HEC MONTRÉAL

How do Incentives Affect Individuals' Behaviour in Portfolio Choice Experiments?

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Mémoire présenté en vue de l'obtention
du grade de maîtrise ès sciences
(M. Sc.)

July 2023

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Abstract

The aim of this thesis was to determine whether monetary incentives affect choice behaviour, and additionally ascertain whether they encourage subjects to make honest and non-arbitrary decisions that improve their welfare. To do so, we offer participants in an experiment the choice to purchase an educational treatment intervention that offers financial information, targeted at enhancing decision-making in a portfolio allocation exercise that is incentivized for some participants and not incentivized for others. We first measured the subjective value that participants place on the treatment intervention, and found that the perceived effectiveness of the knowledge intervention was similar across payout groups. We then explored investment behaviour across payout groups. The markers of investment behaviour examined were based off Markowitz mean-variance optimization. We found that on average, the fully incentivized group reduced portfolio variance from the first allocation task to the second, however this difference in portfolio volatility was not significant when compared to the partially incentivized and non-incentivized payout groups. However, we did discover that the unincentivized group's portfolio volatility increased after the treatment intervention, which we believe was likely a result of their underestimating how much risk they would have avoided in a real-world situation. We then explored the use of naïve diversification and found that in all cases where a subset of respondents within a payout group implemented the naïve diversification investment strategy, they had a lower portfolio return than those who did not. We also performed a high-level analysis of the treatment intervention and discovered that after the financial education intervention, portfolios appeared to be increasingly clustered along the efficient frontier. Nevertheless, the aim of this thesis was not to conduct research into how the treatment affected decision-making, thus we cannot conclude on the efficacy of the treatment. The majority of our findings, considered in tandem, were not statistically significant, indicating no fundamental differences in choice behavior across payout groups. Since evaluating the impact of incentives on decision-making can be complicated and multifaceted, further research on the topic can produce additional insights in the field of household finance.

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List of acronyms

ATE Average Treatment Effect

BDM Becker-DeGroot-Marschak (BDM)

BRIS Between-Subjects Random Incentive Structure

CDF Cumulative Distribution Function

EUT Expected Utility Theory

HEC Hautes études commerciales

KS Kolmogorov-Smirnov

PT Prospect Theory

RL Return Loss

RSRL Relative Sharpe Ratio Loss

MPL Multiple Price List

MSCI Morgan Stanley Capital International

MSc Masters of Sciences

TSX Toronto Stock Exchange

WRIS Within-Subjects Random Incentive Structure

WTP Willingness to Pay

Acknowledgements

First and foremost, I want to express my deepest thanks and gratitude to my supervisor, Professor Pierre-Carl Michaud. I have learned a tremendous amount from you while serving as both your student and research assistant. Through your guidance, encouragement and patience, this project has come to an end.

I would also like to thank Pierre-Carl's team, Irina Gemmo and Olivia Mitchell, for allowing me to participate in their study on the value of financial knowledge, an opportunity that I am extremely grateful for. Moreover, I would like express my gratitude to HEC's Retirement and Savings Institute for providing me with financial assistance and the chance to take part in really fascinating projects throughout my time at HEC Montréal.

Many thanks to the teachers I had the opportunity to meet during my studies at HEC Montréal. My skills would have been worthless if it wasn't for their efforts to create an environment so conducive to learning and development. I would also like to thank the members of the jury who accepted to evaluate my work.

Last but certainly not least, I would also like to thank my family, friends, and coworkers who supported me throughout this process. Your unconditional support and encouragement have greatly helped me overcome this major challenge.

Introduction

To this day, there is a demand in the field of household finance to understand how individuals make decisions using experiments, whether that be in the laboratory, the field, or in natural experiments. Household financial decision-making is critical to household welfare, as it determines how much money is saved, how financial resources are invested, what investment products are utilized, how much risk is taken, and therefore how much return can be achieved. In the household context, experiments are used for evaluating how individuals make decisions during complex tasks. Given the nature of complex tasks in experiments, if individuals are unrewarded for their efforts, it is possible they reduce their efforts as consequence. This phenomena of reduced effort could introduce noise into experiments as consequence and impede our ability as researchers to understand how decisions are in fact made in real life.

Understanding decision making in the field of household finance is important for the following reasons. First, research has shown that individuals are exhibiting surprisingly low levels of financial literacy. In the US, the Financial Industry Regulatory Authority (FINRA) issues a short financial literacy test as part of its National Financial Capability Study. This test measures individuals' knowledge regarding interest rate compounding, risk diversification, and bond pricing. In the most recent 2018 test, just over a third of respondents got four or more questions out of five correct, suggesting widespread financial illiteracy (FINRA, 2018). These abysmal levels of financial literacy are a growing concern for now more than ever, given that today, people have great responsibility in managing their retirement accounts, student debt, mortgage debt etc. In contrast to past generations, where retirement accounts were mostly defined benefit (DB) plans managed by professionals, individuals today play an active role in managing their wealth and decide themselves how much to contribute. Moreover, financial products have become increasingly complex over the past few decades, thus one could argue that the average person may struggle in this environment to make decisions that improve their welfare. Second, research has shown evidence of sub-optimal choices (i.e., individuals are making decisions that are not maximizing their utility). Research has shown that financial incentives can have a significant impact on decision-making. Incentives are a way of reducing noise in experiments, as they have the potential to motivate individuals in applying their full effort. Financial incentives can increase savings behavior, encourage individuals to take on more risk in investment decisions, and motivate employees to work harder and achieve better performance.

This is where the notion of solicitation comes into play. Some researchers such as Holt and Laury (2002) argue that incentives are critical in measuring individuals' risk aversion. The authors examine the relationship between risk aversion and incentives by conducting an experiment with university students to investigate how individuals respond to different levels of risk and incentives in decision-making tasks. Their findings suggest that understanding the interplay between risk aversion and incentives can be useful in designing effective policies and interventions to influence behavior. Other well-known studies published in prestige journals to do not incentivize at all, such as the work done by Kahneman and Tversky (1979). Kahneman and Tversky's research sheds light on the ways in which people make decisions and evaluate risk, and argue that incentives can sometimes backfire and actually lead to worse outcomes. On another note, in the field of psychological experimental research, the use of real incentives is rare, and reputable methodological articles caution against their use. Some researchers argue that it is important to incentivize to gain knowledge about financial decision making. Charness et al. (2016) argue that incentives can encourage individuals to make optimal and non-arbitrary decisions that accurately reveal characteristics of their true preferences.

This thesis investigates the impact of real incentives on individuals' behaviour in portfolio choice experiments. Our aim is to conduct an experiment of financial incentives using the setup of a recent experiment conducted by Gemmo et al. (2023). The authors conduct portfolio allocation experiments where each respondent (in a relatively large internet panel sample) chooses between different investment options. This investment task is performed twice. Interestingly enough, the authors allow respondents to purchase a financial education treatment using their allocation for the second task. They use a BDM procedure to elicit willingness to pay. Our experiment was conducted as a pilot study for the experiment in Gemmo et al. (2023). In the pilot study, we split the sample in three incentive groups: one where we provide real financial rewards in financial task 2 for each respondent (Pay All), another where we pay only a subset based on a lottery (Pay Some) and finally one where we do not pay respondents (Pay None). The aim of this study is to investigate how estimates (portfolio performance and willingness to pay elicitation) obtained by Gemmo et al. (2023) vary across the three incentive groups mentioned above. It is interesting to note that there is currently little research examining whether individuals' willingness to pay for financial education changes depending on whether or not we pay them.

We find that the differences in distributions of WTP and investment behaviour across the three payout groups are not statistically significant. However, we do observe some distinct patterns of implied risk aversion and investment allocation strategies across payout groups. This paper first explores the literature related to real incentive structures in experimental economics and methods of measuring investment behaviour, then goes on to explain our methodology, experimental design, results, and discussion.

Literature review

The primary objective of this study is to determine whether individuals' behaviour in an experimental portfolio allocation task differs depending on the probability of being compensated for this task as well as the amount of compensation. However, the impact of real incentives on financial decision-making depends on a variety of factors, including the type and magnitude of the incentive (i.e., the payoff amount and the probability of receiving payment), the individual's motivation and personality (socioeconomic factors, risk aversion, loss aversion, investment behaviour), and the context in which the decision is being made (portfolio choice/lottery/dictator experiments, labs/surveys). For that reason, there will be two parts to the literature review. We will first explore the different incentive structures that exist and the current literature on how each type relates to decision making under uncertainty. Second, we will explore methods of measuring investment behaviour. We will also explore different causes for noise in our findings, relating to behavioural and experimental factors.

1 Pay All? Pay a Subset? Pay None? Background

In a risky portfolio choice experiment, individuals' behaviour may depend on the size of the stake and the likelihood of receiving payment. In the traditional *Pay All* incentive system, all participants are guaranteed to receive payment. In the *Pay a Subset* incentive system, only a subset of participants are chosen at random to receive payment. Finally, with the *Pay None* incentive system, stakes are purely hypothetical, thus none of the subjects receive payment. The current literature testing the validity of the *Pay All*, *Pay a Subset*, and *Pay None* incentive structures in experimental economics is heavily fragmented. The effectiveness of financial incentives in encouraging individuals to behave in a way that is congruent with how they would act in the "real world", when in an experimental environment, is equivocal and difficult to assess. This lack of consensus is due to the heterogeneity in the assumptions of researchers regarding how individuals value investments and how individuals make investment decisions[1].

1.1 Pay None? Evidence Under Uncertainty

In the late 20th century, the hypothetical *Pay None* incentive structures were widely accepted by researchers in the field of experimental economics. Kahneman and Tversky (1979) set this precedent by arguing that incentivized experimental designs using either field studies or laboratory experiments are inadequate in accurately eliciting individuals' preferences. Kahneman and Tversky studied how incentives can impact decision-making, and found that incentives can sometimes backfire and actually lead to worse outcomes. For example, they claim laboratory studies often involve contrived gambles for small stakes and a high number of repetitions of very similar problems. This phenomenon is known as the "overjustification effect," where external incentives can reduce intrinsic motivation and lead to worse performance. As a result, this complicates the interpretation of results and restricts their generality. This lends itself to the authors' support for the use of hypotheti-

[1] In the past decades, several models have developed that challenge the four axioms of expected utility theory; prospect theory, rank-dependent expected utility and cumulative prospect theory, and bounded rationality. Given that the validity of an experiment is directly impacted by its theoretical framework, as models for choice behaviour become increasingly complex, findings are more likely to be inconclusive.

cal choice experiments, arguing that they are the simplest mechanism for many theoretical questions to be investigated. The scholars assume that individuals know how they would behave in situations of choice, and that they have no inherent motive to disguise their true preferences. In other words, should a researcher have to choose between paying a small number of lab participants and running a hypothetical trial with thousands of participants, they would be inclined to prioritize the higher sample size in order to ensure external validity of the study.

Lottery Choice Experiments

Years later, Holt and Laury (2002) tested the validity of using hypothetical incentives in static risky choice experiments, arguing that the nature of risk aversion and how it depends on the size of a stake remains an empirical issue. The experiment involved a binary-choice lottery design using a multiple price list (MPL)[2]. The study is a 2x2 design, where one dimension varies payoffs between *Pay All* and *Pay None*, and the other in terms of the magnitude of the stakes. Moreover, the magnitude dimension varies the scale of prizes to be paid by 20x, 50x, and 90x the baseline MPL (under both *Pay All* and *Pay None* dimensions)[3]. Half of the participants were undergraduate students, roughly one third were MBA students, and 17% were business school faculty. They found that in the *Pay All* -low-stakes payoff condition, subjects displayed a stronger tendency towards risk averse behaviour. After scaling up payoffs by 20x, risk aversion is even more prominent as the number of

[2]The MPL design involves an array of 10 decision tasks presented in rows. Each row features a riskier option (higher variance) and a safer option (lower variance). The higher variance option becomes more attractive as one moves down the rows given that the likelihood of the high payoff increases. MPL's are relatively transparent to subjects and provide a simple incentive for truthful revelation. A risk neutral person will chose Option A in the four top rows and B in the six bottom rows, and the row one switches from A to B depends on their level of risk aversion. Those who are risk loving will switch options early in the experiment, however those who are risk averse will have a tendency to switch later, as the payoff becomes increasingly attractive for the additional risk incurred (Charness et al., 2016)

[3]The baseline payoffs were 2.00$ and 1.60$ and 3.85$ and 0.10$ for lottery A and lottery B, respectively

safe choices reported in the MPL increased significantly (80% of subjects display risk aversion by including a minimum of 7 or more safe choices out of 10). The amount of risk aversion needed to explain this behaviour in the low stake's *Pay All* treatment implies absurd predictions of constant absolute risk aversion in the high stakes *Pay All* treatment. Interestingly enough, they found that respondents in the hypothetical group did not exhibit this behaviour (i.e. did not change choice patterns as payoffs were scaled up). Contrary to the arguments made by Kahneman and Tversky (1979), Holt and Laury (2002) argued subjects facing hypothetical choices are not able to fathom how they would behave under high-incentive conditions; they underestimate the extent to which they would avoid risk. In sum, these findings imply that the *Pay None* incentive structure produces similar choices to the *Pay All* incentive structure in small stake environments only. This phenomenon does not transpose well to high stakes environments.

1.2 Pay Some vs Pay All? Evidence Under Uncertainty

Lottery Choice Experiments

Harrison et al. (2007) further tested the effect of increasing the stakes in the context of a lottery choice experiment by using payoffs 150x the base payoffs in the Holt and Laury (2002) case, but only paid 10% of participants. In addition to the main study, they report an additional small experiment to test whether only paying a subset of participants produces the same results as paying all participants. Their control group was identical to 10x the payoffs in the baseline Holt and Laury (2002) design. In the treatment group, payment was decided with the roll of a 10-sided dice. The sample consisted of 51 subjects in the *Pay All* control group and 26 subjects in the *Pay a Subset* treatment group. They computed an interval regression to estimate the effect of the treatment on risk attitudes in their MPL. After testing their hypotheses, the researchers failed to reject the null hypothesis (i.e. the hypothesis that the behaviour in the *Pay All* and *Pay a Subset* groups is the same). These findings provide evidence in favour of the *Pay a Subset* incentive structure, suggesting there may not be a substantial loss of motivation when eliciting risk aversion and only paying a subset of participants.

Andersen et al. (2014) sought to test whether the findings presented by Harrison et al. (2007) are not only present in risk elicitation experiments but also when estimating an individual's discount function. The discounting task consisted of 40 discounting choices that varied in terms of when subjects would prefer to receive money (ranging from 2 weeks to 1 year), and each participant had a 10% chance of being paid at random. In addition, they further tested the effect of probabilistic discounting by varying the exogenous probability of payment from 10% to 100%[4]. They maintained the stakes of this experiment at the original levels of the main discounting task, to ensure that any deviations in behaviour can be fully attributed to the change in incentive structure. The randomized sample consisted of 413 Danes aged 18 to 75 pooled from the Danish Civil Registration Office. They re-estimated each functional form of the main discounting task (exponential, simple hyperbolic, fix cost hyperbolic, generalized hyperbolic and Weibull models) with a dummy variable to capture the effect of the new experiments for each of the discounting parameters. They found that the effect of probabilistic discounting is non-existent in their sample. Their results provide further support for Harrison et al. (2007)'s findings, that the use of a *Pay All* incentive structure or a *Pay a Subset* incentive structure has little to no effect in eliciting risk aversion and estimating discounting functions.

[4]The original text of the discounting task was: You will have a 1-in-10 chance of being paid for one of these decisions. The selection is made with a 10-sided die. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of these 40 decisions, then we will further select one of these decisions by rolling a 4-sided and a 10-sided die. The text for the new discounting task was: You will be paid for one of the 40 decisions. We will select one of these 40 decisions by rolling a 4-sided and a 10- sided die (Andersen et al., 2014).

Dynamic Choice Experiments

While Harrison et al. (2007) and Andersen et al. (2014) found no significant effects of altering incentive structures on behaviour, these findings fail to examine behaviour outside the context of static choice settings. Consequently, the research on the performance of only paying a subset of participants versus paying all participants in dynamic risky choice settings remains limited. This research lends itself to the work of Baltussen et al. (2012), who investigate risk aversion in a dynamic risky choice setting while only paying a subset of participants. The dynamic risky choice design requires significantly more mental effort than a static choice experiment, which they believe will strengthen the validity of the study.

Under a Within-subjects Random Incentivized System (WRIS), respondents undergo a series of multiple tasks and only one is picked at random for payment. Holt (1986) argued that under a WRIS design, subjects may not perceive each choice in a multiple choice experiment in isolation, but rather as a probability distribution over the different choices, resulting in contamination effects and violating the independence axiom of expected utility theory. Under a Between-subjects Random Incentivized System (BRIS), each subject performs a single task, after which a subset of subjects is randomly selected to receive payment in full. Holt (1986) argued that a BRIS design may produce biased risk preferences if subjects integrate the choice problem they face with the RIS lottery[5]. To further test whether the feasibility of BRIS (where one task is performed but only subset of individuals receive payment at random) or WRIS (where multiple tasks are performed and payment is guaranteed but only one task is picked at random for payment) in eliciting risk preferences. Baltussen et al. (2012) implemented a Deal-Or-No-Deal (DOND) experimental design, inspired by the viral NBC television series[6]. They found that BRIS yields bias

[5]In other words, a single lottery choice problem requires only easy multiplication of probabilities of payout, violating the independence axiom of expected utility theory.

[6]At the start of a game, the contestant chooses one case out of a total of 26 numbered cases, each hiding

towards less risk aversion: two thirds of the subjects displayed risk seeking behaviour by rejecting actuarially fair bank offers, providing preliminary evidence that a BRIS design has considerable effects on risk behaviour. As argued by Holt (1986), the authors believe that subjects under BRIS tend to overweight small probabilities hence encouraging risk taking behaviour. However, for subjects under WRIS, they argue the process of reduction is more complex, thus subjects tend to process tasks in isolation. They also found respondents in the WRIS group are clearly influenced by outcomes of prior tasks, as risk aversion increased after unfavourable results and decreased after favourable results. They believe that the presence of carry over effects under WRIS were the result of overly optimistic subjects and misunderstood randomness. These results question the extent to which expected utility theory is able to explain risk aversion under BRIS, as subjects' behaviour violated stochastic dominance by non linearly valuing probabilities. In fact, these findings provide support for prospect theory and rank dependent utility in explaining choice behaviour under uncertainty. These models consider stochastic dominance as comparisons of cumulative distributions; subjects' probability weightings are fixed to the inverse cumulative distribution (not to the probability density) in order to preserve stochastic dominance.

Further, Hackethal et al. (2023) explore the effect of monetary incentives on the results of risk preference elicitation experiments. The authors employ a WRIS incentivized regime as well as a non-incentivized regime in order to compare behaviour of respondents under each condition. There were two parts to the experiment. Participants in the first portion of the experiment did a normal lottery-choice task in which they had to select be-

one out of 26 randomly distributed amounts of money. The content of the chosen case, which she then owns, remains unknown until the end of the game. Next, the first round starts and she has to select 6 of the other 25 cases to be opened, revealing their prizes, and revealing that these prizes are not in her own case. Then, the banker specifies a price for which he is willing to buy the contestant's case. If the contestant chooses "No Deal", she enters the second round and has to open 5 additional cases, followed by a new bank offer. The game continues this way until the contestant either accepts an offer ("Deal"), or rejects all offers and receives the contents of her own case. The maximum number of game rounds to be played is 9 (Baltussen et al., 2012) tween a guaranteed sum of money and a riskier lottery with a bigger potential prize after being shown a series of fictitious lotteries. The lotteries were created with various levels of risk, and participants finished the assignment with and without incentives. In the condition that offered incentives, participants were informed that, depending on how well they completed the job, they would be given a financial reward. In the second phase of the experiment, participants worked through a series of cognitive tasks both with and without incentives. The results of the experiment suggest that the effect of monetary incentives on behavior and cognitive performance depends on the specific context of the experiment, including the level of risk involved and the structure of the incentives. Overall, the authors concluded that the use of monetary incentives can affect participants' risk preferences, and that this effect may depend on the design of the experiment.

Portfolio Choice Experiments

To further investigate the performance of the *Pay All* approach vs the *Pay a Subset* approach, Beaud and Willinger (2015) use a WRIS design to examine the impact of an actuarially neutral background risk on individual's risk taking behaviour, while varying the incentive structure. The experimental design consisted of a portfolio choice environment, where respondents had to allocate their wealth between a safe and a risky asset. Each subject faced the portfolio choice task in two situations, situation A and situation B, presented sequentially[7]. Situation A was a standard portfolio choice problem with no background risk, whereas in situation B, subjects were exposed to an independent, additive, and actuarially neutral background risk. Moreover, they conducted two experiments. Experiment 1 consistent of 91 subjects who can earn up to 250 euros, however only 10% of participants were randomly selected for payment. Experiment 2 consisted of 181 subjects where all

[7]Half of subjects faced situation A prior to situation B, and the other half faced situation B prior to situation A, to avoid any contamination effects due to the order of tasks.

participants were guaranteed payment, however they had to work to accumulate wealth prior to the experiment by performing a tedious task[8]. They define risk vulnerable subjects as those who act as though independent risks are substitutes (i.e., they do not increase their investment in the risky asset in favour of the safe asset when exposed to an actuarially neutral or independent additive background risk that affects their initial wealth). They found that the two experiments produced equal frequencies of risk-vulnerable subjects, and that a large majority of subjects are risk vulnerable (80% in experiment 1 and 81% in experiment 2, fishers exact 5% test). The argue the null hypothesis of equal distributions of percentages invested in experiments 1 and 2 cannot be rejected for situation A nor for situation B (KS test, two sided at 5%). Moreover, they find the null hypothesis of equal distributions of investments in non-risky assets in experiments 1 and 2 cannot be rejected either (KS test, two sided at 5%). These findings provide evidence that under a RRPM design, paying only a subset of participants or paying all participants produces no significant differences in investment behaviour.

The Dictator Game

While many of the previously mentioned studies either varied the probability of payment or the stake in their choice experiment, they failed to keep expected payoffs constant. This may generate skewed results as consequence from behavioural biases across individuals (i.e., loss aversion). As a result, it becomes increasingly difficult to draw any definitive conclusions on how investment behaviour changes across payoffs. Clot et al. (2018) close this gap in the literature by investigating the impact of BRIS on behaviour using a dicta-

[8]In behavioral finance, the house money effect occurs when subjects risk more money than they would have otherwise when the money is not theirs. In order to avoid this effect, subjects had to report the frequency at which the number 1 appeared in a matrix consisting of 0's and 1's. 10 matrices were presented, varying in size. Only subjects who completed the task correctly for all 10 matrices received a flat reward of 20 euros. Subjects who failed could still participate in the study, however the stakes were fictitious (9% subjects).

tor game experimental design[9]. The control group was defined as the full-pay standard-stake group, where dictators played with a 10-euro stake and all subjects were paid. The first treatment group was defined as the random-pay standard stake group, where dictators played with a 10-euro stake and had a 10% probability of being paid. The second treatment group was the random-pay high-stake group, where dictators played with a 100-euro stake and had a 10% probability of being paid (note that the control group and the second treatment group have equal expected payoffs). The third treatment group was the hypothetical-pay standard-stake group, where dictators played with a 10-euro stake and had a 0% probability of being paid. Eight laboratory sessions were conducted with a total of 320 participants. They found that the groups with identical 10-euro stakes (i.e., the control group and the first treatment group) exhibited identical behaviour (yielded similar transfer distributions) despite the heterogeneity in expected payoffs. Holt (1986) and Beaud and Willinger (2015) argued subjects under BRIS are susceptible to reduction in risky choice experiments, however these findings provide evidence that subjects under BRIS are more influenced by the stake of the reward itself rather than the probability of receiving it. Overall, BRIS is used to control for between-subject variability, while WRIS is used to control for within-subject variability. Both designs have their own strengths and limitations, and the choice of design will depend on the specific research question and the characteristics of the participants and treatments involved in the study.

2 How Do We Measure Individuals' Behaviour?

Thus far, we have investigated the various forms of real incentives in experimental economics and their implications in measuring choice behaviour. At this point we can recog-

[9] In the dictator game, the first player, "the dictator", determines how to split a monetary endowment between themselves and the second player.

nize that in addition to altering the incentive nature and magnitude, decision behaviour may differ among incentive groups for a number of other reasons, including both behavioural and experimental reasons.

Naturally, the next step is to investigate which investment decisions individuals face in portfolio choice experiments and subsequently how changes in behaviour can measured. First we will explore the Becker-DeGroot-Marschak (BDM) method of eliciting individuals' perceived value of financial knowledge (i.e. willingness to pay). Second, we will explore means of measuring changes in investment behaviour. Two of the most widely accepted measures of portfolio performance are mean-variance optimization and naive diversification.

2.1 Willingness to Pay

One of the questions this thesis seeks to answer is whether the distribution of willingness-to-pay differs across incentive treatment groups. Willingness to pay (WTP) is a concept in experimental economics used as a measure of a participant's valuation of a particular good or service. This paper leverages WTP in order to provides insights into individuals' investment behaviour across alternative real incentive structures. By measuring the distribution of WTP in a controlled experimental setting, we can evaluate whether individuals' willingness to pay for financial education differs across incentive groups.

The Becker-DeGroot-Marschak (BDM) mechanism, developed by Becker et al. (1964), is an incentive-compatible method for eliciting individuals' willingness to pay (WTP) in experiments. The BDM mechanism was created through a sequential experiment that estimated the subject's utility at each stage of the experiment. Each individual has utilities, which are numerical constants connected to potential outcomes of his choices under uncertainty (Becker et al., 1964). The authors argue that if we knew the values of these numerical constants (personal probabilities) he assigns to various external events, we could predict his choice among an available set of actions. He will choose an action with the highest expected utility by weighting outcomes of the personal probabilities he assigns to the corresponding events. It is assumed that these probabilities do not change during the time period under consideration, thus precluding learning or any systematic change of behaviour. A typical BDM process involves the subject formulating a bid, which is then contrasted with a price chosen by a random number generator. If the subject's bid is higher than the random asking amount, they pay the random asking price, and get the item up for auction. The subject receives and pays nothing if their bid is less than the random asking price. Consequently, the Becker-DeGroot-Marschak (BDM) mechanism can be applied to elicit accurate and individual-level WTP, enhancing the data produced by randomised studies.

The main advantages of using the BDM mechanism in eliciting individuals' WTP is that it accounts for individual differences across the sample, it is easy to implement, and it provides precise measurement.

2.2 Investment Theory

A second aim of this research is to investigate whether investment decisions change depending on whether or not we incentivize respondents. For this reason, we will explore varying methods of measuring investment behaviour. Even though the main focus of this thesis is on the shift in investment behaviour from the initial portfolio allocation task to the final task, rather than on the investment behaviour itself, it is still beneficial to recognise the ways investment decisions can differ across individuals. Heterogeneity in behavioural heuristics across incentive groups can produce noise in our findings, making it difficult to establish causal relationships in the experiment.

Some investors employ basic heuristics when asked to allocate funds among different risky assets. One common heuristic exposes them to the risk of over-diversification, by simply allocating an equal share of the endowment to different stocks. This phenomenon is refereed to as the diversification heuristic (or the 1/N strategy or the naïve diversification strategy), and argues that when asked to make decisions simultaneously, individuals tend to diversify. In other words, individuals allocate their contributions evenly across N options offered in an investment plan, hoping to minimize the risk exposure of their portfolio. The 1/N strategy has a long history in asset allocation and has been recommended since as early as the fourth century in the Talmud: "A man should always place his money, a third into land, a third into merchandise, and keep a third at hand" (Benartzi and Thaler, 2001). In 1952, Harry Markowitz introduced the mean-variance optimization investment theory. The mean-variance optimization model highlights the return - risk trade off and despite its simplicity, remains one of the most commonly used models of portfolio choice. Markowitz theorized that the optimal allocation of assets depends only on investment returns and the covariance matrices of returns, thus, a mean-variance optimizer will find the highest possible return based on their preferred level of risk, while at the same time generating the least amount of risk for their required return. Only the weightings for each investment depend on preferences, a finding commonly referred to as the two-fund separation theory.

The debate between the sensibility of the 1/N strategy and the optimization strategy continues to this day. For instance, the 1/N strategy can be a reasonable strategy for investors who realize they are not sophisticated enough to understand complex asset allocation exercises. Benartzi and Thaler (2001) investigate the sensibility of the 1/N strategy among investors making decisions in the context of defined contribution saving plans. They found that even though participants who used the 1/N portfolio were below the efficient frontier, they nevertheless were relatively close to the frontier. As consequence, the ex-ante welfare costs (measured as loss in utility) associated with a sub-optimal investment strategy are quite low[10]. On another note, the 1/N strategy could be a sensible strategy when considering the cost of information. The process of solving for one's optimal allocation weightings can be very complex and require high amounts of attention (Gabaix, 2017). As a result, the marginal costs associated with a mean-variance optimization strategy can be very high for average person- namely for those with low financial literacy, numeracy, and cognitive ability.

Nonetheless, Benartzi and Thaler (2001) found that the array of funds presented to an investor can have a strong influence on the asset allocation selected. If investors are presented with an array of individual assets as opposed to diversified funds, the 1/N strategy can produce substantial welfare costs resulting from the higher idiosyncratic volatility of individual assets compared to diversified funds. In that case, an investor who uses a 1/N strategy will have higher risk exposure to a given asset class relative to a mean-variance optimizer. Further, investors often use the 1/N strategy if they rely on their employer (with defined contribution plans) or advisor (with personal saving investment vehicles) to present an array of diversified funds in an investment portfolio. Benartzi and Thaler (2001) argue employers and financial advisors do not anticipate that participants will behave this way. Due to the heterogeneity in risk attitudes across investors, the 1/N strategy will not provide coherent decision making with an individual's preferences. On the other hand, a mean-variance optimizer will maximize the utility of their investment irrespective of the array of funds presented. DeMiguel et al. (2009) shows that the mean-variance optimization strategy would be beneficial only in environments where the number of assets presented is relatively low. They argue that as the number of assets in an allocation task increases, solving for the optimal weights becomes increasingly costly. In this case,

[10]The authors note that it is estimated on average, non traditional financial planning advice only results in 20 bps below frontier. This provides further evidence that the cost of picking a sub-optimal portfolio is quite small.

financial knowledge could assist investors in refraining from using such heuristics.

2.3 Our Motivation

The effects of incentives can be multifaceted and differ depending on a number of factors, including the size and nature of the incentive as well as individual differences in motivation and risk-taking. Studies in this field to date differ not only in incentive structures, but also in methods of data collection (field surveys, laboratory experiments), in experimental design (between subjects or within subjects), and in environment (dictator game, ultimatum game, lottery choice, portfolio choice etc). For this reason, researchers to date debate the impact, if any, that real incentives have on financial decision making in the field of household finance. Our study extends the limited research on the role incentive structures play in understanding financial decision making in experiments, and will help make sense of the heterogeneity we see in this field. Our work is one of the first to take into account a multiple task portfolio choice experiment, with alternative incentive and payoff structures (while maintaining expected payoffs).

Our study mainly differs from previous studies along four dimensions. First, there is currently little research examining whether individuals' willingness to pay for financial education changes depending on whether or not we pay them. By eliciting individuals' willingness to pay for financial education using the BDM mechanism, we are able to examine both the relationship between peoples' willingness to pay for financial education and its actual effectiveness. Second, we compare the performance of BRIS in a *Pay Some* context and *Pay None* context, while ensuring that expected payoffs are kept constant. Third, our study seeks to find widespread support for the use of hypothetical incentives within experimental economics and finance. More specifically, we seek to investigate whether the evidence supporting the use of hypothetical incentives (such as in the dictator game context) remains consistent in a portfolio allocation setting. While the dictator game can quantify systematic behavioural differences between populations, its ability to prove rationality in experimental economics is not widely accepted. Our goal remains to motivate individuals to reveal their true investment preferences in a portfolio allocation exercise, and in order to do so, we must ensure the experimental design is most representative of how an individual would behave in real life. Fourthly, several of the aforementioned studies failed to pool both random and diversified sample sets that are representative of the population[11]. If the sample size is small and not selected at random, it can include individuals who are systematically more likely to be chosen than other members of the population. This phenomenon, also known as "Sampling bias," restricts the generalizability of findings since it jeopardises the population validity of the findings that is an important component of external validity. Our study includes a nationwide sample from a large panel of Canadians, covering the entire spectrum in terms of socio-demographic and economic status. Subjects were pooled through the AskingCanadians database, to ensure our data reflects the financial and demographic diversity of the population.

[11] Holt and Laury (2002) sample was restricted to business school students and faculty from Georgia State University, the University of Miami, and the University of Central Florida. Harrison et al. (2007) pooled respondents from the University of Florida. Beaud and Willinger (2015) restricted their sample by simply pooling random students from the University of Rotterdam. Clot et al. (2018) sampled participants from the University of Montpellier database of individuals who showed interest in participating in economic experiments.

Chapter 1

Methodology

1 Experimental Design

Our experiment includes three incentive structures schemes, altering two variables: the stake and the probability of receiving payment. Subjects' final payouts depend on the realized performance of their portfolio, so the decision is incentivized. As summarized in Table 1.1, Group 1 is the *Full Payout* group, whereby all respondents receive a monetary endowment of 30$, with 100% probability of receiving payment. Group 2 is the *Randomized Payout* group, where all respondents receive an endowment of 300$ with a 10% probability of receiving payment. Given the fact that the *Full Payout* group and the *Randomized Payout* group have equal expected payouts, expected utility theory would predict that individuals preferences remain consistent in both groups. Group 3 is the *Hypothetical Payout* group, where all respondents receive an endowment of 3000$, however this endowment is purely hypothetical hence respondents have a 0% probability of receiving payment. By creating these three incentive groups, we can investigate which out of the *Pay All*, *Pay a Subset*, or *Pay None* incentive structures is most appropriate when analyzing behaviour in the context of portfolio choice experiments.

Group Name	Incentive Structure	Description
Full Payout (1)	*Pay All*	Endowment = 30$ Probability= 100%
Randomized Payout (2)	*Pay a Subset*	Endowment = 300$ Probability= 10%
Hypothetical Payout (3)	*Pay None*	Endowment = 3000$ Probability= 0%

Table 1.1: Descriptions of incentives in each payout group. The first column describes the three types of payout groups of the experiment. The second column describe the incentive structure for each respective group. In the third column, we can see that groups differ in endowment amounts and the probability of receiving payment.

Our design for the experiment consists of two modules. The first module is the background and information module, consisting of survey questions used to collect extensive information on demographics and preferences. Respondents are also randomly assigned to one of three incentive structure groups, summarized in Table 1.1. The second module is the experimental module, consisting of the baseline portfolio allocation exercise, followed by the opportunity to receive financial knowledge, and then by the final portfolio allocation exercise.

1.1 The Background and Information Module

To study the investment behaviour of households across incentive structures, we would like to have sample data that is representative of the Canadian population. In order to do so, we need to ensure that our incentive group placement in the sample is purely random. We begin by eliciting basic demographic and financial information such as age, gender, marital status, children, education level, and income. Next, in order to understand the driving forces behind individuals' investment behaviour and their willingness to acquire financial knowledge, we record several measures related to financial knowledge and ability. To record financial literacy, we calculate a binary financial literacy score based on the *Big Three* questions designed by Lusardi and Mitchell (2008). These questions include knowledge of compound interest, purchasing power, and diversification. To measure subjects' cognitive ability, we employ the cognitive reflection test proposed by Frederick (2005). This test consists of three questions, designed to measure a person's tendency to override an incorrect intuitive response and engage in further reflection to find the correct answer. High scores on the test have been found to correlate with elevated numeracy and ability to understand complex economic and financial theory. To measure levels of numeracy, we use the Berlin numeracy test proposed by Cokely et al. (2012). The test consists of 4 questions to assess numeracy, risk literacy and general decision-making skills. For all the above-mentioned tests, a respondent receives a score value of 1 if they answered all questions correctly, and 0 otherwise. This vast amount of background information provides us with the data necessary to run tests of randomization, to ensure that no demographic variable predicts incentive group placement.

1.2 The Experimental Module

The second module of the survey is the experiment. The experiment is part of a larger project being conducted at HEC Montréal, investigating the the value of financial knowledge. More specifically, this project, led by Irina Gemmo, Pierre-Carl Michaud, and Olivia S Mitchell, investigates how financial knowledge can help individuals improve their investment decisions. The experiment is divided into three parts: the first portfolio allocation exercise, a willingness-to-pay elicitation for financial knowledge, and then a second portfolio allocation exercise. The first portfolio allocation task serves as a baseline of investment behaviour under uncertainty for each respondent. Next, respondents were told that they could obtain knowledge which might increase their return in a second investment task. They had a new initial endowment equal to that of the baseline portfolio allocation task. The amount paid for the financial knowledge treatment, if chosen to receive it, was deducted from their initial endowment before they participated in the second portfolio allocation task. Lastly, the second portfolio allocation task is completed following the financial knowledge intervention. This experimental design allows the aforementioned researchers to measure the subjective value that participants place on receiving financial knowledge by eliciting their willingness to pay for it.

The Baseline Portfolio Allocation Task

The first portfolio allocation exercise is designed under purely hypothetical conditions, to later serve as a benchmark when investigating the casual effect of alternative incentive structures on portfolio choice decisions. In this task, respondents are required to allocate their endowment across the following three assets: Fund X, Fund Y, and Fund Z. The first asset is presented as “Fund X” and represents a domestic stock from the Toronto Stock Exchange (TSX) index. The second asset is presented as “Fund Y” and represents a global stock from Morgan Stanley Capital International (MSCI) World index. The third asset is a bond fund. We present information about historical returns and their volatility. Data for the three funds were chosen to replicate the 5-year compound returns based on annualised returns and sigma over 20 years, from 2000-2019. The expected returns (μ_p) and standard deviation of returns (σ_p) for all three funds are summarized in Table 1.2. After subjects have formed their own beliefs regarding their expected portfolio performance, they allocate their endowment in full across the three assets. The full allocation exercise appears in Section 4 of the questionnaire in Appendix B. It is important to note that short selling was strictly prohibited in both portfolio allocation tasks, thus the maximum allocation in each of the three funds was the respondent's endowment in full[12].

	Asset Type	Standard Deviation σ_p	Returns μ_p
Fund X	Domestic Stock (TSX)	0.502	0.444
Fund Y	Global Stock (MSCI World)	0.403	0.275
Fund Z	Bond Fund	0.076	0.189

Table 1.2: Fund information provided to respondents. This table displays the three asset types included in the portfolio allocation task. For each fund type, the expected standard deviation is presented in the third column and the expected return is presented in the fourth column. We can see that both the expected standard deviation and expected return increase with the overall risk of the fund.

Equation 1.1 provides the covariance matrix of returns for each of the three funds presented in Table 1.2. The matrix consists of asset variances along the main diagonal, and all other non-diagonal values represent co-variances between pairs of assets. Hence, the covariance matrix quantifies the risk associated with a particular portfolio. In order to make it simpler to quantify the gains resulting from diversification, we fixed the correlation between all assets to be 0. Since the three assets are perfectly uncorrelated, respondents can reduce portfolio risk by holding a combination of the three asset types. Although we elicit risk preferences and ambiguity aversion in the the study, this paper will not explore the role risk aversion plays in measuring the impact of real incentives on individuals'

[12]Short selling occurs when a person believes an asset to be *overvalued*, thus betting that the price will fall in the near future. In this case, a person will borrow the undervalued asset (i.e., allocating a negative weight to the asset) in order to sell it. Next, they will take the profit from that sale and buy the asset they believe to be *undervalued* (i.e., allocating a weight of over 100% to the asset). Consequently, the individual is overweight in the asset they believe will appreciate in value, and underweight in the asset they believe will depreciate in value.

investment behaviour. We will assume that a risk averse investor would only increase the risk of their portfolio if compensated by a higher expected return.

$$\sum = \begin{pmatrix} \sigma_x^2 & \rho_{xy} & \rho_{xz} \\ \rho_{xy} & \sigma_y^2 & \rho_{yz} \\ \rho_{xz} & \rho_{yz} & \sigma_z^2 \end{pmatrix} = \begin{pmatrix} 0.2520 & 0 & 0 \\ 0 & 0.1624 & 0 \\ 0 & 0 & 0.0057 \end{pmatrix} \tag{1.1}$$

The Willingness to Pay Elicitation

Next, respondents are provided information with respect to payment and payoff structures for the final portfolio allocation exercise. Respondents in the *Full Payout* group are presented a text reading the following: *"You will receive your payout from Allocation Task 2 as an additional payment to the compensation for your participation in this survey"*. Respondents in the *Randomized Payout* group are presented a text reading the following: *"The computer will randomly select one respondent out of ten who will receive their payout from Allocation Task 2 as an additional payment to the compensation for their participation in this survey"*. Respondents in the *Hypothetical Payout* group are presented a text reading the following: *"[...] you will need to invest the remaining amount on a second hypothetical allocation task that is the same as Allocation Task 1"*. Moreover, respondents have the opportunity to purchase a treatment in the form of financial knowledge. The objective of the treatment is to provide respondents with the knowledge required to build mean-variance optimised portfolios.

The financial knowledge treatment is comprised of two concepts related to financial decision-making: portfolio diversification, and risk-adjusted portfolio returns. The design of the treatment intervention first defined the process of portfolio allocation and then discussed the value of diversification. Then, provided a verbal and graphical demonstration with a hypothetical investment opportunity made up of three distinct funds with identical expected returns and standard deviation (referred to as portfolio risk). The aim was to demonstrate that when an endowment is evenly distributed across those three funds as opposed to investing the entire amount in one fund, the standard deviation of the portfolio reduces but the expected return remains constant. The second step of the treatment intervention comprised of the concept of risk-adjusted returns. We introduced a second hypothetical investment opportunity consisting of three funds with different expected returns and standard deviations. The aim of the second demonstration was to explain how to maximize returns while keeping the portfolio risk constant. To accomplish this, we recommended that participants divide the expected return of each fund by its standard deviation to determine the risk-adjusted return, and then allocate more money to the funds with higher risk-adjusted returns (see Appendix B for more details).

The willingness to pay (WTP) elicitation is a critical component in pricing the financial knowledge treatment. Nonetheless, there are behavioural biases that could threaten the accuracy of the measure. If a subject believes that her answer to the question "How much are you willing to pay?" will affect the purchase price, then her answer will be biased. For this reason, we use a Becker-DeGroot-Marschak (BDM) mechanism for eliciting respondent's WTP for the knowledge intervention, an incentive-compatible method for experimental studies (Becker et al., 1964). This method begins with respondent's stating the maximum amount they are willing to pay out of their endowment for the treatment. Next, a random number generator determines the price of the treatment. If the price of the treatment is higher than the elicited willingness to pay, the respondent does not receive the treatment. If the price of the treatment is lower than the elicited willingness to pay, the respondent receives the treatment. In the latter case, the cost of the treatment is equal to the price generated by the random number generator. Those who did not receive the treatment form the control arm, whereas those who did form the treatment arm. As a result of the BDM that is both random and conditional on willingness-to-pay, each incentive group will have two subgroups: one group who receives the knowledge intervention (treatment arm) and one group who does not (control arm). The BDM mechanism provides increased precision in demand estimation compared to a standard bidding design, due to the fact that with a standard bidding design, people may feel that they can influence the price of a product by bidding low. Finally, we increased the number of participants who received a treatment in order to generate sufficient validity for our study, by selecting a normal distribution for the random number generator over the range of [0, X]$. As such, even subjects who are unwilling to pay for financial education may be selected to receive it, with the exception of respondents who opted for the option to not receive treatment in all cases[13].

The Final Portfolio Allocation Task

In the second and final allocation task, subjects receive a second endowment equal to the initial endowment they received for baseline portfolio allocation task. For respondents in the *Full Payout* group, this portfolio allocation task was fully incentivized. For respondents in the *Randomized Payout* group, this portfolio allocation task was partly incentivized, as individuals are randomly selected for payouts upon survey completion. As expected, for respondents in the *Hypothetical Payout*, this portfolio allocation task is not incentivized. The ultimate amount of capital subjects have available for the final portfolio allocation task is equal to their respective endowment minus the price they paid for the treatment (if they received it). The expected returns (μ) and standard deviation of returns(σ) for all three funds remain the same as the first allocation task, and are summarized in Table 1.2.

[13] Participants with a stated willingness to pay of zero still had a chance to receive the treatment, when the random price generated equaled zero. However for participants who did not expect any benefit from the treatment, there was an option to reject the treatment rather than stating a zero willingness to pay.

2 Data Collection Methods

To investigate whether incentive structures affect people's behaviour in portfolio choice experiments, we had to acquire considerable amounts of both qualitative and quantitative data from a well-diversified sample set. For this reason, we fielded a study using the online panel of *Asking Canadians*, a Canadian survey panel organization. This data collected was entirely separate from the data collected for the primary study, as it was solely intended for use in this pilot study. The study was fielded on August 13, 2021 and ended on August 21, 2021. There was a total of 210 completed surveys. The Incidence Rate (IR) was 96.77%, as consequence of removing 7 people due to removing some subjects due to reasons of age or region[14]. The *Full Payout* group consisted of 66 respondents, the *Randomized Payout* group consisted of 64 respondents and the *Hypothetical Payout* consisted of 80 respondents. Moreover, 123 respondents were male while 87 were female. The Length of Interview (LOI) median and average were both 31 minutes[15].

[14]IR is defined as as the number of respondents from our sample pool that qualified for our study.

[15]LOI is the time it takes a respondent to complete the research questionnaire, from the time the respondent first starts the survey to when they finish the survey.

Chapter 2

Preliminary Analyses

1 Descriptive Statistics

We begin with a preliminary analysis of the main socio-demographic, financial outcome, and financial knowledge variables in Table 2.1. We first elicit information regarding demographics. Marital Status holds a value of 1 if the subject is currently married, and 0 otherwise. College holds a value of 1 if the subject completed college, and 0 otherwise[16]. University holds a value of 1 if the subject attained a least a bachelor's diploma, and 0 otherwise. Next, we elicit information related to subjects' financial outcomes[17]. High Income holds a value of 1 if subjects' income is greater than or equal to 105,000$, and 0 otherwise. Low Income holds a value of 1 if subjects' income is less than or equal to 55,000$, and 0 otherwise. Lastly, we elicit information regarding financial knowledge and asses financial ability. Exposure High School provides a score of 1 if subjects studied either economics or finance in high school, and 0 otherwise. Exposure Stock Market provides a score of 1 if

[16]College is defined as either CEGEP, other non-university certificate or diploma (other than trades certificates or diplomas), or a university certificate or diploma below the bachelor's level.

[17]Thresholds for income level were approximated based off latest Canadian statistics, for more details see: https://www150.statcan.gc.ca/n1/daily-quotidien/220323/dq220323a-eng.htm.

subjects have a history with trading stocks or other financial instruments, and 0 otherwise. Financial Literacy provides a score of 1 if subjects responded correctly to all three Big Three questions by Lusardi and Mitchell (2008). Cognitive Ability provides a score of 1 if subjects responded correctly to all three questions in the cognitive reflection test by Frederick (2005). Numeracy holds a value of 1 if subjects responded correctly to all three questions in the Berlin Numeracy Test by Cokely et al. (2012).

	count	mean	std	25%	50%	75%
Demographics						
Age	210	51.414	14.405	39	52.5	64
Marital Status	210	0.662	0.474	0	1	1
Children	210	0.605	0.490	0	1	1
College	210	0.200	0.401	0	0	0
University	210	0.595	0.492	0	1	1
Financial Outcomes						
High Income	210	0.300	0.459	0	0	1
Low Income	210	0.190	0.394	0	0	0
Exposure High School	210	0.276	0.448	0	0	1
Exposure Stock Market	210	0.376	0.486	0	0	1
Financial Knowledge and Ability						
Financial Literacy	210	0.676	0.469	0	1	1
Cognitive Ability	210	0.081	0.273	0	0	0
Numeracy	210	0.043	0.203	0	0	0

Table 2.1: Descriptive statistics of key explanatory variables: This table aggregates the summary statistics for all subjects participating in the study. Key explanatory variables of the study include variables related to socio-demographic status, income, exposure to financial products, and financial knowledge. The variability in these results, presented in column four, provides preliminary evidence of diversity in our sample.

Next, figure 2.1 provides a summary of the frequency of subjects per province in the sample. We can see clear geographic diversity in our sample given that subjects have been pooled from all over the nation. The geographic diversity in our sample will increase the likelihood that our findings approximate what would have resulted had the entire Canadian population participated in the study. Due to technical considerations with how the survey was fielded on a short time frame, the experiment was conducted among English speakers outside of Quebec.

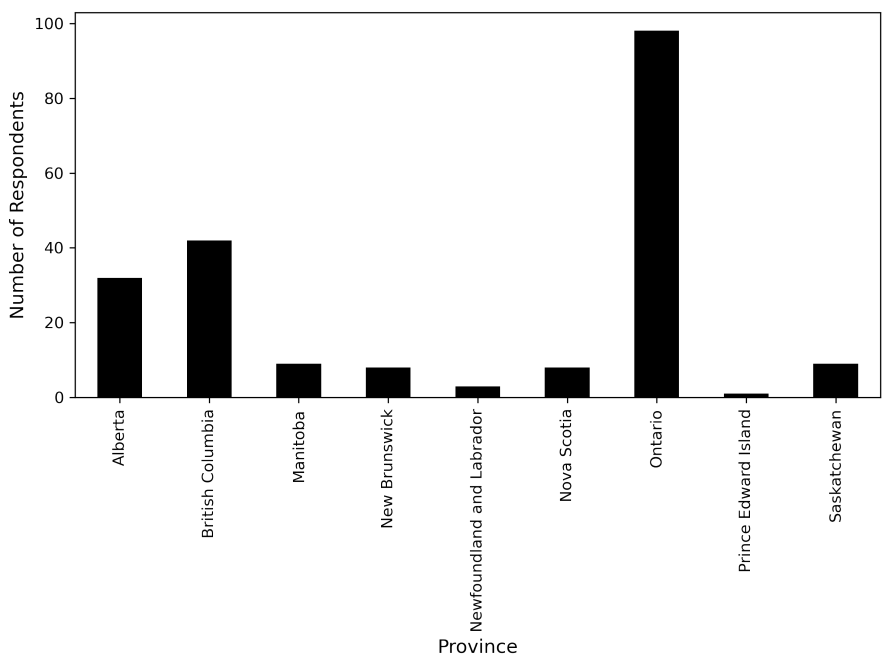

Figure 2.1: Frequency of respondents per province: This figure shows the frequency of respondents per province. Respondents were pooled from provinces all across the nation. Given that Ontario is the most populous province in Canada, it is not surprising that a significant portion of respondents originate from there.

2 Randomization Tests

Next, we sought to confirm whether payout group allocation was truly random, as non-random group allocations introduce bias and can result in incorrect interpretations. To do so, we first calculated the mean values of several socio-demographic, financial outcome, and financial knowledge variables per payout group. P-values are compared across payout groups using a two-sided t-test of two independent samples of scores. This tests for the null hypothesis that the two payout groups have identical average values and that the populations have identical variances. If we find great variability of any of the of socio-demographic, financial outcome, and financial knowledge and ability variables across payout groups, further statistical inferences with this dataset would be limited. As we can see in Table 2.2, our data shows great homogeneity in means across payout groups and produces no significant p-values at 5%. As a result, we fail to reject the null hypothesis that the *Full Payout*, *Randomized Payout Hypothetical Payout* groups have similar average values for the given socio-demographic, financial outcome, and financial knowledge variables. These findings provided preliminary evidence that our sample was well balanced across treatment groups.

	Payout Group					
	Full	*Randomized*	*Hypothetical*		p-value	
Variables	(1)	(2)	(3)	(1)-(2)	(1)-(3)	(2)-(3)
Age	49.848	50.375	53.538	0.835	0.127	0.188
Gender	0.621	0.531	0.600	0.303	0.795	0.411
High Income	0.227	0.391	0.288	0.044*	0.413	0.195
Low Income	0.227	0.125	0.212	0.129	0.831	0.171
University	0.621	0.578	0.588	0.619	0.681	0.911
Exposure High School	0.333	0.266	0.238	0.404	0.202	0.701
Exposure Stock Market	0.364	0.344	0.412	0.814	0.550	0.402
Financial Literacy	0.606	0.672	0.738	0.439	0.092	0.393
Cognitive Ability	0.076	0.047	0.112	0.497	0.456	0.159
Numeracy	0.030	0.047	0.050	0.626	0.554	0.932

Table 2.2: Mean analysis of key explanatory variables per payout Group: This table provides the mean of a given explanatory variable per payout group. The last three columns of the table contain the results of the test with their respective p-values, analyzed at a 95% confidence interval. Results indicate that there is no significant variability in socio-demographic, financial outcome, and financial ability across payout groups.

Further, we implemented a Multinomial Logistic regression analysis as a secondary test to ensure payout group placement was done randomly. The Multinomial Logistic regression estimates regression parameters through an iterative Maximum Likelihood algorithm. This analysis predicts the probability of categorical membership of several independent variables (demographic, financial outcome, and financial knowledge) on payout group placement (*Full Payout*, *Randomized Payout*, and *Hypothetical Payout*). The null hypothesis assumes that the coefficients in the model are zero, indicating that payout group placement was purely random.

Randomized Payout (2)	coef	std err	z	$P > \|z\|$	[0.025	0.975]
Const	-0.0641	0.222	-0.289	0.772	-0.499	0.370
Age	-0.1391	0.223	-0.623	0.533	-0.577	0.298
Gender	-0.2378	0.232	-1.032	0.306	-0.693	0.218
High Income	0.4061	0.238	1.704	0.088	-0.061	0.873
Low Income	-0.1700	0.231	-0.735	0.462	-0.623	0.283
University	-0.1862	0.232	-0.801	0.423	-0.642	0.269
Exposure High School	-0.0253	0.212	-0.120	0.905	-0.441	0.390
Exposure Stock Market	0.1201	0.232	0.518	0.604	-0.334	0.574
Financial Literacy	0.0713	0.221	0.322	0.747	-0.362	0.505
Cognitive Ability	-0.3988	0.272	-1.469	0.142	-0.931	0.133
Numeracy	0.1966	0.220	0.893	0.372	-0.235	0.628
Hypothetical Payout (3)	coef	std err	z	$P > \|z\|$	[0.025	0.975]
Const	0.2567	0.203	1.266	0.206	-0.141	0.654
Age	0.3364	0.207	1.627	0.104	-0.069	0.742
Gender	-0.0617	0.215	-0.287	0.774	-0.483	0.359
High Income	0.2047	0.230	0.892	0.373	-0.245	0.655
Low Income	0.0048	0.198	0.024	0.981	-0.384	0.393
University	0.0002	0.219	0.001	0.999	-0.429	0.403
Exposure High School	-0.2857	0.209	-1.370	0.171	-0.695	0.123
Exposure Stock Market	0.1902	0.214	0.887	0.375	-0.230	0.610
Financial Literacy	0.1584	0.215	0.736	0.462	-0.263	0.580
Cognitive Ability	-0.0612	0.194	-0.315	0.753	-0.442	0.320
Numeracy	-0.1175	0.227	-0.517	0.605	-0.563	0.328

Table 2.3: Multinomial logistic regression output: This table provides the output of the Multinomial Logistic Regression performed using the MNLogit function in python. The base group is the *Full Payout* group (1). P-values are analyzed at a 95% confidence interval. Given that results are not statistically significant, we can conclude that payout group placement fails to accurately determine categorical membership into any of the pertinent independent variables.

Our results provide evidence that the Multinomial Logistic regression model predicts payout group placement significantly worse than the constrained model. As seen in Table 2.3, none of the p-values are significant. Additionally, in Table 2.4 we find that the LL-Null is equal to -171.17 and that the LLR p-value is equal to 0.4950[18]. Given these findings, we fail to reject the null model and conclude that payout groups were assigned randomly. This is important as it allows to give a causal interpretation to differences across treatment arms without having to control for an extensive set of covariates or worry about unobservables and selection.

MNLogit Regression	
Dep. Variable:	payout Group
No. Observations:	157
Model:	MNLogit
Method:	MLE
Converged:	True
Covariance Type:	nonrobust
Df Residuals:	135
Df Model:	20
Pseudo R-squ.:	0.05671
Log-Likelihood:	-161.47
LL-Null:	-171.17
LLR p-value:	0.4950

Table 2.4: Multinomial logistic regression results: This table provides the results of the multinomial logistic regression. The LL-Null value is equal to the result of the maximized log-likelihood function when only an intercept is included. The LLR p-value provides the p-value from a Likelihood Ratio Chi-Squared test of the validity of the model at hand vs the constrained model. Given the weak p-value, we have further evidence to support the claim that payout group placement was done randomly.

[18]There are only 157 number of observations (out of 210 in the sample) due to fact that with multinomial logistic regressions, if some categories have very few observations, they may be collapsed or combined with other categories, which can reduce the number of observations in the regression output.

Chapter 3

Results

1 Willingness to Pay

To begin investigating investment behaviour across payout groups, we examine mean willingness to pay (WTP) values per group. We calculate mean WTP to evaluate whether payout group placement impacts a subject's perceived effectiveness of the treatment. Subjects who perceive the knowledge intervention as completely effective will offer the highest maximum price of the treatment, and those who perceive the knowledge intervention as ineffective will offer prices closer to zero. To control for endowment effects, we standardized WTP values by dividing a subjects' WTP by the highest maximum price of their respective payout group. This method of standardizing WTP values is referred to as "max normalization", and is responsible for transforming WTP so that its values fall between 0 and 1 (with the maximum value being 1). As a result, we are able to easily compare distributions of WTP across incentive groups with differing WTP intervals (i.e., alternative payout structures). By construction, the upper bounds of WTP values for the Full Payout, Randomized Payout, and Hypothetical Payout groups were 5$, 50$, and 500$ respectively.

We compare standardized mean WTP values across payout groups, using a two-sided t-test of two independent sample scores. The resulting p-values are all insignificant at 5%, indicating that the perceived effectiveness of the knowledge intervention was similar across payout groups, on average.

Payout Group	Willingness to Pay (WTP)
Full (1)	0.446
Randomized (2)	0.417
Hypothetical (3)	0.379
$p-value$ (1) vs (2)	0.619
$p-value$ (1) vs (3)	0.231
$p-value$ (2) vs (3)	0.468

Table 3.1: Mean willingness to pay: This table summarizes the mean WTP per payout group. WTP was standardized using the maximum possible purchase price for the treatment in each payout group. These results show no significant difference in perceived effectiveness of the treatment across payout groups.

However, there are limitations that come from simply comparing mean WTP across payout groups. Mean WTP is easily influenced by outliers and can cause skewed distributions. For this reason, we sought to estimate the likelihood that WTP values across payout groups were drawn from the same and unknown probability distribution. We employed a Kolmogorov-Smirnov test (K-S test) in order to evaluate whether the distributions of respondents' WTP values are homogeneous across payout groups. This two-sample KS test accounts for differences in both location and shape of the empirical cumulative distribution functions of WTP among payout groups. Figure 3.1 reports a graphical representation of the Empirical Distribution Functions (EDF) of WTP per payout group. The empirical distribution function of WTP provides a way to model cumulative probabilities for WTP values that do not fit a standard probability distribution. Reported in Table 3.2, the K-S test performed at 5% significance level resulted failing to reject the null hypothesis that the three WTP distributions were drawn from the same continuous distribution. These findings provide preliminary evidence that the distribution of perceived effectiveness of the treatment was similar across payout groups.

Payout Group	Kolmogorov–Smirnov (Statistic)	Kolmogorov–Smirnov ($p-value$)
Full (1) vs *Randomized (2)*	0.141	0.483
Full (1) vs *Hypothetical (3)*	0.202	0.089
Randomized (2) vs *Hypothetical (3)*	0.175	0.202

Table 3.2: Kolmogorov–Smirnov test of WTP: This table provides the results of a two-sample Kolmogorov-Smirnov Test. The K-S Statistic represents the maximum distance between the two distributions samples. The null hypothesis assumes that the distribution of WTP values in both payout group samples come from the same distribution ($p > 0.05$) whereas the alternative hypothesis assumes that the distribution of WTP values in both payout group samples do not come from the same distribution ($p \leq 0.05$). These results imply that there was a similar distribution of perceived treatment efficacy across payout groups.

Despite the fact that the distributional differences across payout groups are not statistically significant, it is noteworthy to observe that the relation between the *Full Payout* group and the other groups is fuzzy. As shown in Figure 3.1, when WTP is roughly between 0.2 and 0.5, there is a distinct difference between CDF's. This clear distance in CDF's we observe represents the maximum distance between the distribution samples. Even though the difference is not material over all values of WTP, it is possible that the *Full Payout* displayed diverging WTP distributions than other groups for certain WTP values.

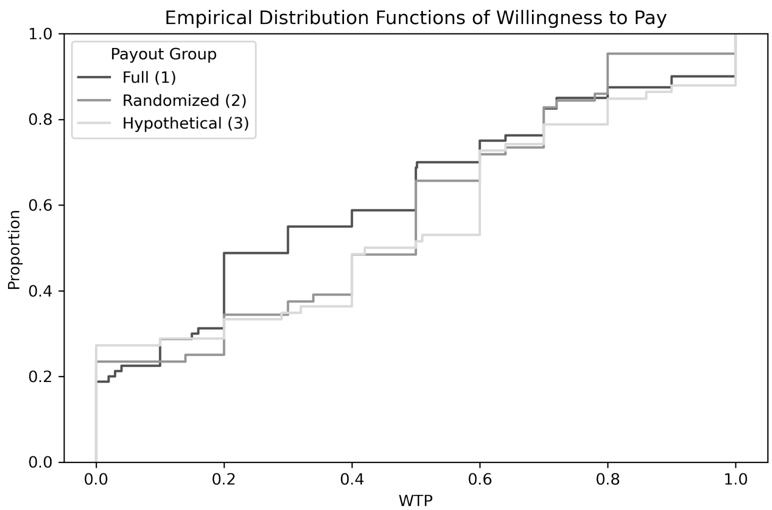

Figure 3.1: Empirical Distribution Functions of WTP: This figure shows the empirical distribution functions of WTP data per payout group. The EDF is a step function, where the value of WTP at any specified value of WTP is the is the fraction of observations of WTP that are less than equal to the specified value of WTP.

2 Portfolio Performance

2.1 Mean-Variance Optimization

We next analyze portfolio performance across payout groups. First, we analyze the change in volatility of a respondent's portfolio by calculating the change in portfolio standard deviation ($\Delta\sigma_p$) defined as the absolute changing in standard deviation from the first allocation task to the second: $\Delta\sigma_p = \sigma_{p_2} - \sigma_{p_1}$. Note that both asset variance and return remained constant throughout all allocation tasks, implying that portfolio variance in the first and second allocation task were equal to $\sigma_{p_1} = \sqrt{0.252w_{x_1}^2 + 0.162{w_{y_1}}^2 + 0.006{w_{z_1}}^2}$ and $\sigma_{p_2} = \sqrt{0.252w_{x_2}^2 + 0.162{w_{y_2}}^2 + 0.006{w_{z_2}}^2}$ respectively. Second, we calculate the change in portfolio risk ($\Delta\mu_p$) by solving for the absolute change in return $\Delta\mu_p = \mu_{p_2} - \mu_{p_1}$. Portfolio return in the first and second allocation task were equal to $\mu_{p_1} = 0.444w_{x_1} + 0.275w_{y_1} + 0.189w_{z_1}$ and $\mu_{p_2} = 0.444w_{x_2} + 0.275w_{y_2} + 0.189w_{z_2}$ respectively. Lastly, we analyze the change in a respondent's portfolio Sharpe ratio (ΔS_p) by finding the absolute change in Sharpe $\Delta S_p = S_{p_2} - S_{p_1}$. Portfolio Sharpe in the first and second allocation task were equal to $S_{p_1} = \frac{\mu_{p_1}}{\sigma_{p_1}}$ and $S_{p_2} = \frac{\mu_{p_2}}{\sigma_{p_2}}$ respectively.

Table 3.3 presents a summary analysis of mean performance variables across payout groups. The first column presents the average delta portfolio standard deviation for each payout group. We find that the *Full Payout* group was the only group to reduce portfolio risk ($\Delta\sigma_p = -0.007$) on average. However, these results are not significant when compared to the average change in portfolio risk of both the *Randomized Payout* and the *Hypothetical Payout* groups at a 5% significance level. The second column presents the mean delta portfolio return per payout group. We can see that on average the change in portfolio return is fairly similar across the three groups ($\Delta\mu_p = -0.001, 0.004, 0.000$) and that the differences in these returns are not statistically significant at a 5% significance level.

The third column presents the mean delta portfolio Sharpe per payout group. The Sharpe ratio is a measure of portfolio efficiency, as it indicates how much excess return a respondent receives for the extra volatility he endures for holding a riskier asset. Thus, diversification losses can be computed by comparing the average change in Sharpe ratio across payout groups. We observe that on average, subjects in the *Full Payout* group were the only sample to increase portfolio Sharpe ($\Delta S_p = 0.025$) from the first portfolio allocation task to the second portfolio allocation task. Thus, the *Full Payout* group improve their portfolio risk adjusted returns which implies a higher portfolio Sharpe ratio on average.

Payout Group	Change in Standard Deviation $\Delta\sigma_p$	Change in Return $\Delta\mu_p$	Change in Sharpe ΔS_p
Full (1)	-0.007	-0.001	0.025
Randomized (2)	0.002	0.004	-0.044
Hypothetical (3)	0.009	0.000	-0.072
p (1) vs (2)	0.659	0.656	0.308
p (1) vs (3)	0.341	0.858	0.124
p (2) vs (3)	0.649	0.721	0.635

Table 3.3: Change in portfolio performance per payout group: This table shows the average change in portfolio performance per payout group, following the final portfolio allocation task. Change in portfolio performance is measured by-means-of the absolute change in portfolio standard deviation, return, and Sharpe ratio. These findings demonstrate that among payout groups, the mean difference in portfolio standard deviation and average change in portfolio return are generally similar.

Figure 3.2 presents a summary histogram of these findings. As we can see from the graph, the average change in portfolio standard deviation and average change in portfolio return are fairly similar across payout groups. However with Sharpe ratios, we observe considerable heterogeneity in portfolio efficiency. The mean change in Sharpe ratio was substantially positive for the *Full Payout* group, and got increasing negative with the *Randomized Payout* ($\Delta S_p = -0.044$) and the *Hypothetical Payout* ($\Delta S_p = -0.072$) groups. One possible interpretation of this pattern is that individuals investing with purely hypothetical endowments exhibit less risk averse behaviour than those with under real and high-payout conditions. As Holt and Laury (2002) argue, respondents facing hypothetical choices under a *Pay None* payout structure are not about to visualize how they would behave under a *Pay All* or *Pay Some* payout structure. Thus, it is possible that individuals in the *Hypothetical Payout* substantially increased the share of overall volatility in their portfolios because they underestimated the extent to which they would have avoided risk in a real life setting. Nonetheless, the differences in Sharpe ratios across payout groups are not significant when analyzed at 5% significance level.

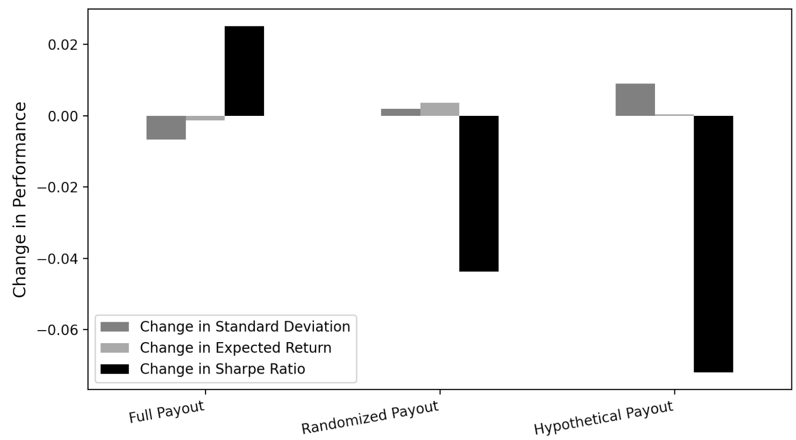

Figure 3.2: Histogram of performance changes per payout group: This graphic illustrates the average change in portfolio performance per payout group, following the final portfolio allocation task. Change in portfolio performance is measured by-means-of the absolute change in portfolio standard deviation, return, and Sharpe ratio. Differences in portfolio performance are not statistically significant at a 5% significance level. Nonetheless, we can see a substantial decrease in Sharpe ratio in the Hypothetical Payout group. Thus, one could infer that individuals investing with purely hypothetical endowments exhibit less risk averse behaviour than those with under real payout conditions.

There are limitations with the usage of Sharpe Ratio to measure portfolio efficiency, due to certain assumptions and the way it has been defined. First, the Sharpe ratio does not differentiate forms of volatility, thus welfare assessments may be biased if subjects are not risk neutral. Using the Sharpe ratio as a measure portfolio efficiency implies that highly concentrated risky portfolios are a result of a sub-optimal investment. For this reason, it would be inappropriate to assume all respondents seek to maximize return using a mean-variance optimization strategy. To an investor looking for a potentially rewarding investment, sharp volatility to the upside is not necessarily a bad thing.

2.2 Heuristics: 1/N Strategy

Next, we investigate whether payout group placement affects a subjects' likelihood of implementing the 1/N investment strategy. A subject employs the 1/N strategy if they allocate their wealth as $w_x, w_y, w_z = 1/3$ in either portfolio allocation task. This strategy does not involve any optimization as it completely ignores the array of assets presented. For comparison with the mean-variance optimization strategy, this strategy implies that expected returns are proportional to total risk rather than systematic risk.

We begin with an analysis of the frequency and performance of the 1/N strategy across all payout groups. Table 3.4 presents the frequency of respondents who used the 1/N strategy in both the first and second portfolio allocation tasks. We see that in the second portfolio allocation task (following the knowledge treatment intervention) the frequency of subjects who executed the 1/N strategy decreased from 47 to 1. The significant decrease from 47 to 1 could imply that the respondents have gained knowledge from the treatment intervention, thus shifting their behaviour from a naive diversification strategy to one more catered to their level of risk aversion. However, this shift in investment strategy could also be due to a learning effect, resulting from the repetitive nature of the experiment. In other words, it's plausible that the participant gained information during the experiment, but it is also plausible that they changed their behaviour as a result of what they learnt from the initial allocation task's outcomes. Nonetheless, investigating if respondents are maximizing their utility and investing optimally given their individual preferences is beyond the scope of this paper[19]. In fact, the purpose of this study is to determine whether respondents from distinct payout groups used different investment techniques and whether these groups' behaviour varied following the intervention.

[19] The main paper by Pierre-Carl Michaud and his co-authors quantifies the relative sharp ratio loss for each respondent, which for a given level of risk aversion, will indicate whether and individual made a decision that made them better off after the treatment intervention.

	Payout Group			
	Full	*Randomized*	*Hypothetical*	Total
Allocation Task 1				
Equally Weighted	24.24%	25%	18.75%	22.38%
Non-Equally Weighted	75.76%	75%	81.25%	77.62%
Allocation Task 2				
Equally Weighted	0%	1.56%	0%	0.48%
Non-Equally Weighted	100%	98.44%	100%	99.52%

Table 3.4: Frequency of the naive diversification investment strategy per payout group: For each portfolio allocation task, this table presents the percentage of respondents who employed a naive diversification strategy versus those who did not, per payout group. We can see a significant decrease in the use of the naive diversification strategy in the second portfolio allocation task, where nearly 100% of respondents in all payout groups sought out an alternative investment strategy.

Despite the fact that this research is not intended to analyse treatment effects, we still want to look at how using the 1/N portfolio differed from not using it in terms of portfolio performance, in order to shed some light on the performance of the naïve diversification strategy. As mentioned previously, the naïve diversification strategy can be a reasonable strategy for investors who realize they are not sophisticated enough to understand complex asset allocation exercises, as the marginal costs associated with a mean-variance optimization strategy can be very high for average person- namely for those with low financial literacy, numeracy, and cognitive ability.

	Full Payout (1)			*Randomized Payout (2)*			*Hypothetical Payout (3)*		
	σ_p	μ_p	S_p	σ_p	μ_p	S_p	σ_p	μ_p	S_p
Allocation Task 1									
Equally Weighted	0.216	0.303	1.401	0.216	0.303	1.401	0.216	0.303	1.401
Non-Equally Weighted	0.291	0.331	1.312	0.271	0.322	1.383	0.255	0.313	1.468
Allocation Task 2									
Equally Weighted	N/A	N/A	N/A	0.216	0.303	1.401	N/A	N/A	N/A
Non-Equally Weighted	0.266	0.323	1.359	0.260	0.321	1.343	0.257	0.311	1.384

Table 3.5: Mean performance of naive diversification vs alternative investment strategies: This table reports the average performance of respondents who employed a naive diversification strategy versus those who did not for each portfolio allocation task and across all payout groups. The Sharpe ratio of the equally weighted portfolio was 1.401. These results show that the *Hypothetical Payout* group was the only payout group where respondents achieved superior risk-adjusted returns from using an alternative investment strategy.

As we can see in the Table 3.5, the portfolio Sharpe ratio for respondents who utilized the naïve diversification strategy is 1.401[20]. Interestingly enough, the *Hypothetical Payout* group was the only group where subjects with a non-equally weighted portfolio generated a higher Sharpe ratio than those with an equally weighted portfolio. These results could provide some preliminary evidence against the efficacy of incentives in causing people to make optimal and non-arbitrary decisions, however this would depend on how many respondents in the *Hypothetical Payout* group actually chose the naïve diversification strategy.

In all cases where a subset of respondents within a payout group implemented the 1/N portfolio, they had a lower expected portfolio return than those who did not. On the one hand, those who implemented the naive diversification strategy on average generated higher Sharpe ratios than those who did not. However, the Sharpe ratio is only an appropriate performance measure when respondents are mean-variance optimizers. On the

[20]Given that the expected return of the three assets did not change from the first allocation task to the second, the expected return of the naïve portfolio is 1.401 in both tasks.

other hand, those who implemented the naive diversification strategy on average generated lower expected returns than those who did not. Given that in this paper we did not explore the role of risk aversion and preferences, the interpretation of these results remains limited. If respondents are risk averse and have poor financial literacy and/or have trouble understanding the notion of Markowitz diversification, naive diversification (albeit ineffective) may be a safe investing strategy. The naive diversification strategy, however, would be sub-optimal if respondents were risk loving or were looking to maximise efficiency.

2.3 Treatment Effects

Finally, we can investigate the effect of the financial education treatment across payout groups. Although the primary study examines the efficacy of financial education programs, we may still assess whether choice behaviour changed following the treatment intervention[21].

Figure 3.3 presents subjects' portfolios in the first portfolio allocation task, and Figure 3.4 presents subjects' portfolios in the second portfolio allocation task [22]. All possible portfolio allocation combinations can be plotted in this space. The upward-sloping hyperbola is referred to as the efficient frontier. As previously noted in Table 3.5, the expected return of the equally weighted portfolio was 0.303 ($\mu_p = 0.303$), and the standard deviation was equal to 0.216 ($\sigma_p = 0.216$). We can see from Figure 3.3 that many respondents across all payout groups employed the naive diversification strategy, leading to a concentration of sub optimal portfolios. Portfolios are considered optimal if they have the highest

[21]The main study by Gemmo et al. (2023) investigates whether consumers who benefit most from financial knowledge or financial advice are also willing to pay more for it. They do so by eliciting subjects' assessment of the marginal benefit of knowledge and shed light on its determinants in the cross-section of individuals.

[22]The number of observations in Figure 3.4 and Figure 3.3 are equal, despite the fact that it appears that Figure 3.4 has more observations. The overlap of data points in Figure 3.3 is due to the fact that many respondents used the naive diversification technique.

achievable predicted level of return given their degree of risk. In addition, Figure 3.4 illustrates the significant decrease in the use of the equally weighted portfolio across all payout groups, where nearly 100% of respondents in all payout groups sought out an alternative investment strategy. In fact, following the exogenous addition of financial education, portfolios appear to be increasingly clustered along the efficient frontier. As a result, it is possible to infer that the financial education intervention aided respondents in all payout categories comprehend and apply the benefits of diversification.

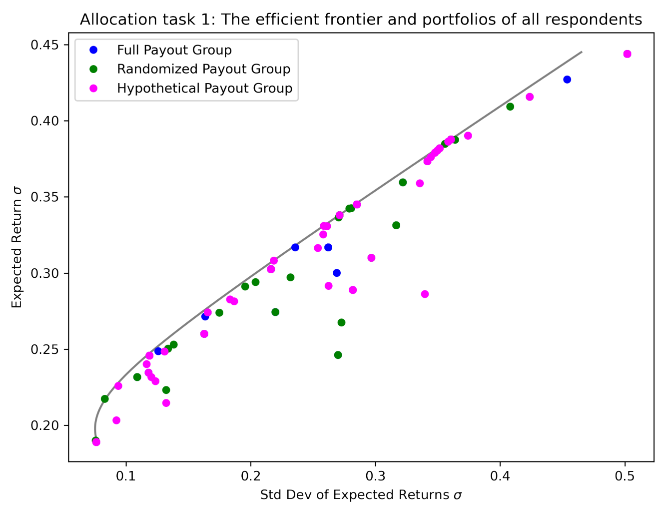

Figure 3.3: The efficient frontier and portfolio allocations of task 1: This figure illustrates portfolios across all payout groups in the initial portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk. These results demonstrate that in the first allocation task, investment behaviour was generally similar across payout groups.

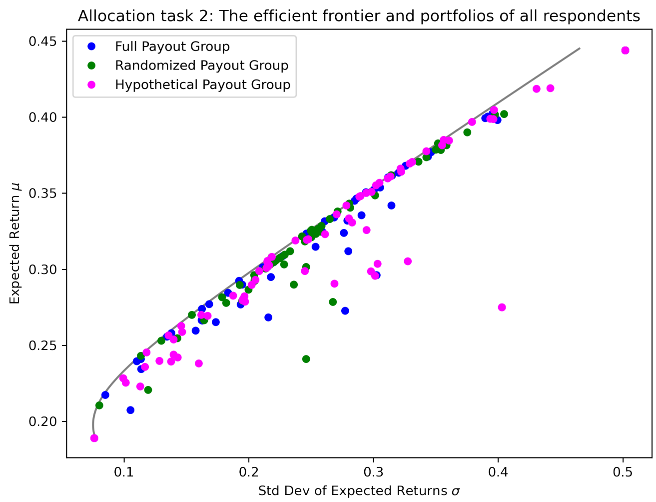

Figure 3.4: The efficient frontier and portfolio allocations of task 2: This figure illustrates portfolios across all payout groups in the second portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk. These findings confirm that investment behaviour was typically consistent across payout groups, and since several portfolios are located near the efficient frontier, it is possible that respondents in all payout groups benefited from the effects of diversification.

2.4 Limitations

This study has potential limitations. Firstly, expected payoffs across the three payout groups are only held constant in the Randomized Payout and Full Payout groups, where the endowments are 300$ and 30$ respectively. However, subjects might be vulnerable to psychological biases and framing effects (i.e., the irrational phenomena were individuals frame a transaction as a loss or as a gain). Future studies could therefore include additional payout group structures, where both the *Randomized Payout* group and the *Full Payout* group hold not only expected payoffs constant but also endowments constant in order to control for behavioural biases. Secondly, as previously mentioned, we did not elicit subjects' preferences. Because of this, we were unable to determine the extent (if any) respondents' improved their utility as consequence of the treatment intervention. Although the primary study by Gemmo et al. (2023) focuses on quantifying the value of the treatment intervention, this study could have explored a high level analysis of whether respondents made welfare improvements post treatment intervention. Given the time constraints and that this research topic was predominantly explored in the main study, we decided to omit these analyses. Lastly, despite the widespread use and acceptance of surveys as a method of data collection in experimental economics, the framing of certain questions can still create framing effects. Even though we ensured that the questionnaire contained a sizable series of questions (in a variety of forms), the use of the Likert scale can be a limiting factor when asking attitudes or behavioural questions. The extreme responses of "Strongly Disagree" and "Strongly Agree" may be avoided by many participants in favour of the medium options of "Agree" and "Disagree," which may misrepresent the true intensity of the participants' attitudes and behaviours. Given that these options allowed respondents to express extreme opinions, they had to be included. Nonetheless, to validate that there aren't inconsistencies producing biases in the data, future studies should look into the consistency of individuals' responses across survey question forms.

Conclusion

The aim of this research was to determine whether monetary incentives affect choice behaviour, and additionally ascertain whether they encourage subjects to make honest and non-arbitrary decisions that improve their welfare. In order to do so, we first explored mean willingness to pay (WTP) across payout groups to evaluate whether payout group placement impacts a subject's perceived effectiveness of acquiring financial knowledge. We document that the perceived effectiveness of the knowledge intervention was similar across payout groups. To confirm this finding, we also evaluated the empirical cumulative distribution functions (ECDF) across payout groups to estimate the likelihood that WTP values across payout groups were drawn from the same and unknown probability distribution. The two-sample Kolmogorov-Smirnov test (K-S test) showed no statistically significant differences in the distributions of WTP, providing further evidence that the distribution of perceived effectiveness of the treatment was similar across payout groups. However, there are still clear differences in probability distributions across payout groups over certain ranges of WTP. Although we normalised WTP values to take endowment effects into account, it is plausible that for particular wealth levels, respondents may behave differently across reward groups. We then explored investment behaviour across payout groups. The markers of investment behaviour examined were based off Markowitz mean-variance optimization. We found that on average, the *Full Payout* group reduced portfolio variance from the first allocation task to the second, however this difference in portfolio volatility was not significant when compared to the the *Randomized Payout* and *Hypothetical Payout* groups. We did however find that the *Hypothetical Payout* group increased portfolio volatility following the treatment intervention. We point out that a likely explanation for this is that participants with hypothetical incentives increased the share of excess volatility in their portfolios because they underestimated the extent to which they would have avoided risk in a real life setting. Also, we found that on average, respondents in the *Full Payout* group increased portfolio Sharpe ratio following the treatment intervention. Nonetheless, the differences in Sharpe ratios across payout groups are not significant when analyzed at 5% significance level. Lastly, we found that the *Hypothetical Payout* group was the only group where subjects with a non-equally weighed portfolio generated a higher Sharpe ratio than those with an equally weighted portfolio. These results provide some preliminary evidence against the efficacy of incentives in causing people to make optimal and non-arbitrary decisions. That being said, we want to stress that the Sharpe ratio on its own is not an appropriate measure to use when respondents are not seeking to maximize return using a mean-variance optimization strategy. In fact, in all cases where a subset of respondents within a payout group implemented the 1/N portfolio, they had a lower portfolio return than those who did not. Lastly, we found that following the financial education intervention, portfolios appeared to be increasingly clustered along the efficient frontier. However, the effects of the treatment on decision-making were not investigated in this thesis, thus we cannot conclude on the efficacy of the treatment.

In sum, the role incentives play in eliciting behaviour in portfolio choice environments remains fuzzy. The majority of our results were not statistically significant, indicating no fundamental differences in choice behaviour across payout groups. Possible reasons for the inconclusive results could be due to experimental reasons (type of study, depth of analyses), or behavioural reasons (low effort of the respondents, ways of defining/measuring behaviour). In order to optimize the likely hood of respondents making meaningful investment decisions in portfolio allocation exercises, research can be done on the effects of incentives in conjunction with other motivational factors.

On that note, measuring the impact of incentives on decision-making can be complex and multifaceted, however we do believe that incentives can have an impact on individuals' motivation. Further research should be done to investigate if there really are differences across payout groups in portfolio allocation environments, which may eventually produce valuable insights in the field of household finance.

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Appendix A– Supplementary Figures

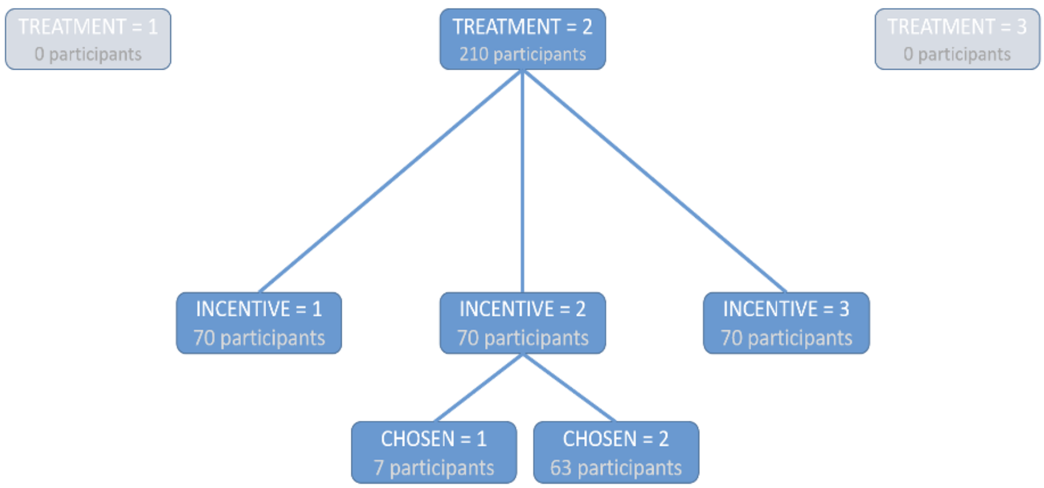

Figure 1: Illustration of payoff groups in the study: This figure presents the experimental design of this study. The main study has three treatment arms, however, only treatment 2 (i.e., financial education) was included in the pilot study. In addition, we can see the three payout group structures.

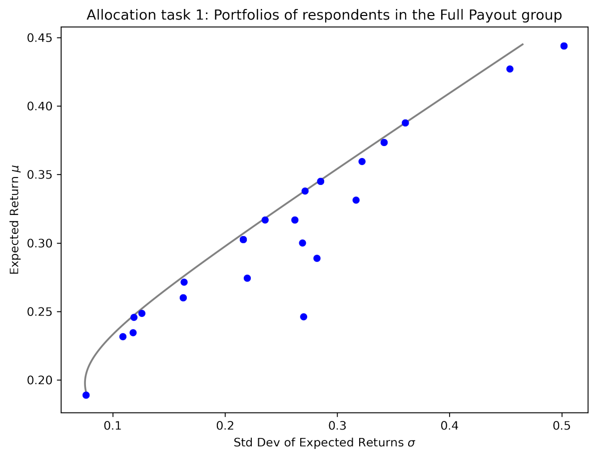

Figure 2: Portfolios of respondents in the Full Payout group in the first allocation task: This figure illustrates portfolios of respondents in the Full Payout group, in the initial portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk.

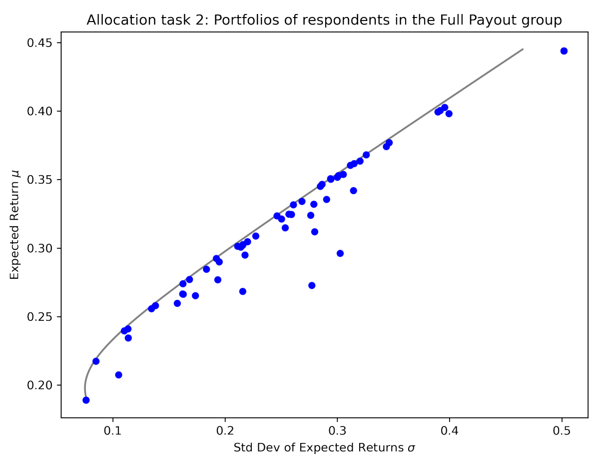

Figure 3: Portfolios of respondents in the Full Payout group in the second allocation task: This figure illustrates portfolios of respondents in the Full Payout group, in the final portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk.

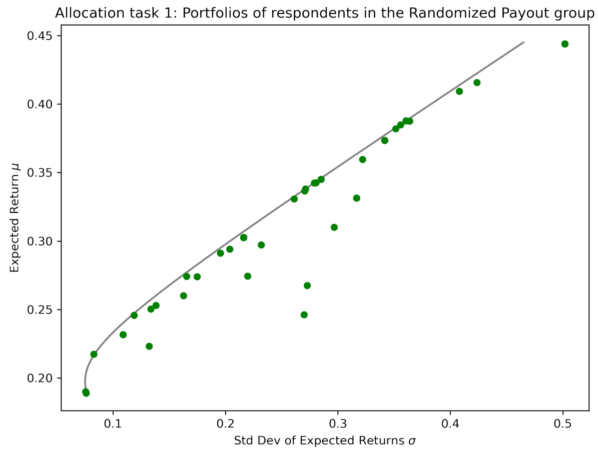

Figure 4: Portfolios of respondents in the Randomized Payout group in the first allocation task: This figure illustrates portfolios of respondents in the Randomized Payout group, in the initial portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk.

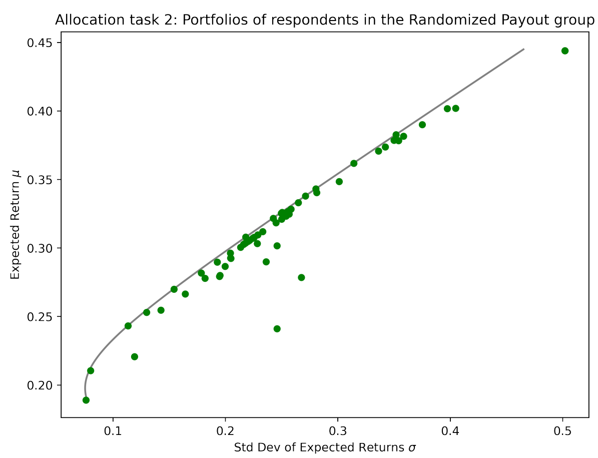

Figure 5: Portfolios of respondents in the Randomized Payout group in the second allocation task: This figure illustrates portfolios of respondents in the Randomized Payout group, in the final portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk.

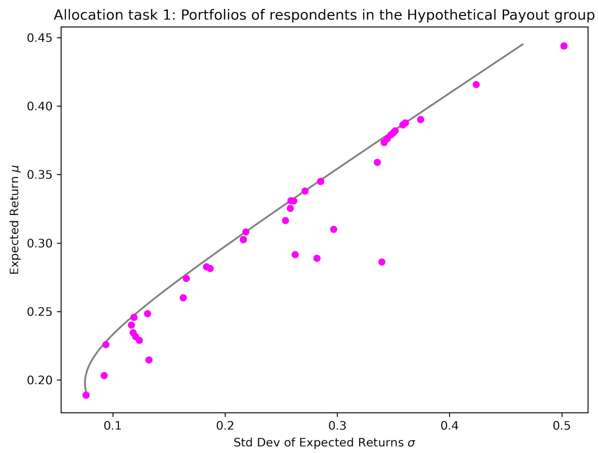

Figure 6: Portfolios of respondents in the Hypothetical Payout group in the first allocation task: This figure illustrates portfolios of respondents in the Hypothetical Payout group, in the initial portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk.

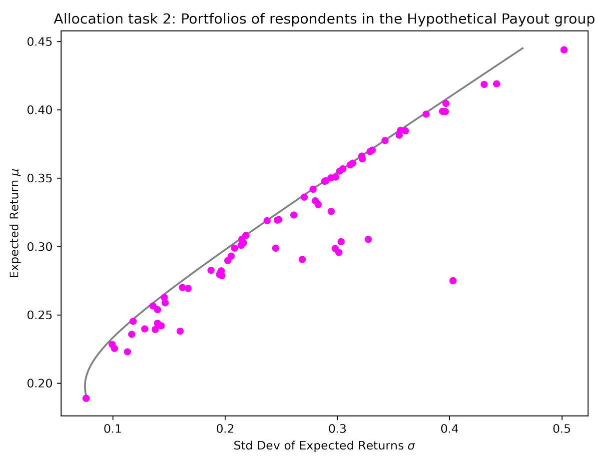

Figure 7: Portfolios of respondents in the Hypothetical Payout group in the second allocation task: This figure illustrates portfolios of respondents in the Hypothetical Payout group, in the final portfolio allocation task. Portfolios along the frontier are considered optimal given that they maximize returns for a given level of risk.

Appendix B – Survey Questionnaire

INSTRUCTIONS INCLUDED WITH THIS ANONYMOUS QUESTIONNAIRE

UNDERSTANDING FINANCIAL DECISIONS

The following pages contain an anonymous questionnaire which we invite you to complete. This questionnaire was developed as part of a research project at HEC Montréal.

Since your first impressions best reflect your true opinions, we request that you please answer the questions included in this questionnaire without any hesitation. We do ask, however, that you take the time needed to consider certain questions that might involve concepts with which you are less familiar, or which require more specific information about your situation. There is no time limit for completing the questionnaire, although we have estimated that it should take approximately 20 minutes.

The information collected will be anonymous and will remain strictly confidential. It will be used solely for the advancement of knowledge and the dissemination of the overall results in academic or professional forums. It is possible that the collected data will be shared with other researchers, solely for non-commercial research purposes, for projects other than the one for which the data were originally collected.

The online data collection provider agrees to refrain from disclosing any personal information (or any other information concerning participants in this study) to any other users or to any third party, unless the respondent expressly agrees to such disclosure or unless such disclosure is required by law.

You are free to refuse to participate in this project and you may decide to stop answering the questions at any time. By completing this questionnaire, you will be considered as having given your consent to participate in our research project and to the potential use of data collected from this questionnaire in future research. Since the questionnaire is anonymous, you will no longer be able to withdraw from the research project once you have completed the questionnaire because it will be impossible to determine which of the answers are yours.

If you have any questions about this research, please contact the principal investigator, Pierre-Carl Michaud, at the telephone number or email address indicated below.

HEC Montréal's Research Ethics Board has determined that the data collection related to this study meets the ethics standards for research involving humans. If you have any questions related to ethics, please contact the REB secretariat at (514) 340-6051 or by email at cer@hec.ca.

Thank you for your valuable cooperation!

Pierre-Carl Michaud
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pierre-carl.michaud@hec.ca

[FOR THE PILOT RECRUITEMENT: PREPARE 3 RANDOM SAMPLES THAT ARE INVITED TO RESPOND TO THE SURVEY IN ORDER TO ACHIEVE THE FOLLOWING: FOR A RANDOM 1/3 OF THE RESPONDENTS (70 OUT OF 210), SET INCENTIVE = 1, FOR A RANDOM 1/3 OF THE RESPONDENTS (70 OUT OF 210), SET INCENTIVE = 2, FOR A RANDOM 1/3 OF THE RESPONDENTS (70 OUT OF 210), SET INCENTIVE = 3. FURTHER, IF INCENTIVE == 2. THEN, FOR A RANDOM 1/10 OF THE RESPONDENTS WITH INCENTIVE = 2 (7 OUT OF 70), SET CHOSEN == 1, FOR A RANDOM 9/10 OF THE RESPONDENTS WITH INCENTIVE= 2 (63 OUT OF 70), SET CHOSEN == 2. FIGURE 1 IN THE APPENDIX PROVIDES AN ILLUSTRATION OF THE GROUPS.]

[FOR PILOT SET TREATMENT==2]

[SECTION 1. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Background**

QA. Are you…?
1 Male
2 Female
3 Other
8888888 Refuse to answer

QB. How old are you? Please specify. [PN: MUST ENTER THE 2 CHARACTERS]
Numeric (25-80)
[NOTE: TERMINATE IF NOT 25-80 INCLUSIVELY]

QC. Which province or territory do you live in?
1. British Columbia
2. Alberta
3. Saskatchewan
4. Manitoba
5. Ontario
6. Quebec [FOR THE PILOT TERMINATE IF QC==6]
7. New Brunswick
8. Nova Scotia
9. Prince Edward Island
10. Newfoundland and Labrador
11. Northwest Territories
12. Nunavut
13. Yukon
14. None of the above [TERMINATE IF QC==14]

Q0 What is the highest certificate, diploma or degree you have obtained?
1 Less than high school diploma or its equivalent
2 High school diploma or a high school equivalency certificate
3 Trade certificate or diploma
4 College, CEGEP or other non-university certificate or diploma (other than trades certificates or diplomas)

5 University certificate or diploma below the bachelor's level
6 Bachelor's degree (e.g. B.A., B.Sc., LL.B.)
7 University certificate, diploma, degree above the bachelor's level

Q1 What is your marital status?
1 Married
2 Living common-law
3 Widowed
4 Separated
5 Divorced
6 Single, never married

Q2 Do you have children?
1 Yes
2 No

[SECTION 2. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Financial Matters**
We will now ask you a few questions concerning your familiarity with certain numerical concepts. Please answer the questions as best you can.

Q3 Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow during these 5 years?
1 More than $102
2 Exactly $102
3 Less than $102
7777777 Don't know
8888888 Refuse to answer

Q4 Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, with the money in this account, would you be able to buy…
1 More than today
2 Exactly the same as today
3 Less than today
7777777 Don't know
8888888 Refuse to answer

Q5 Do you think the following statement is true or false? "Buying a single company's stock usually provides a safer return than a stock mutual fund."
1 True
2 False
7777777 Don't know
8888888 Refuse to answer

Q6 A bat and a ball cost $ 1.10 in total. The bat costs $ 1.00 more than the ball. How much does the ball cost?
Numeric (0.00-100000.00) [ALLOW TWO DECIMALS; ADD A "$" BEHIND THE INPUT SPACE]
7777777 Don't know
8888888 Refuse to answer

Q7 If it takes 5 machines 5 minutes to make 5 widgets, how many minutes would it take 100 machines to make 100 widgets?
Numeric (0-100000)
7777777 Don't know
8888888 Refuse to answer

Q8 In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take the patch to cover half of the lake?
Numeric (0-100000) [ADD THE WORD "days" BEHIND THE INPUT SPACE]
7777777 Don't know

8888888 Refuse to answer

Q9 Out of 1,000 people in a small town, 500 are members of a choir. Out of these 500 members in the choir, 100 are men. Out of the 500 inhabitants that are not in the choir, 300 are men. What is the probability that a randomly drawn man is a member of the choir? (Please indicate the probability in percentage).
Numeric (1-100) [ALLOW TWO DECIMALS]
7777777 Don't know
8888888 Refuse to answer

Q10 Imagine we are throwing a loaded die (6 sides) 70 times. The probability that the die shows a 6 is twice as high as the probability of each of the other numbers. On average, out of these 70 throws, how many times would the die show the number 6?
Numeric (0-70)
7777777 Don't know
8888888 Refuse to answer

Q11 In a forest, 20% of mushrooms are red, 50% brown and 30% white. A red mushroom is poisonous with a probability of 20%. A mushroom that is not red is poisonous with a probability of 5%. What is the probability that a poisonous mushroom in the forest is red? (Please indicate the probability in percentage).
Numeric (1-100)
7777777 Don't know
8888888 Refuse to answer

[SECTION 3. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Preferences**

Q12 Please evaluate your patience when it comes to financial decisions.
1 Very patient
2 Patient
3 Impatient
4 Very impatient
7777777 Don't know
8888888 Refuse to answer

Q13 For this question, we ask you to indicate your preferences regarding 10 different hypothetical lotteries. In each case, you must decide whether you would prefer to participate in Lottery A or Lottery B. Each of the two lotteries offers you a given chance of winning different dollar amounts.

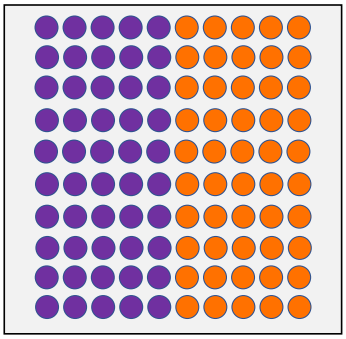
Let's take, for example, the first choice, which corresponds to the first row of the following table. In this case, Lottery A gives you a 10% chance of winning $20 and a 90% chance of winning $16. Lottery B, on the other hand, gives you a 10% chance of winning $39 and a 90% chance of winning $1. All other choices work in the same way, but the chances of winning each amount change from one choice to the next. For each choice, you need to select your preferred lottery, either Lottery A or Lottery B.

Choice			Lottery A				Lottery B			
	Lottery A	Lottery B	Chances of winning	Amount to win	Chances of winning	Amount to win	Chances of winning	Amount to win	Chances of winning	Amount to win
1	❑	❑	10%	$20	90%	$16	10%	$39	90%	$1
2	❑	❑	20%	$20	80%	$16	20%	$39	80%	$1
3	❑	❑	30%	$20	70%	$16	30%	$39	70%	$1
4	❑	❑	40%	$20	60%	$16	40%	$39	60%	$1
5	❑	❑	50%	$20	50%	$16	50%	$39	50%	$1
6	❑	❑	60%	$20	40%	$16	60%	$39	40%	$1
7	❑	❑	70%	$20	30%	$16	70%	$39	30%	$1
8	❑	❑	80%	$20	20%	$16	80%	$39	20%	$1
9	❑	❑	90%	$20	10%	$16	90%	$39	10%	$1
10	❑	❑	100%	$20	0%	$16	100%	$39	0%	$1

Q14 [DEFINE THE VARIABLES MP50low=0 AND MP50up=100. THE VALUES FOR THESE VARIABLES SHOULD BE REASSIGNED / OVERWRITTEN ACCORDING TO RESPONDENTS' ANSWERS TO THE FOLLOWING QUESTIONS.]

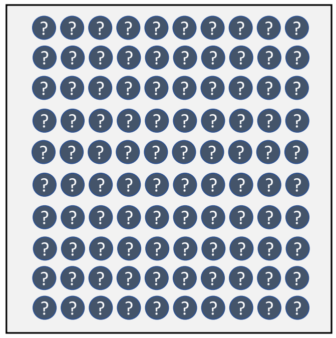
Q14a The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance	You win
50%	$15
50%	$0

BOX U



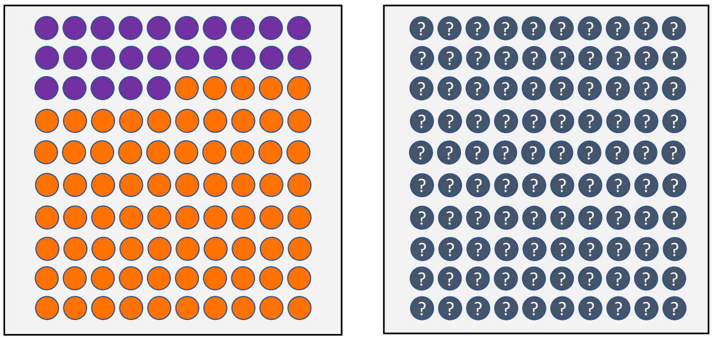
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14a==1, THEN $MP^{50}_{up} = 50$.
IF Q14a ==2, THEN $MP^{50}_{low} = 50$.
IF Q14a== 3, THEN $MP^{50}_{low} = 50$ *AND* $MP^{50}_{up} = 50$ *AND GO TO Q15.]*

[ASK IF *Q14a==1*]
Q14b The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K　　BOX U



Chance	You win
25%	$15
75%	$0

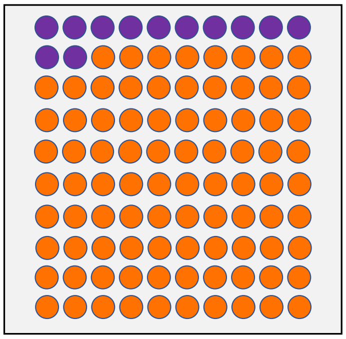
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14b==1, THEN $MP^{50}{}_{up}$ = 25.
IF Q14b==2, THEN $MP^{50}{}_{low}$ = 25.
IF Q14b==3, THEN $MP^{50}{}_{low}$ = 25 AND $MP^{50}{}_{up}$ = 25 AND GO TO Q15.]

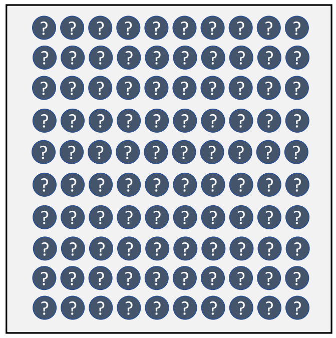
[ASK IF *Q14b==1*]
Q14c The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance	You win
12%	$15
88%	$0

BOX U



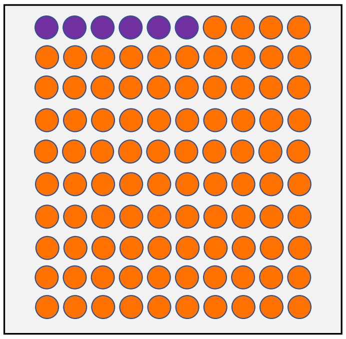
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14c==1, THEN $MP^{50}_{up} = 12$.
IF Q14c==2, THEN $MP^{50}_{low} = 12$.
IF Q14c==3, THEN $MP^{50}_{low} = 12$ *AND* $MP^{50}_{up} = 12$ *AND GO TO Q15.]*

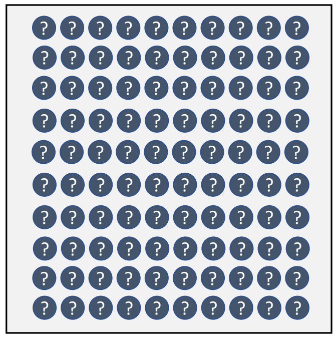
[ASK IF *Q14c==1*]
Q14d The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance		You win
purple	6%	$15
orange	94%	$0

BOX U



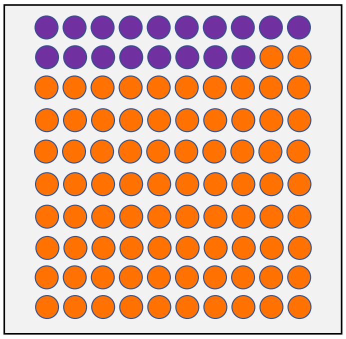
Chance		You win
purple	?%	$15
orange	?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

*[IF Q14d==1, THEN $MP^{50}_{up} = 6$.
IF Q14d==2, THEN $MP^{50}_{low} = 6$.
IF Q14d==3, THEN $MP^{50}_{low} = 6$ AND $MP^{50}_{up} = 6$.
GO TO Q15.]*

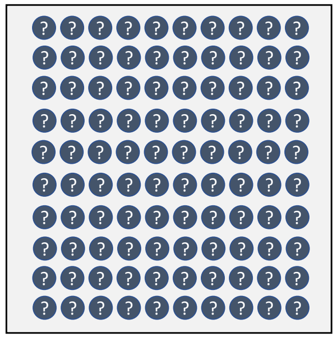
[ASK IF *Q14c==2*]
Q14e The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance		You win
(purple)	18%	$15
(orange)	82%	$0

BOX U

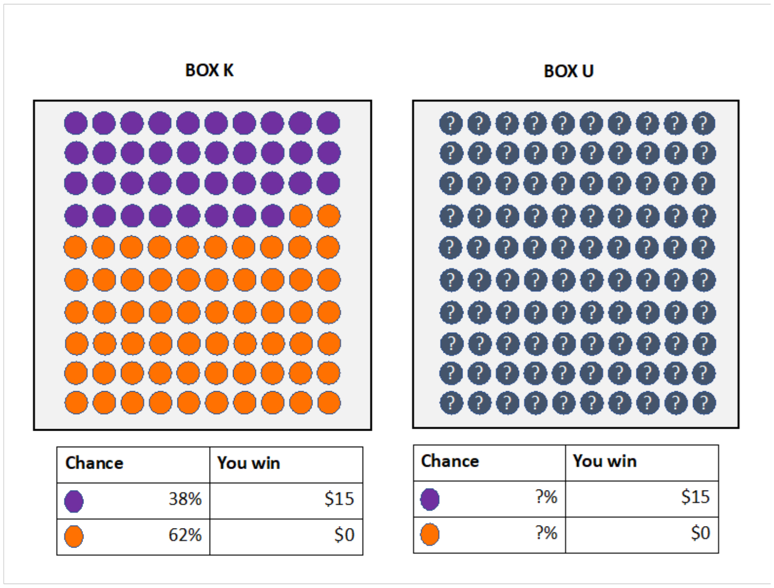


Chance		You win
(purple)	?%	$15
(orange)	?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14e==1, THEN MP^{50}_{up} = 18.
IF Q14e==2, THEN MP^{50}_{low} = 18.
IF Q14e==3, THEN MP^{50}_{low} = 18 AND MP^{50}_{up} = 18.
GO TO Q15.]

[ASK IF *Q14b==2*]
Q14f The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

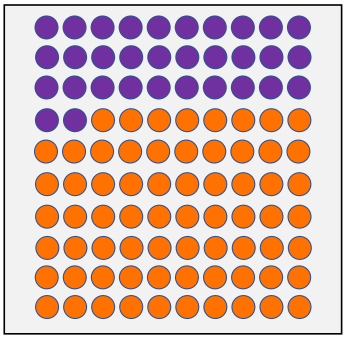


Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14f==1, THEN MP^{50}_{up} = 38.
IF Q14f==2, THEN MP^{50}_{low} = 38.
IF Q14f==3, THEN MP^{50}_{low} = 38 AND MP^{50}_{up} = 38 AND GO TO Q15.]

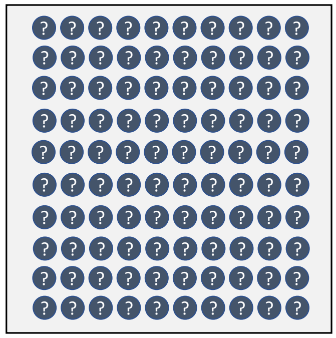
[ASK IF *Q14f==1*]
Q14g The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance		You win
	32%	$15
	68%	$0

BOX U



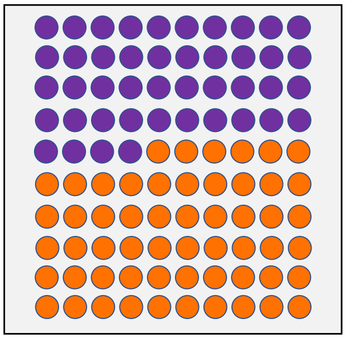
Chance		You win
	?%	$15
	?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14g==1, THEN $MP^{50}_{up} = 32$.
IF Q14g==2, THEN $MP^{50}_{low} = 32$.
IF Q14g==3, THEN $MP^{50}_{low} = 32$ *AND* $MP^{50}_{up} = 32$.
GO TO Q15.]

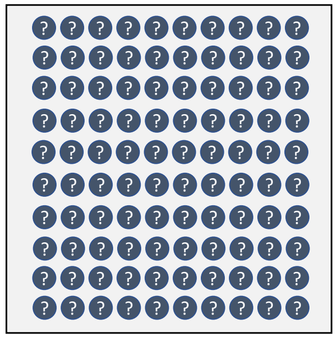
[ASK IF *Q14f==2*]
Q14h The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance	You win
44%	$15
56%	$0

BOX U



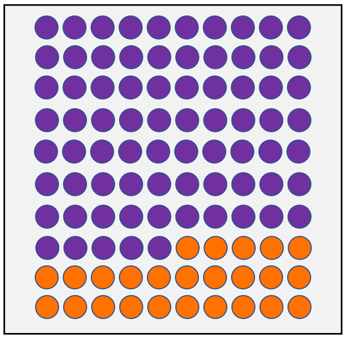
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14h==1, THEN $MP^{50}_{up} = 44$.
IF Q14h==2, THEN $MP^{50}_{low} = 44$.
IF Q14h==3, THEN $MP^{50}_{low} = 44$ *AND* $MP^{50}_{up} = 44$.
GO TO Q15.]

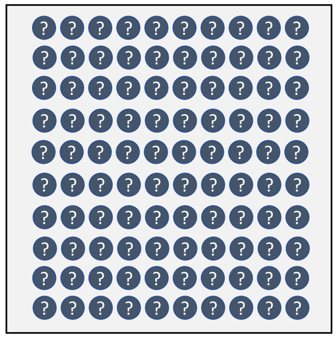
[ASK IF *Q14a==2*]
Q14i The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance		You win
	75%	$15
	25%	$0

BOX U



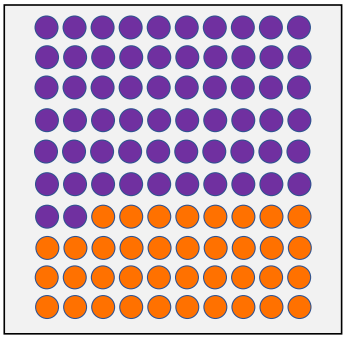
Chance		You win
	?%	$15
	?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14i==1, THEN $MP^{50}_{up} = 75$
IF Q14i==2, THEN $MP^{50}_{low} = 75$
IF Q14i==3, THEN $MP^{50}_{low} = 75$ *AND* $MP^{50}_{up} = 75$ *AND GO TO Q15]*

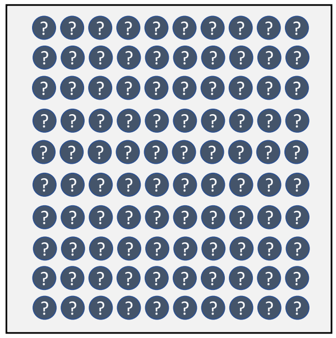
[ASK IF *Q14i==1*]
Q14j The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance	You win
62%	$15
38%	$0

BOX U



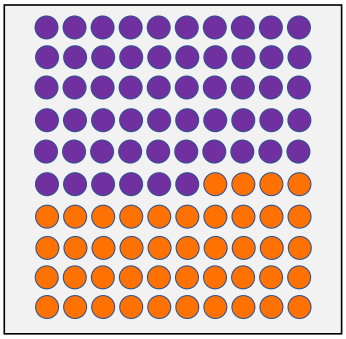
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14j==1, THEN $MP^{50}_{up} = 62$
IF Q14j==2, THEN $MP^{50}_{low} = 62$
IF Q14j==1, THEN $MP^{50}_{low} = 62$ *AND* $MP^{50}_{up} = 62$ *AND GO TO Q15]*

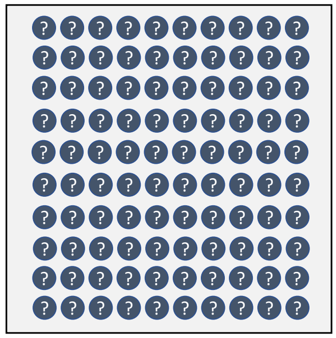
[ASK IF *Q14j==1*]
Q14k The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance	You win
56%	$15
44%	$0

BOX U



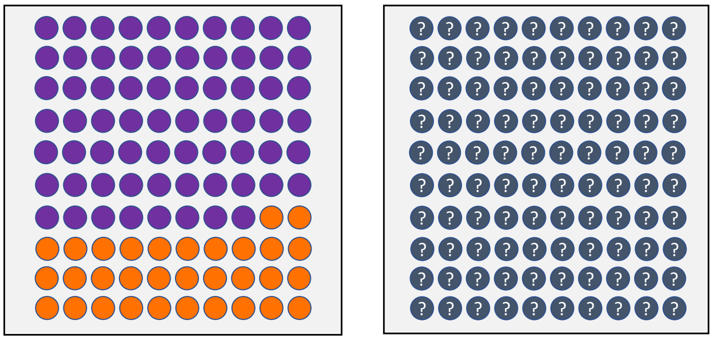
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14k==1, THEN $MP^{50}_{up} = 56$.
IF Q14k==2, THEN $MP^{50}_{low} = 56$.
IF Q14k==3, THEN $MP^{50}_{low} = 56$ *AND* $MP^{50}_{up} = 56$.
GO TO Q15.]

[ASK IF *Q14j==2*]
Q14l The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K BOX U



Chance	You win
68%	$15
32%	$0

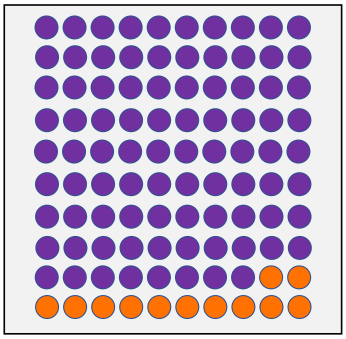
Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14l==1, THEN MP^{50}_{up} *= 68.*
IF Q14l==2, THEN MP^{50}_{low} *= 68.*
IF Q14l==3, THEN MP^{50}_{low} *= 68 AND* MP^{50}_{up} *= 68.*
GO TO Q15.]

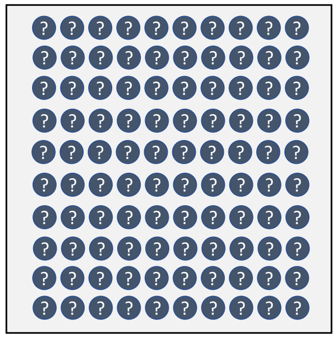
[ASK IF *Q14i==2*]
Q14m The following question asks you to make a hypothetical choice between two boxes, either Box K or Box U. Both hold 100 balls which can either be purple or orange. For Box K, the exact mix of purple and orange balls is given below. Box U also holds purple and orange balls, but the mix is unknown. In other words, both boxes hold 100 balls with two different colors (purple and orange). The mix of purple and orange balls is known for Box K and unknown for Box U. One ball will be drawn at random from the box you choose. A purple ball is worth $ 15 and an orange ball is worth $ 0. There are no right or wrong answers for these questions. If you feel both boxes are equally attractive, please choose indifferent.

BOX K



Chance	You win
88%	$15
12%	$0

BOX U



Chance	You win
?%	$15
?%	$0

Which box do you prefer?
1 Box K
2 Box U
3 Indifferent

[IF Q14m==1, THEN $MP^{50}_{up} = 88$.
IF Q14m==2, THEN $MP^{50}_{low} = 88$.
IF Q14m==3, THEN $MP^{50}_{low} = 88$ *AND* $MP^{50}_{up} = 88$.
GO TO Q15.]

[SECTION 4. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Allocation Task 1**

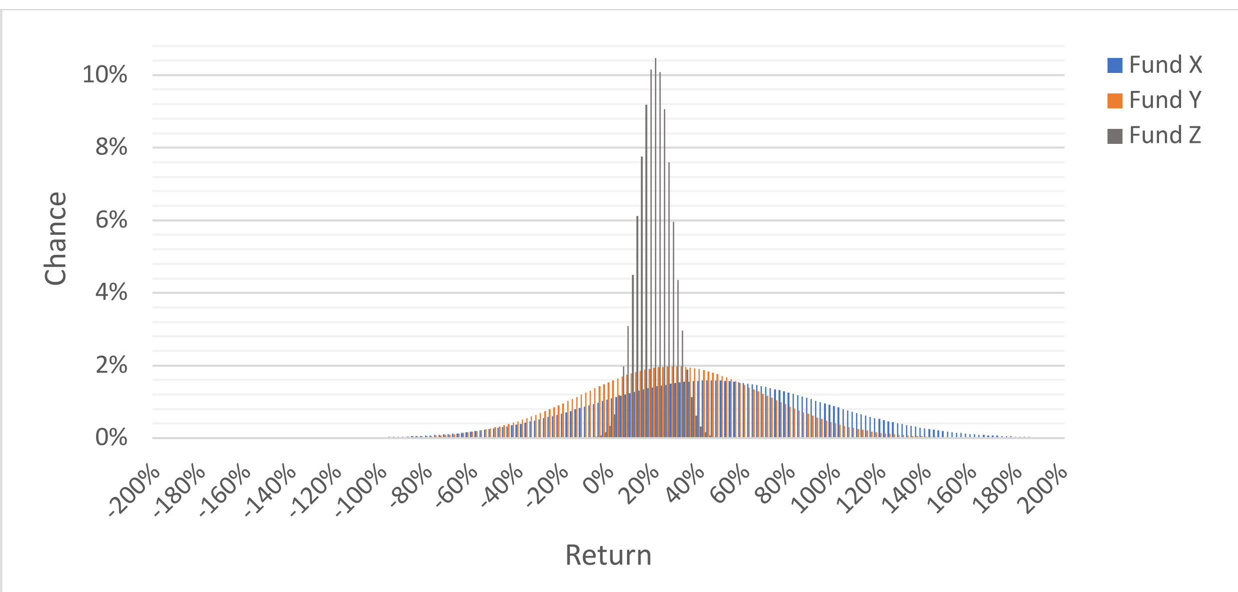
[TAKE THE TIME FOR THIS SECTION AND SAVE SECONDS AS VARIABLE "TIMEALLOCATION1". START TAKING TIME FOR VARIABLE "TIMEALLOCATION1" HERE.]

Suppose that you received an amount of [IF INCENTIVE==1, INSERT "**$30**", IF INCENTIVE==2, INSERT "**$300**", IF INCENTIVE==3, INSERT "**$3000**"] that you need to allocate (assign) to three different investment opportunities ("funds"). The table below provides a brief description of these three funds, showing their expected 5-year return (payoff) and the return variability (technically, standard deviation).

Funds	Expected 5-year Return (%)	5-year Variability (%)
Fund X	44.4	50.2
Fund Y	27.5	40.3
Fund Z	18.9	7.6

You can interpret the expected return as follows. When you invest $10 in a fund with an expected 5-year return of 30%, it is likely that you will receive your original investment of $10 and a return of $3 from this investment after 5 years. When a fund has a high variability, your return from investing in this fund is likely to differ from the expected return.

For a better understanding of how this table can be interpreted, the figure below illustrates the chances of different 5-year returns for each fund. The higher the bars are for each return, the greater chance this return will occur. You can end up with more than you started if the return is positive and with less than you started if the return is negative.



Q15 Please indicate how much money you would allocate to each fund if you had to assign the entire amount of [IF INCENTIVE==1, INSERT “$30”, IF INCENTIVE==2, INSERT “$300”, IF INCENTIVE==3, INSERT “$3000”] across the three funds for 5 years. Please select how much you would assign to each fund by specifying it in the second column of the table below (“Investment ($)”). When you specify the amount in dollars, the third column will indicate how much this amount is in terms of percentage of your overall account balance of [IF INCENTIVE==1, INSERT “$30”, IF INCENTIVE==2, INSERT “$300”, IF INCENTIVE==3, INSERT “$3000”].

Funds	Expected 5-year Return (%)	5-year Variability (%)
Fund X	44.4	50.2
Fund Y	27.5	40.3
Fund Z	18.9	7.6

	Investment ($)	Percent (%) of [IF INCENTIVE==1, INSERT “$30”, IF INCENTIVE==2, INSERT “$300”, IF INCENTIVE==3, INSERT “$3000”]
Fund X	[“CELL A”, SAVE PARTICIPANTS’ INPUT AS VARIABLE “X1” AND SEE INSTRUCTIONS BELOW] (Numeric, 0- IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”])	[“CELL E” SEE INSTRUCTIONS BELOW]
Fund Y	[“CELL B”, SAVE PARTICIPANTS’ INPUT AS VARIABLE “Y1” AND SEE INSTRUCTIONS BELOW] (Numeric, 0- IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”])	[“CELL F” SEE INSTRUCTIONS BELOW]
Fund Z	[“CELL C”, SAVE PARTICIPANTS’ INPUT AS VARIABLE “Z1” AND SEE INSTRUCTIONS BELOW] (Numeric, 0- IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”])	[“CELL G” SEE INSTRUCTIONS BELOW]

Total invested	[“CELL D” SEE INSTRUCTIONS BELOW]	[“CELL H” SEE INSTRUCTIONS BELOW]

[CELLS A, B, AND C, SHOULD BE FILLED BY THE PARTICIPANTS. CELL D SHOULD DISPLAY THE AUTOMATICALLY CALCULATED SUM OF X1, Y1, AND Z1. IF THIS SUM IN CELL D IS SMALLER THAN [IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”], THERE SHOULD BE AN ERROR MESSAGE SAYING “YOU HAVE NOT ALLOCATED THE WHOLE AMOUNT ACROSS THE THREE FUNDS.“ IF THE SUM IS GREATER THAN [IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”], THERE SHOULD BE AN ERROR MESSAGE SAYING “YOU HAVE ALLOCATED MORE MONEY ACROSS THE THREE FUNDS THAN YOU CAN ALLOCATE.“. THE LAST COLUMN, I.E. CELLS E, F, AND G, SHOULD CALCULATE AND DISPLAY THE INVESTMENT AMOUNT PER FUND IN PERCENT OF THE ENDOWMENT, I.E., THE DISPLAYED VALUE IN CELL E SHOULD BE X1 DIVIDED BY [IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”], THE VALUE IN CELL F SHOULD BE Y1 DIVIDED BY [IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”], AND THE VALUE IN CELL G SHOULD BE Z1 DIVIDED BY[IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”]. CELL H SHOULD CALCULATE THE SUM OF THE VALUES IN CELLS E, F, AND G, AND SHOULD THEREFORE RESULT IN 100. IF CELL H IS NOT EQUAL TO 100, THIS SHOULD YIELD IN THE ERROR MESSAGES DESCRIBED ABOVE.]

[RESPONDENTS SHOULD NOT BE ABLE TO GO BACK AND CHANGE THEIR RESPONSES TO THIS SECTION]

[STOP TAKING TIME FOR VARIABLE “TIMEALLOCATION1” HERE WHEN RESPONDENTS MOVE TO NEXT SECTION.]

[SECTION 5. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Evaluation of Allocation Task I**

Q16 What do you expect to be the change in value from the allocation you just selected, as a percent of your original balance?
Percent (-100000.00-100000.00) [BOX WITH % SIGN NEXT TO IT; ALLOW AT MOST TWO DECIMALS]
7777777 Don't know

Q17 How confident are you about your response to the previous question?
1 Extremely confident
2 Very confident
3 Somewhat confident
4 Not very confident
5 Not at all confident
7777777 Don't know
8888888 Refuse to answer

Q18 In this question, we present you with five possible scenarios for the returns of your allocation, and we ask you to indicate the chances that each scenario will occur.
Please type in the number to indicate the percentage chance that you attach to each scenario. The sum of chances across all five scenarios must add to 100%.
(Please answer only with values between 0 and 100 with at most two decimals.)

Your total return will be…

more than 50 %	Percent [BOX WITH % SIGN NEXT TO IT] (RANGE: 0% TO 100%, ALLOW AT MOST TWO DECIMALS)
between 35 % and 50%	Percent [BOX WITH % SIGN NEXT TO IT] (RANGE: 0% TO 100%, ALLOW AT MOST TWO DECIMALS)
between 5 % and 35 %	Percent [BOX WITH % SIGN NEXT TO IT] (RANGE: 0% TO 100%, ALLOW AT MOST TWO DECIMALS)
between -10 % and 5 %	Percent [BOX WITH % SIGN NEXT TO IT] (RANGE: 0% TO 100%, ALLOW AT MOST TWO DECIMALS)
less than -10%	Percent [BOX WITH % SIGN NEXT TO IT] (RANGE: 0% TO 100%, ALLOW AT MOST TWO DECIMALS)
Total	["CELL A" SEE INSTRUCTIONS BELOW]

[CELL A SHOULD DISPLAY THE AUTOMATICALLY CALCULATED SUM OF THE CELLS ABOVE. IF THIS SUM IN CELL A IS SMALLER THAN 100% WHEN THE PARTICIPANT CONTINUES TO THE NEXT SECTION, THERE SHOULD BE AN ERROR MESSAGE SAYING "YOU HAVE NOT ALLOCATED 100%. " IF THE SUM IS GREATER THAN 100% WHEN THE PARTICIPANT CONTINUES TO THE NEXT SECTION, THERE SHOULD BE AN ERROR MESSAGE SAYING "YOU HAVE ALLOCATED MORE THAN 100%.".]

[RESPONDENTS SHOULD NOT BE ABLE TO GO BACK AND CHANGE THEIR RESPONSES TO THIS SECTION]

[GO TO SECTION 9, IF TREATMENT==1]

[SECTION 6. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Expression of Interest in Action**

[TAKE THE TIME FOR THIS SECTION AND SAVE SECONDS AS VARIABLE "TIMEWTP". START TAKING TIME FOR VARIABLE "TIMEWTP" HERE.]

[IF INCENTIVE==1, INSERT "You will now receive an amount of **$30** that you can spend on this part of the survey.", IF INCENTIVE==2, INSERT "You will now receive an amount of **$300** that you can spend on this part of the survey.", IF INCENTIVE==3, INSERT "Suppose that you now received an additional amount of **$3000** that you could spend on this part of the survey."]

[IF TREATMENT==2 & (INCENTIVE==1 OR INCENTIVE==2), INSERT "You can use this money to obtain additional information that might help you make better financial decisions and may increase your results in Allocation Task 2, later in this survey."

IF TREATMENT==3 & (INCENTIVE==1 OR INCENTIVE==2), INSERT "You can use this money to obtain advice on how to invest which may increase your results in Allocation Task 2, later in this survey."

IF TREATMENT==2 & INCENTIVE==3, INSERT "Suppose you could use this money to obtain additional information that might help you make better financial decisions and may increase your results in the hypothetical Allocation Task 2, later in this survey."

IF TREATMENT==3 INCENTIVE==3, INSERT "Suppose you could use this money to obtain advice on how to invest which may increase your results in the hypothetical Allocation Task 2, later in this survey."]

The remaining amount that you do not spend on acquiring [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"] will stay in your [IF INCENTIVE==3, INSERT "hypothetical"] account. Then, you will need to invest the remaining amount on a second [IF INCENTIVE==3, INSERT "hypothetical"] allocation task ("Allocation Task 2") that is the same as Allocation Task 1. [IF INCENTIVE==1, INSERT "**You will receive your payout from Allocation Task 2 as an additional payment to the compensation for your participation in this survey**.", IF INCENTIVE==2, INSERT "**The computer will randomly select one respondent out of ten who will receive their payout from Allocation Task 2 as an additional payment to the compensation for their participation in this survey**."]

In order to determine whether or not you will receive this [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"], we would like to know the price you would be willing to pay for purchasing this [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"].

You will be asked to **state the highest** [IF INCENTIVE==3, INSERT "**hypothetical**"] **price that you would be willing to pay for the** [IF TREATMENT==2, INSERT "**financial information**", IF TREATMENT==3, INSERT "**financial advice**"]. Then the computer will draw a random number between 0 and [IF INCENTIVE==1, INSERT "$5.00", IF INCENTIVE==2, INSERT "$50.00", IF INCENTIVE==3, INSERT "$500.00"], where all numbers between (and including) 0.00 and [IF INCENTIVE==1, INSERT "$5.00", IF INCENTIVE==2, INSERT "$50.00", IF INCENTIVE==3, INSERT "$500.00"] occur with equal probability. The number drawn will be stated in dollars and cents (with up to two decimals).

There are two cases to keep in mind:

If the number drawn at random by the computer is higher than or equal to the [IF INCENTIVE==3, INSERT "hypothetical"] price you have specified, you will not purchase the treatment. That is, you will not receive [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"], and you do not have to pay anything out of your [IF INCENTIVE==3, INSERT "hypothetical"] account balance.

If the number drawn at random by the computer is smaller than the price you specify, you will purchase the treatment. That is, you will receive the [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"] and you must pay the price drawn by the random number generator out of your [IF INCENTIVE==3, INSERT "hypothetical"] account balance. Note that you will never have to pay more than the price that you have specified, and that specifying a higher price raises the chance that you receive [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"].

Here is an example:

Let's imagine that you specify a price of [IF INCENTIVE==1, INSERT "$3.10", IF INCENTIVE==2, INSERT "$31.00", IF INCENTIVE==3, INSERT "$310.00"].

If the computer draws [IF INCENTIVE==1, INSERT "$2.30", IF INCENTIVE==2, INSERT "$23.00", IF INCENTIVE==3, INSERT "$230.00, you will purchase [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"] for [IF INCENTIVE==1, INSERT "$2.30", IF INCENTIVE==2, INSERT "$23.00", IF INCENTIVE==3, INSERT "$230.00"].

If the computer draws [IF INCENTIVE==1, INSERT "$4.40", IF INCENTIVE==2, INSERT "$44.00", IF INCENTIVE==3, INSERT "$440.00"], you will not purchase any [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"].

You will only receive [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"] if you state the same price or a higher price than what the computer generated.

Q19 Now imagine that you specify a price of [IF INCENTIVE==1, INSERT "$4.50", IF INCENTIVE==2, INSERT "$45.00", IF INCENTIVE==3, INSERT "$450.00"] and that the computer draws [IF INCENTIVE==1, INSERT "3.20", IF INCENTIVE==2, INSERT "32.00", IF INCENTIVE==3, INSERT "320.00"]. Please state which of the following outcomes is correct.

1 You will purchase the [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"] for [IF INCENTIVE==1, INSERT "$3.20", IF INCENTIVE==2, INSERT "$32.00", IF INCENTIVE==3, INSERT "$320.00"].

2 You will purchase the [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"] for [IF INCENTIVE==1, INSERT "$4.50", IF INCENTIVE==2, INSERT "$45.00", IF INCENTIVE==3, INSERT "$450.00"].

3 You will not purchase any [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"].

[SAVE THE RESPONSE TO THE FOLLOWING QUESTION AS THE VARIABLE "WTP"]

Q20 Please state now the highest price that you are willing to pay out of your [IF INCENTIVE==3, INSERT "hypothetical"] account balance of [IF INCENTIVE==1, INSERT "$30", IF INCENTIVE==2, INSERT "$300", IF INCENTIVE==3, INSERT "$3000"] in order to receive [IF TREATMENT==2, INSERT "financial information", IF TREATMENT==3, INSERT "financial advice"]. The price that you state should be between $0 and [IF INCENTIVE==1, INSERT "$5.00", IF INCENTIVE==2, INSERT "$50.00", IF INCENTIVE==3, INSERT "$500.00"].

Numeric (0.00-[IF INCENTIVE==1, INSERT "5.00", IF INCENTIVE==2, INSERT "50.00", IF INCENTIVE==3, INSERT "500.00"]) [BOX WITH $-SIGN NEXT TO IT, ALLOW AT MOST TWO DECIMALS]

6666666 I do not want to receive any [IF TREATMENT==2, INSERT "financial knowledge", IF TREATMENT==3, INSERT "financial advice"]

[RESPONDENTS SHOULD NOT BE ABLE TO GO BACK AND CHANGE THEIR RESPONSES TO THIS SECTION]

[STOP TAKING TIME FOR VARIABLE "TIMEWTP" HERE WHEN RESPONDENTS MOVE TO NEXT SECTION.]

[SECTION 7. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Expectation of Allocation Task 2**

Later in this survey you will face Allocation Task 2, which is **the same as Allocation Task 1**. That is, you will need to allocate a fixed amount across the three investment opportunities ("funds") that you have seen before. As a reminder, the table below provides a brief description of these three funds, showing their expected 5-year return (payoff) and the return variability (technically, standard deviation).

Funds	Expected 5-year Return (%)	5-year Variability (%)
Fund X	44.4	50.2
Fund Y	27.5	40.3
Fund Z	18.9	7.6

Q21 Do you think you will be able to apply the [IF TREATMENT==2, INSERT "financial knowledge", IF TREATMENT==3, INSERT "financial advice"] provided to your investment decision in Allocation Task 2, later in this survey?

1 No
2 Probably not
3 Probably
4 Yes
7777777 Don't know

Q22 Do you expect your total return from Allocation Task 2 to be higher than the total return from Allocation Task 1, if you acquire additional [IF TREATMENT==2, INSERT "financial knowledge", IF TREATMENT==3, INSERT "financial advice"]?

1 No
2 Probably not
3 Probably
4 Yes
7777777 Don't know

[ASK IF Q22==3 OR Q22==4; DISPLAY ON SAME SCREEN]
Q23 How much additional value do you think you'll receive from Allocation Task 2, compared to the value you expected from Allocation Task 1, if you acquire [IF TREATMENT==2, INSERT "financial knowledge", IF TREATMENT==3, INSERT "financial advice"]? Please make a guess (in % with at most two decimals).

Percent [BOX WITH %-SIGN NEXT TO IT] (RANGE: 0% TO 100%, ALLOW AT MOST TWO DECIMALS)
7777777 Don't know

[ASK IF Q22==3 OR Q22==4; DISPLAY ON SAME SCREEN]
Q23a How confident are you about your answer to the previous question?

1 Extremely confident
2 Very confident

3 Somewhat confident
4 Not very confident
5 Not at all confident
7777777 Don’t know
8888888 Refuse to answer

[RESPONDENTS SHOULD NOT BE ABLE TO GO BACK AND CHANGE THEIR RESPONSES TO THIS SECTION]

[SECTION 8]

[FOR EACH RESPONDENT, DRAW A RANDOM NUMBER WITH TWO DECIMALS FROM A UNIFORM DISTRIBUTION OVER [0.00, IF INCENTIVE==1, INSERT "5.00] OR DRAW FROM TABLE 2 IN THE APPENDIX", IF INCENTIVE==2, INSERT "50.00] OR DRAW FROM TABLE 3 IN THE APPENDIX", IF INCENTIVE==3, INSERT "500.00] OR DRAW FROM TABLE 4 IN THE APPENDIX"] AND SAVE THIS AS THE VARIABLE "PRICE."]

[INSERT THE FOLLOWING SUBSECTION, IF TREATMENT==2 AND WTP >= PRICE.]
[SECTION 8.1 SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Treatment: Financial Knowledge**

[TAKE THE TIME FOR THIS SECTION AND SAVE SECONDS AS VARIABLE "TIMETREATMENT". START TAKING TIME FOR VARIABLE "TIMETREATMENT" HERE.]

[SCREEN 1:]

[IF INCENTIVE==1 OR INCENTIVE==2, INSERT
"**You have purchased financial information for the price of $[INSERT=PRICE].** This additional information may help you make better financial decisions and increase your results in Allocation Task 2, later in this survey."

IF INCENTIVE==3, INSERT
"**You have purchased financial information for the hypothetical price of $[INSERT=PRICE].** This additional information may help you make better financial decisions and increase your results in the hypothetical Allocation Task 2, later in this survey."]

A portfolio consists of all your investments in the financial market, and portfolio allocation refers to the task of distributing your money across different investment opportunities. In the following description, we will teach you two very important concepts for making a good portfolio allocation: 1) The value of diversification, and 2) The value of high risk-adjusted portfolio returns. You can use the knowledge about these concepts to improve your decision in Allocation Task 2.

[SCREEN 2:] **The value of diversification**

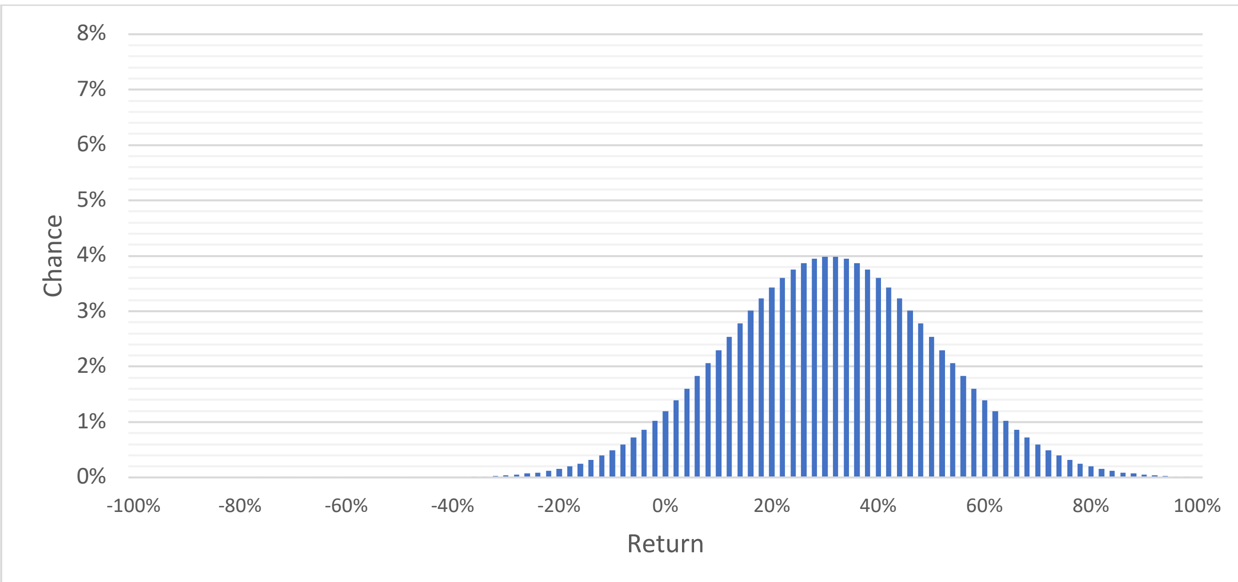
Suppose you have the opportunity to invest in three different funds, A, B and C. They all have the same expected return of 30% and variability of 20%.

Funds	Expected 5-year Return (%)	5-year Variability (%)
Fund A	30	20
Fund B	30	20
Fund C	30	20

[SCREEN 3. ADD TO SCREEN 2 THE FOLLOWING TEXT BELOW.] **The value of diversification**

Since they are all equal in terms of return and variability, you may be tempted to invest all your money in just one fund. If you do, you might be lucky and it performs well. However, if you are unlucky and the fund that you invested in performs badly, you can also lose a lot of money.

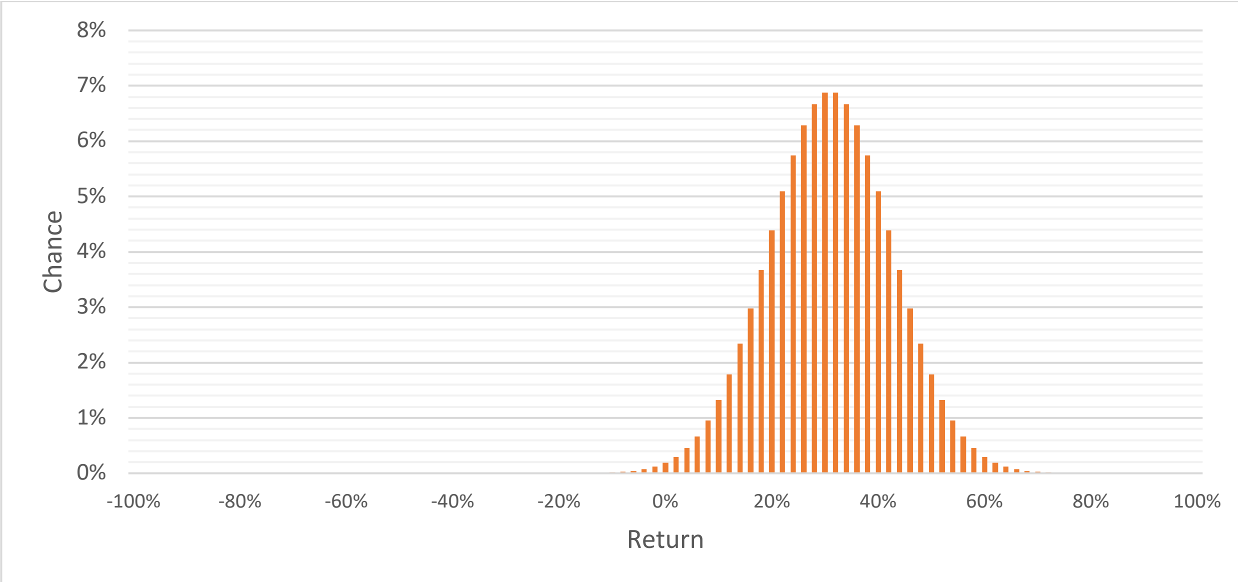
When you invest all your money into a single fund (out of the three funds described above) for 5 years, your portfolio will have an expected return of 30% with 20% variability. The figure below illustrates the likelihood of different 5-year returns for this case. The higher the bars are for each return, the more likely is this return.



[SCREEN 4. KEEP ONLY THE TABLE WITH FUNDS' RETURNS FROM SCREEN 2 AND ADD THE FOLLOWING TEXT.] **The value of diversification**

Now consider dividing your investment across all three funds. The expected return is still 30%. Makes sense. But the variability of each fund is not related. That is, the chance that one fund has an above-average return is the same whether or not the other funds do well or poorly. You can take advantage of this by putting the same amount into each of the funds. This will reduce the overall variability of the portfolio, which now becomes about 11.55%. So you are now getting the same expected return as when you invested in just one fund, but the return is much less volatile. How awesome is that?

The figure below illustrates the likelihood of different 5-year returns for this case. The higher the bars are for each return, the more likely is this return to occur.



[SCREEN 5.] **The value of diversification**

This concept is called diversification. When funds returns are volatile but do not move together (are not correlated), spreading your investment across several funds reduces the variability of your portfolio. Putting all your eggs in a single basket is risky.

[SCREEN 6:] **The value of high risk adjusted portfolio returns**.

Ok, you get it. But what about when funds differ in terms of expected return and variability? Consider the following three funds.

Funds	Expected 5-year Return (%)	5-year Variability (%)
Fund D	40	25
Fund E	30	20
Fund F	30	30

Now consider dividing your investment equally across all three funds (that is, you invest one-third (33.33%) of your money in each fund). After all, you are an expert in diversification now!

The expected return of this portfolio is 33.33% and the variability is 14.62%: not bad. But can you do better? Yes, if you can increase the expected return without changing the variability, right? For the same risk, you could increase the expected return.

[SCREEN 7.] **The value of high risk-adjusted portfolio returns**.

One way to accomplish this is to look at risk-adjusted returns. We can calculate these by dividing the expected return by the variability.

Fund D is the one with the highest risk-adjusted return, while Fund F has the lowest. Fund F has the highest variability. So you can tilt your investment more heavily towards Fund D. Let's try this and see how the expected return can increase, while keeping variability constant.

For example, when you increase your investment in Fund D from 33.33% to 46%, you increase your investment in Fund E from 33.33% to 35%, and you decrease your investment in Fund F from 33.33% to 19%, **the expected return of your portfolio increases from 33.33% to 34.60%, while the variability stays constant at 14.62%.**

You have now created value in terms of returns for a given level of variability. How much variability you are willing to bear is a decision you have to make. But you can certainly play with your allocation to get the best return possible. Using risk-adjusted returns is one way of identifying potential gains.

[SCREEN 8:]

To sum up what we have learned, **diversifying** is definitely something to try. First, for a given expected return, diversifying will often reduce the variability of your investment. Second, for a given amount of variability you are willing to bear, tilting your investment towards funds with higher risk-adjusted returns will generally increase your expected return without exposing you to higher variability.

[STOP TAKING TIME FOR VARIABLE "TIMETREATMENT" HERE WHEN RESPONDENTS MOVE TO NEXT SECTION.]

[INSERT THE FOLLOWING SUBSECTION, IF TREATMENT==2 AND WTP < PRICE]
[SECTION 8.2.]

The price randomly generated by the computer turns out to be higher than your willingness to pay for financial information. **Therefore, you did not purchase financial information and you can use all your money for Allocation Task 2**.

[INSERT THE FOLLOWING SUBSECTION, IF TREATMENT==3 AND WTP >= PRICE]
[SECTION 8.3 SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Treatment: Advice**

[THIS SUBSECTION WILL BE COMPLETED IN THE PERIOD BETWEEN THE PILOT AND THE MAIN SURVEY]

[INSERT THE FOLLOWING SUBSECTION, IF TREATMENT==3 AND WTP < PRICE]
[SECTION 8.4.]

[THIS SUBSECTION WILL BE COMPLETED IN THE PERIOD BETWEEN THE PILOT AND THE MAIN SURVEY]

[SECTION 9. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Allocation Task 2**
[DEFINE VARIABLE ENDOWMENT2 = (IF INCENTIVE==1, INSERT "30.00", IF INCENTIVE==2, INSERT "300.00", IF INCENTIVE==3, INSERT "3000.00") - PRICE]

[TAKE THE TIME FOR THIS SECTION AND SAVE SECONDS AS VARIABLE "TIMEALLOCATION2". START TAKING TIME FOR VARIABLE "TIMEALLOCATION2" HERE.]

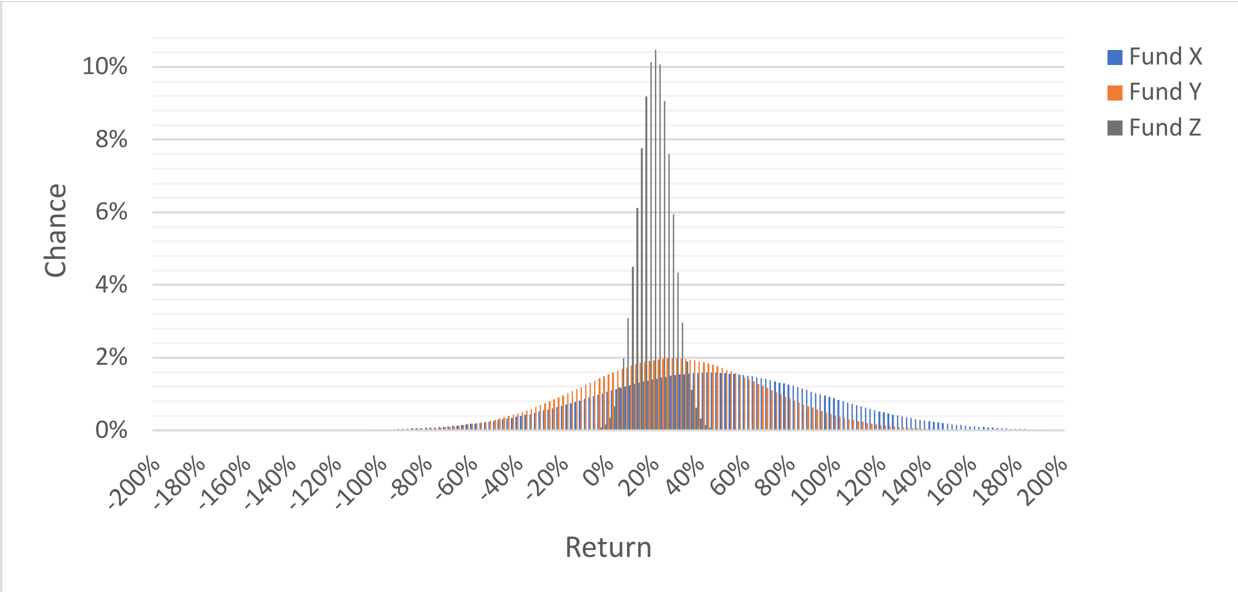
You will now need to allocate (assign) your remaining [IF INCENTIVE==3, INSERT "hypothetical"] amount of **$[INSERT=ENDOWMENT2]** across the same three investment opportunities ("funds") that you saw in Allocation Task 1. The table below is simply to remind you of the description of these three funds, showing their expected 5-year return (payoff) and the return variability (technically, standard deviation).

Funds	**Expected 5-year Return (%)**	**5-year Variability (%)**
Fund X	44.4	50.2
Fund Y	27.5	40.3
Fund Z	18.9	7.6

You can interpret the expected return as follows. When you invest $10 into a fund with an expected 5-year return of 30%, it is likely that you receive your original investment of $10 and a return of $3 from this investment after 5 years. When a fund has a high variability, your return from investing in this fund is likely to differ from the expected return.

For a better understanding of how this table can be interpreted, the figure below illustrates the chances of different 5-year returns for each fund. The higher the bars are for each return, the greater chance this return will occur. You can end up with more than you started if the return is positive and with less than you started if the return is negative.

[IF INCENTIVE==1, INSERT "**You will receive the return from this allocation task as an additional payment to the compensation for your participation in this survey**.", IF INCENTIVE==2, INSERT "**The computer will randomly select one respondent out of ten who will receive their return from this allocation task as an additional payment to the compensation for their participation in this survey**."]



Q24 [IF INCENTIVE==1 | INCENTIVE==2, INSERT "Please indicate how much money you would like allocate to each fund. You have to assign the entire remaining amount of $[INSERT=ENDOWMENT2] across the three funds for 5 years.", IF INCENTIVE==3, INSERT "Please indicate how much money you would allocate to each fund if you had to assign the entire remaining amount of $[INSERT=ENDOWMENT2] across the three funds for 5 years."] Please select how much to invest into each fund by specifying it in the second column of the table below ("Investment ($)"). When you specify the amount in dollars, the third column will indicate how much this amount is in terms of percentage of your overall account balance of $[INSERT=ENDOWMENT2].

Funds	Expected 5-year Return (%)	5-year Variability (%)
Fund X	44.4	50.2
Fund Y	27.5	40.3
Fund Z	18.9	7.6

	Investment ($)	Percent (%) of $[INSERT= ENDOWMENT2]
Fund X	["CELL A", SAVE PARTICIPANTS' INPUT AS VARIABLE "X2" AND SEE INSTRUCTIONS BELOW] (Numeric, 0-ENDOWMENT2)	["CELL E" SEE INSTRUCTIONS BELOW]
Fund Y	["CELL B", SAVE PARTICIPANTS' INPUT AS VARIABLE "Y2" AND SEE INSTRUCTIONS BELOW]	["CELL F" SEE INSTRUCTIONS BELOW]

	(Numeric, 0-ENDOWMENT2)	
Fund Z	[“CELL C”, SAVE PARTICIPANTS’ INPUT AS VARIABLE “Z2” AND SEE INSTRUCTIONS BELOW] (Numeric, 0-ENDOWMENT2)	[“CELL G” SEE INSTRUCTIONS BELOW]
Total invested	[“CELL D” SEE INSTRUCTIONS BELOW]	[“CELL H” SEE INSTRUCTIONS BELOW]

[CELLS A, B, AND C, SHOULD BE FILLED BY THE PARTICIPANTS. CELL D SHOULD DISPLAY THE AUTOMATICALLY CALCULATED SUM OF X2, Y2, AND Z2. IF THIS SUM IN CELL D IS SMALLER THAN ENDOWMENT2, THERE SHOULD BE AN ERROR MESSAGE SAYING “YOU HAVE NOT ALLOCATED THE WHOLE AMOUNT ACROSS THE THREE FUNDS.“ IF THE SUM IS GREATER THAN ENDOWMENT2, THERE SHOULD BE AN ERROR MESSAGE SAYING “YOU HAVE ALLOCATED MORE MONEY ACROSS THE THREE FUNDS THAN YOU CAN ALLOCATE.“. THE LAST COLUMN, I.E. CELLS E, F, AND G, SHOULD CALCULATE AND DISPLAY THE INVESTMENT AMOUNT PER FUND IN PERCENT OF THE ENDOWMENT, I.E., THE DISPLAYED VALUE IN CELL E SHOULD BE X2 DIVIDED BY ENDOWMENT2, THE VALUE IN CELL F SHOULD BE Y2 DIVIDED BY ENDOWMENT2, AND THE VALUE IN CELL G SHOULD BE Z2 DIVIDED BY ENDOWMENT2. CELL H SHOULD CALCULATE THE SUM OF THE VALUES IN CELLS E, F, AND G, AND SHOULD THEREFORE RESULT IN 100. IF CELL H IS NOT EQUAL TO 100, THIS SHOULD YIELD IN THE ERROR MESSAGES DESCRIBED ABOVE.]

[RESPONDENTS SHOULD NOT BE ABLE TO GO BACK AND CHANGE THEIR RESPONSES TO THIS SECTION]

[STOP TAKING TIME FOR VARIABLE “TIMEALLOCATION2” HERE WHEN RESPONDENTS MOVE TO NEXT SECTION.]

[SECTION 10. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Financial situation**

Q25 What is your best estimate of the total income received by all members of your household in 2020, from all sources, before taxes and deductions?
Numeric (0-9999998) [ADD A "$" BEHIND THE INPUT SPACE]
9999999 Don't know or prefer not to say

[ASK IF Q25==9999999; DISPLAY ON SAME SCREEN]
Q25a Is it more than $60,000?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

[ASK IF Q25a==1; DISPLAY ON SAME SCREEN]
Q25b Is it less than $120,000?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

[ASK IF Q25b==1; DISPLAY ON SAME SCREEN]
Q25c Is it more than $90,000?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

[ASK IF Q25a==2; DISPLAY ON SAME SCREEN]
Q25d Is it more than $30,000?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

Q26 Including yourself, how many people living in your household are supported by this income?
Numeric (1-100000) [ALLOW ONLY INTEGER]
7777777 Don't know
8888888 Refuse to answer

Q27 Of the following types of assets or plans, please select all that you own/participate in. Also, give us your best estimate of the amount of money in each (account balance) as well as the fraction invested in shares of stock of publicly held corporations, including through mutual funds or investment trusts.

		Ownership	Account balance ($)	Fraction invested in shares
Q27a	Individual RRSPs (Registered Retirement Savings Plans)	☐		
Q27b	Individual TFSAs (Tax-Free Savings Accounts)	☐		
Q27c	Group plans acquired through employer, such as a Group RRSP (offered by the employer; contributions are taken on work income; the employer can contribute to the group RRSP) and a Group TFSA (offered by the employer; contributions are taken on work income; the employer can contribute to the group TFSA)	☐		
Q27d	Defined contribution (DC) pension plan, including simplified pension plans (This type of pension plan pays benefits that depend on the pension plan's returns. You and your employer deposit contributions.)	☐		
Q27e	Other accounts	☐		

[NEED A CHECKBOX OF SOME SORT IN THE "Ownership" COLUMN AND A DROP DOWN MENU FOR EACH CELL IN THE "Fraction invested in shares" COLUMN, WHERE RESPONDENTS CAN SELECT zero OR a quarter OR half OR almost all. ANSWERS IN THE "Account balance" COLUMN ARE: Numeric (0 – 2,000,000). RESPONDENTS CAN ONLY STATE AN ACCOUNT BALANCE AND A FRACTION IF THEY HAVE SELECT THE ASSET OWNERSHIP.
CODING SUGGESTION: SAVE RESPONSES IN TWO VARIABLES PER SUB-QUESTION. VARIABLES Q27a1-Q27e1 TAKE THEIR VALUES FROM COLUMN 1 AND COLUMN 3 AS FOLLOWS. IF OWNERSHIP IS UNSELECTED, THE VALUE IS 1 AND NO FRACTION CAN BE SPECIFIED. IF OWNERSHIP IS SELECTED, THE VALUE OF THE VARIABLE IS EITHER 2, 3, 4, OR 5, DEPENDING ON THE SELECTION IN COLUMN 3: 1 OWNERSHIP UNCHECKED, 2 Zero, 3 A quarter, 4 Half, 5 Almost all. THE SECOND VARIABLE Q27a2-Q27e2 TAKES ITS VALUE FROM COLUMN 2 (NUMERIC BETWEEN 0 AND 2,000,000). ALTERNATIVELY, IF THE PROGRAMMING OF Q27a1-Q27e1 IS TOO COMPLICATED, WE COULD CREATE 3 VARIABLES PER SUB-QUESTION, ONE FOR EACH COLUMN. THEN, THE FIRST ONE FOR THE OWNERSHIP SELECTION IN COLUMN 1 IS BINARY,

THE ACCOUNT BALANCE VALUE IN COLUMN 2 IS NUMERIC (BETWEEN 0 AND 2,000,000) AND THE FRACTION IN COLUMN 3 IS CATEGORICAL (2, 3, 4, or 5).]

Q28 Do you currently participate in a **Defined Benefit (DB) pension plan** offered by your employer? This type of pension plan pays fixed benefits during retirement. The benefits depend on number of years worked and income, but not on the pension plan's returns.

1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

Q29 How would you assess your overall financial knowledge?

1 Very low
2 Low
3 Moderate
4 High
5 Very high
7777777 Don't know
8888888 Refuse to answer

Q30 Please indicate whether the following statement is true or false: "Imagine that Fund Q yields the highest expected return of investment opportunities available to you. Then you will always earn the highest return when you invest everything into fund Q."

1 True
2 False

Q31 Please indicate whether the following statement is true or false: "Comparing risk-adjusted returns across funds can help you increase your expected return for a given variability, by putting more money in certain funds than in others."

1 True
2 False

Q32 Please indicate whether the following statement is true or false: "Diversification means investing your money in several funds instead of investing everything in one fund".

1 True
2 False

Q33 Please indicate whether the following statement is true or false: "Spreading your money across all available funds equally is the best investment strategy for everyone."

1 True
2 False

Q34 Have you ever received financial advice either from a financial professional, friends, or family members?

1 Yes, from a financial professional
2 Yes, from friends or family

3 Yes, from a financial professional and from friends or family
4 No
7777777 Don't know
8888888 Refuse to answer

[ASK IF Q34==1,2, OR 3; DISPLAY ON SAME SCREEN]
Q34a Did you request this advice, or was it simply provided to you without you requesting it?
1 I requested it
2 It was simply provided to me without me requesting it
7777777 Don't know
8888888 Refuse to answer

[ASK IF Q34==1,2, OR 3; DISPLAY ON SAME SCREEN]
Q34b Have you ever acted on this financial advice?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

Q35 How would you rate your knowledge about the stock market?
1 Very low
2 Low
3 Moderate
4 High
5 Very high
7777777 Don't know
8888888 Refuse to answer

Q36 Have you ever traded stocks or other financial instruments yourself (e.g., using a brokerage account or with an app)?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

Q37 When you were growing up, did your parents invest in stocks or other financial instruments?
1 Yes
2 No
7777777 Don't know
8888888 Refuse to answer

Q38 Did you study economics or finance in high school?
1 Yes
2 No
7777777 Don't know

8888888 Refuse to answer

Q39 Could you tell us how clear you found the questions in this survey?
1 Very clear
2 Clear
3 Confusing
4 Very confusing

[SECTION 11]

[DEFINE WORTH = ENDOWMENT2 + X2* RETURNX2+ Y2* RETURNY2+ Z2* RETURNZ2, WHERE RETURNX2, RETURNY2, AND RETURNZ2 ARE DRAWN FROM TABLE 5 IN THE APPENDIX]

[INSERT THE FOLLOWING SUBSECTION, IF INCENTIVE ==1]
[SECTION 11.1. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Your Payout**

From the $30.00 received for Allocation Task 2, you spent $[INSERT = PRICE] on [IF TREATMENT==2, INSERT "financial knowledge", IF TREATMENT==3, INSERT "financial advice"] and invested the remaining $[INSERT= ENDOWMENT2] in the allocation task. After five years, your portfolio is now worth $[INSERT= WORTH].
[IF WORTH >0, INSERT= "You will receive this as an additional payment to the compensation for your participation in this survey".] We thank you very much for your participation.

[INSERT THE FOLLOWING SUBSECTION, IF INCENTIVE ==2]
[SECTION 11.2. SHOW THE FOLLOWING TITLE TO RESPONDENTS:] **Your Payout**

[INSERT THE FOLLOWING PARAGRAPH, IF CHOSEN ==1]
Congratulations, the computer selected you for the payout from Allocation Task 2. From the $300.00 received for Allocation Task 2, you spent $[INSERT = PRICE] on [IF TREATMENT==2, INSERT "financial knowledge", IF TREATMENT==3, INSERT "financial advice"] and invested the remaining $[INSERT= ENDOWMENT2] in the allocation task. After five years, your portfolio is now worth $[INSERT= WORTH].
[IF WORTH >0, INSERT= "You will receive this as an additional payment to the compensation for your participation in this survey".] We thank you very much for your participation.

[INSERT THE FOLLOWING PARAGRAPH, IF CHOSEN ==2]
Unfortunately, the computer did not select you for the payout from Allocation Task 2. Therefore, you will not receive any additional payments on top of the baseline compensation for this survey. We thank you very much for your participation.

[INSERT THE FOLLOWING SUBSECTION, IF INCENTIVE ==3]
[SECTION 11.3]
We thank you very much for your participation.

[APPENDIX: THE FOLLOWING TABLES ARE INTENDED FOR PROGRAMMERS ONLY AND SHOULD NOT BE SHOWN TO THE PARTICIPANTS]

TABLE 1 VARIABLES

VARIABLES	POSSIBLE VALUES	VALUE PILOT	VALUE MAIN
INCENTIVE	1, 2, 3	1, 2, 3	To be determined after pilot
TREATMENT	1, 2, 3	2	1, 2, 3
CHOSEN	1, 2	1, 2	To be determined after pilot
PRICE	Random draw of numeric value with two decimals from uniform distribution over [0.00, IF INCENTIVE==1, INSERT “5.00 (or draw from Table 2)”, IF INCENTIVE==2, INSERT “50.00 (or draw from Table 3)”, IF INCENTIVE==3, INSERT “500.00 (or draw from Table 4)”]		
WTP	[0.00, IF INCENTIVE==1, INSERT “5.00”, IF INCENTIVE==2, INSERT “50.00”, IF INCENTIVE==3, INSERT “500.00”]	Participants’ response to Q20	Participants’ response to Q20
ENDOWMENT2	IF INCENTIVE==1, INSERT “30.00”, IF INCENTIVE==2, INSERT “300.00”, IF INCENTIVE==3, INSERT “3000.00”) - PRICE		
X1	0- IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”]		
Y1	0- IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”]		
Z1	0- IF INCENTIVE==1, INSERT “30”, IF INCENTIVE==2, INSERT “300”, IF INCENTIVE==3, INSERT “3000”]		
X2	0- ENDOWMENT2		
Y2	0- ENDOWMENT2		
Z2	0- ENDOWMENT2		
RETURNX2	Normally distributed with mean = 0.444 and standard deviation = 0.502 (Or draw from Table 5)		
RETURNY2	Normally distributed with mean = 0.275 and standard deviation = 0.403 (Or draw from Table 5)		
RETURNZ2	Normally distributed with mean = 0.189 and standard deviation = 0.076 (Or draw from Table 5)		
WORTH	WORTH = ENDOWMENT2+X2* RETURNX2+ Y2* RETURNY2+ Z2* RETURNZ2		

TABLE 2 RANDOM PRICE FOR TREATMENT IF INCENTIVE ==1

Outcome	Probability
0	$\frac{1}{501}$
0.01	$\frac{1}{501}$
0.02	$\frac{1}{501}$
0.03	$\frac{1}{501}$
0.04	$\frac{1}{501}$
0.05	$\frac{1}{501}$
…	…
…	…
…	…
4.95	$\frac{1}{501}$
4.96	$\frac{1}{501}$
4.97	$\frac{1}{501}$
4.98	$\frac{1}{501}$
4.99	$\frac{1}{501}$
5	$\frac{1}{501}$

This table is shortened to save space. It represents 501 outcomes that each occur with equal probability (1/501)

TABLE 3 RANDOM PRICE FOR TREATMENT IF INCENTIVE ==2

Outcome	Probability
0	$\frac{1}{5001}$
0.01	$\frac{1}{5001}$
0.02	$\frac{1}{5001}$
0.03	$\frac{1}{5001}$
0.04	$\frac{1}{5001}$
0.05	$\frac{1}{5001}$
…	…
…	…
…	…
49.95	$\frac{1}{5001}$

49.96	$\frac{1}{5001}$
49.97	$\frac{1}{5001}$
49.98	$\frac{1}{5001}$
49.99	$\frac{1}{5001}$
50	$\frac{1}{5001}$

This table is shortened to save space. It represents 5001 outcomes that each occur with equal probability (1/5001)

TABLE 4 RANDOM PRICE FOR TREATMENT IF INCENTIVE ==3

Outcome	Probability
0	$\frac{1}{50001}$
0.01	$\frac{1}{50001}$
0.02	$\frac{1}{50001}$
0.03	$\frac{1}{50001}$
0.04	$\frac{1}{50001}$
0.05	$\frac{1}{50001}$
…	…
…	…
…	…
499.95	$\frac{1}{50001}$
499.96	$\frac{1}{50001}$
499.97	$\frac{1}{50001}$
499.98	$\frac{1}{50001}$
499.99	$\frac{1}{50001}$
500	$\frac{1}{50001}$

This table is shortened to save space. It represents 50001 outcomes that each occur with equal probability (1/50001)

TABLE 5 RETURN DISTRIBUTIONS FOR THE SECOND ALLOCATION TASKS

KEY FOR RANDOM DRAW (WITH EQUAL PROBABILITY 1/99)	OUTCOME

	RETURNX2 (Fund X)	RETURNY2 (Fund Y)	RETURNZ2 (Fund Z)
1	-0.723826633	-0.662518193	0.012197562
2	-0.586981953	-0.552660811	0.032915083
3	-0.500158391	-0.482959824	0.046059686
4	-0.434844408	-0.430526487	0.055947859
5	-0.381716521	-0.387876012	0.063991124
6	-0.336496344	-0.351573759	0.070837207
7	-0.296847096	-0.319743784	0.076839882
8	-0.261345923	-0.291243839	0.082214561
9	-0.229059027	-0.265324279	0.087102617
10	-0.199338886	-0.241465281	0.091602081
11	-0.171717116	-0.219290832	0.095783863
12	-0.14584337	-0.198519677	0.099701004
13	-0.121448347	-0.178935625	0.103394274
14	-0.098320309	-0.160368694	0.10689573
15	-0.076289562	-0.142682656	0.110231062
16	-0.055217857	-0.125766527	0.113421201
17	-0.034990957	-0.109528597	0.116483441
18	-0.015513274	-0.09389213	0.119432253
19	0.00329606	-0.078792207	0.122279882
20	0.021506141	-0.064173357	0.125036786
21	0.039176534	-0.049987763	0.127711985
22	0.056359006	-0.036193865	0.130313316
23	0.073098882	-0.02275528	0.132847639
24	0.089436113	-0.009639933	0.135321005
25	0.105406145	0.003180631	0.137738779
26	0.121040606	0.015731802	0.140105749
27	0.136367879	0.028036365	0.142426213
28	0.151413563	0.040114873	0.144704045
29	0.166200871	0.051985958	0.146942761
30	0.180750943	0.063666593	0.149145561
31	0.195083126	0.07517231	0.151315374
32	0.209215203	0.086517384	0.153454891
33	0.223163591	0.097714994	0.155566599
34	0.236943509	0.108777359	0.157652802
35	0.250569126	0.119715852	0.159715645
36	0.264053686	0.130541106	0.161757132
37	0.27740962	0.141263101	0.163779146
38	0.290648644	0.151891242	0.16578346
39	0.303781845	0.162434429	0.167771753
40	0.316819754	0.172901117	0.16974562
41	0.329772422	0.183299374	0.171706582
42	0.342649473	0.193636928	0.173656096
43	0.355460169	0.203921212	0.175595563

44	0.368213454	0.214159406	0.17752634
45	0.380918004	0.224358477	0.179449738
46	0.393582272	0.234525211	0.181367037
47	0.406214529	0.244666246	0.18327949
48	0.418822901	0.254788106	0.185188328
49	0.431415408	0.26489723	0.187094763
50	0.444	0.275	0.189
51	0.456584592	0.28510277	0.190905237
52	0.469177099	0.295211894	0.192811672
53	0.481785471	0.305333754	0.19472051
54	0.494417728	0.315474789	0.196632963
55	0.507081996	0.325641523	0.198550262
56	0.519786546	0.335840594	0.20047366
57	0.532539831	0.346078788	0.202404437
58	0.545350527	0.356363072	0.204343904
59	0.558227578	0.366700626	0.206293418
60	0.571180246	0.377098883	0.20825438
61	0.584218155	0.387565571	0.210228247
62	0.597351356	0.398108758	0.21221654
63	0.61059038	0.408736899	0.214220854
64	0.623946314	0.419458894	0.216242868
65	0.637430874	0.430284148	0.218284355
66	0.651056491	0.441222641	0.220347198
67	0.664836409	0.452285006	0.222433401
68	0.678784797	0.463482616	0.224545109
69	0.692916874	0.47482769	0.226684626
70	0.707249057	0.486333407	0.228854439
71	0.721799129	0.498014042	0.231057239
72	0.736586437	0.509885127	0.233295955
73	0.751632121	0.521963635	0.235573787
74	0.766959394	0.534268198	0.237894251
75	0.782593855	0.546819369	0.240261221
76	0.798563887	0.559639933	0.242678995
77	0.814901118	0.57275528	0.245152361
78	0.831640994	0.586193865	0.247686684
79	0.848823466	0.599987763	0.250288015
80	0.866493859	0.614173357	0.252963214
81	0.88470394	0.628792207	0.255720118
82	0.903513274	0.64389213	0.258567747
83	0.922990957	0.659528597	0.261516559
84	0.943217857	0.675766527	0.264578799
85	0.964289562	0.692682656	0.267768938
86	0.986320309	0.710368694	0.27110427
87	1.009448347	0.728935625	0.274605726
88	1.03384337	0.748519677	0.278298996

89	1.059717116	0.769290832	0.282216137
90	1.087338886	0.791465281	0.286397919
91	1.117059027	0.815324279	0.290897383
92	1.149345923	0.841243839	0.295785439
93	1.184847096	0.869743784	0.301160118
94	1.224496344	0.901573759	0.307162793
95	1.269716521	0.937876012	0.314008876
96	1.322844408	0.980526487	0.322052141
97	1.388158391	1.032959824	0.331940314
98	1.474981953	1.102660811	0.345084917
99	1.611826633	1.212518193	0.365802438

[INSTRUCTIONS FOR THE TABLE: THE REALIZATION OF THE VARIABLES RETURNX2, RETURNY2, AND RETURNZ2 CAN BE DRAWN BY ASSIGNING ONE OF THE VALUES IN THE RESPECTIVE COLUMN ("RETURNX2", "RETURNY2", OR "RETURNZ2") WITH EQUAL PROBABILITY 1/99. IT IS IMPORTANT THOUGH THAT THE REALIZATION FOR EACH VARIABLE AND EACH PARTICIPANT IS DRAWN SEPARATELY. THAT IS, FOR EACH PARTICIPANT, DRAW A NUMBER BETWEEN 1 AND 99 (WITH EQUAL PROBABILITY) FOR THE VARIABLE RETURNX2. IF THE NUMBER IS FOR EXAMPLE 95, ASSIGN THE RETURNX2=1.269716521. THEN, DRAW A NUMBER BETWEEN 1 AND 99 (WITH EQUAL PROBABILITY) FOR THE VARIABLE RETURNY2. IF THE NUMBER IS FOR EXAMPLE 2, ASSIGN THE RETURNY2=0.032915083. THEN, DRAW A NUMBER BETWEEN 1 AND 99 (WITH EQUAL PROBABILITY) FOR THE VARIABLE RETURNZ2. IF THE NUMBER IS FOR EXAMPLE 74, ASSIGN THE RETURNZ2=0.237894251.]