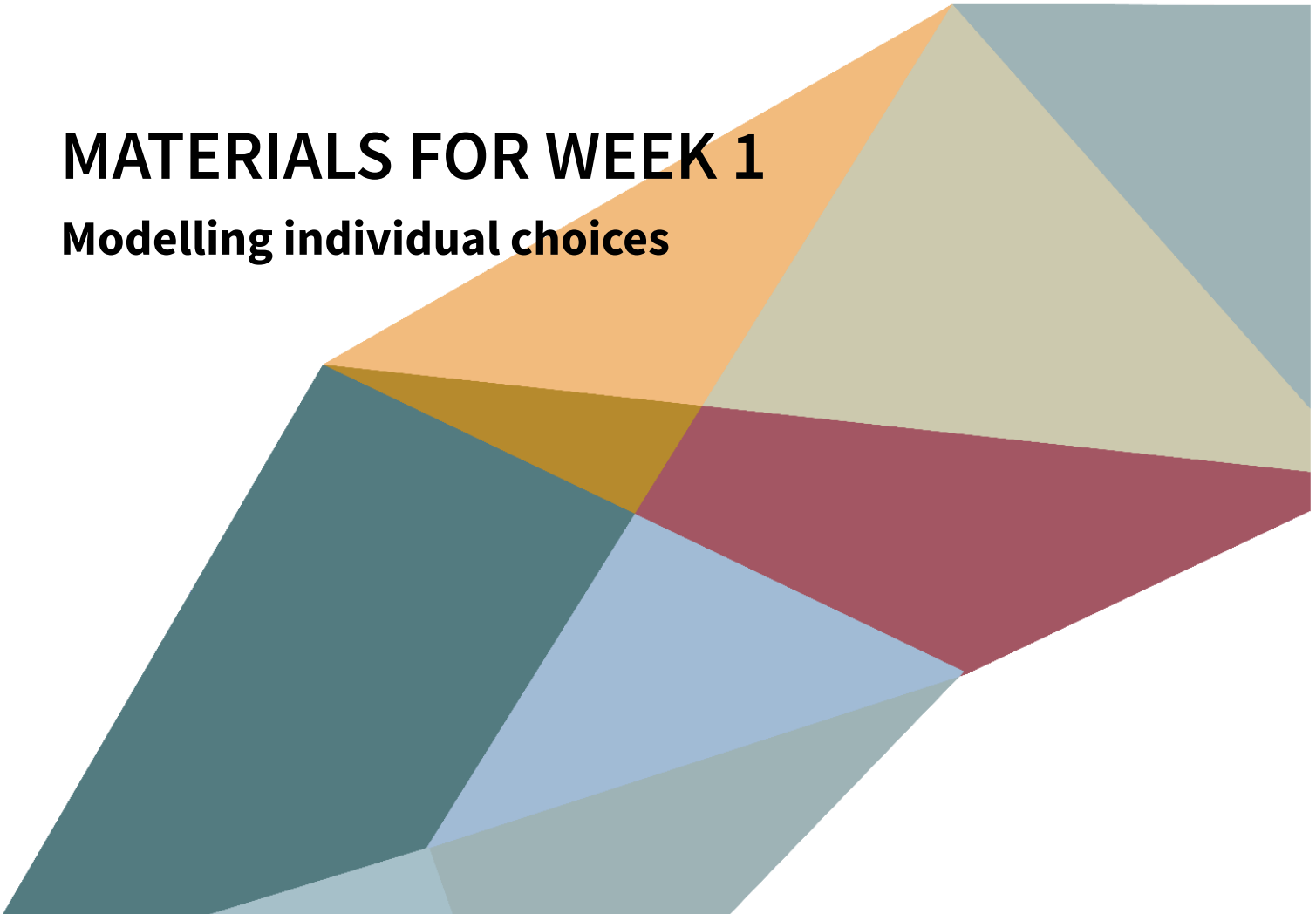
ACTISS
ACTION FOR COMPUTATIONAL THINKING
IN SOCIAL SCIENCES

THEMATIC COURSE

Decision Making in a Complex World: Using Computer Simulations to Understand Human Behaviour

MATERIALS FOR WEEK 1

Modelling individual choices



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Modelling individual choices

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ACTION FOR COMPUTATIONAL THINKING
IN SOCIAL SCIENCES
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OVERVIEW OF THIS WEEK'S MATERIALS

This week we will reflect on how **people** make decisions and judgments. We will think about what a rational decision is and how it can be modeled. We will see how choice behavior may change depending on the circumstances. Finally we will discuss the theory of bounded rationality developed by psychologists and economists and see how it can help us understand choices when information available is scarce and cannot be relied upon.

STRUCTURE OF THIS WEEK'S MATERIALS

Welcome to the course.
In these steps we introduce the course and its educators.

STEPS:

Welcome to the course! – ARTICLE
Introductions – DISCUSSION
Modelling individual behaviour - VIDEO

Classical Choice Theory

STEPS:

How do people make choices? – DISCUSSION

Rational choice in economics – VIDEO

What preferences can become utilities? – ARTICLE

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Theories to predict and theories to prescribe – ARTICLE

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Pick a card, any card - POLL

Who is the underaged drinker? - POLL

Human cognition - POLL

Rounding up Week 1
In this step we summarize Week 1.

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EDUCATIONAL MATERIALS

1. Welcome to the course! – ARTICLE

Choosing between a healthy apple and an unhealthy doughnut © Andres Ayrton on Pexels.com

Welcome to the course Decision making in a Complex World: $#$#subtitle.

Within the next three weeks, you will be exploring how human decision making can be represented in computer simulations. We will see how this helps to understand both the individual choices and the social dynamics of change, such as transitions in our diet, dealing with an energy transition, and adapting to a virus. On the way, you will have the opportunity to experience how computational approach to social problems works, with a focus on modelling decision making and social simulations. For that, we will use examples, and game-like tools - no mathematical and programming skills are required!

Each week of the course has a specific focus:

Week 1: How people make decisions

This week you will reflect on how people make decisions and judgments in a complex world. We will talk about how people choose houses, tea and means of transport. You will see that we can think about decisions in many

different ways and that it is often not obvious what a rational choice. On our way through the week we will talk about utilities, attributes, bounded rationality, and algorithms.

Week 2: Social influences

This week, you will explore how individual decisions can be influenced by our social networks. You will see how this sociality of individual decisions can shape the environments in which we live. We will talk about information sharing and social norms. You will also have the opportunity to play with some simple computer models.

Week 3: Integrated models

This week you will have a chance to see how knowledge from various disciplines such as psychology, sociology, and economics can be used to understand our world better. We will talk about habits, innovation spread, city referenda, and social policy. You will also have the opportunity to think about models themselves and reflect on how they should be built to be useful.

Each week you will learn by engaging in different activities, such as watching videos, undertaking quizzes, reading articles, doing exercises, and discussing topics related to social dynamics with other learners.

###What will you learn?###

At the end of the course you should be able to:

- Explain how humans make decisions, according to classic and more contemporary theories on human decision-making from different disciplines: economics, psychology, and sociology.
- Explain how the environment and societal clues can shape choices and the other way around.
- Apply a simple algorithm / model describing a decision process in a chosen situation.
- Experiment with different individual decision processes and their impact on the social level.
- Debate the need for accurate representation of individual choice and decision behaviour when analysing social phenomena.
- Identify which human behaviour has been included in a (computational) model.

problems that we face when we share goods or when we need to cooperate and you'll be investigating some solutions that can help deal with those problems. On the way, you'll have a chance to experience how computational approach to social problems works, with a focus on game theory and social simulations.For that we will use examples, animations and game-like tools - no mathematical and programming skills are required!

Share with others

We are looking forward to your contributions in the comment sections. Also, consider joining us on social media to build the debate. For those of you who use Twitter, the hashtag #FLdecisionmaking will help you to share ideas and experiences of the course. Don't forget to check your privacy settings before posting anything to the course hashtag, to ensure you are happy.

More on social dynamics, modelling and simulations

This course is a part of ACTiSS - an educational initiative Action for Computational Thinking in Social Sciences - if you're interested in the project, please check out our website.

2. Introductions - DISCUSSION

The ACTISS project team

In this step the course team is introduced and we invite you to introduce yourselves as well.

Katarzyna Abramczuk, lead educator.
is a social scientist working at the University of Warsaw. She specializes in interdisciplinary research on decision making and social research. Her expertise spans several subject areas including formal modelling in social sciences, cognitive psychology, methodology of social research, statistics, and digital sociology.

Wander Jager, lead educator
Wander Jager (1962) is a social scientist with a broad interdisciplinary interest in social complex phenomena and transition to a sustainable society. Being inspired by the work of John Holland on chaos and self-organisation in the 90's, he has since then been working and teaching on social dynamics. His PhD thesis "Modelling Consumer Behaviour" integrated key behavioural theories into a computer simulation of human population behaviour. Over the last 25 years he has been working on social simulation projects addressing the dynamics of opinions, the societal processes of acculturation related to migration, the diffusion of sustainable products and practices, on littering and cleaning strategies, crowd behaviour, team performance, and social innovation in communities, to mention a few examples.

Esther Arrindell, online learning designer

Esther Arrindell (1974) is online learning design specialist and video-in-education expert at University of Groningen. She specialises in supporting experts from different disciplines in building inspiring online education. For this, she uses her experience as a teacher trainer, as project manager, and her love for research in the fields of education and psychology.

Tom Spits, online learning designer
Tom Spits is online learning design specialist and video-in-education expert at University of Groningen. He specialises in designing Massive Open Online Courses and has co-created all of University of Groningen's FutureLearn courses since 2014.

The course was co-developed with support from Computational Social Science specialists:

Agata Komendant-Brodowska, Sociologist
Hi, my name is Agata Komendant-Brodowska, I'm a sociologist at the University of Warsaw and I'm passionate about using models and simulations in order to understand social processes. I love the way even simple models can help illuminate some important issues related to what happens in our society. I'm leading the project "Action for Computational Thinking in Social Sciences" and we created this course as a part of this project.

Anna Baczko-Dombi, social researcher
Hi, my name is Anna Baczko-Dombi and I'm a social researcher from the University of Warsaw. I'm leading the Digital Sociology masters programme and I love translating difficult things into easy and understandable ones. In this course we designed the materials in such a way that they are accessible and understandable. I hope you will experience that modelling and simulations are fun and much easier than they might sound.

Nataliia Sokolovska, technical project manager.
Hi, my name is Nataliia and I'm a researcher and project manager at the Alexander von Humboldt Institute for Internet and Society in Berlin, where we study digitalisation of society. I'm passionate about finding ways how to connect the world of academic research with societal needs with the help of using digital tools. In the project **Action for Computational Thinking in Social Sciences**, I developed and implemented strategies for transforming analog study materials into an online course.

Franziska Cagic, video editor and producer.
Hi, my name is Franzi and I'm a video producer and editor. I enjoy creating visual instruments that explain complex material in an accessible format. In the project **Action for Computational Thinking in Social Sciences**, I was shooting and editing the course videos, and designing short animations.

We would also like to thank Manvi Agarwal who contributed to developing the basic models of network dynamics and Shaoni Wang, who worked out the simulation exercises.

Support

We also thank David, for his wonderful support in getting all texts, videos and images to the platform.

ACTISS

This course is a part of ACTiSS - an educational initiative Action for Computational Thinking in Social Sciences, co-funded by Erasmus+. It's aim is to develop engaging and accessible online courses introducing the basics of computational social sciences. The project is carried out by a team of simulation, modelling and open education enthusiasts from three partner institutions: University of Warsaw (leader), University of Groningen and The Alexander von Humboldt Institute for Internet and Society. The project is funded by Erasmus+ KA2: Strategic Partnership in the Field of Higher Education. If you'd like to know more, please check out our website.

University of Warsaw

University of Warsaw is the leading research university and the largest higher education institution in Poland, with a comprehensive portfolio of research and teaching activities.

University of Groningen

The University of Groningen is a research university with a global outlook, deeply rooted in Groningen, in the north of the Netherlands.

HIIG

The Alexander von Humboldt Institute for Internet and Society from Berlin is exploring digitalisation together with economic, political and civil society stakeholders.

Safe language

When discussing topics around behaviour, it is possible that we will touch on sensitive issues. While it is important that we remain open to debate and differing perspectives, we also must recognise that certain kinds of racist, dismissive or demeaning language can cause real harm and psychological distress. We would like to remind you that even as we welcome constructive discussion, we also want to ensure that we all follow the FutureLearn Code of Conduct.

Over to you

So, now you know who we are and what you can expect from us. Maybe you would want to introduce yourself in the discussion section on this page. Please use a few sentences on who you are and why you have joined this course. Also have a look at what other learners posted and start learning together.

3. Modelling individual behaviour – VIDEO

Click on the icon to view the video

Why on earth should we replicate humans in computational models, whilst there are actually almost eight billion real people we can study? And indeed, in the social sciences a lot of experimentation takes place to learn about how we - as humans - make decisions, change our mind and perceive the world. And probably you have been filling in polls and surveys, that all add to the knowledge social science has about preferences and opinions of different people.

In this video we discuss why it is interesting to model human behaviour, and what the challenges are in going from a simple optimising model towards more realistic behavioural drivers and processes.

4. How do people make choices? – DISCUSSION

Choosing between a healthy apple and an unhealthy doughnut © Andres Ayrton on Pexels.com

Let's start our journey with a short thought experiment. Below we present a few decisions that people make. Some of them are big decisions that we typically only make once or a few times in a lifetime. Others are everyday decisions that we make repeatedly. Some examples of decisions you need to make that you could think of are the following:

- What to have for lunch?
- Whether to drive or ride a bike to work?
- Which car to buy?
- Whom to go on a date with?
- Where to spend holidays?
- Where to sit on a bus?
- What flat to rent?

Please think of situations like these (you can of course introduce your own examples) and reflect on the following questions:

How do you (or people in general) make these decisions? What information is important to make them? What can influence the choice? Are they made the same way? Please share your reflection in the comments. Keep a note of your thoughts. We will come back to it later.

5. Rational choice in economics – VIDEO

Click on the icon to view the video

In this video we talk about the classic understanding of what is a rational choice.

6. What preferences can become utilities? - ARTICLE

Cup of tea ©Anna Pou via Pexels

In the previous video, we said that utilities are just numbers chosen to represent preferences revealed by people's choices. We can say that utilities are models of preferences or models of choices. There are two important types of utilities: ordinal and cardinal. Cardinal utilities require thinking about lotteries and probabilities. Ordinal utilities are much simpler, but they still can give you a feeling of how classic choice theory approaches choice and rationality. We will introduce them now.

Ordinal utilities

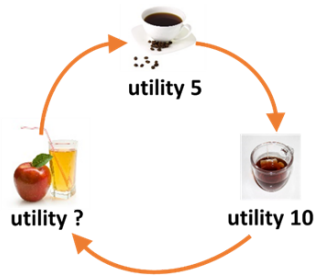
Ordinal utilities can be used to model preferences that allow for ordering all the possible options from the most to the least preferred. If such an ordering is not possible, the preference cannot be described using ordinal utilities and is called irrational. An example of such (rational) ordering is presented below. The arrows point from the less to the more preferred option.

In this example, tea is the most preferred option. It is better than both coffee and juice. Coffee is the second best option. It is better than juice, which is the least preferred option. The last row of the table contains exemplary utilities that can be used to describe these preferences. The numbers were chosen completely arbitrarily. There is only one condition: the more preferred option has to get a higher number than the less preferred option.

When we look at an example like this, the classical approach seems fairly straightforward. Afterall, what could possibly happen to make ordering the options impossible? Well, simplifying slightly*, there are two cases in which things could go wrong. First, the order might become a circle. Second, there might be gaps in the ordering. We will now look at these two cases.

Circular Preferences

Imagine a person who prefers tea to coffee, coffee to juice, and juice to tea. If we wanted to illustrate these preferences on a graph similar to the previous one, we would get something like this:



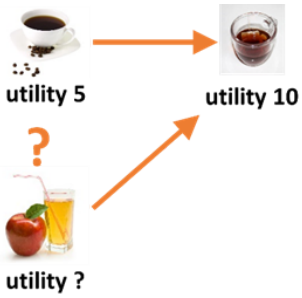
Ordering these options according to preference is not possible, because the preferences form a circle rather than an order. Consequently, there are no numbers to represent these preferences. If we assign 10 to tea and 5 to coffee, we will have problems assigning a number to juice. We will need a number that at the same time is greater than 10 (juice is better than tea) and smaller than 5 (juice is worse than coffee).

In the classic choice theory, such preferences are called nontransitive. **Transitivity** means that if option A is at least as good (could be better or equally good) as option B and option B is at least as good as option C, then option A should be at least as good as option C.

Gaps in Preferences

Imagine now a person who prefers tea to coffee and tea to juice, but is unable to choose between coffee and juice. There is no preference there. This **does not mean** that coffee and juice are equally good. It means that if we asked this person to choose between coffee and juice, they could say, for example, that these two drinks are

incomparable. If we wanted to illustrate these preferences on a graph similar to the previous one, we would get something like this:



Ordering these options according to preference is not possible, because there is a gap in preferences. Consequently, there are no numbers to represent them. We do not know which number to assign to juice. It has to be smaller than 10, that is for sure. But should it be smaller, equal, or larger than 5?

In the classic choice theory, such preferences are called incomplete. **Completeness** means that for every possible pair of options, there is some preference: one option is better than the other, or they are equally good.

Real choices

Ordinal utilities exist if preferences are transitive and complete. In the classical approach, such preferences are called rational. In real life, it is often the case that preferences do not follow these rules. Intransitive preferences are a common occurrence in real life. If you are interested in an example and want to learn about their consequences, watch this video with Johanna Thoma from the London School of Economics.

Click on the icon to view the video

Johanna Thoma on "Money Pump," argument & rational choice

Incomplete preferences are also sometimes encountered. People can perceive certain options as impossible to compare because, to them, they seem to belong to different domains. For example, coffee and a cupcake can be incomparable, because one is food and the other a drink. Sometimes there is no preference because the choice maker has no experience with some or both options, for example, choosing between Cherimoya or Kiwano. Finally, both options can be valued too high to choose between them, for example, choosing between health and freedom.

Cardinal utility notes

Economists typically use the stronger type of utilities, called **cardinal utilities**. They are also numbers representing preferences, but they are devised to tell us not only which option is better, but also by how much.

There are a number of conditions that have to be met beyond completeness and transitivity for these utilities to exist. They refer to choosing between lotteries.

8. Questions about the utility concept - QUIZ

Check your understanding of the utility concept with these questions.

QUESTION 1

The movie preferences of four people are presented below. Whose preferences are transitive?

- **Agatha: *"Romantic movies are better than thrillers, thrillers are worse than comedies, and comedies are better than romantic movies".***
- Beatriz: *"Horror movies are better than dramas, dramas are better than comedies, comedies better than horror".*
- **Cadeo: *"Action movies are worse than fantasy movies, fantasy and historical movies are equally good, and historical movies are better than action movies".***
- Dabang: "*Science fiction movies are better than westerns, science fiction and action movies are equally good, and action movies are worse than western".*

QUESTION 2

The movie preferences of four people are presented below. If some preferences are not given it means they do not exist. Whose preferences are complete?

- **Agatha: "*Romantic movies are better than thrillers, thrillers are worse than comedies, and comedies are better than romantic movies".***
- Edmund: *"Horror movies are better than dramas, and dramas are better than comedies".*
- **Dabang: *"Science fiction movies are better than westerns, science fiction movies and action movies are equally good, and action movies are worse than westerns".***
- Fadil: *"Comedies are better than romantic movies, romantic movies are better than thrillers, and thrillers are better than horror movies".*

QUESTION 3

Do you recall Agatha's movie preferences: romantic movies are better than thrillers, thrillers are worse than comedies, and comedies are better than romantic movies. Which numbers can be used to represent these preferences?

- **romantic movies: 5, thrillers: 3, comedies: 7**
- romantic movies: 8, thrillers: 3, comedies: 7
- romantic movies: 5, thrillers: 5, comedies: 7
- **romantic movies: 8, thrillers: 2, comedies: 9**

QUESTION 4

What do we need to know to check if some decision was rational according to rational choice theory based on revealed preference and utilities?

- **What was chosen**
- What influenced the choice
- How fast the choice was made
- What information was used to make the choice

9. Theories to predict and theories to prescribe - ARTICLE

Frowning child with fresh vegetables ©Storyblocks

Classical choice theory was originally thought to be a descriptive theory. Descriptive theories are built to describe how people make decisions. For example, what do people choose, what happens with a market if the price of a product increases, and how do experiences and opinions on product quality spread through social networks? In contrast with descriptive theories we use the concept of Normative theories to describe theories that set out to determine how decisions should ideally be made, and what is the best option to choose.

Not only was classical choice theory originally thought to be a descriptive theory, it was also claimed that it describes only what people choose, and not **how** they choose it. This is why it was referred to as **outcome-based** or an '**as if**' model. The classical choice theory simply states that a decision is rational when the observed outcomes are consistent: the decision-makers choose *as if* they were maximizing their utility. In classical choice theory one does not need to understand **how** people make decisions, and what information they use. This is often not needed in economics applications that set out to **predict** market behaviour. The classic understanding in economics is that while utilities may not accurately model the psychological mechanisms of decision making, they allow for correctly predicting choices.

Nowadays it is argued that classical choice theory is a normative theory because we have learnt quite a bit about the differences between what this theory predicts and what actually happens in reality. We will talk about this briefly later on. However, sometimes a utility-based approach can be used in a normative way. This

decision-support type of use is popular in business, management, and public policy, where people are often faced with very complex decision problems with multiple and difficult to compare consequences or attributes. This creates a need for tools that help them to make better decisions by dividing large problems into smaller ones that are easier to assess. An example of such a tool is Multi-Attribute Decision Analysis.

10. Predict or prescribe - DISCUSSION

We would like you to perform a simple exercise illustrating the difference between descriptive and normative approaches.

Look at the illustrations and think of the different (individual and social) outcomes that are relevant for the person in question. Can you think of his/her behaviour as providing optimal outcomes for the person? Can you also imagine this behaviour being not the optimal choice? Why?

Try to answer the following two questions:

1. What is the person doing in the illustration?

2. What should the person be doing?

1. a person in sports clothes in an elegant restaurant or in a fancy party;
2. a person eating with a fork and knife in an Asian restaurant where everybody uses chopsticks;
3. a person leaving a safe mountain trail and entering the deep forest/wilderness;
4. a person choosing between a long and a short cue in a supermarket and deciding to choose the long one.

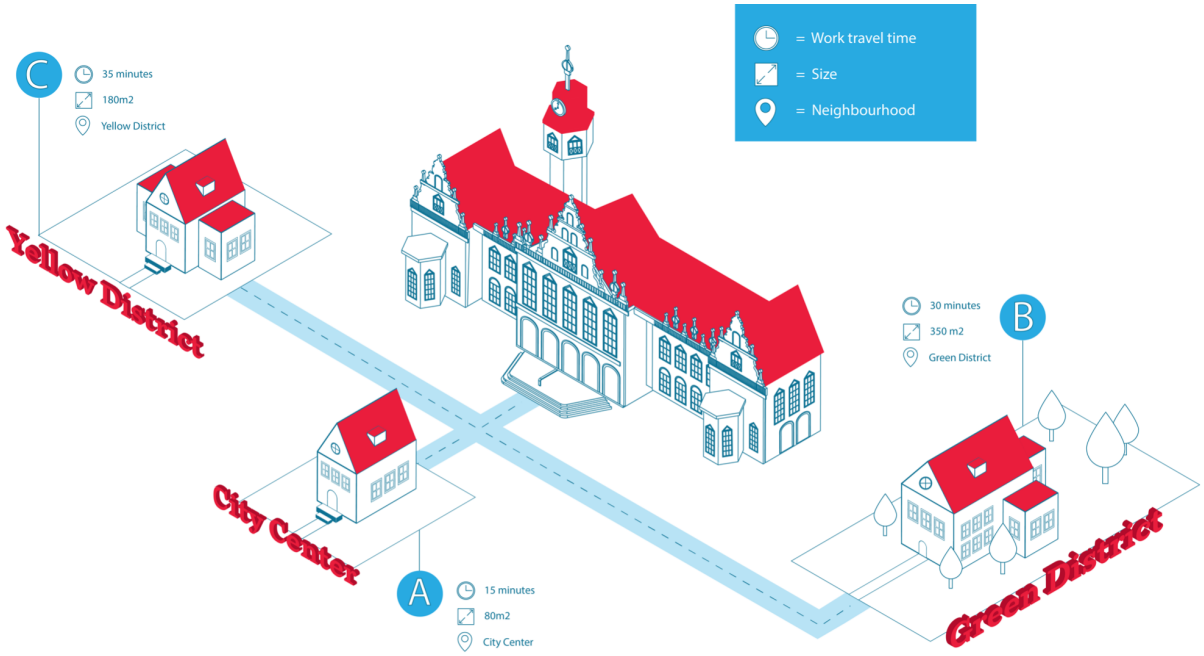
Share in the comments section your thoughts on what is needed to answer the second question: What should the person be doing. What do you base your answer on? Why can there be differences between what people do and what we think they should do?

11: Computing optimal choice - ARTICLE

Image by Meyke, with three houses and a workplace on a map

Multi-Attribute Decision Analysis tells us how to make a decision when the question at hand is complex and has multiple consequences. It was not devised to describe how actual people make decisions. Rather, it was developed to tell us how decisions should be made to ensure they are optimal in the sense that they are consistent with the underlying preferences. It posits that every problem, however complicated it may seem, can be divided into smaller parts, which are easier to solve. Once we solve these smaller problems we can combine what we learned into a final decision.

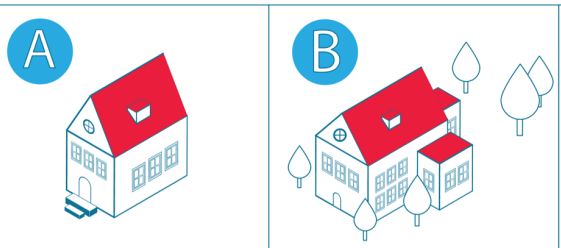
This approach is based on multiattribute utility concept. To use it, the decision-maker must go through three basic steps. We talk about them below using an example of buying a house, which seems to be a decision complex enough to apply this approach.



Step 1: What are the important attributes

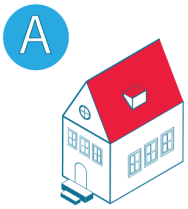
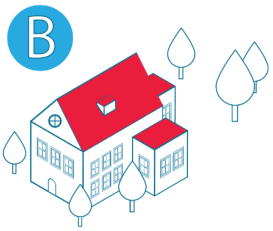
First, we need to divide the big problem into smaller ones. For this, we decide what are the things about possible options that contribute to these options' attractiveness. These things are called **attributes**. For the house buying example, important attributes could be, for instance, the time needed to travel to work, the spaciousness of the house, and how nice the neighbourhood is. The table below gives you three houses to choose from along with their attributes.

Attributes	A	B	C
Work travel time	15 minutes	30 minutes	35 minutes
Size	80m2	350 m2	180m2
Neighbourhood	City Center	Green District	Yellow District



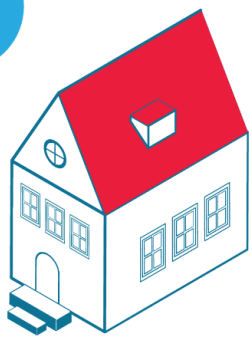
Step 2: What are the utilities of the attributes values

Second, we need to determine how attribute values translate into **utilities**. This is done for each attribute separately. It is typically assumed that the utilities used are cardinal, which means that we need to rank the attribute values and decide how much one value is better than the other. Without going into complicated details of how this can be done and what it exactly means, we can notice several things that can happen in the house example. For the work-travel time, we can think that 30 minutes is twice as good as 15 minutes travel, but 35 and 30 minutes are virtually the same value and have the same utility. For the area, we might decide that the 180 m^2 house is the best because house A is too small and house B is too big. The neighbourhood attribute is the most subjective one, and we cannot measure it in metres or seconds, which we will later translate into utilities. Say that our preferences are reflected by the following numbers:

Attributes	A	B	C
			
Work travel time	10	5	5
Size	4	6	10
Neighbourhood	6	10	8

Step 3: How important is each attribute

Before we combine the information on attributes' utilities into options' utilities, we have to determine how important each attribute is. For this, we need to decide, for example, how willing we are to resign from getting to work fast in exchange for a better space. Once again, without going into details of how this can be done and what it exactly means, we can, for instance, decide that getting fast to work is worth twice as much, and assign twice higher weight to the travel time attribute. We choose the weights so they sum up to 100%. We could, for example, come up with the following solution:

Attributes	A 
Work travel time	60%
Size	30%
Neighbourhood	10%

Once we complete the steps listed above, the utility of each option can be computed if we make some additional assumptions. It is the simplest to assume that the final utility is a sum of the utilities of the attributes **weighted** by how important each attribute is. For example, the utility of HOUSE A is given by:

Utility of travel time from house A x importance of travel time + utility of house A area x importance of area + utility of the house A neighbourhood x importance of the neighbourhood

Or in numbers: 10*0,60 + 4*0,30 + 6*0,10 = 7,8.

Similarly, the utility of HOUSE B is: 5*0,60 + 6*0,30 + 10*0,10 = 5,8.

And for HOUSE C it is: 5*0,60 + 10*0,30 + 8*0,10 = 6,8

Given the computed utilities, we should choose HOUSE A.

Evaluating the decision

The last step of the procedure of Multi-Attribute Decision Analysis is evaluating whether we are happy with the reached decision. The outcome of the analysis can differ from our intuitive choice. This can happen because some more emotional attributes are not well represented in the attributes. For example, a certain house just may “feel good” to live in, despite some attributes being far from optimal. This opens up the door for reevaluating what is important in the given situation. It also shows us that ultimately, it is the intuition that we rely on when making a decision.

If you are interested in a simple and non formal description of an example of using this procedure you can read this short paper.

12: Questions about Multi Attribute Decision Making - QUIZ

Check your understanding of Multi Attribute Decision Making with these questions.

QUESTION 1

Which of the following things can be considered attributes when deciding to buy a used car?

- **Gas mileage**
- **Safety features**
- **Colour**
- Road quality

QUESTION 2

Genevieve wants to rent a flat. She chooses between a flat A that has a size of $30m^2$ and is 5 minutes from her University and a flat B that has a size of $40m^2$ and is 20 minutes from her university. Her utilities are given in the table below. Which flat should she choose, if she was using the multi-attribute decision analysis? Please select all statements that are correct.

	Flat A	Flat B
Size	4	8
Work travel time	10	7

- **If both attributes are equally important, she should choose flat B**
- **If the 'travel time' importance is 70%, she should choose flat A.**
- If the travel time from work importance is 30%, she should choose flat A
- She should always choose flat B because the sum of utilities is bigger for this option.

QUESTION 3

Haadiya and Ian were choosing which university to study at: A or B. They both used the multi-attribute approach to come to a decision. They chose two different universities. Why could this have happened?

- **One of them chose different attributes to consider.**
- **One of them had different utilities for some attribute values.**
- **Both chose the same attributes, but one of them chose different weights.**
- It does not make sense. If they both use the multi-attribute approach they both must choose the same university.

QUESTION 4

Keith and Norah are deciding what is the better option for their daily commute to work: riding a bike or driving by car? The attributes they think are important are costs, safety, and environmental friendliness. The table below presents their attribute utilities and weights. Which of the following statements are true?

	Attribute	Attribute weight	Utilities	
			Car	Bike
Keith	Cost	40%	3	9
	Safety	30%	6	8
	Environment	30%	2	9
Norah	Cost	25%	6	8
	Safety	45%	8	5
	Environment	30%	5	8

- **Cost is more important for Keith than it is for Norah.**
- The environmental impact is more important for Norah than it is for Keith.
- Both Keith and Norah think that cars provide better safety utility than bikes.
- Because Keith and Norah have different attribute utilities and different weights, they will choose different transportation options.

13: More on how people make decisions - DISCUSSION

Choices ©Alexander Schimmeck via Unsplash

Think back to the discussion we started this journey with, where you reflected on how people make choices. Compare this with the classical choice theory and the multi-attribute decision making we have just discussed. Do you see any important differences?

1. What are the things you thought of when reflecting on actual decision making that seem to be missing in the utilities-based approaches?
2. Are you convinced now that multi-attribute procedures should be used whenever possible, or do you think that in some cases other decision making processes are better?

Please share your thoughts in the comments.

14: Are we multi-attribute decision makers? - VIDEO

In this video we discuss the limitations of multi-attribute decision making, and reflect on how we make decisions in reality.

Suppose you are making a decision to follow a certain study at a particular institute. Can you list all the aspects that are of importance to you? Can you indicate the relative importance of these aspects? How would you ultimately come to a decision (or a shortlist)?

15: Human behaviour and decision making - ARTICLE

Similarly looking women © 浮萍 闪电 on Unsplash

Classical choice theory is very abstract. It does not pay attention to many aspects that the social sciences found to be important in human decision-making, such as time-pressure, importance of decision and the social context.

Classical choice theory has a rather limited view on what a good basis for a decision is, and makes many assumptions about what people know and what the situation is like. For example, it is often assumed that people know the consequences of their choices beforehand or at least know how probable they are (perfect knowledge). It is assumed that they are always motivated to make the best possible decision (optimising outcomes). It is assumed that decisions should be made on the basis of logically related facts, and that intuitions are unreliable. In other words, classical choice theory often fails to see the context in which decisions are made.

In reality, there is a lot of uncertainty in the world. We often do not really know what is important and what will happen if we make a certain choice. We also have limited processing capacity, and cannot process all information that might be relevant. Allocating our limited cognitive capacity to the right choice tasks is a challenge for us, but we are a smart species and we use many shortcuts to make decisions that we call intuition, experience, or heuristics, and these shortcuts can be surprisingly effective. We also often go for outcomes that are “good enough” instead of securing the best possible outcome on the basis of all information and save ourselves time and effort.

Herbert Simon was a researcher who studied human decision making in a systematic way. He coined the term **bounded rationality**. *Bounded* here stands for *defined* rather than *restricted*. Simon said that *"human behaviour is shaped by scissors whose two blades are the structure of environments and the computational capabilities of the actor"**. (from Herbert Simon's summary of his ideas concerning human cognition.)

In other words, when we study decision making, we should study not only the problem that needs a solution, but also the people who need to solve it and the context in which the decision is made.

For example, when we want to understand how people choose groceries to buy, the features of the available products are only part of the story. The other, perhaps more important parts, are the people who make these decisions and the environment in which these decisions are made. People usually do not want to spend too much time reading product labels, but they have a pretty good memory for certain visuals and probably know the opinions of their friends on some of the brands. Our social environment consists for a large part of people having similar tastes and values as ourselves. The supermarket environment is relatively stable and most supermarkets have a kind of similar lay-out. All these things together make it really easy to follow habits or mimic the choices of our social circle when buying groceries. Habits and imitation form great examples of bounded rationality, as they save cognitive effort while providing "good enough" outcomes. While habitually filling your shopping cart with products you like, you can use free cognitive capacity for a phone call with a friend who has a question about a job choice.

The interesting twist about bounded rationality is that it often allows us to reconcile what should be chosen (the normative approach) and what is actually chosen and how it is chosen (the descriptive approach). For example, can we justifiably claim that people choosing what to buy following their friends' choices actually make bad choices? Would it really be better for them had they read all the product labels instead and weighted them according to their preferences? Or is it a perfect rational strategy to use the knowledge accumulated in your social network? Bounded rationality expands the criteria for rational decision beyond individual logical consistency. It pays attention to the easily available resources the decision maker can use to make decisions.

We are a very social species, and using the behaviour and experiences of other people is an essential aspect of our smart decision making. Hence in this module we will spend some special attention to the sociality of our decision making.

Monty Python made a humoristic sketch about the tension between individuality and sociality in the movie "Life of Brian".

16: Models of decision heuristics - ARTICLE

Finding a good enough apartment ©Storyblocks

In this step, we want to show you how decision processes can be modelled without using utilities and weights. The models presented below are known in the literature as **heuristics**. You can think of them as algorithms, instructions, or procedures allowing us to make certain decisions. They consist of a series of steps to be executed one after the other and can easily be turned into computer programs.

One of the most prominent advocates of this approach to studying human decision making is Gerd Gigerenzer. He proposes to study what heuristics people use, when these heuristics work, and when they lead to mistakes. If you are interested in these topics, you can watch this video.

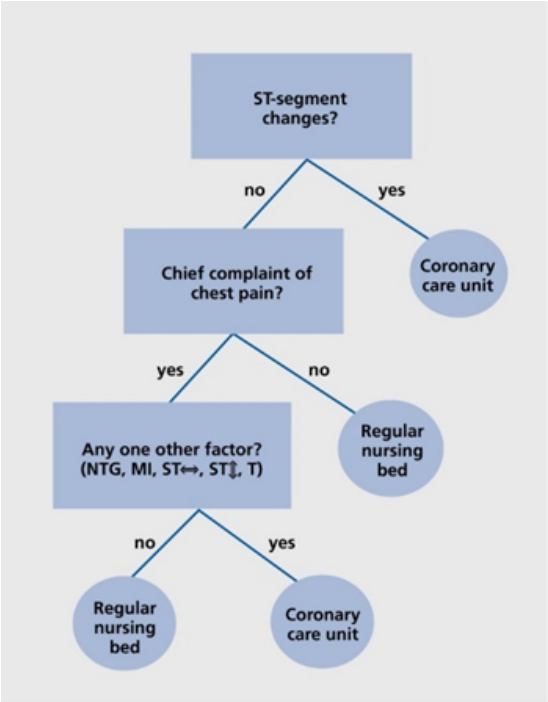
We will introduce two simple examples and invite you to try to think of your own simple decision procedures.

MEDICAL DECISION EXAMPLE

The first example is from the medical domain. Julian Marewski and Gerd Gigerenzer tell the following story:

"Accompanied by his anxious wife, a middle-aged male patient arrives at a rural Michigan hospital. He suffers from serious chest pain. The physician in charge, a compassionate-looking woman, suspects acute ischemic heart disease, but is not entirely sure. Should she assign the patient to a regular nursing bed for monitoring? If it really is

acute ischemic heart disease, however, the patient needs to be rushed immediately to the coronary care unit. On the other hand, unwarrantedly sending the patient to the care unit is not only expensive, but can also decrease the quality of care for those patients who need it, while those who do not are exposed to the risk of catching a potentially harmful, hospital-transmitted infection."



The authors continue to propose (after Green and Mare) the following diagram (called fast and frugal decision tree) to make this type of decision.

The decision process described by this tree is as follows.

1. If a certain anomaly in the patient's electrocardiogram (so called ST-segment) is found, the patient is sent to the coronary care unit. No other information is considered.

2. If there is no anomaly, the doctor considers whether the patient's primary complaint is chest pain. If not, the patient is assigned to a regular nursing bed. Again, no additional information is considered.

3. If the answer is yes, a third and final question is asked to classify the patient.

The full description of this example can be found here.

Satisfycing

The second example comes from Herbert Simon himself. It is a heuristic called *satisficing* (combining the words *satisfy* and *suffice*). Simon proposed this approach for problems and environments characterised by high uncertainty, little structure, and little preceding knowledge. Especially problems in which options tend to appear one after another rather than at the same time. Examples of such problems can be seeking a first job, seeking a mate, or seeking a flat to rent in a new city. What one could do in this situation is described by the following procedure:

1. Explore the options for some time.

2. On the basis of this experience, formulate an expectation of how good a solution you can reasonably achieve.

3. Choose the first option that meets your expectations.

Using this procedure does not guarantee that the chosen option will be optimal. But it will be good enough and the decision will be made in a reasonable time.

For example, Diana is looking for a flat to rent. First, she is visiting apartments to rent for two weeks to see what the market is like. Based on this experience, she decides that she can afford a flat that has about 40 m^2 and is about 25 minutes from her new work place. She finds a 39 m^2 flat 15 minutes away and immediately signs the papers.

What if she cannot find this apartment? In this case, Simon says, she can adjust her expectations. For example, after 2 weeks of unsuccessful search she can decide she has to consider smaller flats – about 30 m^2 big. In this way, she remains responsive to the conditions in which she makes her decision.

17: How do you make decisions? - DISCUSSION

Decisions ©Storyblocks

Think back to the decisions we asked you to consider earlier:

- What to have for lunch?
- Whether to drive or ride a bike to work?
- Which car to buy?
- Whom to go on a date with?
- Where to spend holidays?

- Where to sit on a bus?
- What flat to rent?

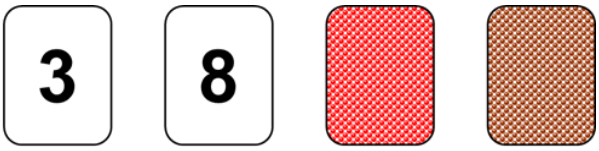
Pick one of these examples and try to think of how this decision can be made. Can you think of a simple procedure that describes this process? Try to write down the steps in a few bullet points and share your ideas in the comments.

18: Pick a card, any card - POLL

Now, we would like you to try to answer two short questions. Try to be as fast as possible and decide without making any additional notes. Do not worry if you are not sure of the answer. This is part of the experience.

QUESTION

You are shown a set of four cards placed on a table, each of which has a number on one side and a coloured patch on the other side. The visible faces of the cards show 3, 8, red, and brown. In order to test the truth of the proposition that **if a card shows an even number on one face, then its opposite face is red,** which card(s) must you turn over?



- The first card to check the colour on the other side of 3
- The second card to check the colour on the other side of 8
- The third card to check the number on the other side of red
- The fourth card to check the number on the other side of brown

19: Who is the underaged drinker? - POLL

Again, try to be as fast as possible and decide without making any additional notes. Do not worry if you are not sure of the answer. This is part of the experience.

QUESTION

You are a bouncer in a Boston bar and you'll lose your job unless you enforce the following law: **If a person is under the age of 20, then they can have non-alcoholic drinks only**. The figure below shows four men sitting at a table in your bar. You know that the first man is 22, the second man is 17, the third man is drinking cola, and the fourth man is drinking beer. Whose drink or age do you need to check to see if any of them is breaking the law?

- The first man to see what the 22-year-old is drinking
- The second man to see what the 17-year-old is drinking
- The third man to see how old is the man drinking cola
- The fourth man to see how old is the man drinking beer

20 Human cognition - POLL

Think about the two questions you have just answered about the cards and the underaged drinker.

How did you do?

QUESTION

Which question was easier to answer?

- cards question
- beer question

21 Conclusion of Week 1 - ARTICLE

Choosing between a healthy apple and an unhealthy doughnut © Andres Ayrton on Pexels.com

This week we briefly explored some approaches to modelling individuals making decisions. We talked about the classical choice theory based on the concept of utility. We saw how this approach can be used to divide big problems into smaller ones that are easier to manage and understand. We also saw that ultimately, even when we do use multi-attribute decision analysis, we like to rely on intuition when we evaluate the outcome.

Later we talked about the bounded rationality approach. We saw that there are many factors that play a role when people make decisions, and rationality is not only about *what* is chosen, but also about *how* it is chosen, *where*, *when* and *by whom*. We also saw some models of simple heuristics for decision making.

One of the most important lessons we learn from a bounded rationality approach is that human cognition and how people make choices is largely shaped by who we are as a species and what resources we have available to make decisions. Many of our decisions are made in a social context. People adapted to this by developing some cognitive strategies that help us make decisions and judgments in the social world. For example, when we try to solve a logical puzzle like the Wason selection task, it seems to be easier when it is framed as a story about following and breaking social norms. Some researchers have argued that this shows that how we think is context dependent. We are used to solving some types of problems, like social compliance, and not used to solving other problems, like cards' compositions. Even if these problems are logically the same, only the first one triggers the easily available mechanisms or heuristics for solving it that we have developed.

The larger picture here is that understanding human decision making is impossible without looking at the broader, especially social, context. If we want to understand how people decide, we need to look at them as part

of their environment, their group. But we cannot also fully understand the group without paying attention to the individuals. In the next week we will see how our sociality shapes our world through individual decisions.

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