FINAL CASE STUDY

BANA 6640: Decision Analysis

Professor: Tony Cox Jr.

Date: 29th April 2022

CREATED BY:
URVISH PATEL

Abstract

This report summarises research papers and articles related to Behavioural Decision Theory, which includes the Behavioural Decision Theory Paradox which is all about the relative nature of decisions & how humans make decisions in the face of ambiguity. This report also gives insights on Hyperbolic discounting decisions that come under Behavioural Economics & the effects of the same. It goes something like our tendency to choose immediate benefits over ones that arrive later in the future, even if these immediate rewards are lower. Lastly, the report includes a book review on Decision analysis in Management Judgement by Paul Goodwin & George Wright, which is all about the psychological issues that occur while making managerial decisions without assistance and the decision analysis approaches that can help us overcome them.

Article 1: Behavioural Decision Theory

Introduction

Behavioral decision theory is a psychological theory that describes human judgment, decision-making, and behavior and can be used in political science. The theory can help with risk management and regulation in a variety of ways. In recent years, empirical and theoretical study on risky decision-making has yielded a corpus of information that should be useful to anyone attempting to comprehend and improve social decisions. Now controlling technology dangers has become a major public issue and an increasing government obligation in modern industrial nations.

Despite tremendous attempts to mitigate these threats, many people feel increasingly exposed to them and believe the worst is yet to come. Risk management organizations have become entangled in bitter disputes, stuck between a terrified and dissatisfied public on the one hand and frustrated engineers and industrialists on the other, there is chaos everywhere. The way these conflicts are handled may be in the fate of certain technologies, but also the fate of industrial civilizations and their social structures. The use of behavioral choice theory to risk management and regulation can help in a variety of ways.

Now there is another thing known as the behavioral decision theory paradox. A behavioral decision theory paradox can be explained as when someone selects an option that is later proven to be inferior (but the

decision-maker still prefers the lesser option). Now this paradox can be explained through another theory called “Regret Theory”. We humans indeed anticipate remorse if we make the wrong decision and take this into account when making decisions. Fear of regret can play a crucial impact in either deterring or pushing someone to act. Regret theory can affect an investor's rational conduct, making it more difficult for them to make financial decisions that benefit them rather than hurt them. Here Regret is not an emotional word, rather it is the loss function that usually has two terms, one of which indicates the difference between a total loss and unavoidable loss. This "extra loss," or "regret," must be reduced to the absolute minimum.

Explanation

Suppose, let’s say a person has two options to choose from the following table.

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
A	10	20	30	40	50	60
B	20	30	40	50	60	10

Now, which option should be chosen by the person? Well, most of the time Option B is chosen. This is mainly because Option B is better than Option A in most of the events.

For the same reason, most people will choose Option C than B, according to the following table.

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
B	20	30	40	50	60	10
C	30	40	50	60	10	20

Likewise Option D than C

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
C	30	40	50	60	10	20
D	40	50	60	10	20	30

Likewise Option E than D

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
D	40	50	60	10	20	30
E	50	60	10	20	30	40

Likewise Option F than E

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
E	50	60	10	20	30	40
F	60	10	20	30	40	50

Likewise Option G than F

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
F	60	10	20	30	40	50
G	10	20	30	40	50	60

But now, isn't Option G identical to A? So, consequently the decision-maker exhibits the following preference cycle, where "<" means "is less desirable than",

A < B < C < D < E < F < A (As G = A).

The decision-maker can be "milked" forever if he is willing to pay a fee, no matter how modest, for the privilege of selecting the chosen alternative each time a pair of alternatives is shown. Because the paired alternatives are identical but for a permutation of entries, the above preferences are manifestly irrational.

Explanation by regret theory.

For the same scenario, let's say a person has two options to choose from in the following table.

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
A	10	20	30	40	50	70
B	20	30	40	50	60	10

Well, most of the time Option B is chosen. This is mainly because Option B is better than Option A in most of the events. Now according to the following table which option to choose.

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
B	20	30	40	50	60	10
C	10	20	30	40	50	60

Well, most people will choose B. Now what will the people choose between the options A & C. (Below table)

	Profit Amount for Events in $					
Option	E1	E2	E3	E4	E5	E6
A	10	20	30	40	50	70
C	10	20	30	40	50	60

Now definitely, most of the people will choose A, just because 70>60.

But now,

B > A i.e. B is preferred to A

C = B i.e. C and B are equivalent

A > C i.e. A is preferred to C (therefore A should be preferred to B), Well this is the paradox.

Now the paradox demonstrates the need of weighing all factors when evaluating alternatives. It was required to recognize that two options (B and C) are not always equivalent, even though they have similar outcomes and probabilities. When a decision-maker is competing with another person, the fact that the outcomes occur with different occurrences becomes crucial, and the decision-maker will regret (possibility of loss) having achieved less than a competitor. In this instance, regret factors influence the decision-maker.

Mental accounting

There is one more concept known as mental accounting, our mind calculates things differently from what we expect and most of the time unconsciously. Now consider a genuine real-life scenario with these two cases.

1. You go to the drama theatre with a ticket worth $35, and somehow you lost it before reaching there and you decide to buy one on reaching there.
2. You are going to see a pact, not just drama theatre and you will buy a ticket worth $35 on reaching there but in between say you lost $35 along the way, still you decide to buy a ticket for the drama.

Now, which one do you think you'll do? Most people will go for scenario 2. Although you lost the same money in both cases ($35), you may have set aside $35 for a theatre in the first scenario. Purchasing another ticket would put your mental theatre budget over the top. In the second example, you had not yet surpassed your mental theatre budget because the money you lost did not belong to any account.

Conclusion

In any descriptive (as opposed to normative) theory of risky conduct, such paradoxes, contradictions, or misconceptions show that subjective elements and psychological predilections caused by the way decision issues are stated must be taken into consideration.

Article 2: Hyperbolic Discounting Decisions

Introduction

Hyperbolic discounting is a cognitive bias that characterizes people's tendency to prefer a smaller-earlier reward over a larger-later benefit as the delay occurs earlier rather than later.

There are a lot of real-world examples but the most common is the free shipping offers. Let’s say "If you spend $35 or more, you get free delivery." But you only have $25 in your cart, now from this you are obligated to keep buying to earn the discount. In other words, cognitive bias prefers rapid gratification (justifying a greater purchase with free shipping) to patience and waiting for a bigger payoff (having more money in your bank account and making another purchase when the budget allows).

Another example would be Point Systems & Loyalty Program, offers that are for a limited time only, and Credit cards where you’re Payment might be deferred. These are all examples of hyperbolic discounting, where your mind is eager to spend more to get the discounts.

Explanation

Because it encourages impulsivity and quick reward, hyperbolic discounting can lead to poor decision-making. Short-term gratification decisions frequently overlook and detract from our long-term well-being. Let’s consider a classic example of smoking, the immediate high of dopamine is prized over one's long-term health. While addiction has been connected to an undervaluation of delayed, or long-term results, nicotine addiction has also been linked to an undervaluation of immediate, or short-term outcomes (i.e. impulsivity).

Another way to look at it is that hyperbolic discounting can blind us to the advantages of long-term decision-making, which can occasionally include returns substantially higher than those of more immediate judgments. For example, if one had extra cash, it could be a good idea to put some of it towards retirement. However, prioritizing the immediate enjoyment of purchasing food or clothing too highly may lead to a lack of investment. This may have been a terrible movie, as having this money compound interest for their future retirement would have likely benefited them far more.

Short-term thinking has the potential to harm a wide range of institutions and professions. Government administrations that put political advantage ahead of the public interest during their period in office risk jeopardizing the public good for years to come. Similarly, a company that just cares about quarterly profits may be unwilling to undertake costly changes to its production or management structure that are required for future prosperity. Any profession that involves a long-term cost-benefit analysis is affected. Investors in finance, for example, must weigh the benefits of high short-term yields, which are often associated with high risk, against long-term investments, which often have lower risk and yields.

There are two types of discounting techniques, the first is the Exponential discounting technique, and the second is the quasi-hyperbolic discounting technique.

Let’s take an example, suppose you have two choices from the following table.

Option	Profit	Time
A	$100	Now
B	$200	Next Year

Now for Option A, you can make a profit of $100 now, and in option B you can make a profit of $200 next year. Which option will you choose?

Well, most of the people will go for Option A, as you will make a profit now, you don't want to wit next year for $200.

Now choose one between two options from the following table.

Option	Profit	Time
A1	$100	In 4 Years
B1	$200	In 5 Years

If you chose B1, you're one of the many people. Most people will choose option B1 only. Now let me explain why exponential discounting does not work here.

Let's take exponential delta's discount rate = **d (0, 1)** (delta).

For Option A, the utility of getting $100 today is = **100** ($1 per utility unit).

For Option B, the utility of getting $200 in a year = **200*(1-d)** ($1 per utility unit & discount factor).

So, for options A & B the $\blacktriangle u_1 = 100 - 200*(1 - d)$ → Equation1

Now, for Option A1, the utility of getting $100 in 4 year = $100*(1-d)^3$ ($1 per utility unit & discount factor).

For Option B1, the utility of getting $200 in 5 year = $100*(1-d)^4$ ($1 per utility unit & discount factor).

So, for options A1 & B1 the $\blacktriangle u_2 = (1-d)^3 [100 - 200(1 - d)]$ → Equation2

So now, most people chose Option A over Option B, which means **Equation1 > 0**. Same way, most people chose Option B1 over Option A1, which means **Equation2 also should be > 0.** That means people should choose A1 over B1, but they chose the total opposite. This is why the theory of exponential discounting does not work over here.

Now let's work the same example with the quasi-hyperbolic discounting technique. Here too our delta will remain the same (d). But will add one more unit known as beta (b) which is a factor, it discounts all future periods with a constant.

So now, let's take a beta factor of quasi-hyperbolic discounting = **b (0, 1)** (beta).

For Option A, the utility of getting $100 today is = **100** ($1 per utility unit).

For Option B, the utility of getting $200 in a year = **200*(1-d)*(b)** ($1 per utility unit, discount factor, & discounting from beta).

So, for options A & B the **$\blacktriangle u_3 = 100 – 200*(1 - d)$** → Equation3

The same goes

For Option A1, the utility of getting $100 in 4 year = **$100*(1-d)^3*(b)$** ($1 per utility unit, discount factor, & discounting from beta).

For Option B1, the utility of getting $200 in 5 year = **$100*(1-d)^4*(b)$** ($1 per utility unit, discount factor, & discounting from beta).

So, for options A1 & B1 the **$\blacktriangle u_4 = (b)*(1-d)^3 [100 – 200(1 - d)]$** → Equation4

For normal people the value of (**[100 – 200(1 - d)]**) in Equation4 should be **< 0** (considering at most discount would be 10%), value of (**$1-d)^3 > 0$** from exponential equations and (**b)** is also > 0. So overall our **$\blacktriangle u_4$** should be **< 0.**

Now we can explain why people chose B1 over A1.

For choices made between Option A & Option B, let's look at Equation3,

$\blacktriangle u_3 = 100 – 200*(1 - d),$ let's give the discount value (d) = 0.1,

So **200*(1 - d) = 180,** now if the **(b)** is smaller enough like **(b) = (0.5)**.

Now, our **$\blacktriangle u_3 > 0$** as **$\blacktriangle u_3 = 100 – 180*(0.5); \blacktriangle u_3 = 10$**.

From this, we can reason why people choose Option A over Option B.

How can we explain regret theory through this example? Now consider yourself in a situation where you have to choose between Option A & Option B. See the table below for how regret works. For (d) = 0.1 & (b) = 0.5

Option	Today	Next Year
A $\blacktriangle u_1$	**$100**	**$100**
B $\blacktriangle u_2$	**200(1 - d)*(b) = $90**	**$200**

Suppose you made a choice this year and got $100 but **$\blacktriangle u_1$** in next year will be the same as $100. For **$\blacktriangle u_2$** today's utility will be $90, though you will not get this until next year. Now you are into next year and think back about the choice you made of choosing Option A, you will think that if I would have chosen Option B then I would have made more now. This is regret. You

thought of getting more today but did not think of getting more than this next year.

Conclusion

We tend to choose immediate benefits over ones that arrive later in the future, even if they are less, which is known as hyperbolic discounting.

It is a variant of the wider phenomena known as "delay discounting," but it differs from it in that it is not consistent over time. People may be willing to wait longer for rewards they anticipate receiving in the far future, but not for minor delays in rewards, they anticipate receiving in the near future. This occurs because decision-makers are typically risk-averse, and long-term gains are regarded to be riskier than immediate returns due to their uncertainty. This is due to "temporal myopia," or the inability to assess the future.

Article 3: Book review on Decision Analysis on Management Judgement.

Introduction

Decision Analysis on Management Judgment is written by **Paul Goodwin & George Wright**. Paul Goodwin is a management science professor at the School of Management at the University of Bath. He is the Editor-in-Chief of the International Journal of Forecasting and a member of the editorial board of the Journal of Behavioral Decision Making. George Wright is a professor at the Strathclyde Business School at the University of Strathclyde. He is an Associate Editor of Decision Support Systems and the International Journal of Forecasting, as well as the Editor of the Journal of Behavioral decision making.

Economic forecasting, judgmental forecasting, uncertainty & human perception, a combination of statistical models (particularly in spreadsheets) and judgments, and their usage in modern forecasting software are just a few of Paul Goodwin's well-known works. While George Wright's work focuses on scenario planning, strategic decision making, organizational behavior, human decision-making processes, business science, and risk analysis.

Without employing mathematical notation or tools that are outside the scope of most of the book's intended readership - practical managers and business students - presents and explains decision analysis approaches.

The material is covered in sufficient depth to allow readers to apply methods appropriately and with full knowledge of their rationale, assumptions, and limitations. Rigorous in its presentation of methods - the material is covered in sufficient depth to allow readers to apply methods appropriately and with full knowledge of their rationale, assumptions, and limitations.

This book covers a wide range of decision-making techniques. Topics include descriptions of unique methods geared to handle resource allocation and negotiation difficulties, as well as a demonstration of how decision analysis can be used in concert with scenario planning in strategic decision making, which are rarely if ever, covered in other textbooks.

Overview of the book.

The following is a breakdown of the book's structure. The biases that might occur when unaided decision-makers face decision issues with many objectives are discussed in Chapter 2. Chapter 3 shows how to use decision analysis to solve situations like these. This chapter focuses on problems in which there is little or no uncertainty about the outcomes of various courses of action. Uncertainty is handled in Chapters 4 and 5, where it illustrates how probability theory can be used to assess uncertainty and how the decision maker's attitude to risk can be incorporated into the analysis.

Chapters 6 and 7, shows how to use decision trees, influence diagrams, and simulation models to assist in elucidating this complexity. Of course, judgment is at the heart of every decision. Decision analysis isn't meant to take the place of these judgments; rather, it's meant to give a framework for decision-makers to clarify and articulate them. Chapter 8, shows how a decision-maker should revise their judgments in light of new information, and Chapter 9, it focuses on psychological research on how good people are at estimating probability using judgment. The ramifications of this research are discussed in Chapter 10, where it shows how to extract probabilities from decision-makers using methodologies that have been established.

Most managers, according to data, regard their responsibility as attempting to reduce and manage risks whenever possible. Chapter 11 demonstrates

how decision analysis models may be used to structure risk and uncertainty management so that the components of a decision with the greatest potential for lowering risks or maximizing opportunities can be identified. Although decisions made in organizations are ultimately the responsibility of an individual, the decision-making process frequently involves a group of people. Chapters 12 and 13 discuss issues that can arise in group decision-making and the function of decision analysis in these situations.

Decision conferencing and resource allocation challenges between conflicting areas of an organization are given special attention. Because the original choice problem was wrongly phrased, major errors in decision-making can occur. In particular, when it comes to strategic decision-making, the decision can be made without taking into consideration fundamental changes in the organization's environment. As a result, overconfident decisions based on obsolete assumptions are possible. Chapter 14 discusses framing problems and the cognitive inertia that can accompany them, while Chapter 15 demonstrates how scenario planning, a different technique of dealing with uncertainty, can serve to alert decision-makers to potential environmental changes.

Alternative forms of decision assistance, such as the analytic hierarchy process, bootstrapping, and expert systems, are contrasted with the other choice-aiding approaches addressed in the book in Chapters 16 and 17. Chapter 17 also examines the key questions that a decision-maker should ask to maximize the effectiveness of decision-aiding methods and concludes with a summary of the different types of problems that the various methods are designed to address.

Some Interesting concepts from the book

Normative theory:

The most optimal decision for a given scenario is modeled by normative decision theory. Normative decisions are always taken with the goal of getting the highest expected value. Only a rational person is capable of exactly calculating the highest expected value.

In this theory, the leader facilitates the process while allowing the group to make the final decision. If the group is unable to establish a consensus, this may include making the decision. Consider an executive who requests his or her executive team to come up with a catastrophe recovery strategy.

The normative model is just the proper response for quantitative judgments (e.g., population of cities, proportions of heads in coin tosses). This also applies to comparative questions like, which city has the most population? Departures from the correct responses can also be quantified in a variety of ways.

One type of normative model, which is applied to a group of similar judgments, scores the judgments by distance from 0 (no) or 1 (yes) and applies some formula to these scores for evaluations of the probability of unique events. A similar strategy is to group judgments with the same stated likelihood and inquire if the proportion is correct.

Alternatively, we might examine the coherence, or agreement, between probabilities of linked unique events. You are not coherent if you declare that the probability of P winning a competition is 0.5 and the probability of V winning is 0.6.

We can occasionally analyze the consistency of judgments using basic decision-making principles such as dominance (if P is better than V in some cases and worse in no cases, then choose P).

Most of the time, we evaluate the coherence of sets of decisions by applying a mathematical model to define coherence, such as expected-utility theory or exponential discounting.

Multi-attribute theory:

Decision Trees, a visual decision support tool that maps out choices and their likely results, are frequently used by managers who desire an organized approach to decision making. Basic decision trees, on the other hand, are limited in their ability to handle complicated problems involving several competing decision criteria. Multi-attribute decision analysis is a broad term for a systematic approach to various types of situations (MADA). In its most basic form, the MADA procedure consists of four stages:

1. Defining the decision and identifying the goals and objectives that the decision-maker must meet
2. All choice alternatives and any relevant attributes that address the decision-making objectives are identified.
3. Preferences can be specified for each of the individual attributes as well as between the attributes in the framework.
4. Given the attribute data for each of the choice alternatives, rank the decision alternatives according to the supplied preferences.

SMART Decision Making:

Goals give us focus and direction, yet many of us have trouble achieving them. The SMART Formula is one technique to ensure that goals are clear and succinct. Particular, measurable, attainable, relevant, and time-bound is an acronym that stands for specific, measurable, achievable, relevant, and time-bound.

Specific - The more clearly defined your goal is, the easier it will be to set a course and stay motivated. To begin, consider what you want to achieve and why it is so essential to you. After that, think about where and/or how you'll accomplish it. For instance, I want to pay off $5,000 in debts by paying at least $150 per month.

Measurable - Financial goals are the easiest to measure because the numbers are visible, but other goals are more difficult to quantify. Consider how you'll know when you've reached your aim. For example, I'll keep track of my progress by making sure I pay $150 every month. When I've paid off all of my debts, I'll know I've achieved my aim.

Attainable - Your objective should be challenging but not impossible to achieve. Identify any potential roadblocks to your aim, and then consider whether it is still feasible. For example, instead of eating out frequently, I may meet my aim by bringing my lunch to work.

Relevant - Determine whether this objective aligns with your desires and is something you are willing and able to work toward at this point. Make sure your objective is something you're passionate about! For example, I'd like to pay off my bills so that I may start saving for a Caribbean vacation.

Time-bound - Goals must be completed by a specific date. When we have a deadline, it creates a sense of urgency in us, and we are more likely to strive toward achieving our goal. For instance, I plan to pay off this debt in 36 months.

Uncertainty Management Theory:

Reduced predictability and control over events and the world around us might be seen as the source of subjective uncertainty. Within communication science and social psychology, there are various approaches to characterize the nature of uncertainty, its antecedents and

predictors, and the tactics that people use to manage and reduce uncertainty.

Uncertainty reduction theory, uncertainty management theory, and methods to uncertainty management are three popular theories of uncertainty in communication that focus on states of uncertainty and decreased predictability in the context of interactive communication with others. Communication with others is fundamental to the generation, maintenance, and management of uncertainty in these ideas. The methods in which these three communication-based approaches understand uncertainty and its management in communicative contexts also differ. Uncertainty reduction theory views uncertainty as an unpleasant state that people strive to eliminate. Alternatively, while anxiety/uncertainty management theory and approaches to uncertainty management treat ambiguity as an aversive state, they also include instances in which uncertainty may be a desirable state.

The concept of uncertainty has been treated differently in social psychology. Individuals' tolerance for and experience with uncertainty has been regarded as a persistent individual difference or a personality trait in certain methods. Uncertainty has also been described by social psychologists as a component of a person's identity and self-concept. Uncertainty-identity theory, for example, describes uncertainty as a context-invoked unpleasant condition connected with diminished perceived predictability of self and others—uncertainty about who one is, how one should behave, and how others would treat one. Individuals are driven to eliminate such uncertainty by seeking group memberships, according to the idea, because organizations give a framework for self-definition that aids in the management of self-conceptual uncertainty.

While this theory has been used to understand when and why people seek information about their relationship partners, relationship problems, and general relational uncertainty in health contexts, it can also be used in interpersonal contexts to understand when and why people seek information about their relationship partners, relationship problems, and general relational uncertainty.

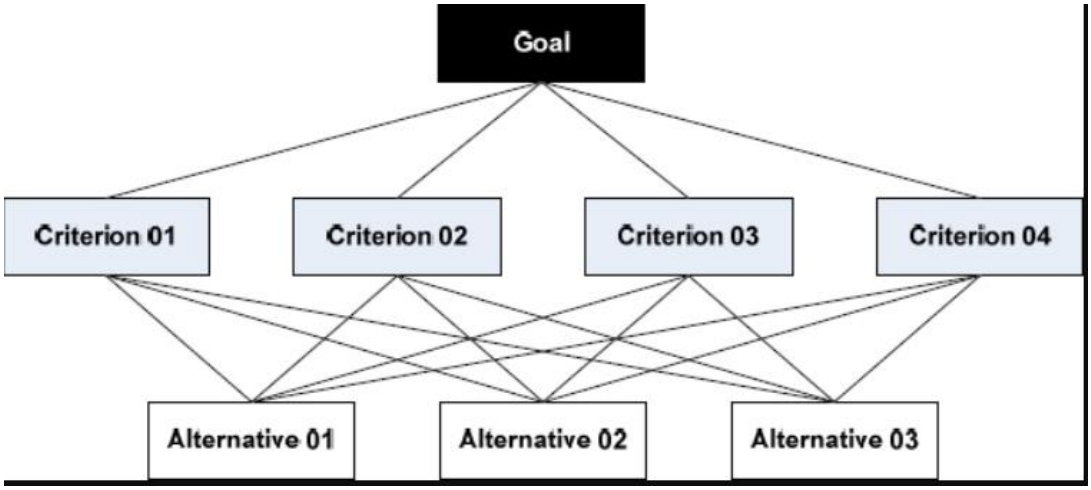
Analytic hierarchy process:

The analytic hierarchy process is used to perform multi-criteria programming, which is a strategy for making decisions in complicated

situations where many variables or criteria are examined in the prioritizing and selection of alternatives or projects.

AHP was created in the 1970s by Thomas L. Saaty and has since been extensively explored. It is now utilized in complex decision-making scenarios where individuals collaborate to make decisions where human perceptions, judgments, and outcomes have long-term ramifications (Bhushan & Rai, 2004).

The use of AHP begins with the decomposition of an issue into a hierarchy of criteria so that it may be studied and compared independently (Below Image). After constructing this logical hierarchy, the decision-makers can use pair-wise comparisons for each of the criteria to systematically evaluate the options. As a technique to input subordinate information, this comparison may use concrete data from the alternatives or human assessments (Saaty, 2008).



The empirical comparisons are transformed into numerical values, which are then processed and compared using AHP. The weight of each factor enables the evaluation of each element within the given hierarchy. When compared to other comparing techniques, the AHP technique's capacity to turn empirical data into mathematical models is its most distinguishing feature.

The numerical probability of each alternative is computed once all of the comparisons have been done and the relative weights between each of the criteria to be examined have been defined. The possibility that the alternative will achieve the intended aim is determined by this probability. The higher the likelihood, the more likely the alternative is to meet the portfolio's ultimate goal.

References

Crossref DOI link: https://doi.org/10.1016/J.JMATECO.2016.04.001

BEHAVIORAL DECISION THEORY By WARD EDWARDS Engineering Psychology Group, Willow Run Laboratories, University of Michigan, Ann Arbor, Michigan.

Decision Analysis for Management Judgment Third Edition Paul Goodwin The Management School, University of Bath, George Wright Durham Business School, University of Durham.

A BEHAVIORAL DECISION THEORY PARADOX by Harold Bierman, Jr. Cornell University.

https://www.elsevier.com/social-sciences-and-humanities/economics-econometrics-and-finance/journals

Testing hyperbolic discounting in consumer decisions: Evidence for Argentina Hildegart A. Ahumada, Maria Lorena Garegnani.

https://gbr.pepperdine.edu/2012/08/making-decisions-with-multiple-attributes-a-case-in-sustainability-planning/

https://www.frontiersin.org/articles/10.3389/fpsyg.2012.00577/full