EFR summary

Introduction to Behavioral Economics, FEB12015X

2022-2023

Lectures 1 to 7

Weeks 1 to 7

Details

Subject: Introduction to Behavioral Economics

Teacher: Kirsten Rohde and Jan Stoop

Date of publication: 14.04.2023

Introduction to Behavioural Economics - Week 1

What is behavioural economics?

Economics had its roots in the human mind from Adam Smith until World War II: individuals were assumed to maximise pleasure and minimise pain (hedonic psychology). This changed in the 1940s, when several neoclassical economists began doubting the predictive reliability of earlier theories. They argued that pleasure and pain are subjective, and thus cannot be used to build universally valid models. Therefore, standard economics began focusing on the observable--people's choices. This is called the principle of **revealed preferences**.

Thus, Behavioural economics is a combination of the studies in economics and psychology that strives to **understand** behaviour in order to **predict** and **influence** it.

Homo Economicus (the traditional economic individual in Neoclassical Economics) assumes:
- no bounded rationality (no problems acquiring and processing information)
- a homo economicus will maximise expected utility
- knows how to deal with probabilities
- has consistent time preferences
- cares only about their own payoffs

For these individuals, social norms play no role in their decision making and models are assumed to be normatively and descriptively valid.

However, many of these assumptions are not compatible with people in reality – i.e. homo sapiens.

Normative versus descriptive

The models and theories used in economics to forecast people's behaviour are grouped into two main classes: **normative** and **descriptive**. Standard economics (the neoclassical school), takes their theories to be both normatively correct and descriptively sufficient. What does this mean? Let us define the two terms first and then come back to the claim.

Normative

Normative models and theories show how people **should** decide and make choices between options, including how people should perceive situations. Normative models define what is called rational behaviour in behavioural economics.

Descriptive

Descriptive models and theories show how people **actually** decide and make choices in their real lives.
Behavioural economists make a distinction between descriptive and normative models.

Experiments in Economics

Correlation

People with a gym-subscription on average visit the gym more often than people without a subscription.

Causality

This does not mean that buying a gym-subscription will automatically cause you to go to the gym more often.

Initially, the main methodology was simply thought experiments that authors used to analyse subjects' responses. An example of such an experiment would be the following:
"Which would you prefer? A: 60% chance to win 500 and 40% chance to win nothing; B: 250 for sure." These choice questions were replaced nearly entirely by laboratory experiments, and more recently field experiments.

Laboratory experiments

Participants are observed in a controlled setting, where they make choices involving real money. The experiments have either one or several different treatments, which the experimentalists then analyse.

Field experiments

These are similar to laboratory experiments, with the difference that subjects are observed in their natural setting, e.g. students in a classroom.
In the case that an experiment has several treatments, the subjects must be assigned randomly to these treatment groups in order to guarantee that differences in behaviour pertain to the difference in treatment. The experiment can be designed in one of two ways: **between-subjects** or **within-subjects.**

Between-subjects

Between-subjects design means that in the experiment, each person or group is given only one treatment (only goes through one situation). The (possible) differences in behaviour are thus observed across different individuals.

Within-subjects

Within-subjects design means that in the experiment, each person or group is given both treatments at a different point in time. The (possible) differences in behaviour are thus observed from the same individual(s). Advantages of using this is that the experiments would need fewer data points as they use the same individual(s), however the individual's knowledge of both situations may influence the participant's choice (i.e. placebo).

Experimentalists think that the choices in laboratory subjects should be as realistic as possible, and thus **real incentives** are used. This means that possible winnings in behavioural experiments are paid out in real life. This is done with the aim of increasing the chance that participants reveal their true preferences: using real incentives decreases the effect of social pressure and compensates for the effort needed to, for example, read the questions carefully. However, there do exist incentives with fixed payment for participation. Such payments are called **Flat Fees**.

A last note about the methods used in behavioural economics: **deception is not used**. The aim of the experiments is to observe real behaviour and using deception could cause distrust in the subjects and thus bias results.

Preferences and Feasibility

People make choices based on feasibility (which is objective), and preferences (subjective).

For all types of modern economics, preferences are fundamental. A preference relation is simply a relationship between two entities (things, people, etc., here a and b). The preferences introduced in the slides are the following:

Weak preference	a ≥ b	"a is at least as good as b" Property: The weak preference relation is **reflexive**: a ≥ a for all a (where a ≥ a meaning good as good as itself)
Strict preference	a > b	"a is better than b" Definition: a > b if and only if a ≥ b and it is not the case that b ≥ a. Property: The strict preference relation is **antisymmetric**: if a > b, then it can never be that b > a The strict preference relation is **irreflexive**: there is no a with a > a
Indifference	a ~ b	"a is as good as b" Definition: a~b if and only if a ≥ b **and** b ≥ a. Property: the indifference relation is **symmetric**: if a~b, then always also b~a. It is also **transitive**: if a~b, b ~ c then a ~ c.

Note that the definitions for the strict preference relation and indifference relation are derived from the weak preference relation (Angner, 2016).

Now that we have defined the three types of preference relations and their properties, we add two terms to describe properties of the **weak preference relation**. These properties depend on the universe of entities (all possible things that can be chosen to have a relation with one another, or itself), and thus are not always true.

Transitivity	The weak preference relation ($a \geq b$) is transitive in the following case: if $a \geq b$ and $b \geq c$, then $a \geq c$ for all a, b, c
Completeness	The weak preference relation ($a \geq b$) is complete in the following case: either $a \geq b$ or $b \geq a$ (or both) for all a, b IMPORTANT! Completeness implies that any two entities chosen from the universe have a preference relation; it is important to remember that this also concerns two of the same entities. Thus, a criterion of completeness is also **reflexivity**: $a \geq a$, $b \geq b$, $c \geq c$, etc.

In standard economics, the transitivity and completeness of the weak preference relation ($\geq$) are taken as axioms (basic propositions that are taken for granted). With these axioms, the weak preference relation is called a **weak order**. This means that any preference relation that satisfies both transitivity and completeness is called a weak order.

Suppose utility function v(.) represents the preferences of the weak order. This is to say the following:

$$a \geq b \leftrightarrow v(a) \geq v(b)$$

The arrow from left-to-right is called the **revealed preference** principle. It states that preferences (and thus the utilities) can be found out by observing people's choices, here $a \geq b$.

To present the following definitions, let us first create a new utility function w(.). This new function is created such that for every "a", it has $w(a) = 5v(a) + 15$. **It represents the same preferences (≥) as the earlier function v(.), because it is a linear function of v(.)!** Now, suppose Carly has the first utility function v, and James has the utility function w. Let us say Carly attains utility 4 from a cup of coffee. Thus, James attains utility 5 * 4 + 15 = 35. It may seem that James likes coffee more than Carly does, but this is false! **For all utility functions, interpersonal satisfaction should never be compared!** They are only for comparing bundles of goods within one person. So, using v and w to model an individual's preference, both functions will yield the same choices in standard theory.

Now, we are ready to define **cardinal** and **ordinal** utility. As before, both types are only for comparing bundles **within one person**.

Ordinal Utility

Ordinal utility functions order individual bundles of consumption from least preferred to most preferred. The different numerical values of this type of utility function have no additional meaning. For these utility functions, we can replace the existing function for all inputs, provided that the new function is increasing.

Example:
o represents an ordinal utility function, and o(a) = 1, o(b) = 2, o(c) = 4 → all we can say is that b is preferred to a and that c is preferred to b, but we cannot compare the "sizes" of these differences between the preferences (the numbers have no specific meaning).

Cardinal utility

Cardinal utility functions are distinct from ordinal ones only by the fact that numerical values have a significance above the mere ordering of preferences: they can be used to compare differences in satisfaction between various bundles. Hence, a larger utility difference indicated a stronger preference for the individual. Though transformed cardinal utility functions may look different, it is possible that they have the exact same outcome. A new utility function can equally predict only if it is constructed by a linear function.

Example:
c represents a cardinal utility function, and c(a) = 1, c(b) = 2, c(d) = 4 → now we can say that the d is preferred more strongly over b than b is preferred over a: we can thus compare the sizes of the differences between the preferences (the numbers do have a specific meaning relative to each other).

These definitions can also be replaced by the following, more formal ones:

A utility function is **ordinal** if it can be replaced by another function, as long as that function is an **increasing function**, e.g. $w(v(a)) = 5(v(a))^2 + 15$

A utility function is **cardinal** if it can be replaced by another function, if that function is a **linear increasing function**, e.g. $w(v(a)) = 5v(a) + 15$

For two different approaches to welfare analysis, we can use different utility functions:
- Pareto (better so long as no one is worse off & least one person is better off): works for both ordinal and cardinal utility
- Utilitarianism: assumes cardinal utility and that one unit of utility means the same for each person.

Revealed Preference

Revealed preference is a choice-based measure of utility – by observing choices, we can find out preferences. Take note that utility cannot be measured through simply one's willingness to pay.

There are issues that suggest that the assumptions of decision utility are too strict so that experienced utility may differ from decision utility. These phenomena are called projection bias, diversification bias, duration neglect, and the peak-end rule.

Projection bias

A phenomenon where people have been shown to assume that they will have similar preferences in the future as they currently do. A good example of this is buying fireworks. At the store, one may be enthusiastic to set off a large number of fireworks and buys a quantity in accordance with that preference. However, when the time comes to enjoy the fireworks, he/she does not prefer to use as much and notices that too many were acquired.

Diversification bias

When presented with a lot of diverse choices, people tend to overestimate the extent to which they will like the variety in the future. Thus, they choose to go for more variety in their present choice than they actually prefer once it is time to, for example, consume the products. Of course, diversification bias concerns all kinds of entities, not just goods. An example would be the making of a music playlist for a future road trip. It may well be the case that one selects far too many songs from a broad range of genres; once the time comes to play the songs, only a fraction may be actually played.

Duration neglect

This phenomenon concerns the ex post evaluation of prior experiences. It states that when a past experience is assessed, the duration of the experience plays a relatively small role. An example can be taken from going to the movies: a movie is evaluated retrospectively more heavily based on its entertainment value, rather than its duration.

Peak-end rule

Related to the duration neglect phenomenon is the peak-end rule. Instead of putting relatively high weight on the duration of a past experience, it is evaluated based on the peak and the end of the experience. The peak of the experience is the moment with highest intensity, whereas the end refers to the intensity with which the experience finished. To go back to the movie example, the peak would normally be the climax of a movie plot, while the end denotes the final scenes. These are the moments which normally determine how good or bad the movie is perceived to have been.

Introduction to Behavioural Economics - Week 2

Risk and Uncertainty

It is important to understand the distinction between choices under risk and choices under uncertainty. With choices under uncertainty, there is no knowledge of probabilities for different states of the world. For decisions under risk, probabilities for different states of the world are known.

Decisions under uncertainty have a specific outcome for each act, depending on the state the world ends up being in. These combinations can be shown as follows:

$$\mathbf{A(Act) = (s_1{:}x_1,..,s_n{:}x_n)}$$

Thus, each act gives an outcome of x, which depends on the state of the world s, with n different states possible.

Outcomes in decisions under risk can be shown as follows:

$$\mathbf{L(Lottery) = (p_1{:}x_1,\ldots,p_n{:}x_n)}$$

Thus, the outcome x depends on the probabilities each outcome takes, with n different possibilities.
Note: $p_1+p_2+\ldots+p_n$ must add up to 1!

Choice under Risk

In order to motivate the use of **expected utility** as a model for decision under risk, the option of using **expected value** is first considered—and refuted with the **St. Petersburg paradox.**

Expected value is calculated as follows:

Expected value (of lottery) = $p_1C_1+p_2C_2+\ldots+p_nC_n$

Is the expected value a reasonable model for individual behaviour?
The **St. Petersburg paradox** thought experiment shows why this is not the case. The paradox starts with the assumption of a fair coin. The coin is tossed until it gives heads, say n times, and the player earns €2^n. The question is how much an expected value maximiser would pay to play this game, and the answer turns out to be infinity.

$$EV = ½*2+¼*4+\ldots = 1+1+\ldots = \text{infinity}$$

Of course, nobody would pay an infinite amount to play such a game, because for example throwing 5 tails in a row would already have the probability (½)^5 = 0.03, for which the player would win only 6 * €2 = €12. Because the probability decreases at an exponential rate, it is very unlikely to win a large amount of money.

The answer to the St. Petersburg paradox is that instead of maximising expected value, people maximise expected utility. To see this, consider the utility function u(x) = ln(x). With this utility function, the expected utility of the Petersburg gamble does not equal infinity!

How expected utility is computed:

$$EU(\text{lottery}) = p_1\, u(X_1) + \ldots + p_n\, u(X_n) = \sum_{i=1}^{n} pi \; * \; u(Xi)$$

In words, the probabilities of each outcome happening are multiplied with the utility of the outcome, and these are summed. **It is important to compute the utilities first, and only then multiply them with the respective probabilities!** With this knowledge, the utility of the St Petersburg gamble ends up being 1.39.
The important follow-up question now is how much the utility maximiser with a utility function ln(x) actually would pay to play the lottery. To find the answer, you must take the inverse of the utility function, which in this case is e^x. The interpretation of the inverse is of course the amount one would pay in order to receive utility x: here $e^{1.39} = 4$. Thus, the person would pay €4 to play the St. Petersburg gamble.

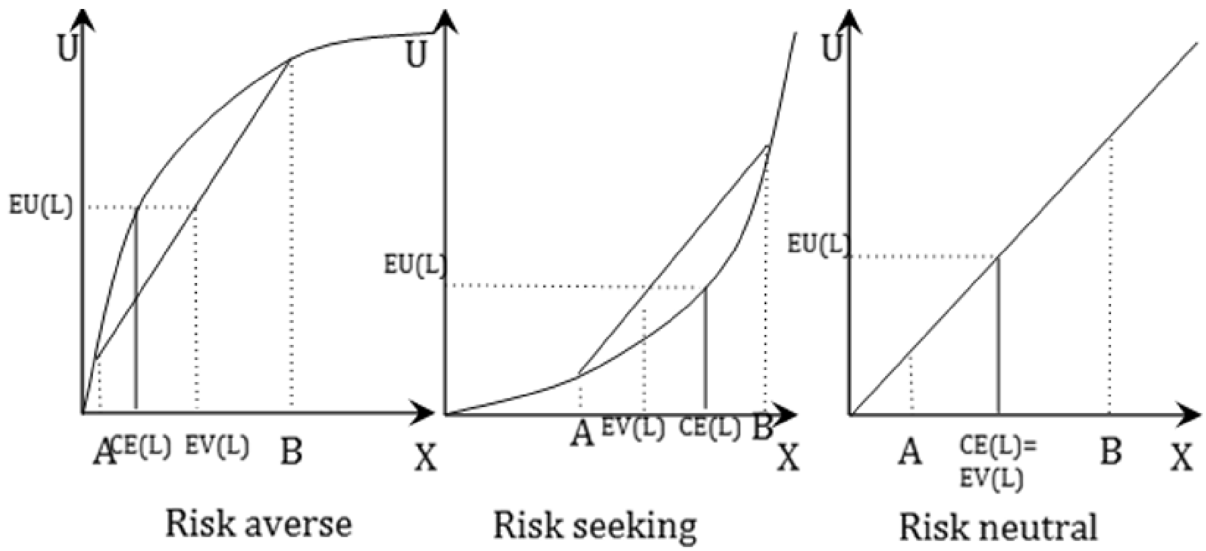
In more general terms, the €4 is the **certainty equivalent** of the lottery; the sure amount that is as good as going for the risky game. The utility of the certainty equivalent must be equal to the expected utility of the lottery. To demonstrate, consider utility function u(x), where x is an amount of money. In the lottery, the expected value is EV(L), and thus expected utility u(EV(L)). This must be equal to the utility of the certainty equivalent. The inverse of the utility function gives the money amount for each utility level, and thus CE = u^{-1}(u(EV(L)), or more simply CE = u^{-1}(EU(L)).

There are three general attitudes toward risk:

Risk-averse
certainty equivalent is lower than the expected value (concave utility function).

Risk-neutral
certainty equivalent is equal to the expected value (linear utility function).

Risk-seeking
certainty equivalent is higher than the expected value (convex utility function).



As explained earlier, standard economics regards the expected utility model as being both normative and descriptive. An implication of this is something called the **sure thing principle.**

A person maximising expected utility cannot base his/her decision between two risky choices on an outcome that is exactly the same in both choices. Thus, the outcomes that are shared between the choices do not affect preferences.

Example:
Consider the risky choices denoted L and M. L = (0.2:100,0.4:50,0.4:10) and M = (0.2:100,0.6:60,0.4:20). Because the first outcome is considered a "sure thing", regardless of which risk is chosen, it does not affect the choice (if it does, that would be a violation of expected utility theory).

However, there does exist a violation of the sure-thing principle. An example of this is the **Allais Paradox**, which is driven by the certainty effect.

Allais Paradox

This problem displays another case where people often exhibit preference reversal. Let us present it with a table.

	0.89	0.10	0.01
Choice 1 Option A	1	1	1
Choice 1 Option B	1	5	0
Choice 2 Option A	0	1	1
Choice 2 Option B	0	5	0

Two consecutive choice questions are presented, with two options for each choice (a and b).

People tend to choose option a in choice 1, but option b in choice 2. This violates the sure thing principle, because the column 0.89 should be disregarded—each outcome in this column is the same in both choices. After column 0.89 is disregarded, the two options and their choices become identical (see table). The occurring preference reversal is called the **certainty effect**: people tend to place too much emphasis on outcomes that are certain, and thus should not affect decisions.

Hence, the sure-thing principle has several issues, such as the fact that expected utility is not always normatively accurate, and that the principle does not fully describe actual behaviour.

Violations of expected utility

The expected utility model fails in consistently describing actual behaviour. A reason for this is that losses loom larger than gains—thus, the prospect theory utility function must be adopted. Prospect theory is an extension of expected utility that incorporates:

- Reference points (people derive utility from gains/losses compared to reference points)
- Diminishing sensitivity & reflection effect
- Loss aversion

- Probability weighting

Let us illustrate a situation in which EU fails, and how behavioural theory (particularly the first two points of prospect theory) can solve the problem.

Example: ***The Asian Disease Problem***
Imagine that the US is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume first that the exact scientific estimate of the consequences of the programs are as follows:

A: If program A is adopted, 200 people will be saved.
B: If program B is adopted, there is a 1/3 probability that 600 people will be saved and a 2/3 probability that no people will be saved.
Which of the two programs would you favour?

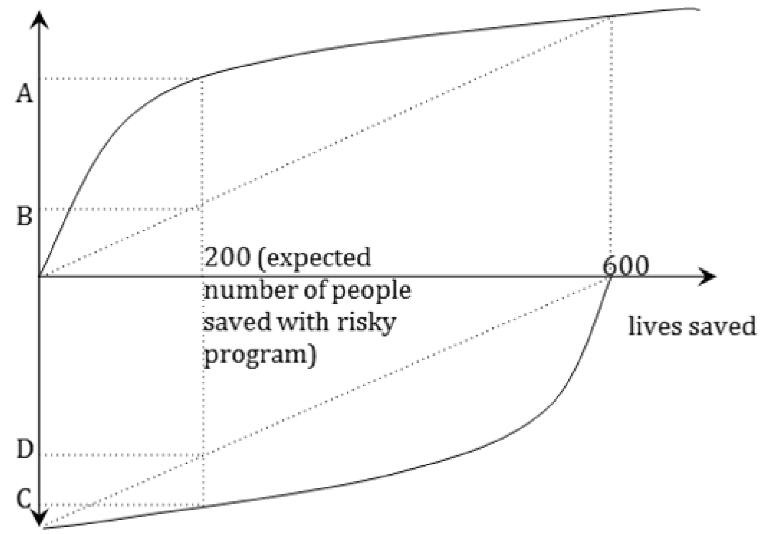
Assume now that the exact scientific estimate of the consequences of the programs are as follows:

C: If program C is adopted, 400 people will die.
D: If program D is adopted, there is a 1/3 probability that nobody will die and a 2/3 probability that 600 people will die.
Which of the two programs would you favour?

Alternatives A and C and alternatives B and D are of course equivalent in effect. There is an important distinction, however. A and B are presented in a gain frame, and choices C and D are presented in a loss frame. This is explicit in the wording: in A and B, the term used to describe outcome is "saving people", whereas in C and D, the outcome is people dying. They are just opposite ways of describing the same outcomes. However, the framing effect causes people to use different reference points for the two different sets of choices. This ultimately leads to preference reversal; indeed, in the literature the most common outcome is that people choose option A in the first choice but option D in the second one.

The **prospect theory value function** explains the preference reversal with ease. It does so by noting that people are risk averse in gains, and risk seeking in losses. Thus, when the gain frame is used (in A and B), people tend to choose the sure choice (because they are risk averse in gains); when the loss frame is used (C and

D), people tend to choose the risky choice (because they are risk-seeking in losses.) This is apparent from looking at the figure below:



Notice that A has higher utility than B, and D has a lower utility loss than C. This is why the preference reversal occurs, and it is a consequence of the concave utility function in gains and convex utility function in losses. The gain frame induces the reference point to be zero lives saved, because each additional person is regarded as a gain. The loss frame induces the reference point to be 600 lives saved, because every dying person is regarded as a loss.
The different risk attitude for gains (risk averse) as compared to that for losses (risk seeking) is known as the **reflection effect**. Important: the reflection effect is not driven by loss aversion! Reflection effect appears even when losses are the same in magnitude as gains, whereas loss aversion describes how losses have a higher weight than gains!

Diminishing sensitivity is a property of prospect theory utility functions, that is similar to diminishing marginal utility. Diminishing sensitivity means that the effect of additional gains and losses gets smaller, the further away one is from the reference point.

Moreover, continuity states that small changes in probabilities are insignificant to someone's preference. Meaning there are no 'jumps' in people's preferences. If someone prefers point D along a preference curve to point C, the points very close to D will still be preferred over point C.

Choices under uncertainty

Recall that choices under uncertainty are made with no knowledge of probabilities for states of the world. The classical models used to describe choice under certainty are **maximin, maximax,** and **minimax-regret.**

Let us present an example to explain the different models.

Utility payoffs	Cold	Warm
Wear a jacket	5	5
Do not wear a jacket	0	7

Maximin

Acting in a way that has the highest outcome for the worst-case scenario. A maximin person would choose to wear a jacket, because 5 > 0.

Maximax

Acting in a way that has the highest outcome for the best-case scenario. A maximax person would choose not to wear a jacket, because then it is possible to attain utility 7 (but there is a risk of attaining utility 0).

Minimax-regret

Regret payoffs	Cold	Warm
Wear a jacket	5 - 5 = 0	7 - 5 = 2
Do not wear a jacket	0 + 5 = 5	7 - 7 = 0

The values come from keeping a column constant and changing the acts. Say it is cold: choosing to wear a jacket is the best option (see first table), so the regret is 0. If you do not wear a jacket and it is cold, you regret the lost utility of 5. The regrets in warm weather are calculated similarly. Thus, a minimax-regret person would wear a jacket, because the maximum regret of 2 is smaller than 5 when not wearing a jacket.

These decision rules under uncertainty do not always hold in real life, as they don't account for the likelihoods of states. Say, for example that you move to California. A maximin person would always wear a jacket in order to minimise the worst-case scenario, which is irrational as cold weather is very improbable. Thus, a better rule would be to estimate probabilities for the different states of the world.

Ellsberg Paradox

People are **ambiguity averse**. This is seen in considering again the table for the Allais problem, but with small modifications.

	Red 1/3	Black or Yellow 2/3	
Choice 1 Option Red	1	0	0
Choice 1 Option Black	0	1	0
Choice 2 Option Red or Yellow	1	0	1
Choice 2 Option Black or Yellow	0	1	1

This new setting is called the **Ellsberg Paradox**. Notice that the probabilities are fully known for choice 1, option Red and choice 2, option Black or Yellow but ambiguous for Choice 1 Option Black and Choice 2 Option Red and yellow.
The reason people choose as they do, is regarded as due to them being averse to the ambiguity of options BLACK and RED OR YELLOW.

Introduction to Behavioural Economics - Week 3

Discounted Utility and Impatience

This week is about choices that have an impact over two or more points in time, called **intertemporal choices**. Modelling these is important, because often the consequences of decisions are not felt immediately. We first discuss the approach of standard economics, and find that it cannot explain some common behaviour, such as (Rohde, 2019):
- People set alarm clocks but continue snoozing in the morning
- People subscribe to gyms but use them so little that it would have been cheaper to pay separately per visit
- People plan to stop smoking cigarettes but fail to do so

Once again, behavioural economics provides answers to these problems with its more descriptive models. However, these models are not as flexible as the standard ones, because they require more information about individuals.

Temporal distance is the difference between decision and consumption time.

Intertemporal choice

Due to the difference between the decision time and time of consumption, referred to as temporal distance, intertemporal choices concern **outcome streams**, which give different money outcomes at different points in time:

Outcome stream $a = (a_0, \dots, a_n)$

Here, subscripts 0 ~ n denote different points in time. 0 represents the present, so is an outcome that would happen immediately if the outcome stream is realised; 1 represents one period ahead in time, and so on.

As learned in week 2, people do not make choices based on monetary values, but based on utility. Thus, outcome streams must be converted into **utility streams**. Utility function u(.) and outcome stream result in a utility stream:

$u = (u_0, \dots, u_n)$, or more precisely $u = (u(a_0), \dots, u(a_n))$

Outcomes and utilities can also be denoted as follows:

(time of occurrence: outcome/utility)

For example, *(0:100 utils)* means receiving 100 utils immediately (period 0=present), *(1: 100 utils)* would mean receiving 100 utils period 1 in the future. These can be combined as *(0: 100 utils, 1:100 utils)*.

Impatience

An important characteristic about making intertemporal choices is that the different utilities must be converted to a same point in time. The reason is that most people are **impatient** (preference for positive utility sooner than later, wherein for all x > 0 and t > s, we have that (s:x) > (t:x)) and thus future utilities are **discounted**. Discounting the utilities results in their present value being smaller than the utility they bring in the future, D(t) is decreasing.

There are three major arguments for why impatience happens:

Market interest

We can earn interest on money **(problematic, because this assumes interest rates came before people became impatient)**

Risk and uncertainty

The future is uncertain; a sure gain now will be preferred to a gain that is dependent on the unfolding of future events

Pure time preference

Psychologically, we simply care about the present more than we do about the future. There are also associations of impatience with health behaviour (BMI), occupational choice (job attachment), and the behaviour of children and adolescents.

Note: This course uses a different definition for impatience than the book does. In this course, impatience simply means that future utilities are discounted, whereas the book requires that they are discounted a lot—which is vague.

How are separate points in time discounted? With a **discount function**. A discount function is a multiplier assigned to every point in times that is not the present (time zero), and is denoted as . Thus , because the present is not discounted. A utility stream that is discounted is called **discounted utility**, denoted . With this information, we can construct a discounted utility function for utility stream a:

$$DU(a) = u(a_0) + \dots + D(n)\,u(a_n)$$

Note that the discount function is a decreasing in time! This means that the $D(0) > D(1) > D(2)$, etc.

This results in a weighted sum of all the expected utilities. Thus, the decision maker will choose the outcome stream that gives the largest discounted utility. Discounted utility combined with impatience indicate that you want positive utilities as soon as possible and negative utilities as late as possible.

Constant vs decreasing impatience

Constant impatience means that your degree of impatience is the same for the near and the far future. This means that adding a common delay to all options, then it will not change the preferences before the options. This only works if the outcome and the time differences for the options are kept the same.

Decreasing impatience means that you are more impatient for the near future than for the far future. For s < t and x < y and all a > 0 we have that if (s:x) ~ (t:y) then (s + a : x) < (t + a : y). In the far future you are more likely willing to wait for the better outcome.

This affects people's **time consistency** (wherein the passage of time doesn't affect preferences). Constant impatience would lead to time consistency whereas decreasing doesn't. With decreasing impatience, for example, in one year you are willing to wait for an extra day for a larger amount of money but if you are offered the same amount of money now versus a larger amount of money tomorrow, you would choose the earlier option. This is an example of time inconsistency.

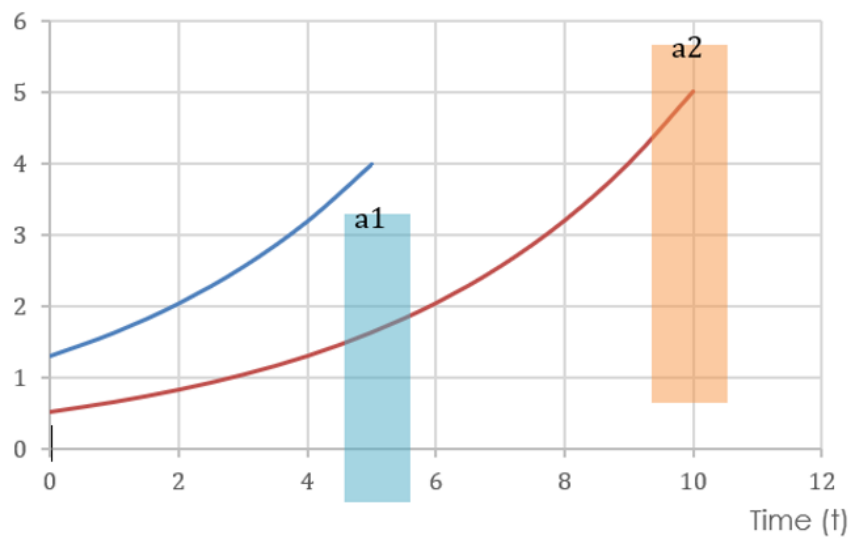
Exponential discounting

Standard economics uses **exponential discounting**, where the discount function ,
looks as follows:
 is called the **discount factor** and is smaller than 1 if the individual is impatient. If **δ** = 1, the individual values the future exactly as s/he values the present. A high discount factor means that the individual has high patience and a higher difference in utility in the future. This person is more likely to save money or plan for the future.

Therefore, using the discount factor decreases the present value of future outcomes. Discount factors have a corresponding **discount rate**

Here, a clear distinction must be made. This r is different from the **discount rate** used in finance, which is the interest rate. The r here is a subjective, individual discount rate; it can be regarded as a “subjective interest rate”. (Rohde, 2019)

An example of a discount function, with discount factor :
The exponential discount function implies **time consistency**. Therefore, standard economics cannot explain why people choose to snooze in the morning even though they decided to wake up at that time before going to bed. Here, the time difference between the alarm and an early-morning appointment is the same when going to bed as it is in the morning, and thus preferences should not change per exponential discounting. Rationality does not require individuals to have one over another. To illustrate, see figure below, where from every time perspective—preferences are time consistent.



Exponential discounting assumes **constant impatience**: the discount rate between two outcomes separated by time is constant regardless of how close or far they are in the future.

Quasi-hyperbolic discounting

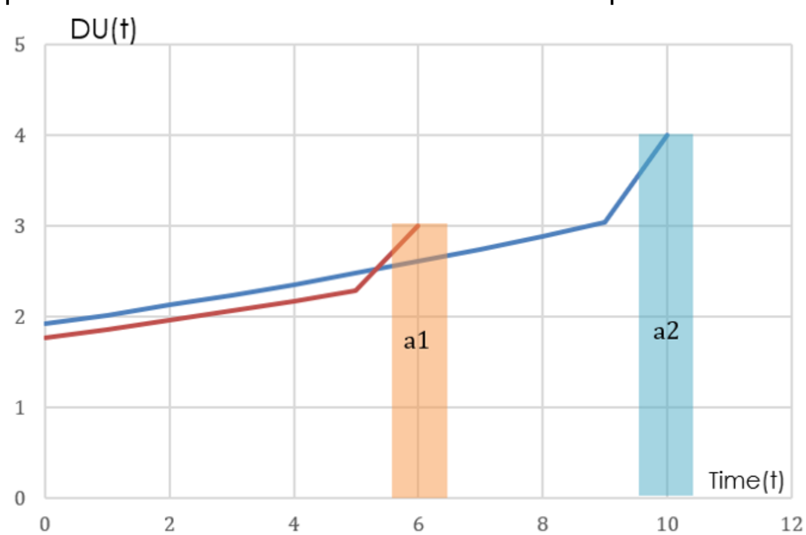
So, what explains observations such as pressing the snooze button in the morning? This occurrence is a result of **decreasing impatience**: the level of impatience is less when two options are placed in a later setting. To illustrate:

- Consider the choice between €100 today or €120 in two weeks. Most people choose €100 today
- Consider the choice between €100 in a year or €120 in a year and two weeks. Now most people choose €120

Thus, people tend to exhibit greater impatience for events that are closer than in the future. This is incorporated into the discount function using **quasi-hyperbolic discounting.**

The idea behind **quasi-hyperbolic discounting** is that there is an additional factor in addition to discounting which influences preferences about the future. This factor is named beta , a present-bias parameter implying that the difference between today and tomorrow is larger than the difference between tomorrow and the day after. It factors into all discount functions as a constant.

The way to think about is that it is merely an added discount for the fact that something will not happen immediately. It causes a kink in the discount function, which enables preference reversal due to time distance possible.



The discount function is now:

$$D(t) = \beta\delta^t \; for\; t > 0;\; where\; 0 < \delta \leq 1 \; and\; 0 < \beta < 1$$

Important: D(0) is still 1! (same as that of the exponential discounting)

The figure explains how the outcome for the problem with €100 and €120 is possible. Very close to t=6, is the preferred choice because $DU(a_1)$ is higher than $DU(a_2)$ and thus a_1 is discounted less. Hereby the person chooses , even though it has a lower utility than a_2 when we consider at t=0 , which is further in the past.

Hence if $\beta = 1$, the individual who discounts the future hyperbolically will behave exactly like he would if he had discounted the future exponentially. And if $\beta < 1$, all outcomes beyond the present time will be discounted more under exponential discounting.

Self-commitment

Sometimes, people are aware of their tendency for time-inconsistency, and therefore set up systems to mitigate the effect; some people place their alarm clock on the other side of the room in order to force themselves awake to stop it in the morning.

Violations of discounted utility

An assumption the discounted utility makes is that the discount function and utility function are separated.

Sometimes the whole notion of discounted utility is violated:

Magnitude effect

People discount large outcomes at a lower rate than smaller outcomes. So, e.g. a gain of €100 in a year has a lower than a gain of €1000 in a year.

Sign effect

People tend to discount losses at a lower rate than they do gains. Hence their δ will be higher for losses than for gains.

People are impatient for gains but not for losses, however, at the same time, some people tend to want **unpleasant events** to be over as soon as possible, although their present loss is higher than the future discounted loss. A reason for this is proposed as **anticipation utility**, where people gain negative utility from awaiting unpleasant outcomes—thus, for example, the wait for a painful dentist appointment could itself cause utility loss, and therefore people want to minimise the wait.

Preference for improving profiles

Entirely contradicting discounted utility is how people often prefer an increasing utility profile to a decreasing one, although the decreasing one has a higher present value. People care about the shape of their utility stream, not just about the discounted individual utilities. The downfalls of both hyperbolic and exponential discounting is their failure to account for people's preference on their utility profiles.

For example, consider two choices A and B:

A: (0:100,1:150, 2:200); B: (0:200, 1:150, 2:100)

Choice B clearly has a higher present value as more of the gains are in the near future and thus should be chosen according to discounted utility because of impatience. In practice many prefer A, and this is sometimes explained with loss aversion (people being more sensitive to losses): people may regard stream B as losing money with every period, and thus they experience loss. Choice A also ends with a higher value, which corresponds to the **peak-end rule**.

Preference for variation

Many people choose a variation of different characteristics of options over time, rather than opting for repetitiveness. As an example, consider a group planning their dinner for the next two days in either Burger King or KFC. They have two sets of options: A or B, and C or D.

A: Burger King today, KFC tomorrow
B: Burger King today, Burger King tomorrow

C: KFC today, KFC tomorrow
D: KFC today, Burger King tomorrow

Faced with this problem, people often choose variation: A or D. This is inconsistent, however, because choosing A implies KFC is preferred to Burger King (as today is the same in A and B), and similarly D implies Burger King is preferred. The problem is related to the sure-thing principle, whereby the unchanged (extra) outcome between two choices should not influence this decision.

Preference for spread

People want to spread the events evenly over a period of time. For example, people prefer to have the nice event in the middle of a week rather than in the beginning. This violates discounted utility as it indicates that the preference between two options should depend only when the utility really differs, not when for different options you have the same event on specific days of the week. Hence a preference for spread cannot be solved by positive or negative time preferences.

Can we predict future utilities?

Many problems that the models encounter are due to **projection bias**, or the difficulty of predicting what our future self wants (more precisely, overestimating the degree to which our future selves will have the same preferences as our current selves). We often underestimate the degree to which we adapt to change (**underprediction of adaptation->see lecture 1**), and we overestimate the extent to which we like variety in the future **(diversification bias->see lecture 1)**.

Introduction to Behavioural Economics - Week 4

Strategic Interaction

Individual economic outcomes are often affected by other people. The type of behaviour that takes into account the consequences for yourself and others is called **strategic interaction** and can be analysed with **game theory**. Hence, the people are called “players”. Game theory uses the concept of a **Nash equilibrium (NE)** to provide **strategy profiles**—lists of strategies for every possible circumstance.

There are two main types of strategic games: **sequential games** and **simultaneous-moves games.**

Simultaneous-moves game

There is no time difference between players making choices, and the outcome is only revealed once all choices have been made. Players cannot first observe what others have done before determining their own optimal strategy (e.g. the prisoner’s dilemma). The solution for this game is solved by finding the Nash Equilibrium.

Sequential game

There is a time difference between players making choices, so players have knowledge of what has happened earlier. e.g. tic-tac-toe is a sequential game. Sequential games are often represented with decision trees (see Figure below). Using **backward-induction**, it is possible to find one or more **subgame-perfect equilibria.**

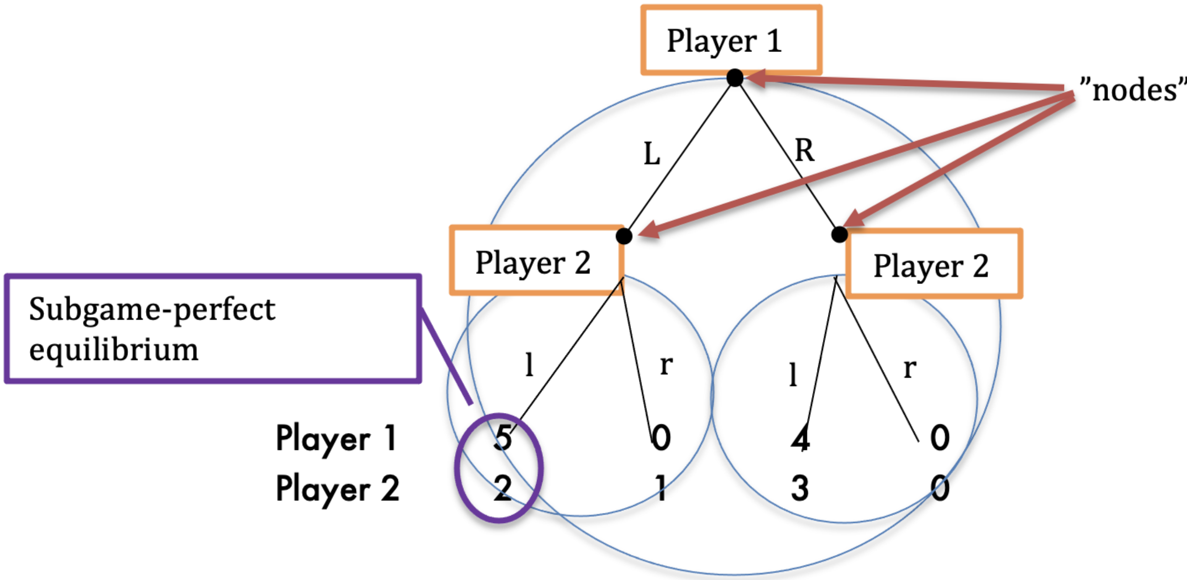


Figure: Example of a sequential game. Note: the proposer may have more options than just two!

Backward induction

Check the best responses starting from the bottom of the tree and then move your way up.

In the game that Figure above represents, finding the subgame-perfect equilibrium is straightforward:

- Responder chooses l if proposer chose L, and l if proposer chose R. This is because 2>1 in the first case, and 3>0 in the second case.
- Now, assuming the proposer (player 1) knows this, he chooses L as 5>4.

A feature of a subgame-perfect equilibrium is that it eliminates non-credible threats. To see this, notice how the responder would like to end up in (R,l), as there the payoff of 3 is more than with the equilibrium (2). They might threaten to play r regardless of what the proposer chooses, aiming to frighten the proposer with the prospect of only receiving 0. This threat is not credible, however, as the responder him-/herself is always better off playing l.

Note that all strategic interaction requires players to determine their best responses using two criteria:

1. Their belief about how the other players will act.
2. Their utility functions.

Deviating from the standard equilibria

This is where reality and theory clash, as NE (Nash equilibrium) and SPE (subgame perfect equilibrium) are not what occurs in a real strategic interaction. The followings are proposed as reasons for the deviation, and correspond to the prior two criteria:

- **Limited strategic reasoning:**
  players do not make rational choices based on their beliefs. The equilibria assumes that people have an unlimited capacity to reason strategically. In reality, most people have limited strategic reasoning. Their limited strategic reasoning may be because of (1) self-limitation or (2) the belief that others have limited reasoning. This either applies to oneself or to their beliefs about others, i.e. believing others have limited strategic reasoning. – **in the Guessing game**
- Players' utility depends not only on their own payoff, but also on the payoffs of others (social preferences about their own beliefs or beliefs about others). People have social preferences. Hence, our utility depends on our own payoff and the payoff of others. This is may be because of (1)we ourselves have social preferences or (2) that we believe that other people have these social preferences. - **in the ultimatum, dictator, and trust game.**

Limited strategic reasoning in the guessing game

The **guessing game** is used to illustrate the first reason for deviations from NE and SPE, which is that people have limited strategic reasoning. The guessing game proves that social preferences alone cannot explain the deviation of people's decisions from the Nash equilibrium. The game goes as follows:

- There are three or more players
- All players choose a number between 0 and 100, inclusive
- The mean of the choices is calculated
- **Player closest to 2/3 of the mean wins a fixed amount of money, others get nothing**

There is only one Nash equilibrium in this game, and it is to choose the number 0. Assume that all the other players choose 0. In this example, let p represent the probability 2/3 and x be your chosen number.

Then the distance to p multiplied by the mean for you will be x – p(x/n) = (n-p)(x/n) while for others it will be p(x/n)-0=p(x/n) therefore the others will win as they are closer to the p times the min p(x/n).

To prove that there is no other Nash Equilibrium then let S be the sum of all the numbers the other players chose, and the mean of all numbers be (x+S)/n. Then the distance to p times the mean for you will be x-p(x+S)/n = [(n-p)x-pS]/n resulting in an incentive to lower x to minimise distance to p times the mean.

To find the Nash Equilibrium, we can use **iterated elimination of dominant strategies:**

Iterated dominance in the guessing game

The structure of the game implies that the target can be at most p * 100 = 100p. If people assume strategic reasoning in themselves and others, they will never choose a number over 100p (thus making numbers over 100p **first-order dominated**). If all the players in the game take 100p as the new logical maximum point, the maximum target number becomes p * 100p = $100p^2$ (numbers above $100p^2$ are **second-order dominated**). The chain goes on (with higher orders of dominated numbers), and eventually approaches 0. Hence, the Nash equilibrium choice is 0.

In practice, people do not choose 0, but rather around 40 on average. Hence, they do not follow strategic reasoning, or believe that others do not. Both possibilities cause the previous reasoning to fail. Even if they know the Nash Equilibrium strategy, they may not want to play it as long as they expect other players to play-out-equilibrium strategies In practice, a behavioural model to predict these choices suggest that there are **level-k players**:

- level-0 players choose randomly [0,100] and thus the mean will be 50
- level-1 players think everyone else is level-0 and hence will believe mean will be 50 and will therefore play 50p
- level-2 players think everyone else is level-1 and believes that the mean will be 50p and so will play 50 p^2

The concept of level-k players shows how belief of other players' irrationality influences the higher-level players' choices—even if they themselves do follow strategic reasoning. To play the Nash Equilibrium then the player needs to be at level-∞

Social preferences in the ultimatum , dictator and trust games

The second reason for deviations from NE and SPE can be seen in sequential games that have a **proposer** and **responder: the ultimatum game, dictator game, and trust game.** In these games, limited strategic reasoning does not have a significant role. These games give evidence for social preferences, meaning that the utility function does not only depend on your own payoff, but also the payoffs and intentions of others. A proposer decides how to allocate a money amount between him-/herself and the responder. The responder decides whether to accept or reject the proposer's offer.

Ultimatum game

If the responder accepts the offer, it is fulfilled, and the money is split as proposed. If the responder rejects the offer, nobody gets anything. There are two subgame-perfect equilibria, and the one which realises depends on which of the following assumptions holds:

Assumption 1: the responder accepts only strictly positive offers

⇒**SPE:** Proposer allocates the smallest possible increment of positive amount to responder and keeps the rest.

Assumption 2: the responder accepts any offer

⇒**SPE:** Proposer keeps all the money

It is unlikely that proposers cannot anticipate what responders would do, as the game is very simple. Hence, it is more likely that social preferences play a role. In practice proposers do not keep all the money, as they 1) want to make sure that responders do not reject (strategic concerns of the proposer to maximize only their own utility), and 2) may actually care about the responder’s utility (social concern).

Offers that are below 20% of the money are rejected 50% of the time; Most offers are between 40% and 50%, and almost none below 20%.

In the ultimatum game, the responder is able to determine what maximizes his own utility. Since the responder has no strategic motive, this deviation from the standard prediction cannot be driven by limited strategic reasoning. Instead, this shows that the responder's utility cannot be dependent on their own payoffs. It must also depend on the payoffs of the proposers.

Dictator game

The proposer imposes an allocation (acting as dictator), and it is fulfilled no matter how the responder reacts. It is a sequential game, but it does not matter whether the responder accepts or rejects the dictator's decision.

The dictator game is different from the ultimatum game because:

- Responder has no role (he cannot accept or reject the offer). Hence all strategic concerns are removed.

The **SPE** would be that the dictator keeps all the money to him/herself (offering zero), as there is no risk of rejection.

In practice: Offers by proposer are **lower than in the ultimatum game**, but still above zero. The decrease is due to the removed strategic concern of making sure the responder accepts, but the remaining positive offer indicates that the dictator's utility depends on more than his/her own payoff, i.e. reflecting kindness.

Trust game

1. Proposer gets sum of money S
2. Proposer sends some amount(X) to the responder
3. The money sent to the responder(X) increases by some multiplier(1+r) while in the responder's possession, i.e. the responder can get (1+r)X.
4. The responder can then return some amount to the proposer(y), but the return is based on trust and it may be 0.

Thus the final payoffs of the proposer is S-x+y and those of responder is (1+r)x-y

The **SPE** in this game is that the proposer does not send any money to the responder, because if utility depends only on one's own payoff, the responder will not send any back:

For example, Proposer starts with 100. He/she considers sending 40 to the responder, which would grow to another 80. The responder would maximize his/her own payoff *and return nothing. Knowing this, the proposer sends nothing and keeps the entire 100.*

*There is a tragedy here: if the proposer believes that the responder to return some money, the total payoff would be larger for both. To see this, assume the responder could commit to returning 50%. By applying this to the upper example, the responder would end up with 80*0.5=40 (>0) and the proposer with 140 (>100).*

Hence, assuming r >1, the equilibrium may not be **Pareto optimal** because people may be better off if there exists a written contract proposing the aforementioned 50% return by the responder.

In practice: Proposers on average invest 50%, and responders on average return 95% of the initial amount (before the multiplication). So, in the example above, the proposer would send 50 to the responder, and the responder would return 47.5.

The fact that responders return something shows that they have social preferences. And the fact that proposers do not keep everything for themselves also shows that they have social preferences.

Public good game

The idea that makes public good a strategic interaction is that their value rises as more people contribute. If the number of people contributing is low, the value of the good is not enough for them to receive a net benefit. Thus, the NE of a public good game is that nobody contributes! However, this is not pareto optimal. If enough people would contribute, the gains for everyone could exceed the costs.

In practice people contribute between 40% and 60% of their endowments in a public good game.

Social preferences

We have mentioned that some people care about other peoples' payoffs, but what do their utility functions look like? If x is the personal payoff and y the payoff of another player, the standard utility function u(x,y) depends only on x. **Altruism, envy, Rawlsian preferences, and inequality aversion** can bring y into the equation:

Altruism

$u(x,y)$ increases also in y **keeping own payoff fixed,** e.g. $u(x,y)=2\ln(1+x)+\ln(1+y)$

- This can be observed in some parents, friends, and significant others that make sacrifices for their loved ones happiness.

Envy

$u(x,y)$ decreases in y **keeping own payoff fixed,** e.g. $u(x,y)=2\ln(1+x)-\ln(1+y)$

Rawlsian preferences

$u(x,y)$ increases if payoff of the worst off increases **keeping own payoff fixed** e.g. $u(x,y)=x+\min\{\ln(1+x),\ln(1+y)\}$/ Rawlsian preferences is often described for a preference of fairness.

Inequality aversion

$u(x,y)$ increases if inequality decreases **keeping own payoff fixed,** e.g. $u(x,y)=\ln(1+X)-|\ln(1+y)-\ln(1+x)|$. The absolute value of x-y is used, because it results in a positive value whenever x and y are not the same. Then, the minus before the absolute value causes the utility to decrease as inequality increases. The inequality averse agents ranks allocations between the absolute difference of the best of and worst off players. They care about equality for its own sake, not because it benefits the least well-off.

It is important to remember that the above are considering that own payoffs remain fixed and are not affected. Only the final payoffs enter into the utility functions. You can also see from the examples that the utility functions have selfish and social parts and are only applicable for a given x. Mistaking a player's utility function may in turn cause us to not know what game is being played. Thus, an analysis for the game is likely to fail.

Social preference and Neoclassical theory

Note, moreover, that the analysis does not depart from the neoclassical theory, as it makes no assumptions on people's preference and what can enter as an argument into their utility function. Selfishness is not entailed in the theory, so ultimatum and dictator games cannot refute the “selfishness axiom” of the Neoclassical theory. There is nothing specifically behavioural about the aforementioned models of social preferences, thus it strengthens the Neoclassical theory.

Other terms

In more general terms, the utility attained from the final division of payoffs is called **outcome fairness** (as compared to only caring about one’s own payoff). Outcome fairness is related to **reciprocity**, which means taking into account the intentions of other players (punish for good intentions, reward for bad intentions).

Another way reciprocity embodies itself in strategic interaction is through **process fairness.** Process fairness is the caring about and deriving utility out of the way the final division of payoffs is attained. For example, somebody working more than another person but receiving less in payoffs may be regarded as being unfair from the process fairness point of view. If one cares about reciprocity, he also cares about process fairness.

Cooperation

In games such as that of the Public Goods game, experimental results display a high level of trust that leads to cooperation. Cooperation can be brought about by pre-play communication, altruism, and the repetition of games (if a game is repeated, players tend to make decisions closer to the subgame-perfect equilibrium). Moreover, cooperation had increased when games such as “prisoners’’ dilemma” were re-named as “Community Game”, indicating that social framing effects play a significant role in cooperation. **Labels** trigger **social norms** that can in turn trigger either cooperation or competition. Note that following a norm is conditional upon the thought of others following it as well. Hence, intention, trust, and reciprocity can be incorporated into the Neoclassical framework, though the degree to which it is incorporated is unclear.

Introduction to Behavioural Economics - Week 5

Decision making under uncertainty

As learned before, behavioural economists view deviations from rationality to be large and systematic enough to warrant the separation of normative and descriptive models.f Thus, they believe the neoclassical theories are inadequate in describing actual behaviour, and this week's lectures show why this is the case for **choice under certainty**. Namely, behavioural economists insist that opportunity costs, sunk costs, the decoy effect, and loss aversion create the disparities between real life and the models. As an alternative explanation for the real-life observed behaviour, heuristics and biases are introduced.

Opportunity costs

Opportunity costs are implicit costs of foregoing the net benefit of the best alternative option. According to standard economics, a utility maximising rational agent takes all costs -- both explicit and implicit -- into account when deciding. Thus, in order to make a rational choice, the utility of making a choice must be higher than its opportunity cost. Opportunity costs are simply the missed revenue of the **best**, not chosen alternative.

The standard notation when discussing opportunity costs is the following:
The available choices are labelled a_1, a_2, a_3, etc.
The utilities are $u(a_1)$, $u(a_2)$, $u(a_3)$, etc.
The opportunity costs are $c(a_1)$, $c(a_2)$, $c(a_3)$, etc.

$$C(a_i) = \max \{ c(a_1), c(a_2), \ldots, c(a_{1+i}), c(a_{i-1}), \ldots u(a_n) \}$$

Example
You have the choice of going to the movies for free or buying a ticket to go to the zoo. You value going to the movies at 80 and going to the zoo at 60. However, there is an explicit cost of going to the zoo, the ticket costs 20. What is the opportunity

cost of going to the movies? àThe opportunity cost is the benefit minus the cost, so 60 - 20 = 40, because this is the net benefit you sacrifice by choosing to go to the movies.

For every opportunity chosen, there is always another that is not chosen. Hence, decisions may have two costs namely: Explicit costs (ex: price of the zoo ticket) and the Implicit costs (ex: opportunity costs).

However, opportunity costs are often overlooked. But is this always irrational behaviour?
One legitimate argument is that it can be extremely costly to evaluate all possible alternatives, and thus ignoring opportunity costs may in fact be rational. This would, however, go against the definition of rationality that standard economic theory insists upon, because there the definition of rationality is that a choice must have no other strictly preferred alternative (see Week 1). Thus, standard theory requires that all opportunity costs are taken into account. With a reasonably sized set of choices under certainty, ignoring opportunity costs is strictly irrational.

Sunk costs

Sunk costs are costs that have already been paid in the past, so should have no effect on future outcomes, as it cannot be changed. Thus, they should not affect current decisions.

Making decisions that are distorted by costs incurred earlier in time is called committing the **sunk-cost fallacy**. Frequently, people keep investing in a project depending on the investment they made in the past.

A decision tree is a graphical device that shows what actions are available to an agent. A decision tree is helpful in displaying an agents decision problems.

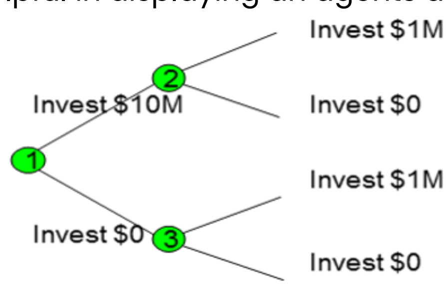


Figure: Decision tree to illustrate concept of opportunity cost

The points in which decisions are made are the green circles, numbered 1, 2, and 3. At points 2 and 3, the decision made at 1 is already in the past: it should therefore not influence the present decision. Hence, the choice to invest $1M or not, should be the same at points 2 and 3. In other words, if point 2 leads to an outcome of $1M additional investment, so should point 3.

Intuitively, the **sunk cost fallacy** (also called **Concorde fallacy**) stems from the idea that if a lot has been invested in a project already, it might as well be completed. Considering the figure above, let us say that in one scenario, $10 million has already been invested in constructing a house. In another scenario, no money has yet been invested. Common to both scenarios are that the house can be completed for an additional $1 million, or it can be left unfinished for no cost. Rational behaviour in the standard economics would be consistent behaviour; if the house is finished in one scenario, it should also be finished in the other. If it is left unfinished in one scenario, this should be the case for the other scenario as well.

The sunk cost fallacy can sometimes be committed for the following reasons:

- To "justify" past behaviour (and convince themselves that their previous actions were rational)
- Because people hope if they keep investing, then something may happen to recover sunk costs, even if this is improbable. This is also because people tend to be risk seeking for losses

The Concorde fallacy can start a vicious cycle called an **escalation situation**, where people may find themselves making even greater sunk costs.

Decoy effects

The **decoy effect** is a type of **menu dependence** that illustrates how people may change their behaviour when an irrelevant additional alternative is added to the set of possible choices.

To explain the decoy effect, it is useful to start with an understanding of the **expansion condition**. The expansion condition states that:

> if x is chosen out of the menu {x,y}, and x is strictly preferred to y, y cannot be chosen out of the expanded menu {x,y,z}, where the irrelevant option "z" is added.

In case **y** is in fact chosen, that would be a violation of standard theory rational behaviour. What behavioural economists show is that the expansion condition is indeed sometimes violated. What is the setting for such a violation to occur? Let us explore this next.

Example

Suppose you sell an entity called Grand, and a competitor sells an entity called Royal. In this illustration, we do not classify Grand and Royal as being goods or bundles of goods, because the decoy effect works in both cases. What is important is that the entities Grand and Royal have different sets of attributes, which can be represented on the x and y axes. To clarify, these attributes can be either quantities of the different goods, if Royal and Grand are bundles of goods, or qualities of one good specific type of good, for example durability and loudness of a loudspeaker.

The decoy effect requires that an asymmetrically dominated alternative option is added to the menu. It must be strictly dominated by the entity you are selling (Grand) in all dimensions (has no better attributes than the entity that you want to), but not be worse than the competitor (Royal) in all dimensions (has better an aspect out of two attributes). Such an alternative option is called a decoy. A key idea to understand its effect, is that it alters the indifference curves of an individual such that their preference changes. To see this, look at figure below.

As can be seen, the decoy is strictly worse in all aspects than Grand, but better than Royal on the attribute represented on the x-axis. This causes an attraction effect towards Grand (because the decoy is dominated in all aspects by Grand), which makes the indifference curves steeper and causes the consumer to choose Grand. Such shifts are considered irrational.

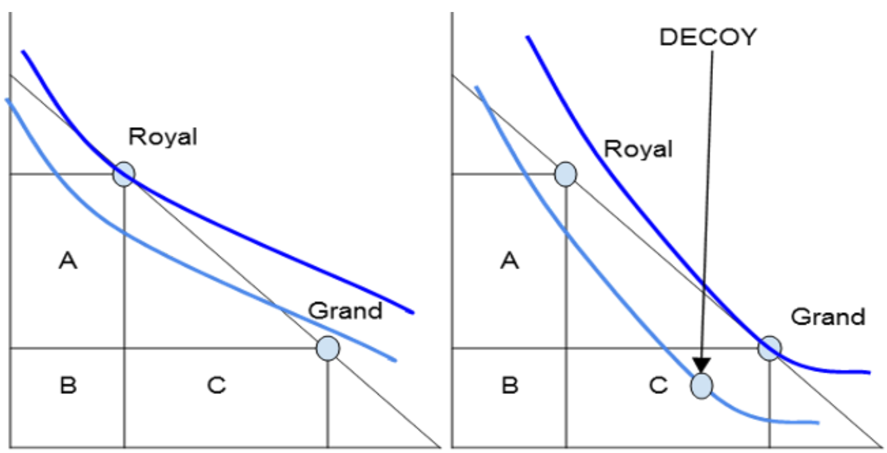


Figure: Illustration of how a decoy can change individuals' indifference curves Take note that the indifference curves have rotated clockwise around the competitor (toward the decoy). This makes Grand lie on the higher indifference curve.

Note that an addition to the menu is not always a decoy, even if it does alter choices. To see this, consider a restaurant serving polar bear meat. This may not have an attraction effect toward any other menu choice but could well cause you to leave the restaurant entirely, in disgust.

Some important terms relating to menu dependence include:

- A product "a" **dominates** another product "b" if "a" is better than "b" in every possible aspect
- A product "b" is **asymmetrically dominated** by "a" if "b" is dominated by "a", but not by any other member of the menu.
- A **decoy** is that which is asymmetrically dominated by the target product being marketed.

In addition to the decoy effect, there are other types of menu dependence. Various forms of menu dependence are often called context effects because decisions appear to be responsive to the **context** in which they are made. Two types are introduced in the lecture, namely the compromise effect and extremeness aversion.

Extremeness aversion

The propensity of people to choose alternatives that are not at the extremes of relevant dimensions in attributes. For example, it is unlikely that people purchase the most expensive product available or choose the strongest type of chili pepper to add to their food.

Compromise effect

This is like extremeness aversion and is sometimes portrayed as stemming from the extremeness aversion. It simply means that people tend to choose the middle option out of the possible set. Referring back to the chili pepper, if three degrees of intensity are available, it is most common to go for the middle choice.

Loss aversion

The manner by which people assess various options can depend on a reference point. This kind of phenomena is often referred to as **reference-point phenomena**. A reference point can be determined by social comparisons.

Loss **aversion** implies that the same amount of losses hurt more than gains. Loss aversion is caused by something called the **endowment effect**. Both the endowment effect and reference point phenomena are instances of framing effects, which happen when preferences are dependent on the **framing** of options.

The **endowment effect** states that once people own something, they all of a sudden put a price to it that is higher than in the case that they had not owned it. Formally, this can be described as having a higher willingness-to-accept than a willingness-to-pay (WTA > WTP). WTA represents the minimum price required to give up something, and WTP represents the maximum price one would pay for something. As an example, the price to sell a good must be higher than the price to purchase the same good. Exemptions from the endowment effect include money and sellers of items.

The phenomenon of loss aversion has led to economists devising a new type of function, the "value function" which is differ to the "utility function".

Utility function (reference-independency)

Let us describe these in more detail. In standard utility functions, the effect of equivalent gains and losses are the same. Thus, the WTA = WTP. So, an individual exhibiting utility function u(x) experiences a gain from going up one unit that is equivalent to the loss he/ she would experience going down from that unit back to the initial position. Suppose an individual derives utility worth €1.50 from the first apple he/she receives. He/she would be maximally willing to pay €1.50 to obtain that apple. Importantly, he/she would be willing to also sell this apple for €1.50, because gains and losses are felt the same. The experienced magnitude of the change in value is independent of it being a gain or a loss

Value function (reference dependency)

Loss aversion can be captured by the value function, which is an important part of **prospect theory**. Two features of the value function are: (1) the function ranges over changes relative to some reference point (unlike the utility function, which ranges over total endowments), and (2) the value function has a kink at the reference point. The curve is steeper in the left of the origin.

With loss aversion, losses loom larger than gains. Thus, a loss of something induces a larger effect on utility than an equivalent gain. This is what reference-dependency denotes. Thus, the value function measures utility in changes with relation to a reference point. If the change is negative, a different weight is used than if the change is positive. Because losses are felt more heavily than gains, changes in the realm of losses are weighted more heavily, and the side of losses is thus steeper. See Figure below.

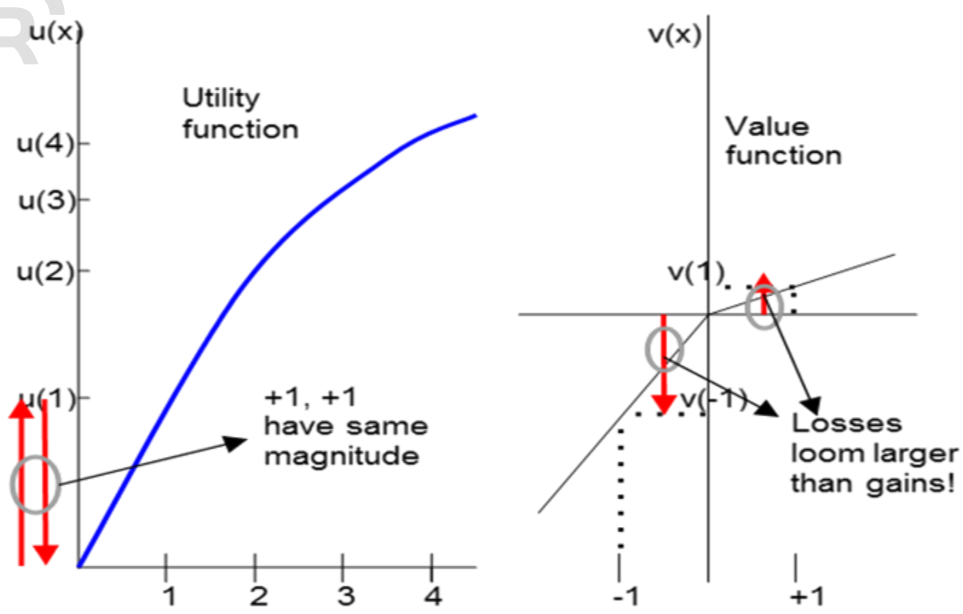


Figure: Utility function vs. Value function

Note that the endowment effect and loss aversion do not always occur. For example, it is normal to be indifferent between swapping a €10 bill for another.

Let us consider another way in which the discrepancy of loss aversion with standard economics takes form. In neoclassical economics, indifference curves are assumed to be downward sloping and exhibiting diminishing marginal rate of substitution.

However, once loss aversion is incorporated in the model, it causes a peculiar effect: the indifference curves become **kinked** at every possible endowment point. The endowment points considered in the figure are points A and B (see Figure below). The kinks occur because each deviation from the endowment point is evaluated as a loss, and therefore proportionately more of the other good must be gained to compensate. The value function that represents the preferences in the Figure below is as follows:

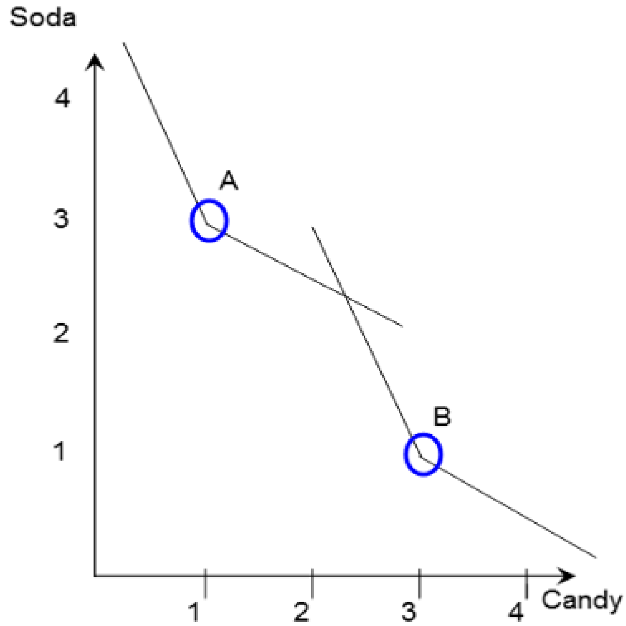


Figure: *Kinked indifference curves due to the endowment effect and loss aversion*

Example

v(x) = {x for gains (x ≥ 0); 2x for losses (x < 0)

Because losses are felt two times more heavily than equivalent gains (in this example the coefficient for losses is 2), two units of the second good must be received in order to compensate for a loss of one unit in the first good.

A **status quo bias** can also occur. In this situation, the agent prefers the existing state of affairs under any circumstances. (i.e. preferring x instead of y if the agent begins with x but also preferring y instead of x if the agent begins with y).

Heuristics & biases

Heuristics can be thought of as mental shortcut/rule of thumb of sorts; they are functional in the sense that they make day-to-day decisions often faster and easier and are usually fairly accurate. However, sometimes these mental shortcuts can be systematically flawed. When this is the case, it leads to **biases** in decision-making and irrational behaviour.

We shall now consider one type of heuristic: **anchoring**, and the bias that stems from it through **adjustment**.

Anchoring and adjustment

Anchoring and adjustment are mental activities used to evaluate an unknown variable. Thus, they concern making a decision **under uncertainty**, or lacking perfect knowledge. To illustrate these concepts, suppose the variable of interest to a person is the true value of a second hand-piece of jewellery. Assume the reported price of the jewellery is €2000. This price is the **anchor**. An anchor can be an irrelevant number. It is called an anchor because it tends to be the initial point for evaluating the true measure of an attribute, in this case the true value of the jewellery. Immediately after the anchor is set, the period of **adjustment** begins. If the person evaluating the jewellery thinks €2000 is too much, he/she will adjust the estimate of its true worth down to something below €2000. The opposite is also true: if he/she thinks €2000 is too little, he/she will adjust the estimate upwards to something above €2000.

When people must do a snap judgement, people adjust wrongly but do it in a predictable way.

What is observed in practice is that anchoring, and adjustment have a significant effect on the final estimate that people make (i.e. usually, the adjustment is insufficient). This is inherently irrational, because the anchor is essentially an arbitrary number. To make the effect more vivid, consider how in a study, participants' valuations of items such as wine bottles were heavily influenced by it. They were asked if they would pay at least the amount of the last two digits in their own social security numbers for the wine. These numbers should have no influence on the value attained from the purchase. Nevertheless, people with digits in the highest quintile (80-99) were willing to pay on average over three times more for the bottle!

Diminishing sensitivity and mental accounting

The diminishing sensitivity (explained earlier) of the prospect theory utility function has two interesting consequences related to **integrating** and **segregating outcomes**. Let us say your utility function is as follows:

$$v(x) = \sqrt{\frac{x}{2}} \, for \ gains$$
$$v(x) = -\sqrt{|x|} \, for \ losses$$

This utility function exhibits reflexivity and loss aversion. Integrating gains leads to a smaller total increase in utility than segregating them, while resetting the reference point in between.

E.g. consider a gain of 15, first as one increase and second as +10 and +5.

integrated: v(+15)= $\sqrt{15/2}$ =2.74

segregated: v(+10) + v(+5) = $\sqrt{10/2} + \sqrt{5/2}$ = 3.82 (>2.74, thus it is **better to segregate gains!**)

Now, consider a loss of 15, first as one loss and second as -10 and -5.

integrated: v(-15)= =-3.87

segregated: v(-10) + v(-5) = $-\sqrt{10} - \sqrt{5}$ = -5.40 (<-3.87, thus it is **better to integrate losses!**)

Integrating and segregating losses and gains is closely related to a concept called **mental accounting**. Mental accounting describes the use of framing to classify money into different virtual categories in the brain. In reality, money is fungible (no unit is different from another) so mental accounts can lead to over- or under consumption. Mental accounts are related to integration and segregation because gains and losses in different accounts will be regarded as segregated. Thus, for example a bonus paid with the salary is not felt as strongly as a bonus paid as a separate cheque. This is because the gains are integrated in the first case but segregated in the second.

End-of-the-day-effect

At the end of the day, many gamblers doing badly will tend to take more risk. This is explained by the fact that they have entered the loss domain, and thus the risk preference is explained by their convex utility function in losses.

House money effect

The house money effect is similar to the end-of-the-day-effect, but due to mental accounting. The picture is of a person who has won a large amount, and immediately spends an irrationally large proportion of it. The person has placed the winnings in a different mental account from his/her savings, for instance. These different accounts have different marginal propensities of consumption (MPC), with the MPC for this winnings account is apparently very high.

Note that a **windfall** means an unexpectedly large or unforeseen profit.

Introduction to Behavioural Economics - Week 6

Judgement under risk and uncertainty

For decisions under uncertainty, probability theory is widely regarded as representing the normatively correct behaviour (how people should behave if they act rationally). It is often also used as a descriptive model, and this is where behavioural economists step in. They argue that actual behaviour deviates significantly from what is expected by probability theory, and explain this behaviour with psychological heuristics, biases, and fallacies.

Note: By pointing towards the phenomena that challenge probability theory as a descriptive model, behavioural economists incidentally also challenge its normative grounds: the demands placed on individual judgment by probability theory are often difficult and costly that its rationality may be disputed.

Heuristics & base rate neglect

Representativeness heuristic

The representative heuristic describes how people rely on the representativeness of an observation to then make judgements on its validity as stemming from a known process. E.g., Seeing a person wearing a suit, one might jump to the conclusion that the individual is a businessperson because wearing suits is so representative of the type.

Most often the judgments are correct, but they can also lead to systematic biases as with all heuristics. Some of the biases stemming from the representativeness heuristic are the law of small numbers, the gambler's fallacy, regression to the mean, and base-rate neglect.

Base-rate neglect (also base-rate fallacy)

Failing to account for the base rate in a decision. For example, (as given in the lecture) people are more likely to say that there is a higher probability that someone who has the characteristics of being precise, not afraid of public speaking, and has a strong sense of justice is a lawyer. However, all of these characteristics can actually apply to a wide range of occupations/people and given that the proportion (base-rate) of lawyers in the Netherlands is smaller than other occupations, it is more rational to say that people of other occupations have a higher probability of fitting the description. Note that the base-rate neglect may also result in a confusion between conditional probabilities Pr(A|S) and Pr(S|A). It also contributes to the planning fallacy, which will be discussed later in the summary.

Law of small numbers

The law of small numbers is the name given to a phenomenon where people overestimate the extent as to which a small part of a large population must agree with the statistics of the larger population. For example, people know that in the general population, about 50% are women and 50% are men. If a person expects a small class, say a class of 6, to have a 50-50-distribution as well, he/she is falling victim to the law of small numbers. Thus, it seems the small class should be representative of the large population, but this is not necessarily the case.

Gambler's fallacy

The gambler's fallacy is a similar phenomenon in a gambling setting: e.g. a player gambling on the outcome of a coin flip may expect that after say 5 consecutive heads the next toss must be tails. Assuming that the coin is unbiased, the probability of attaining tails is, of course, the same as with all probabilities prior to tosses (50-50). The gambler assumes that statistical average events must also happen in the relatively short term, but in fact there is no need for that to happen as every coin flip is an independent event. In other words, the gambler fallacy is the tendency to believe that statistical processes are corrected in the short term. This often happens when people think that two outcomes are dependent when in fact they are not.

Regression to the mean

Regression to the mean is something that people often fail to take into account. Mean occurrences should rationally be expected over a large number of repetitions, but people fail to recognize this trend. For example, consider it has not been raining for two weeks in an area where this is uncommon. A man willing to make it rain goes outside and starts dancing and inviting the sky to pour down. Indeed, it starts to rain and thus the man crowns himself "the Rainman". The man is not considering regression to the mean, which entirely explains his experience. In other words, regression to the mean is failing to see that statistical processes will return to their average in the long run.

Bayes' rule

Stepping back for a moment, let us introduce an important logical theorem from probability theory by the name of Bayes' rule. This rule is important for the context of decisions under uncertainty, because it describes the probability of an event happening based on prior knowledge of similar conditions. Later, deviations from this rule will be demonstrated. To illustrate Bayes' rule, we present the following scenario:

- There are two types of chilli peppers: spicy ones and mild ones. They look very similar, but of course taste different.

- You know from prior experience that 5% of peppers are spicy (95% are mild).
- You estimate that you can determine the type of pepper by looking at it with 90%-accuracy (you fail 10% of the time).

Now, suppose you want to determine the probability that a randomly picked chilli evaluated to be spicy is indeed spicy. The intuitive answer is 90%, but Bayes' rule shows why this is not the case. We will demonstrate this first via an illustration, and subsequently more formally.

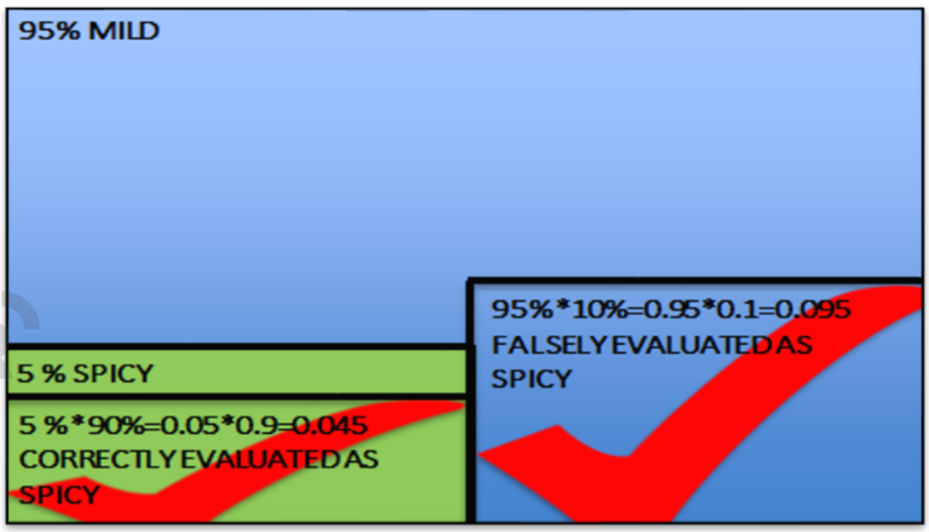


Figure: *probability that randomly picked chilli would be evaluated as spicy.*

The figure represents all the chilis that can be randomly picked (the population). The blue stands for mild ones (95% of population), and the green for spicy ones (5% of population). The red check marks indicate chilis that are evaluated by you to be spicy: 90% of the actually spicy ones and 10% of mild ones—based on your 90% accuracy.

As shown, out of the total population, 0.045 (4.5%) are correctly evaluated to be spicy and 0.095 (9.5%) mistakenly evaluated. We can now quite intuitively determine the probability that a randomly picked chilli evaluated to be spicy is indeed spicy.

- The full subset of chilis evaluated to be spicy is 0.045+0.095=0.14
- The subset of that are correctly evaluated is 0.045

Thus, the fraction of chilis that are indeed spicy, given that they are first evaluated as such is 0.045/0.14 = 0.32. This is much less than 90%! The reason for the overestimation is that the part of the population that is mistakenly classified is underestimated; in reality, this set is usually much larger than the correctly evaluated set because of the small **base-rate**, and is called **base-rate neglect**.

To clarify, Bayes' rule states that the probability of a hypothesis being true given evidence is the probability of the event that the evidence is observed given the hypothesis is true multiplied by the probability that the hypothesis is true, divided by the above plus the probability of the event that the evidence is observed given the hypothesis is false. More formally:

$P(A|S) = \frac{P(S|A) * P(A)}{P(S|A) * P(A) + P(S|-A) * P(-A)}$ or simply $P(A|S) = \frac{P(S|A) * P(B)}{P(S)}$

where

A= actually spicy
S= evaluated as spicy
P(A) = probability of being spicy
P(-A) = probability of being mild
P(S|A) = evaluated as being spicy conditional on actually being spicy
P(S|-A) = evaluated as being spicy conditional on actually being mild

Other probability rules

Conditional probability	Pr(A|S) = Pr(A&S) / Pr(S)
The "AND" Rule	Pr(A&S) = Pr(A|S) * Pr(S), hence: Pr(A|S)*Pr(S) = Pr(S|A)*Pr(A)
Rule of Total probability	Pr(A) = Pr(A|S)*Pr(S) + Pr(A|B)*Pr(B)

Adjustment

Conjunction and disjunction fallacy

The **conjunction fallacy** is when the AND-operator is overestimated, and the **disjunction fallacy** is when the OR-operator is underestimated. What this means is that in these fallacies, the probabilities of many independent events ALL actually happening is overstated, whereas the probability of at least ONE separate event happening is understated. These concepts are effectively illustrated with examples.

Example of the conjunction fallacy:
Consider a car where any one part works 99.99% of the time (0.9999), and there are 1 million parts. The probability of all million parts working at the same time (AND operator; part 1 + part 2 + … + part 1,000,000 all work) is thus 0.9999^1,000,000, or approximately zero. Planners who overestimate this value are guilty of the conjunction fallacy.

- The conjunction fallacy can lead to the **planning fallacy**, where planners overestimate the probability of the conjunction that all pieces of their plan will fall into place. This leads planners to overestimate the probability that their project will succeed.

Example of the disjunction fallacy:
Consider a car as before where any part works 99.99% of the time (0.9999), and there are 1 million parts. Thus, the probability that one part is broken is 0.01%, or 0.0001. The probability of at least one-part breaking is 1-P (no parts breaking), or 1-0.9999^1,000,000, approximately 1. Planners who underestimate this value are guilty of the disjunction fallacy.

- The disjunction fallacy is important in **risk assessment.** When assessing whether a complex system will fail, even if the probability that any one element will fail is low, the probability that at least one element (of the whole system) will fail is high. Those who commit the disjunction fallacy will underestimate the probability of a system breakdown.

As is evident, conjunction and disjunction fallacies are logical symmetries of each other. If the probability of all events happening is overstated, it is necessarily the case that the probability of at least one event happening is understated.

Availability heuristic & confirmation bias

The availability heuristic is a phenomenon where more probability is put on an event that is more easily available in the mind. Most often this type of reasoning is correct, but it can lead to false conclusions. **Availability cascades** occur when behaviour exhibiting the availability heuristic self-reinforces itself in cycles. This mostly happens when multiple individuals have beliefs and behaviours that reinforce each other.

Retrievability of instances

This form of availability heuristic describes the case where memories drive the availability heuristic. Dramatic memories and negative news may come more easily to mind, for example. This causes such events to be weighted more in probability of reoccurring than events which do not have as strong of a memory mark.

Effectiveness of a search set

Sets of entities that come more easily to mind may be provided with a higher probability of occurring. For example, words starting with an “r” may be easier to think of as ones having “r” as the third letter, and thus be judged as more common. (Stoop, 2016)

Imaginability

Imaginability refers to the phenomenon that concepts that are easier to imagine in the mind are given relatively higher probability. For example, it is easy to imagine an elephant barging out of a zoo, whereas maybe harder to imagine how a rare mouse would do the same. This does not mean, however, that the probability of an elephant escaping the zoo is higher than that of a mouse escaping.

Confirmation bias

Confirmation bias is the bias occurring when people interpret evidence in favour of their initial hypothesis or opinion—without great regard to the nature of the evidence. Thus, even negative evidence may be unconsciously twisted into something promoting one’s beliefs. This concept is related to loss aversion in the sense that people would feel a higher negative effect from being proven wrong than what they would gain from adjusting their hypothesis based on the evidence. Where probability theory would estimate people to adjust their hypotheses (or beliefs), based on Bayesian updating, significant deviations occur in the real world.

Some reasons for the occurrence of confirmation bias include:

- People fail to notice evidence that goes against their beliefs (yet are quick to believe evidence that support their beliefs).
- People interpret ambiguous evidence in such a way that it supports their beliefs.
- People require higher proofs for evidence that contradict their beliefs.

Bayesian updating

Reconsider Bayes' rule (with notation from the earlier chilli example):

$$P(A|S) = \frac{P(S|A) * P(A)}{P(S|A) * P(A) + P(S|-A) * P(-A)}$$

Bayesian updating means the updating of the probability of your hypothesis being true. This is equivalent to adjusting the size of P(A)—the probability of a randomly selected chilli actually being spicy (referring to the earlier example)—based on the gained evidence from repeated real-world observations. After adjusting P(A), the function's output changes (P(A|S)), and this new value is subsequently used in place of P(A) when re-applying the function. Via this cycle, all individuals would in the end arrive at the same conclusion as to their hypothesis of the "truth" about the percentage of spicy chilis. The failure of this occurring in the real world is due to confirmation bias.

Introduction to Behavioural Economics - week 7

Policy making in an irrational world

Economic theory is frequently used in policy making with the aim of improving people's choices and their well-being. This type of leadership is called **paternalism** ("paternus" = fatherly), and traditionally appears in the form of **laws (bans)** and **financial incentives**. What behavioural economics brings to the table for policies is something called **nudges.** Nudging is a way for governments and firms to influence behaviour. It seeks to improve choices of an individual by making their actual choices conform more closely to rational ones.

The government can influence behaviour in four main ways. The first way is through **implementing a law.** The second way is through **imposing tax**. Imposing a tax is a good way to discourage certain behaviours where individuals are still free to do as they wish (unlike a law, where they have no choice but to follow). The third way is by **providing information that will steer the community in a certain way desired by the government**. The final way is a **nudge**. A nudge is a way to steer behaviour in a certain direction without violating any freedom of choice. Hence, in a nudge, individuals must have all choice options available to them. A nudge does not forbid any options or significantly change incentives. A nudge must be **(1) easy** and **(2) cheap to avoid.**

Nudges

Nudges are specific modifications of people's choice environment that aim to change behaviour in a predictable way. Because of this, they are classified as **libertarian paternalism**, because they do not impose monetary or legal penalties on deviating from the nudge. (Note that **Soft/light paternalism** is another term for the same thing: libertarian paternalism.). Advocates of the nudge agenda claim that it allows an improvement of people's well being through their choices at minimal cost and without interfering with their liberty/autonomy.

A major characteristic of a good nudge policy is that it exhibits **asymmetric paternalism,** which means that it does not affect people who are already acting in the desired way. They benefit individuals that are acting in a "wrong" way by changing/influencing their behaviour while maintaining the existing behaviour of others and not placing costs on them. Nudges work because people are lazy and they do not like to go against the norm no matter what the norm is.

What is the choice environment?

It simply refers to any environment where people make the choice that is undesirable. If a person chooses unhealthy food in a corporate canteen, the choice environment is the canteen. For this reason, creating nudges is called **choice architecture**: choice architects literally modify the environment where people make choices with the aim of adjusting behaviour.

Example of a nudge

An example of a nudge is the placement of trash bins in frequently used areas. The characteristics of a nudge are all fulfilled:

1. It does not force a decision on a person, but helps people make the right choice.
2. It creates little to no cost for people that are exposed to it (besides maybe bumping into the trash bin, there is not much disutility caused by its existence).
3. The effect on people that already dispose of their trash by for instance carrying it home is negligible.
4. The effect is positive on people that do not already act rationally, because they are saved from having to either live in a dirty environment or paying for it to be cleaned.

Save more tomorrow

Examples of policy plans or intervention based on nudges are default options and the **Save More Tomorrow Program**. Both can be used to solve the problem of saving for retirement. It is behaviourally problematic because of **loss aversion, procrastination, self-control** and because **choosing the right amount of saving is difficult.**

Default options

Options that are chosen if the individual sticks with the status quo, i.e. does not make an active choice. Making this type of nudge can be used in pension policy via **Automatic Enrolment:** people by default save part of their earnings as defined contribution for pensions. This is a useful policy but has the downfall of some people possibly saving more if there were no default option. If this is the case, automatic enrolment cannot be considered a nudge.

Save more tomorrow program (SMarT)

Because of hyperbolic discounting, people want to defer losing money to a future time. The SMarT program utilises this by giving people an option to assign a portion of their future salary increases towards savings. It is not compulsory, and it is framed as a foregone gain instead of a loss: the savings are made from salary increases, so according to loss aversion they are not felt as badly as an out-of-pocket donation. There are 4 components of the program (with attractiveness in brackets):

- contract now to increase savings in the future (hyperbolic discounting)
- savings increased at the next salary increases (loss aversion)
- savings increased until a maximum percentage (status quo bias)
- employees can opt out anytime (freedom).

Decision and experience utility

A criterion for measuring welfare is needed in order to devise nudges that can improve it. When it comes to making welfare criteria, we need to think about how to measure how well-off people are. This is especially important when comparing two policy implications. There are two possible criteria for welfare, and **both are needed because they complement one-another:**

Decision utility

Based on **revealed preference relations,** and therefore **ordinal**. As learned earlier in the course, ordinal utility functions can only be used to rank preferences, but not to quantify the differences between them. So making policies based on decision utility does not always capture what is best for us. It also doesn't take into account changing preferences, the strength of preference between situations, and bias.

Experience utility

Refers to **hedonic experience** and is therefore **quantifiable.** However, experience utility is hard to measure, as it requires some extent of evaluating somebody's subjective intensity of emotions in an activity. In the lecture, four ways of measuring were mentioned:

Experience sampling

Sampling an experience moment-to-moment, e.g. technology that frequently asks you for your wellbeing.
Advantage: no memory biases.

Disadvantage: expensive, time intensive for subjects, rare events are often overlooked, big burden on participants.

Day reconstruction

Summarising what has happened in the past and evaluating the strength of the periods.
Advantage: events are recent, so errors and biases are reduced.
Reduces disadvantages of experience sampling, must be cheaper.

Remembered utility

Retrospective evaluation of the intensity of an experience.
Example: Asking someone how happy he was during the holidays
Advantage: cheap; able to target any event..
Disadvantage: cognitive (memory) biases such as **peak end rule** and **duration neglect.**

Life satisfaction

General satisfaction with life.
Advantage: cheap.
Disadvantage: cognitive biases e.g. sunny days result in higher happiness, the happiness/Easterlin paradox.

Problem with experienced utility

- **Hedonic treadmill:** major life events have a small effect on measurement. Over the long run, people will generally revert to their base level of happiness.
- Happiness – people return back to a base level of happiness
- People adapt to circumstances
- **Disability paradox**: patients report greater happiness than others would expect
- **Contrast effect:** in the short run, mundane activities seem less (more) enjoyable when an extreme positive (negative) event took place

Beyond experienced utility (what experience utility does not capture)

- There may be other dimensions of experience that aren't captured by experience utility, but we value (e.g. knowledge & wisdom)
- We like variety of emotions
- We care about the meaning of what we do
- We care about the opportunities we have (capabilities)
- Decision utility can capture these dimensions

Nudge criticism

Nudging has been criticised as being reliant on biased choice architects and harming people. However, these concerns should then be the same for any policy making. Nudging is a softer and less harmful approach than bans and fines, so the critics should logically criticise paternalism in general. They say there is a fine line between libertarian paternalism and harder forms of paternalism, where nudging easily leads to later more imposing policies. In reality, there is no proof of this and in any case, it is beside the point; criticism of this sort concerns hard paternalism, not soft paternalism. Sometimes the criticism is warranted, as nudges may be inadequate for preventing harmful activities such as murder or theft.

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