the behavior. However, we chose to assume that the respondents ignore other effects and focus on the obscurity effect that the researchers focus on.

There is a difference between cause-and-effect and cause-and-consequence. In a cause-and-effect scenario, we are saying that two like events are related to each other and one preceding the other in a way that the earlier event creates an effect on the latter event. For example, due to the continuous hammering of the keystrokes, the keyboard is damaged. We relate the hammering action as the cause which leads to the effect of a damaged keyboard. In a cause-and-consequence scenario, we are saying that two events

may not necessarily be related, and the one preceding the other is mainly a cause to explain the consequent. There is also a form of bias involved, in which consumers may infer causes based on the consequences. (LeBoeuf and Norton, 2012) For example, water might have spilled into the keyboard 3 months ago and the keyboard was working up to that point. It is important to note that in a cause-and-consequence scenario, we are motivated to understand the consequent through a cause. In a cause-and-effect scenario, we are motivated to study the causal explanation of two related events. In our research paper, we are studying the cause-and-effect of obscurity in a within-subject study.

In a separate study, researchers found that people tend to be more willing to help a single victim over a group of victims, regardless of whether they are identified. In this aspect, consumers that have experienced the obscurity effect may feel a form of victimization and exhibit a behavior of self-help to react against the change in information. They feel the need to react as a victim; this is commonly known as the singularity effect. (Kogut et al., 2015) Will consumers react differently when they obtain the knowledge of collective victimization in the market? Slovic (2007) proposed that as the number of victims increases, the 'feelings and emotions' begin to fade, resulting in a failure to motivate actions. This observation is seemingly more pronounced in societies where individualism is more prevalent, which suggests that local culture influences the 'self-help' as described before. (refer to Triandis (1995) for more information on the research about individualism) This is an area for further research into the obscurity effect. Will collective victimization due to obscurity effect change the consumers' behavior?

6.8 Explaining behavior arising from obscurity effect

In this research paper, the questionnaire consists of qualitative answers given by the respondents after they observe the obscurity effect. The intention is not to capture the reasons for their satisfaction in selling due to the obscurity effect, but their underlying value system when it comes to selling after observing the obscurity effect.

The qualitative responses are tagged into four categories. They are Indifferent, Personal, Pragmatic, and Sensible. They are then correlated with four behavioral patterns as described in the section on *Interpreting Results from LAS Model*. Respondents who were indifferent did not believe in any impact that might arise from selling the product. Respondents who were personal believe in providing reasons using their physical senses. They leaned toward rationalization through their senses. Respondents who were pragmatic looked at the situations and make decisions. They placed more emphasis on social elements rather than deriving the monetary benefits or losses they could get. Respondents who were sensible balanced the gains and losses sensibly, and arrive at a decision that made the most sense in terms of gains and losses.

The following table shows the 4 x 4 contingency table, which is finally reduced to a 2 x 2 contingency table for interpretation purposes.

Consumer Profile	Indifferent	Personal	Pragmatic	Sensible
Altruistic	0	0	0	0
Measured	8	16	32	58
Adventurous	0	17	49	53
Parsimonious	1	4	2	12

Table 9 – 4 x 4 Contingency Table

Consumer Profile	Pragmatic	Sensible
Measured	32	58
Adventurous	49	53

Table 10 – 2 x 2 Contingency Table to Interpret Consumers' Behavior

When it comes to a box of chocolate, millennials in Singapore are predominantly measured and adventurous. They display a pragmatic and sensible attitude toward averting loss. The pragmatic group believes in action-reaction, and the information about buying and selling in the market impacts their decision-making. The sensible group believes in making sense of the problem and solution they face, and predominantly rely on measurable outcome that can be quantified. Both groups are not mutually exclusive and each group is characterized as tending to lean toward one set of values and practices.

The Measured-Pragmatic group believes in losing more at the start if the price is set lower. They are concerned with potential market forces that might rob them of the opportunity to sell higher if the market is truly selling at a higher price. This group of consumers are pragmatic and they believe in acting toward a goal. They also consider the reaction from the market and attune their selling price. The fear of losing amidst challenges in the market grows stronger as they speculate on the selling price and the joy in gaining becomes more intensified as their speculation turns confirmation. In this group, gambles are more exciting than safety but their risk-taking appetite is controlled by the pragmatic values they uphold.

Unlike the Measured-Pragmatic group which is impacted by action-reaction, the Measured-Sensible group believes in making sense of the situation and rationalizing a selling price. They care less about the goal and attune their selling price based on their rationalistic thinking. Similar to the previous group, they believe in attaining excitement through gambles but their risk-taking appetite is controlled by sensible values such as a thousand dollar spent on gambling does not promise the magnitude in the probability of winning.

The Adventurous-Pragmatic group believes in acting with a conscience. They consider selling slightly lower at the start, so as to create measurable action-reaction. And they are quick to lower the price near the end. Unlike the Measured group, the Adventurous-Pragmatic group chooses safety and opts for the options for expected outcomes even though the more likely gain is smaller than the less likely larger gain in a gamble. They are pragmatic as they observe the outcome and measure it against their initial risk avoidance.

Unlike the Adventurous-Sensible group which is impacted by action-reaction, the Adventurous-Sensible group believes in justice when it comes to selling products they have. They make an effort to balance the benefit and loss a consumer may have made if they buy the product. Take note that the balancing act is a theoretical one: this group of people may not be as concerned about the market as the previous group. This is the safest and most sensible group which believes in risk avoidance, rationalistic outcome and explanation for their action.

All groups are not mutually exclusive, but each group has its central tendency as described by this research paper.

Respondents faced 'cool' reasoning whereby they indicated their buying and selling price mainly based on attributes of the good and the current information provided by the market. However, when the respondents observed the obscurity effect, they switched to 'hot' reasoning whereby they were influenced by emotions arising from a change in state. (Brand, 1985) Hot reasoning, or hot cognition, is often automatic, and it draws a parallel comparison with thinking 'fast' in behavioral economics. (Kahneman, 2011) In this regard, consumers do not always form unbiased decision-making when they face hot cognition. Hence, the results may not necessarily be as rationalistic as the utility theory suggests. For this reason, the selling price of consumers who have experienced the

obscurity effect is unexpectedly higher than the selling price of consumers who have yet to experience the obscurity effect. One of the ways to switch from hot cognition to cool cognition is by distancing the self from the decision. (Metcalfe and Mischel, 1999) For example, consumers can provide additional reasons for distancing themselves from the decision they make.

Consumers often exhibit prejudgment when cognition changes from cool to hot and emotions are more involved than rationality. This is especially true when evidence is not readily available, and the ability to distance self from the decision-making becomes more challenging.

6.9 Valuation Match (Mismatch)

In this final discussion, we will gather all data, results, interpretations, and statistics together to explain the valuation match. In Table 7, we have shown that the sellers' average pricing after observing the obscurity effect is higher than the average buying price of the buyers. We shall walk through the steps in explaining the valuation match.

The first point is that the valuation between buyer and seller is a mismatch. And buyers do not know what had transpired among the sellers. Sellers who are seeking maximization need to make difficult decisions when it comes to selling their TSVD product when expiry or full depreciation approaches. And with the obscurity effect impacting their decision-making, they tend to sell higher than expected, resulting in a valuation mismatch. The buyers are clueless about it. And no amount of intelligence – both human and machine – can predict what will happen in the future perfectly. Hence, we observe the valuation mismatch as seen in our research paper.

At times, sellers attribute the obscurity effect to the “like causes like” phenomenon under the representative assumption. (Kahneman and Tversky, 1972; Teigen, 2017) For example, sellers attribute their unpreparedness as the cause of the obscurity effect. In this regard, we are saying that the cause and effect falls within the same representation framework and every cause of such nature will produce an effect of such nature. However, unpreparedness does not cause obscurity effect. And in the view of the sellers, it is an unforeseen event due to a lack of information or misrepresentation arising from the information given. Do lack of information cause the obscurity effect? Again, this is a wrong assumption as the lack of information does not exacerbate the obscurity effect. So what exactly causes the obscurity effect? This is often attributed to the unknown, or as what many researchers call it, the Supernatural. It is important to note that the supernatural here does not refer to anything ethereal: it is simply a classification of events that are conjoined together and decoupling them yields lesser likelihood than conjoining them. For example, there are many sellers within the neighborhood who are selling the same or similar items. By conjoining both events (sellers within my neighborhood and obscurity effect), sellers may attribute the likelihood of observing the obscurity effect higher due to the increased likelihood of identifying a seller who is selling the same or similar item within the neighborhood. And when both events are decoupled, the likelihood of attributing them as the cause and effect become attenuated or weakened. This is referred to as the Conjunction Fallacy (Tversky and Kahneman, 1983) and it was reported that the conjunction fallacy¹⁰⁹ has the strongest effect when it suggests a causal relationship (Nestler and von Collani, 2008) or one of the constituents

¹⁰⁹ It is believed that people who hold on to the conspiracy theory are more susceptible to the conjunction effect. (Brotherton and French, 2014) In our research paper, we assumed that the respondents are not affected by any conspiracy simply because the obscurity effect arises from a system that promotes free trade.

within the conjunct serves as a confirmation concerning the other constituent. (Tentori et al., 2013) Researchers have sought to explain the conjunction fallacy by using various probabilistic models on individual constituents that form the conjunct and these models – though not exhaustively collated - include the weighted average (Fantino et al., 1997), multiplicative combination rules (Birnbaum et al., 1990; Einhorn, 1985), and random variation. (Costello, 2009)

Lack of information, when the market is open, is a typical observation in a trade. When sellers corroborate at a strategic level, monopolistic behavior is observed. For example, there are three sellers, and Seller A conspires with Seller B and Seller C to determine the amount of discount to offer to the buyers. This practice serves as a preventive measure for a trade war among sellers. However, buyers stand to lose more, as the purchase happens not in a competitive market but in a monopolistic market. In our research paper, there is a low likelihood of observing a monopolistic market as there are too many sellers to create a strategic agreement. Moreover, given the low monetary returns of the product and infrequent transaction of such trade (resale of TSVD products), the benefit arising from the strategic agreement does not outweigh the loss in investing time to reach the agreement, and the amount of time required to agree on a mutually consented strategy would take many days and years to reach. Sellers stand to lose more when they arrive at the gain of a strategic agreement which require so much time that loss becomes more prominent.

There is a difference between a judgment and a decision. (Groome and Eysenck, 2016, p.196) Before a decision, consumers gather information and recall experiences to form a judgment. And judgment is also formed through the reference point in which the consumers are in. For example, choosing a bet in a gamble over bankruptcy. The chances of winning in a bet – albeit slim – provide certain probabilities over avoiding certain

bankruptcy. Hence, decision-making through judgment is often a matter of action at a given point in time (Hastie and Dawes, 2010), backed by experience in a field setting within the naturalistic decision-making environment. (Klein, 1993; Zsombok and Klein, 2014) Decision-making by using experience is called the recognition-primed decision (RPD) model within the framework of rapid decision-making. There are three variants to RPD: first, consumers isolate and contain the situation, and make the best course of action – often the first that comes to mind – based on whatever makes sense. Second, consumers develop a story around the situation and diagnose the story for the best course of action. Third, consumers simulate the potential outcome of the situation, have a mental representation of what to expect in the future, and then decide the best course of action. (Lipshitz et al., 2001) In this research paper, the likely method is the first variant, as the respondents had a strategic goal to finish the questionnaire within the shortest period of time. While the responses they provided were valid, it was unlikely that the respondents would spend more time considering the situation and developing a story or simulating the potential outcome.

RPD suggests an adaptation to the environment, whereas decision-making under heuristic bias suggests an adaptation to consumers' ability to make decisions. To reconcile RPD and heuristic bias, we need to consider both the environment and the capabilities of the decision makers to learn about the environment. (Kahneman and Klein, 2009) Juslin et al. (2009) proposed that when consumers face cognitive constraints such as considering RPD and heuristic bias, the linear additive integration (i.e. the straight adding up of probabilities) may offer a more superior bounded rationality. Herbert Simon made an excellent point of view in this regard:

“Human rational behavior ... is shaped by the scissors whose two blades are the structure of the task environment and the computational capabilities of the actor.” (Simon, 1990, p.7)

Modern computations provide multiplicative probability integration but a human’s mind is capable of just a simple linear additive approach, especially when we are operating under an uncertain environment.

Consumers are primed to set the selling price higher when they experience obscurity effect. Such priming is a result of the anchoring effect. For example, consumers indicate \$10 as the selling price for pre-effect question (reference point being the market value of the good), \$8 as the selling price for question with obscurity effect (reference point being \$10), and \$12 as the selling price for post-effect question (reference point being the market value of the good *and* the selling price for question with obscurity effect). Notice that the shift in strategy from a fair-price (i.e. \$8 is the fair price to set for the selling price) to a justified price (i.e. \$12 is the justified price I’m willing to set for the selling price, as the obscurity effect has made me realized that I have set the selling price a little too low). In this aspect, the shift in strategy is a shift in reference point.

Nudging is a practice that looks into the display of options through the lens of the architecture of choices. (Thaler and Sunstein, 2008) For example, in the questionnaire, we asked the respondents to indicate their selling price after observing the obscurity effect. The structure of choices was designed in a way that compelled the respondents to make an intuitive judgment of the date in which the information was provided based on the context of the survey. This is a fast and automatic response. The opposite of such nudging is a context with complete information about the obscurity effect. For example, if respondents knew the date in which the information was provided to be a year ago, the

selling price would have been different from the ones they indicated for the post-effect question in the questionnaire.

Emotions often play a big part in affecting our cognition and there are typically six basic emotions: sadness, happiness, fear, anger, surprise, and disgust. (Ekman, 1992) Such impact usually happens when neural activity in the amygdala – the part of the brain that is known to be involved in emotions – is observed (Mathews et al., 2004), especially when consumers feel unhappy or dissatisfied in a trade. In our research paper, we posit that the respondents experience a certain level of unhappiness due to the obscurity effect. However, such an effect is often short-lived and consumers may soon realize that their emotions can be better controlled if they allow their cognition to take over during that moment of unhappiness. It is important to take note that decisions made with emotions are different from decisions influenced by emotions. The former state of mind refers to prior knowledge about emotion-driven decisions, and the latter state of mind refers to prior knowledge about making a decision that is *influenced* by emotions. We believe that our respondents were influenced by emotions rather than having a knowledge in making an emotion-driven decision.

“The essential difference between emotion and reason is that emotion leads to action, while reason leads to conclusions.” (Roberts, 2016)

In addition to emotions, the scarcity principle suggests that consumers value scarce goods more than abundantly available goods in the market. This often leads to a mismatch in demand and supply. (Gordon, 2023) The scarcity principle and loss aversion work together to explain consumer behavior. For example, due to the scarcity of a good, consumers are more averse to loss and they feel that they lose out more if they lose the

opportunity to gain. In our research paper, the scarcity principle does not apply, as the demand is not expected to be higher if the box of chocolate is resold to the market. Hence, the product is not scarce from the perspective of the market (i.e. both the buyers and sellers).

In the study of social psychology, we believe our respondents exhibited social proof. Social proof refers to the general tendency to follow others, so as to be accepted in a given society. We choose to behave in a certain way in a given situation. Social proof was coined by Cialdini (2009) and it is also known as informational social influence. According to an online poll, more than 90% of the respondents trusted their fellow customers over the words of the company or brand. (“8 Social Proof Statistics to Consider for Business Decisions in 2023,” n.d.) These statistics provide us with a perspective of how powerful social proof is when it comes to marketing. In our research paper, when sellers realized that everyone was selling 50% cheaper than their selling price, they wanted to conform to the market force and followed suit. In the event they failed to follow, they would be deemed foolish. However, such a social behavior may not necessarily result in a positive outcome. At times, consumers may find their actions unwise when their actions resulted in undesirable outcomes. Ultimately, consumers want to feel safe more than they want to feel special. (Harhut, 2022, p.61)

Consumers pay the price for inaction. This is analogous to the cost due to delay in making a decision and the trade-off in gains for the potential loss gets more pronounced when the expiry of goods is near. (Anderson, 2003) For example, consumers are willing to lower their selling price when they know that the potential loss is real, which is a form of trading off the potential gains they can get if they set the selling price higher. And inaction often leads to anticipated regrets. To avoid regrets, consumers act and make a decision. However, acting too early can also lead to regrets when the outcome of the

action does not match the expectation. Therefore, consumers seek alternative options such as retaining the good (the status quo option) for personal consumption even though the total loss is realized when the expiry is reached and they experience lesser regret if they refuse to act in an uncertain environment. (Inman and Zeelenberg, 2002)

The obscurity effect is more pronounced when the days to expiry is longer. We observe this from the effect size (eta-squared), and the effect size for the question with obscurity gets smaller as the number of days to expiry decreases. Hence, valuation mismatch becomes salient (more important) when the product has a longer shelf-life, but less pronounced (less noticeable) when the product reaches the end of the shelf-life.

6.10 Conclusion

We started our discussion chapter with an explanation for the null hypothesis and alternative hypothesis. There were two types of hypotheses – the cradle and the candle. The cradle refers to the foundation of the study and if this foundation was not established, the study would have fallen apart. The candle refers to the test hypotheses that we were interested in. Our objective was to establish the foundation by NOT rejecting the null hypotheses and tested our conjectures of the study by rejecting the null hypotheses. If the cradle was not established, we would need to relook at the study and decide whether to rescope the entire research. If the null hypotheses that we were interested in were rejected, we present the alternative hypothesis to explain the phenomenon.

We also look at the use of p-value. If a p-value fell within the critical region of $\alpha = 0.05$, we assumed that there was a 5% probability of observing chance and the null hypothesis was then rejected. However, we also considered the possibility of the p-value being slightly above the critical value such as $p = 0.051; p > \alpha$. We argued for 1) the use of confidence level to interpret the p-value and 2) the odds ratio whereby the null

hypothesis is assessed based on the alternative hypothesis under the Bayesian framework. Subsequently, when an alternative hypothesis is accepted, it can turn into a null hypothesis for further study. Nonetheless, the probability of accepting the alternative hypothesis should not be translated to the probability of chance. The probability of non-chance for an alternative hypothesis is not translated into the posterior probability of the null hypothesis. Finally, we discussed the use of contrapositive, whereby the null hypothesis is split into two hypotheses – the probability of observing the data given a hypothesis is true and the probability of observing the data given that the hypothesis is not true. The probability of observing the data given that the hypothesis is not true is different from the probability of observing the alternative hypothesis. Plainly speaking, we cannot equate the non-chance in observing an untrue hypothesis with the non-chance in observing an alternative explanation. For example, when we say that all apples are red, we cannot say that all apples that are not red are actually green (contrapositive); some apples are yellow (alternative hypothesis). And the reality is far more complex than just the colors of apples.

After our discussion on the hypotheses, we moved on to discuss the test method deployed in the research. We discussed the parametric and non-parametric methods, and how each method was used based on some basic principles and reasoning. One parametric measurement, for example, is age. We can say that a man who is 15-year-old is younger than a 30-year-old man on a continuum scale. But we can't say the winner of a race is ranked 1.1 and the runner-up is 1.9. In this case, the measurement is non-parametric. For parametric measurement, normality must be assumed. However, in our research paper, normality was not assumed and the Shapiro Test showed non-normality of the data. We deployed non-parametric methods to test the hypotheses. These methods were the Unpaired Two-Samples Wilcoxon Test (for between-subjects study), Wilcoxon

signed-rank test (for within-subjects study of two factors), and Kruskal-Wallis test by ranks (for within-subjects study of more than two factors). We also deployed the ANOVA method to study the effect size of the obscurity effect on selling prices *post-effect* using the eta-squared.

In the next section, we discussed some limitations and challenges. First, we explored the possibility of our respondents facing cognitive dissonance. We concluded that there was a low likelihood of observing cognitive dissonance as the reviewers of the survey instrument did not provide any feedback that might suggest cognitive dissonance. Second, we discussed the effect size of the sample which represented the population. Plainly speaking, if the number of levels in a factor was high (for example, occupation type with so many different types), we would have to cater sufficient sample size for each level, leading to a very high cost and prolonged timeline. In our research paper, we chose the commonly used demographic factors. Third, we discussed the nature of the research. Being a virtual survey, it was unlikely that consumers in the market reacted the same way as our respondents for our virtual survey. There is a need for a more pragmatic approach that yields results that are more applicable to the business world. Fourth, we introduced a new construct – the obscurity effect – but the proof of the pudding lies in the theoretical proof for the construct. Finally, we briefly discussed the Loss Aversion Sensitivity function and how it can be further refined and tuned to fit various aspects of consumers' behavior in the market.

We moved on to discuss the impact of roles on prices and concluded that the first undertaken role (buyer or seller) did not impact prices. We discussed the application of the Loss Aversion Sensitivity and interpreted the results from the survey. We found that our respondents can be classified into four groups: Altruistic, Measured, Adventurous, and Parsimonious. We then discussed the difference between Hyperbolic Discounting,

Exponential Discounting, and Loss Aversion Sensitivity. The Hyperbolic Discounting theory assumes that the value of the good or reward increases over time, whereas the Loss Aversion Sensitivity assumes that the value of the good decreases over time. Moreover, unlike Hyperbolic Discounting, Loss Aversion Sensitivity explains the initial concavity and final concavity of consumers' behavior. While Exponential Discounting is similar to the Loss Aversion Sensitivity function, the Loss Aversion Sensitivity takes the initial market value of the product during ownership or possession and the period to expiry in discounting the curve, whereas Exponential Discounting has a constant rate in discounting the curve.

We then discussed isolating the obscurity effect to make sure that there was no confounding effect from other prior questions. We explained the obscurity effect through a semantic analysis of respondents' qualitative answers. We expanded the four groups of consumers into a 4 x 4 contingency table, which is then reduced to 2 x 2 contingency table for interpretation purposes. We identified four types of consumers for the box of chocolates market: the Measured-Pragmatic, Measured-Sensible, Adventurous-Pragmatic, and Adventurous-Sensible. Each group exhibits unique behavior toward consumerism but they are not mutually exclusive. The descriptions of the groups are simply general tendencies toward a certain profile in the market.

Finally, we discussed the valuation match (or mismatch) between selling price and buying price. We borrowed theories from cognitive psychology and social psychology to help us explain the phenomenon. We concluded our discussion with a note: valuation mismatch becomes salient when the product has a longer shelf-life, but less pronounced when the product reaches the end of the shelf-life due to the obscurity effect.

CHAPTER VII:
SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

7.1 Summary

The rise of behavioral economics started with the notion that human do not behave in a way that is independent of their desires. (Ashraf et al., 2005) Human choose an option among alternatives with the status quo as the reference point, and express their desire by weighing the choices. Researchers have consistently identified human's desire being a driver for irrational decision-making.

We tend to question our decision and try to make the best possible explanations for it. This is likely the case when the brain fails to register the decision as a definitive outcome when the action in making a decision has already make it a definitive outcome.

In our research paper, we went through a comprehensive literature review spanning from generalizability of the stimuli in past literatures, to reference point from which the path to decision is made and endowment theory which suggests that our decision making in selling the product is influenced by our endowment with the product, and finally looking into loss aversion that explains the valuation gap between the buying prices and selling prices. We created definitions through mathematical reasoning and we defined consumers as end-users of the products, and they are not bulk purchasers, trade purchasers, or donators. Moreover, we defined product as tangible good and/or intangible services. Other key definitions were also given.

The test results from the survey showed that the first undertaken role (i.e. buyer in buy-then-sell and seller in sell-then-buy) had no impact on buying and selling prices. Differences in loss aversion ratio across different demographic factors were statistically insignificant. We removed the speculation that the question before observing obscurity effect has a spillover effect onto the question with obscurity effect, and observed a

statistically significant effect sizes when we assessed the impact of the values from the question with the obscurity effect on the values from the question after observing obscurity effect. We concluded that the obscurity effect had caused the respondents to place average selling price after observing the obscurity effect higher than the average buying price before observing the obscurity effect. For example, a buyer expects the price of a product as \$10, but the sellers observed obscurity effect and decided to sell the same product at \$15, *ceteris paribus*. If obscurity effect is not observed, we expect the selling price to be lower than or equal to \$10 which is explained by the loss aversion sensitivity function.

Finally, we discussed about various topics concerning the results. For example, we derived four types of consumers: Altruistic, Measured, Adventurous, and Parsimonious. We further expanded these four types of consumers into a 2 x 2 contingency table to help us understand the respondents after they experienced the obscurity effect. We then utilized concepts from both cognitive and social psychology to explain the valuation mismatch arising from the obscurity effect. Key concepts such as emotions and social proof were considered. For example, sellers may feel ‘hot’ in emotions after observing obscurity effect and set the selling price higher than expected. And they recognize the obscurity effect and want to conform to the market by following others who are selling at higher price.

7.2 Implications

We refer to two use cases whereby the obscurity effect can be curtailed, so as to achieve higher customer satisfaction.

Hotel Pricing

The BED hotel¹¹⁰ in Thailand is built on two simple beliefs. They believe in making life easy, and making effort to truly understand the people who stay with them. The architectural design of the hotel is black-and-white and every space is an area whereby travellers can ‘feel the flow and emotion’. (“About BED Hotels | Chiang Mai, Thailand,” n.d.)

We considered the pricing of hotel room a time-sensitive and value-depreciating product. It is time-sensitive because hoteliers can’t sell rooms that are back-dated. And it is value-depreciating because rooms depreciate in value by means of wear and tear.

We searched for the pricing for a check-in date 18 May 2023 (which is tomorrow from the time of this writing) and check-out date 19 May 2023 (a one day stay over the weekday). It is priced at 26 Singaporean dollars (USD19). And we searched for the pricing for a check-in date 15 June 2023 (29 days away) and check-out date 16 June 2023 (30 days away). It is priced at the same pricing. Assuming that the hotelier is keen to sell all rooms for the check-in date of 18 May 2023, buyers do not have a good sense in pricing if the selling price from the hotelier increases. In Booking.com, there is a statement “Only 4 rooms left at this price on our site”. However, if buyers know that the number of remaining rooms is a result of a certain percentage of booking rate, they will be more willing to accept the higher selling price. For example, the statement can be changed to “Only 4 rooms left at this price on our site. 80% of the rooms were booked within the past 1 week” for the altruistic customers and “Only 4 rooms left at this price on our site. More than 60% of the customers said they completely enjoyed the stay in this hotel” for the adventurous customers. Knowing that the popularity of the hotel is growing

¹¹⁰ We want to thank Jeroen Schedler from Rangsit University for his candid and frank inputs about how LAS function and obscurity effect can be applied to hotel industry.

at a faster rate, the buyers perceive the pricing of the room to be higher, since the demand is higher and the supply is limited. If that revised statements are adopted, and the selling price is increased to 35 Singaporean dollars (approximately USD26), there is a larger likelihood of observing same booking rate for the remaining rooms while increasing revenue. This is just a small scale example in which obscurity effect can be curtailed to improve customer satisfaction and revenue.

Reselling Consumers' Second-hand Goods

Carousell is a Singaporean company and they specialize in consumer to consumer and business to consumer market for buying and selling new and secondhand goods. (“Carousell (company),” 2023) A search for an iPhone 4 leads to a particular product as shown below.

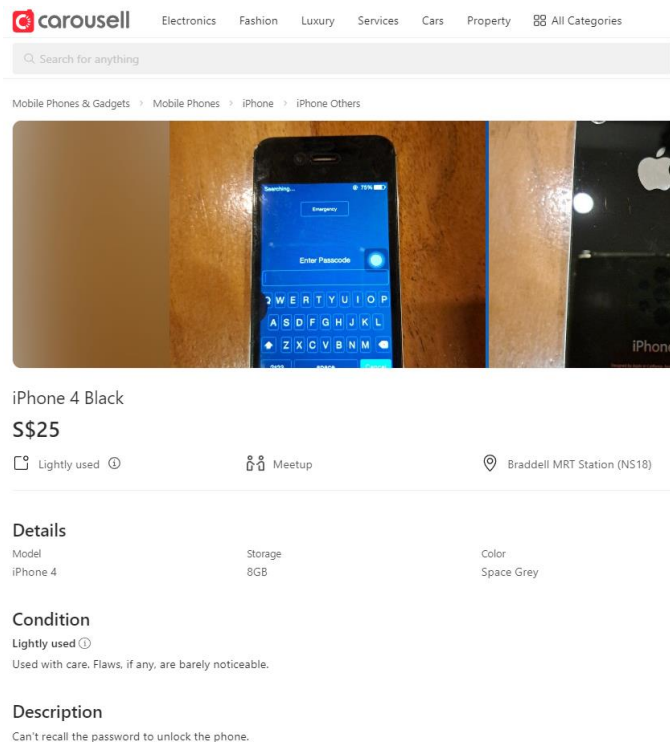


Figure 22 – A snapshot of an iPhone 4 Black posted online on Carousell

In this picture, we observe the selling price is set at Singaporean dollars 25 (approximately USD18.66). It is lightly used, and the seller is selling it because he or she ‘can’t recall the password to unlock the phone.’ The seller is selling it to someone who can unlock the phone and use it. Buyers may price it at a lower price, given that there’s a need to engage someone professional to unlock the phone, which will incur additional cost beyond the current value of the good. For this reason, buyers look for other alternatives. The buyer is more likely to buy it (believing that Singaporean dollars 25 is worth it) if the seller rewrite the description as “Can’t recall the password to unlock the phone. It’s a 3-character password” for the pragmatic and altruistic customers and “Can’t recall the password to unlock the phone. We will provide a contact in which you can get reasonable pricing to unlock the phone” for the pragmatic and measured customers. Naturally, the cost in unlocking the phone is cheaper when the password is shorter. Longer passwords require more complex combination of characters, leading to higher cost in unlocking the phone by the professionals. Even more so, if it is a 2-character password, buyers are even more willing to pay Singaporean dollars 25 for the phone. In this use case, buyers face the obscurity effect and perceive the value of the phone to be lower, whereas the seller is selling it at higher than the average buying price in the market.

The application for dealing with obscurity effect varied across many types of products and industries. Fundamentally, we argue that when buyers are less obscured with more information provided by the sellers, buyers are more willing to increasing their buying prices, so as to match the sellers’ price, leading to greater satisfaction and matching in expectation. Of course, we do not expect a perfect matching. Nonetheless, greater satisfaction leads to higher potential revenue.

7.3 Recommendations for Future Research

We have listed four potential areas whereby future research can look into. These areas include further refining of theoretical model of the LAS function, to the survey in the marketplace which can provide better insights into obscurity effect.

Refining the LAS function

The LAS function is a function that is described by initial concave down curve in decreasing rate, followed by the concave up curve in decreasing rate. These curves are controlled by a single parameter, the b-parameter. Future research can look into the potential of having additional parameter whereby the either curve can be adjusted independently of the b-parameter. For example, the concave down and up curve can be adjusted to have high, moderate or low decreasing rate. This would allow us to better capture consumer behavior with regards to loss aversion for TSVD products.

Additional factors can be considered

We have looked at factors pertaining to selling and buying prices. Future research can look into additional factors such as the psychosis of the respondents in the area of cognitive and social psychology. For example, a measured consumer with b-parameter of 1.6 extracting from the LAS function is cross-validated by the questions pertaining to their personality. This would allow us to validate our interpretations through the study of additional data.

More scenarios whereby obscurity effect is observed can be considered

We have considered the obscurity effect arising from changes in prices. Future research can look into tertiary factors – or latent variables – that might potentially influence the obscurity effect. For example, a respondent's state of mind influence the way how they perceive the obscurity effect and respondents with past similar experiences may view the obscurity effect as more negative than those without past similar experiences.

Application of LAS function and obscurity effect in marketplace

We have considered hypothetical questions using hypothetical products. Future research can look into hypothetical questions using real products in the market. For example, a respondent set their selling prices for real products in the marketplace across various points in time, up to the expiry or full depreciation of the product. The use of real products and hypothetical questions can bring the research closer to reality.

7.4 Conclusion

We have shown that loss aversion behavior for TSVD products is unique. And this uniqueness is disrupted by the obscurity effect. When sellers experience obscurity effect such as incomplete or incorrect information at that time of the day, with added information given to them at a later stage, they set selling prices higher as compared to the prices which the buyers would expect. We can see that the sellers react differently. We have to note that the difference in selling prices with the buying prices is marginal when it comes to obscurity effect. However, this is mainly applicable to small value items such as the box of chocolate. In the case of housing whereby the lease will expire and the value of the house depreciates, the differences may be widened. A loss in \$100 when one's wealth is \$1000 is comparatively more painful than a loss in \$100 when one's

wealth is \$1,000,000. This brings us to the reference point theory whereby one's wealth is taken as the reference point.

However, a loss in \$100 is more painful as compared to a forgone gain of \$100 which is an equivalent loss. This is fundamentally true when the loss is related to one's endowment. Losing a \$100 that is owned by us is more painful because the value of that \$100 is adjusted to include the loss in endowment. In this scenario, one's wealth does not matter. And the reference point is the endowment one has, with the value of the actual loss correlated with the pain one has. Losing a \$1,000,000 as compared to a forgone gain of the same value is more painful than losing a \$100 as compared to a forgone gain of the same value.

For this reason, human decide value of a product by the monetary value of it and the endowment one has with it.

In our research paper, buyers decide value of a product based on the expected market value. And sellers decide value of a product based on the time to expiry or full depreciation. If the TSVD product is not sold before the expiry or full depreciation is reached, total loss is incurred. And losing full value is more painful than the forgone gain one has when the opportunity to sell at the initial stage of ownership or possession is not taken. We can conclude that human react irrationally due to obscurity effect and the larger is the effect, the more irrational human becomes.

APPENDIX A
SURVEY COVER LETTER

(Survey Name: A Study of Obscurity Effect Impacting Consumers' Decision Making in an Uncertain Environment)

Dear Participant,

Thank you for your interest in this survey. The objective of this survey is to provide pertinent and timely data for academic research in the study of marketing. The questions in this academic survey meet the specific requirements of a scientific inquiry. You will be asked what you think and how you feel in various scenarios. No personally identifiable data will be asked for or recorded. If you wish to exit the survey at any time, you may notify pollfish.com and exit the survey. By proceeding with this survey, you have agreed to provide your consent to participate in this survey and to provide your demographic detail for the purpose of data analysis. Once again, thank you very much for your time.

Daniel Koh

Doctoral Candidate, DBA Program

Swiss School of Business and Management, Geneva

APPENDIX B

INFORMED CONSENT

General information

This research project is being conducted by Daniel Koh and it's self-funded for the sole purpose of fulfilling the requirements to obtain the Doctorate of Business Management with the Swiss School of Business and Management, Geneva.

Participant Information Sheet

You are invited to take part in this research project, which is called A Study of Obscurity Effect on Consumers' Decision Making in an Uncertain Environment. You have been invited as part of the respondent panel.

This Participant Information Sheet/Consent Form tells you about the research project. It explains the processes involved with taking part. Knowing what is involved will help you decide if you want to take part in the research.

Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether or not to take part, you might want to talk about it with a relative, friend or local social worker.

Participation in this research is voluntary. If you don't wish to take part, you don't have to.

If you decide you want to take part in the research project, you will be asked to provide your consent on the following:

- Understand what you have read
- Consent to take part in the research project
- Consent to be involved in the research described
- Consent to the use of your personal and health information as described.

There are no foreseeable and significant risks involved in this project.

By proceeding with the survey, you have agreed to provide us with your consent. At any time when you wish to withdraw, you may notify the pollfish.com staff who is handling this survey. There will be no additional data collected if you wish to withdraw. Whatever that has been collected will be retained to ensure that the results of the research project can be measured properly and to comply with law. You should be aware that data collected up to the time you withdraw will form part of the research project results. If you

do not want your data to be included, you must tell the pollfish.com staff when you withdraw from the research project.

Screening

If you decide to take part in the research project, you will first be given a questionnaire asking about your age and current domicile; this will determine if you are eligible to take part. Completing the questionnaire will take approximately 5-7 minutes.

If the screening questionnaire shows that you meet the requirements, then you will be able to start the survey. If the screening questionnaire shows that you cannot be in the survey, you will be screened out of the project.

Bias

This research project has been designed to make sure the researchers interpret the results in a fair and appropriate way and avoids study doctors or participants jumping to conclusions.

Additional Costs and Reimbursement

You will not be reimbursed other than the agreement between you and pollfish.com.

General Terms and Conditions

The questionnaire will take 5-7 minutes to complete. We don't anticipate that there are any risks associated with your participation, but you have the right to stop the interview or withdraw from the research at any time. Please check with the service provider (pollfish.com) if you wish to drop out.

Thank you for agreeing to be a part of the above research project. Ethical procedures for academic research require that respondents explicitly agree to answer questionnaires and how the information contained in the completed questionnaires will be used. This consent form is necessary for us to ensure that you understand the purpose of your involvement and that you agree to the conditions of your participation. By proceeding with this survey, you agree:

1. the choices you submitted will be recorded in the system,
2. the collected data will be analysed by the researcher, Daniel Koh, as the research investigator
3. the access to the data is limited to Daniel Koh and his academic colleagues and researchers with whom he might collaborate as part of the research process
4. any summary or direct quotations from the questionnaire are made available through academic publication or other academic outlets.
5. any summary or direct quotations from the questionnaire will be anonymized so that you cannot be identified, and care will be taken to ensure that other information in the questionnaire that could identify yourself is not revealed
6. the collected data will be kept for a period of 1 year.

7. any variation of the conditions above will only occur with your further explicit approval

Quotation Agreement

You agree that your words may be quoted directly. By proceeding with this survey, you agree to the following statements:

1. I agree to be quoted directly.
2. I agree to be quoted directly if my name is not published and a made-up name (pseudonym) is used.
3. I agree that the researchers may publish documents that contain quotations by me.

Others

All or part of the content of your interview may be used;

1. In academic papers, policy papers or news articles
2. On our website and in other media that we may produce such as spoken presentations
3. On other feedback events
4. In an archive of the project as noted above

By proceeding with this survey, I agree that;

1. I am voluntarily taking part in this project. I understand that I don't have to take part, and I can stop the questionnaire at any time;
2. The collected data may be used as described above.

APPENDIX C

A SAMPLE LIST OF PAST STIMULI FOR LOSS AVERSION

The following table shows the type of goods, incentives or stimuli used since the year 1987. Take note that this list is a snapshot of all the items used, and my assumption is that the items do not differ much in type during those periods.

Year	Buyer	Category	Topic
1987	sucrose octa-acetate	Test	Endowment Effect
	Cash	Cash	Endowment Effect
1989	Mug	Mug	Endowment Effect
	Candy	Food	Endowment Effect
	Money	Cash	Endowment Effect
	Beer	Drinks	Consumer Choice
	Car	Machine	Consumer Choice
	Color TV	Equipment	Consumer Choice
	Apartment	Housing	Consumer Choice
	Calculator	Equipment	Consumer Choice
	Mouthwash	Health	Consumer Choice
	Calculator Battery	Accessory	Consumer Choice
1990	Induced-value Token	Token	Endowment Effect
	Mug	Mug	Endowment Effect
	Pen	Stationery	Endowment Effect
	Gamble	Gamble	Consumer Choice
1991	Mug	Mug	Endowment Effect
1992	Norfolk Island Pine	Tree	Loss Aversion
	University loans	Loans	Consumer Choice
	Public library rules	Policies	Consumer Choice
	Checking Accounts	Banking	Consumer Choice
	Gift Certificate	Gift	Consumer Choice
	Medical insurance policies	Policies	Consumer Choice
	Camcorder	Equipment	Consumer Choice
	Gas BBQ	Equipment	Consumer Choice
	Camera	Equipment	Consumer Choice
	VCR Player	Equipment	Consumer Choice
	CD Player	Equipment	Consumer Choice
	Gamble	Gamble	Consumer Choice
	Apartment	Housing	Consumer Choice
Bicycle	Transport	Consumer Choice	

1993	Orange Juice	Drinks	Loss Aversion
	Gamble	Gamble	Consumer Choice
	Cash	Cash	Consumer Choice
	Coupon book	Coupon	Consumer Choice
	CD Player	Equipment	Consumer Choice
	Vacation Package	Travel	Consumer Choice
1996	Vacation Spot	Travel	Consumer Choice
	Apartment	Housing	Consumer Choice
	Blind Date	Opportunity	Consumer Choice
1997	Bookshelf Speaker	Equipment	Consumer Choice
	Answering Machine	Machine	Consumer Choice
	Laptop	Equipment	Consumer Choice
	Electric Shaver	Equipment	Consumer Choice
	Cordless Phone	Equipment	Consumer Choice
	Headphones for Portable Radio	Accessory	Consumer Choice
	Camera	Equipment	Consumer Choice
	Vacation Spot	Travel	Consumer Choice
	Blind date	Opportunity	Consumer Choice
	Course elective	Opportunity	Consumer Choice
	Apartment	Housing	Consumer Choice
	Cassette tape	Accessory	Consumer Choice
	Binoculars	Equipment	Consumer Choice
2000	Mug	Mug	Endowment Effect
2004	Toaster	Equipment	Endowment Effect
	Mug	Mug	Endowment Effect
	Cash	Cash	Endowment Effect
	Highlighter	Stationery	Endowment Effect
2005	Mug	Mug	Loss Aversion
	Chocolate	Food	Loss Aversion
	Cash	Cash	Loss Aversion
2006	Mug	Mug	Endowment Effect
	Mug	Mug	Endowment Effect
2007	Job Offering	Opportunity	Loss Aversion
	Fine	Fine	Loss Aversion
	Return to Traffic School	Policies	Loss Aversion
2008	Cash	Cash	Loss Aversion
	Hearing Aid	Accessory	WTP-WTA
2010	Package of Coffee	Drinks	Endowment Effect
	Package of Rice	Food	Endowment Effect

	Packet of crisps	Food	Endowment Effect
	Cola	Drinks	Endowment Effect
	Note-pad	Stationery	Endowment Effect
	Pen	Stationery	Endowment Effect
	Toothbrushes	Health	Endowment Effect
	Mug	Mug	Endowment Effect
	Chocolate	Food	Endowment Effect
	Psychological	Psychological	Loss Aversion
	Lottery Ticket	Lottery	Uncertainty Effect
	Gift Certificate	Gift	Uncertainty Effect
	iTune Songs	Music	Uncertainty Effect
	Point System	Reward	Uncertainty Effect
	Point Reward	Reward	Uncertainty Effect
2012	Lottery Ticket	Lottery	Endowment Effect
	Lottery Ticket	Lottery	Endowment Effect
	Candy		Endowment Effect
	Pencil	Stationery	Endowment Effect
	Lottery Ticket	Lottery	Endowment Effect
	Chocolate	Food	Endowment Effect
	Pen	Stationery	Endowment Effect
2013	Velcro cord straps	Accessory	Endowment Effect
	Mug	Mug	Endowment Effect
	Lottery Ticket	Lottery	Endowment Effect
2014	Pen	Stationery	Endowment Effect
2015	Lottery Ticket	Lottery	Loss Aversion
2017	Mug	Mug	Endowment Effect
2018	Psychological	Psychological	Endowment Effect
2019	Psychological	Psychological	Endowment Effect
2020	A cup of M&M	Food	Endowment Effect
2021	Cash	Cash	Endowment Effect
	Mug	Mug	Endowment Effect
	Cash	Cash	Endowment Effect
	Water Bottle	Drinks	Endowment Effect
	Toy Car	Toy	Loss Aversion
	Candy	Food	Loss Aversion
	Pen	Stationery	Loss Aversion

APPENDIX D

RESEARCH INSTRUMENT: SURVEY QUESTIONNAIRE

Survey name:

Obscurity Effect

Q1 I am a Singaporean Citizen or Permanent Resident living in Singapore.

(SingleSelection) (Screening question)

- Yes
- No

Q2 Please choose an option. (SingleSelection) (Screening question)

- Rose
- Tulip
- Dandelion
- Sunflower
- Orchid
- Jasmine
- I do not want to participate in this survey.

Q3 (Survey Name: A Study of Obscurity Effect Impacting Consumers' Decision Making in an Uncertain Environment) Thank you for your interest in this survey. The objective of this survey is to provide pertinent and timely data for academic research in the study of marketing. The questions in this academic survey meet the specific requirements of a scientific inquiry. You will be asked what you think and how you feel in various scenarios. No personally identifiable data will be asked for or recorded. If you wish to exit the survey at any time, you may notify pollfish.com and exit the survey. By proceeding with this survey, you have agreed to provide your consent to participate in this survey and to provide your demographic detail for the purpose of data analysis. Once again, thank you very much for your time. (Description)

-

Q4 You will be asked to indicate your buying/selling price for a box of chocolates (U.P. SGD\$20.25) with a maximum shelf life of 1 year. An expiry date is given for the chocolates. Please indicate your answer in Singapore dollars. (Description)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/574dc726-a557-419e-a223-e223ac19ceb7.jpg>)

-

Q5 You found the box of chocolates in the supermarket. The expiry date is 1 year away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/5f9e4a81-5c04-431b-9f5e-ac0e077d45cb.jpg>)

-

Q6 You bought the box of chocolates. But you found out that the actual expiry date is 6 months away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/5a2f63e1-a491-4ec4-94cd-509ab10bf133.jpg>)

-

Q7 Now that the expiry date is 6 months away. You are planning on selling it on an e-commerce platform. At what price do you think you will sell it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/084ff21b-7783-4d83-92c1-96faec19e12e.jpg>)

-

Q8 You found the box of chocolates in the supermarket. The expiry date is 6 months away. If you are asked to give a price for it, at what price do you think you will pay? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/43afabb5-fa0d-4daa-b298-8b5ad051965a.jpg>)

-

Q9 You bought the box of chocolates. But you found out that the actual expiry date is 2 months away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/11d1df5b-9798-43f3-9294-105ac087b7ee.jpg>)

-

Q10 Now that the expiry date is 2 months away. You are planning on selling it on an e-commerce platform. At what price do you think you will sell it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/2540c5e0-6136-4020-892b-c3577fc3c8a3.jpg>)

-

Q11 You found the box of chocolates in the supermarket. The expiry date is 2 months away. If you are asked to give a price for it, at what price do you think you will pay? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/045e3b33-b559-4500-84e7-de555995caf9.jpg>)

-

Q12 You bought the box of chocolates. But you found out that the actual expiry date is 15 days away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/9c7b692c-71cb-4d1c-8e4e-148202b05675.jpg>)

-

Q13 Now that the expiry date is 15 days away. You are planning on selling it on an e-commerce platform. At what price do you think you will sell it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/b629f561-f607-4632-af0b-2525be1f6744.jpg>)

-

Q14 However, you realized that half of the sellers are selling at 50% cheaper than what you indicated in the previous question. You have decided to lower your selling price by 50% too. How satisfied are you with the new price? (You are losing half of

\$\$\${{refId:2efe7c10-c1b3-11ed-bfa2-6ffcbf6c0c4}}\$) (SingleSelection)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/48bd9b1b-dc38-48be-8b83-cddf5c23fc7a.jpg>)

- Completed Satisfied
- Satisfied
- Does not bother me
- Not Satisfied
- Completed Not Satisfied

Q15 You have this box of chocolates. The expiry date is 1 year away. You are planning on selling it on an e-commerce platform. At what price do you think you will sell it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/74573338-0979-4bcc-941b-2d7690313129.jpg>)

-

Q16 However, you realized that half of the sellers are selling at 50% cheaper than what you indicated in the previous question. You have decided to lower your selling price by 50% too. How satisfied are you with the trade after selling it 50% lower than your expectation? (You are losing half of \$\$\${{refId:cc0f1d12-c1b4-11ed-bfa2-6ffcbf6c0c4}}\$) (SingleSelection)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/48bd9b1b-dc38-48be-8b83-cddf5c23fc7a.jpg>)

- Completely Satisfied
- Satisfied
- Does not bother me
- Not Satisfied
- Completely not Satisfied

Q17 You found a similar product in your local supermarket. The chocolates in the box would expire in 6 months' time. If you are asked to give a price for it, at what price do you think you will pay? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/e3a04770-eeee-4dc3-982e-e7d2991ba4de.jpg>)

-

Q18 You bought the box of chocolate. But you found out that the actual expiry date is 1 year away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/06577a22-c262-47f5-9b2b-a009dfa609cd.jpg>)

-

Q19 You have this box of chocolates. The expiry date is 6 months away. You are planning on selling it on an e-commerce platform. At what price do you think you will sell it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/c932aa1e-7e01-4541-9de8-5e80cb9dbe82.jpg>)

-

Q20 However, you realized that half of the sellers are selling at 50% cheaper than what you indicated in the previous question. You have decided to lower your selling price by

50% too. How satisfied are you with the trade after selling it 50% lower than your expectation? (You are losing half of \${{refId:7da155c2-c1b5-11ed-bfa2-6ffcbf6c0c4}} as your answer) (SingleSelection)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/48bd9b1b-dc38-48be-8b83-cddf5c23fc7a.jpg>)

- Completely Satisfied
- Satisfied
- Does not bother me
- Not Satisfied
- Completely not Satisfied

Q21 You found a similar product in your local supermarket. The chocolates in the box would expire in 2 months' time. If you are asked to give a price for it, at what price do you think you will pay? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/7a7e7f78-e90d-4d00-8b47-e2aa0b6801db.jpg>)

-

Q22 You bought the box of chocolates. But you found out that the actual expiry date is 6 months away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/2ca5d0de-8b7c-4f83-8c2b-a0d87e138a81.jpg>)

-

Q23 You have this box of chocolates. The expiry date is 2 months away. You are planning on selling it on an e-commerce platform. At what price do you think you will sell it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/c3f51b9b-eca9-40e5-a2e3-a9f646708ccc.jpg>)

-

Q24 However, you realized that half of the sellers are selling at 50% cheaper than what you indicated in the previous question. You have decided to lower your selling price by 50% too. How satisfied are you with the trade after selling it 50% lower than your expectation? (You are losing half of \${{refId:93bd4712-c1b5-11ed-bfa2-6ffcbf6c0c4}})
(SingleSelection)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/48bd9b1b-dc38-48be-8b83-cddf5c23fc7a.jpg>)

- Completely Satisfied
- Satisfied
- Does not bother me
- Not Satisfied
- Completely not Satisfied

Q25 You found a similar product in your local supermarket. The chocolates in the box would expire in 15 days' time. If you are asked to give a price for it, at what price do you think you will pay? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/f8453a9c-d6e6-4d1a-9d8f-74a8a6da4d25.jpg>)

-

Q26 You bought the box of chocolates. But you found out that the actual expiry date is 2 months away. If you are asked to give a price for it, at what price do you think you will pay for it? (OpenEndedNumerical)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/5e7ff0a6-bd98-4dac-9b8e-10d673d11eae.jpg>)

-

Q27 In 500 words or less, please provide the reason for your satisfaction rating. (OpenEnded)

-

Q28 The time to expiry for different scenarios is given in the header. On the extreme left of the table, you are asked for the selling price if the chocolates in the box expire in 1 year's time. And on the extreme right of the table, you are asked for the selling price if the chocolates in the box expire tomorrow. At what price are you willing to sell this box of chocolates? (take note: in the event that you are not selling it, you will not receive any monetary return and the box of chocolate will be discarded.) (GridNumericOpenEnded)

(video url: <https://s3.amazonaws.com/pf.survey.image.production/2b6e882c-4c79-4e46-9dee-352f87840054.jpg>)

	1 year	9 months	6 months	2 months	1 month	15 days	1 day
My selling price is...							

Q29 Please indicate how annoyed you are in the following scenarios.

(MatrixSingleSelection)

	Completely annoyed	Somewhat annoyed	A little annoyed	Not annoyed
Your friend has not given you the exact location of the meetup on the day of the scheduled dinner when s/he had agreed to provide you one. you feel...				
Relating to the previous question, if your friend has given you the exact location, you feel...				
You read a piece of breaking news at a popular news publishing site. And at the end of the				

news article, it says "Please check back here for more updates on this breaking news." You feel...				
Relating to the previous question, if you receive a news update on that breaking news within seconds, you feel...				
You make a trip to the nearest supermarket. And you noticed a sign that says, "at least 30% off for some items". (there is no reference to any good) You feel...				
Relating to the previous question, if you enter the supermarket and notice a corner with a sign saying "all items are going at 30%", you feel...				

Q30 Please indicate your race. (SingleSelection)

- Chinese
- Malay
- Indian
- Eurasian
- Others

Q31 Please indicate your household income bracket per annum. (in Singapore dollars) (SingleSelection)

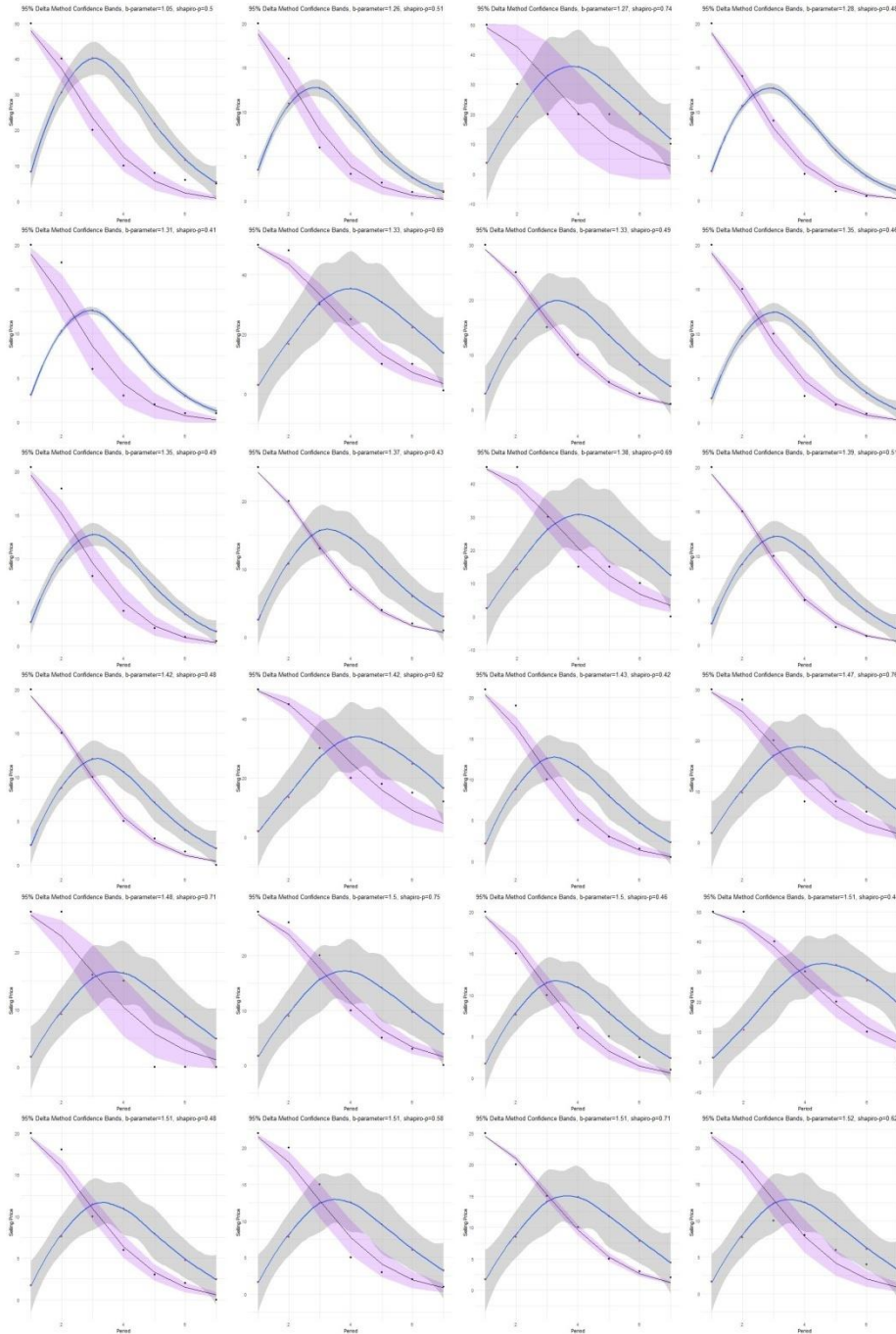
- < \$22,800
- \$22,801 - \$60,000
- \$60,001 - \$110,000
- > \$110,000

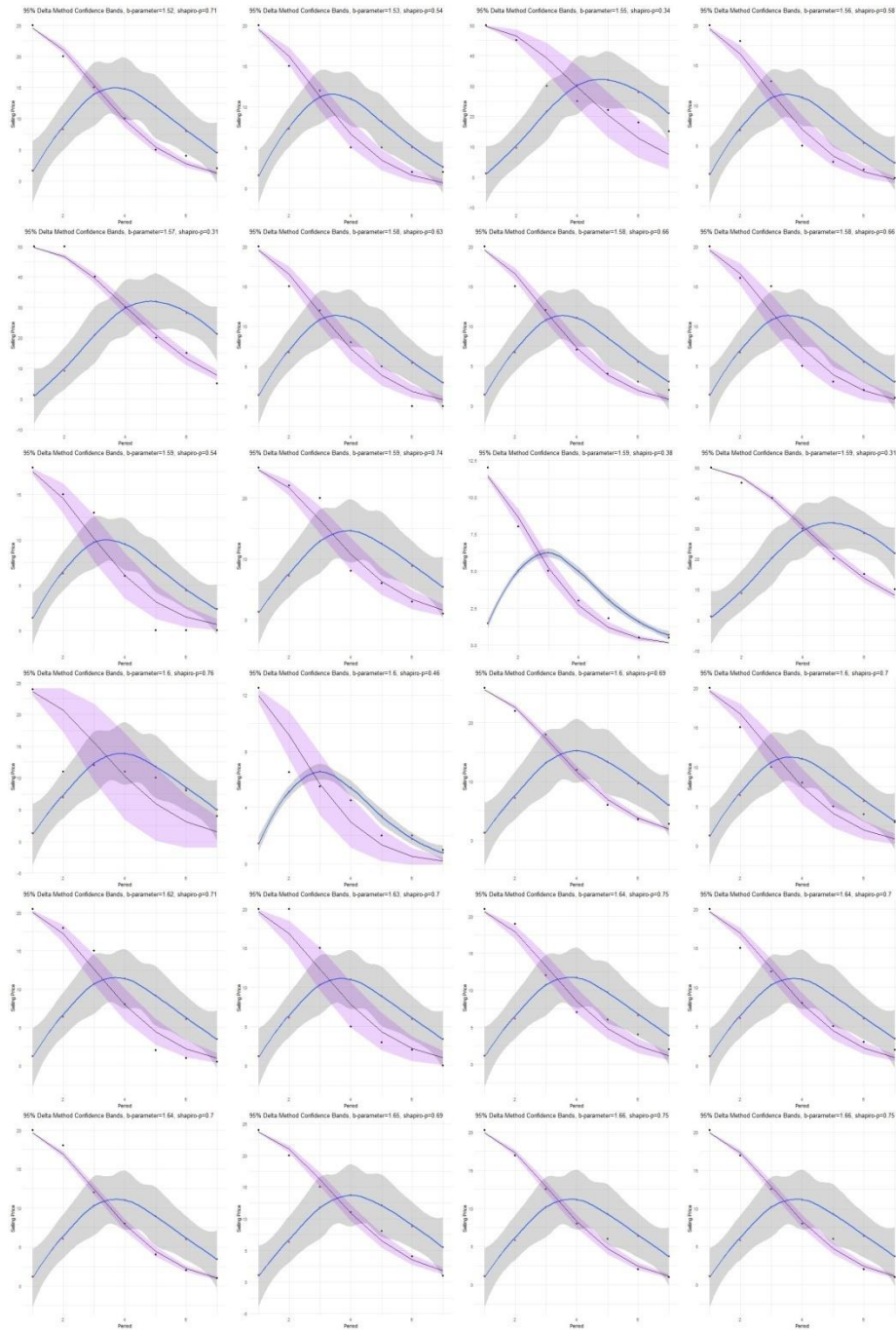
Q32 Please indicate your most recent highest educational qualification. (SingleSelection)

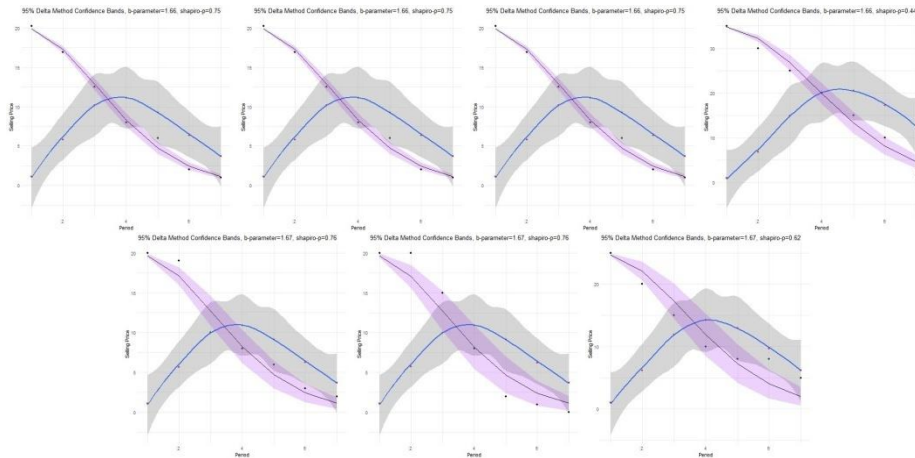
- No formal education
- General Education ('N' Level / 'O' Level / 'A' Level / IB)
- Certificate
- Diploma (Not including Post-Graduate Diploma)
- Undergraduate Degree
- Post-Graduate Diploma
- Masters Degree
- Doctoral Degree

APPENDIX E

CURVE FITTING OF RESPONDENTS' REVERSAL OF LOSS AVERSION (SAMPLE)







R Script – Curve fitting using LAS function (Study 1)

```

setwd('C:/Users/danie/Dropbox/SSBM/Education/Daniel/DBA -
SSBM/Dissertation/Results/Study1')

library(dplyr)
library(tidyr)
library(ggplot2)
library(reshape2)
library(nlraa)
library(nlme)
library(mgcv)

##### Loading of data and codeBook #####

r <- read.csv('results.csv')
qb <- read.csv('codeBook.csv')

##### Proceeding to recode the variables with codes from codeBook
#####

colnames(r) <- qb[,1]

##### Removing redundant columns - Q01 (Manufacturer),Q02 (OS),
Q03 (Country), Q04 (Area), Q05 (County), Q06 (City), Q07
(Provider), Q13 (), Q14 (), Q53 (Spoken Languages), Q56
(Residential Postal Code), Q57 (Location Postal Code), Q58 (US
Census Region), Q59 (US Census Division), Q60 (US Congressional
District), Q61 (DMA Code), Q62 (DMA Name), Q63 (Audience) #####

```

```

r <- select(r, -
c('Q01', 'Q02', 'Q03', 'Q04', 'Q05', 'Q06', 'Q07', 'Q13', 'Q14', 'Q53', 'Q5
6', 'Q57', 'Q58', 'Q59', 'Q60', 'Q61', 'Q62', 'Q63'))

##### Changing class of variables #####

r$time_start <- as.POSIXct(
r$time_start
,format='%m/%d/%Y %H:%M'
)

r$time_finished <- as.POSIXct(
r$time_finished
,format='%m/%d/%Y %H:%M'
)

r <- data.frame(r)

r[,c("Q15", "Q16", 'Q17', 'Q18', 'Q19', 'Q20', 'Q21', 'Q22', 'Q23', 'Q25',
'Q27', 'Q28', 'Q29', 'Q31', 'Q32', 'Q33', 'Q35', 'Q36', 'Q38', 'Q39', 'Q40'
, 'Q41', 'Q42', 'Q43', 'Q44'
)] <-
sapply(r[,c("Q15", "Q16", 'Q17', 'Q18', 'Q19', 'Q20', 'Q21', 'Q22', 'Q23'
, 'Q25', 'Q27', 'Q28', 'Q29', 'Q31', 'Q32', 'Q33', 'Q35', 'Q36', 'Q38', 'Q39
', 'Q40', 'Q41', 'Q42', 'Q43', 'Q44'
)],FUN=as.numeric)

##### Removing Outliers #####

quartiles <-
quantile(r[,c('Q38', 'Q39', 'Q40', 'Q41', 'Q42', 'Q43', 'Q44')]
,probs=c(.25, .75)
,na.rm = TRUE
)

IQR <-
IQR(unlist(r[,c('Q38', 'Q39', 'Q40', 'Q41', 'Q42', 'Q43', 'Q44')]))
,na.rm=TRUE
)

lower <- quartiles[1] - 1.5*IQR
upper <- quartiles[2] + 1.5*IQR

```



```

for(i in 32:38) {
r <- subset(
r
,(r[,i] > lower & r[,i] < upper) | is.na(r[,i])
)
}

##### Tranposing Q38 - Q44 #####

r_las_t <- t(r[,c('Q38','Q39','Q40','Q41','Q42','Q43','Q44')])

##### Putting all responses into a chart #####

##### Declaring the LAS function as proposed by Koh(2022) #####

r_las_t_m <- melt(r_las_t)

las <- function(ini_val,b,t) (
ini_val*(
exp(1)^(
-exp(1)*ini_val^(
-(b/sqrt(t))
)*t
)
)
)
)
)

h <- list()
m = 1

##### Segmenting out subset for non-linear fit #####

x <- c(1:7)

for(i in 1:(max(r_las_t_m$Var2))) {

ini_val <- r_las_t_m[which(
r_las_t_m$Var2==i),'value'][1]

r_las_t_m_u <- r_las_t_m[which(r_las_t_m$Var2==i),]

```

```

fit.1 <- tryCatch({
  nls(
  value ~ las(ini_val,myb,t=x)
  ,data=r_las_t_m_u
  ,start=list(myb=0)
  )}
,error=function(e){1})

if(class(fit.1)!='nls' ) {
  next
} else {
  if(summary(fit.1)$parameters[4] <= 0.05) {
    fm1.P.dm <- predict2_nls(fit.1, interval = "conf")
    PurTrtA.dm <- cbind(r_las_t_m_u, fm1.P.dm,
    gradient=fit.1$m$gradient())

    jpeg(
    file=paste(
    round(summary(fit.1)$parameters[1],2)*100,
    "respondent_"
    ,r_las_t_m_u$Var2[1]
    ,"_curveFitting.jpeg"
    ,sep=''
    )
    )

    plot <- ggplot(
    data = PurTrtA.dm
    ,aes(x = x, y = PurTrtA.dm$value)
    ) +
    geom_point() +
    geom_point(
    data=PurTrtA.dm
    ,aes(x = x, y = PurTrtA.dm$gradient)
    ,color='red'
    ,inherit.aes=FALSE
    ) +
    geom_smooth(

```

```

method=loess
,aes(x = x, y = PurTrtA.dm$gradient)
) +
geom_line(
aes(y = fitted(fit.1))
) +
geom_ribbon(
aes(ymin = Q2.5, ymax = Q97.5)
,fill = "purple"
,alpha = 0.2
) +
ggtitle(
paste0(
"95% Delta Method Confidence Bands, b-parameter="
,round(
summary(fit.1)$parameters[1],2
)
,"", shapiro-p="
,round(
shapiro.test(PurTrtA.dm$gradient)$p,2
,sep=' ')
) +
labs(x='Period',y='Selling Price') +
theme_minimal()

print(plot)

dev.off()

h[[m]] <- data.frame(
respondent=r_las_t_m_u$Var2[1]
,summary(fit.1)$parameters
,t(r_las_t_m_u$value)
,t(PurTrtA.dm$gradient)
)
m <- m + 1
}
}
}

```

```

h2 <- do.call(rbind,h)

##### Performing Estimation using Least Square Method #####

fit.2 <- lm(
Estimate ~ poly(X1,2) + X2 + X3 + X4 + X5 + X6 + X7
, data=h2
)

##### P-value < 0.05 for model, R-squared = xxxx #####

jpeg(file=paste("b-estimate-matrix.jpg",sep=''))
print(plot(predict(fit.2),h2$Estimate,xlab='Predicted b-
estimate', ylab='Actual b-estimate'))
dev.off()

##### Plotting list of standard error for each respondent after
fitting the LAS curve #####

br = seq(0,1,by=0.1)
table(cut(h2$Std..Error,br))

```

R Script for Study 2

```

setwd('C:/Users/danie/Dropbox/SSBM/Education/Daniel/DBA -
SSBM/Dissertation/Results/Study2')

library(dplyr)
library(tidyr)
library(ggplot2)
library(reshape2)
library(car)
library(sjstats)

##### Loading of data and codeBook #####

r <- read.csv('results.csv')
qb <- read.csv('codeBook.csv')

##### Proceeding to recode the variables with codes from codeBook #####

colnames(r) <- qb[,1]

##### Removing redundant columns - Q01 (Manufacturer),Q02 (OS), Q03
(Country), Q04 (Area), Q05 (County), Q06 (City), Q07 (Provider), Q13

```

```

(), Q14 ( ), Q53 (Spoken Languages), Q56 (Residential Postal Code), Q57
(Location Postal Code), Q58 (US Census Region), Q59 (US Census
Division), Q60 (US Congressional District), Q61 (DMA Code), Q62 (DMA
Name), Q63 (Audience) #####

r <- select(r,-
c('Q01','Q02','Q03','Q04','Q05','Q06','Q07','Q13','Q14','Q53','Q56','Q5
7','Q58','Q59','Q60','Q61','Q62','Q63'))

##### Changing class of variables #####

r$time_start <- as.POSIXct(
r$time_start
,format='%m/%d/%Y %H:%M'
)

r$time_finished <- as.POSIXct(
r$time_finished
,format='%m/%d/%Y %H:%M'
)

r <- data.frame(r)

r[,c("Q15","Q16",'Q17','Q18','Q19','Q20','Q21','Q22','Q23','Q25','Q27',
'Q28','Q29','Q31','Q32','Q33','Q35','Q36','Q38','Q39','Q40','Q41','Q42',
'Q43','Q44'
)] <-
sapply(r[,c("Q15","Q16",'Q17','Q18','Q19','Q20','Q21','Q22','Q23','Q25',
'Q27','Q28','Q29','Q31','Q32','Q33','Q35','Q36','Q38','Q39','Q40','Q41',
'Q42','Q43','Q44'
)],FUN=as.numeric)

r_las <-
r[,c('Q15','Q16','Q17','Q18','Q19','Q20','Q21','Q22','Q23','Q25','Q27',
'Q28','Q29','Q31','Q32','Q33','Q35','Q36')]

m <- 1
h <- list()

##### Removing Outliers #####

quartiles <- quantile(
r_las
,probs=c(.25, .75)

```

```

, na.rm = TRUE
)

IQR <- IQR(
unlist(r_las)
,na.rm=TRUE
)

lower <- quartiles[1] - 1.5*IQR
upper <- quartiles[2] + 1.5*IQR

for(i in 1:(ncol(r_las))) {

r_las <- subset(r_las, (r_las[,i] > lower & r_las[,i] < upper) |
is.na(r_las[,i]))

}

##### Performing t-test to identify statistical significance in
difference between mean of buyer and seller - Hypotheses 1 and 2#####

### Buyer ###
buyer6months <- wilcox.test(r_las$Q18,r_las$Q27)
buyer2months <- wilcox.test(r_las$Q21,r_las$Q31)

### Seller ###
seller6months <- wilcox.test(r_las$Q17,r_las$Q29)
seller2months <- wilcox.test(r_las$Q20,r_las$Q33)

##### Forming data frame for WTP/WTA ratio #####

h[[m]] <- data.frame(
loss_aversion='6months'
,ratio=mean(r_las$Q16,na.rm=TRUE)/mean(r_las$Q17,na.rm=TRUE)
,group='buy_sell'
)

m <- m + 1

h[[m]] <- data.frame(
loss_aversion='6months'
,ratio=mean(r_las$Q32,na.rm=TRUE)/mean(r_las$Q29,na.rm=TRUE)
,group='sell_buy'
)

```

```

m <- m + 1

h[[m]] <- data.frame(
  loss_aversion='2months'
  ,ratio=mean(r_las$Q19,na.rm=TRUE)/mean(r_las$Q20,na.rm=TRUE)
  ,group='buy_sell'
)

m <- m + 1

h[[m]] <- data.frame(
  loss_aversion='2months'
  ,ratio=mean(r_las$Q31,na.rm=TRUE)/mean(r_las$Q33,na.rm=TRUE)
  ,group='sell_buy'
)

m <- m + 1

h2 <- do.call(rbind,h)

##### Performing t-test to identify whether subjects exhibit reversal
of loss aversion - Step 1 : Identify WTP/WTA ratio difference between
bts and stb #####

t.test(c(r_las$Q19/r_las$Q20),c(r_las$Q36/r_las$Q33))

##### Identifying reversal of loss aversion across demographic profiles
- Hypothesis 4 #####

r_las2 <-
r[,c('Q19','Q20','Q36','Q33','Q46','Q47','Q48','Q49','Q50','Q51','Q52')
]

r_las2$h3a <- r_las2$Q19/r_las2$Q20
r_las2$h3b <- r_las2$Q36/r_las2$Q33

r_las2 <-
r_las2[,c('h3a','h3b','Q46','Q47','Q48','Q49','Q50','Q51','Q52')]
r_las2[is.na(r_las2)] <- 0
r_las2$las <- r_las2$h3a + r_las2$h3b
r_las2 <- r_las2[,c('las','Q46','Q47','Q48')]
r_las2 <- r_las2[which(r_las2$las != 0),]

```

```

race <- kruskal.test(las ~ Q46, data=r_las2)
income <- kruskal.test(las ~ Q47, data=r_las2)
education <- kruskal.test(las ~ Q48, data=r_las2)

##### identifying the impact of obscurity effect - Hypothesis 6
(1year6months) #####
##Type I##

r_las$Q17 <- sqrt(r_las$Q17)

t1 <- anova(Lm(Q17 ~ Q15 + Q16, r_las))
##Type II##
t2 <- Anova(Lm(Q17 ~ Q15 + Q16, r_las), type=2)
##Type III##
t3 <- Anova(Lm(Q17 ~ Q15 + Q16 + Q15:Q16, r_las), type=3)

##### Identifying the effect size after the obscurity effect is
observed - Hypothesis 8 #####

effectsize::eta_squared(t1)
effectsize::eta_squared(t2)
effectsize::eta_squared(t3)

##### identifying the impact of obscurity effect - Hypothesis 6
(6months2months) #####
##Type I##

r_las$Q20 <- sqrt(r_las$Q20)

t1b <- anova(Lm(Q20 ~ Q18 + Q19, r_las))
##Type II##
t2b <- Anova(Lm(Q20 ~ Q18 + Q19, r_las), type=2)
##Type III##
t3b <- Anova(Lm(Q20 ~ Q18 + Q19 + Q18:Q19, r_las), type=3)

##### Identifying the effect size after the obscurity effect is
observed - Hypothesis 8 #####

effectsize::eta_squared(t1b)
effectsize::eta_squared(t2b)
effectsize::eta_squared(t3b)

##### identifying the impact of obscurity effect - Hypothesis 6
(2months15days) #####

```



```

##Type I##

r_las$Q23 <- sqrt(r_las$Q23)

t1c <- anova(Lm(Q23 ~ Q21 + Q22, r_las))
##Type II##
t2c <- Anova(Lm(Q23 ~ Q21 + Q22, r_las), type=2)
##Type III##
t3c <- Anova(Lm(Q23 ~ Q21 + Q22 + Q21:Q22, r_las), type=3)

##### Identifying the effect size after the obscurity effect is
observed - Hypothesis 8 #####

effectsize::eta_squared(t1c)
effectsize::eta_squared(t2c)
effectsize::eta_squared(t3c)

##### identifying the impact of obscurity effect - Hypothesis 6
(1year6months) #####
##Type I##

r_las$Q28 <- sqrt(r_las$Q28)

t1d <- anova(Lm(Q28 ~ Q25 + Q27, r_las))
##Type II##
t2d <- Anova(Lm(Q28 ~ Q25 + Q27, r_las), type=2)
##Type III##
t3d <- Anova(Lm(Q28 ~ Q25 + Q27 + Q25:Q27, r_las), type=3)

##### Identifying the effect size after the obscurity effect is
observed - Hypothesis 8 #####

effectsize::eta_squared(t1d)
effectsize::eta_squared(t2d)
effectsize::eta_squared(t3d)

##### identifying the impact of obscurity effect - Hypothesis 6
(6months2months) #####
##Type I##

r_las$Q32 <- sqrt(r_las$Q32)

t1e <- anova(Lm(Q32 ~ Q29 + Q31, r_las))
##Type II##

```

```

t2e <- Anova(Lm(Q32 ~ Q29 + Q31, r_las), type=2)
##Type III##
t3e <- Anova(Lm(Q32 ~ Q29 + Q31 + Q29:Q31, r_las), type=3)

##### Identifying the effect size after the obscurity effect is
observed - Hypothesis 8 #####

effectsize::eta_squared(t1e)
effectsize::eta_squared(t2e)
effectsize::eta_squared(t3e)

##### identifying the impact of obscurity effect - Hypothesis 6
(2months15days) #####
##Type I##

r_las$Q36 <- sqrt(r_las$Q36)

t1f <- anova(Lm(Q36 ~ Q33 + Q35, r_las))
##Type II##
t2f <- Anova(Lm(Q36 ~ Q33 + Q35, r_las), type=2)
##Type III##
t3f <- Anova(Lm(Q36 ~ Q33 + Q35 + Q33:Q35, r_las), type=3)

##### Identifying the effect size after the obscurity effect is
observed - Hypothesis 8 #####

effectsize::eta_squared(t1f)
effectsize::eta_squared(t2f)
effectsize::eta_squared(t3f)

r_las <- r_las %>% mutate(period=case_when(!is.na(Q15) ~ '1year-bts',
!is.na(Q18) ~ '6months-bts', !is.na(Q21) ~ '2months-bts', !is.na(Q25) ~
'1year-stb', !is.na(Q29) ~ '6months-stb', !is.na(Q33) ~ '2months-stb'))

r_las_agg <- r_las %>% group_by(period) %>% summarize_all(mean)

```

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