Why actuaries should know behavioral economics

Some general remarks and recent research on the demand for guarantees

- Brussels, April 2016
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Introduction

Observed behavioral patterns (a subjective selection)

An experiment that you can conduct with colleagues and friends

Prospect Theory – one explanation for some behavioral patterns

Conclusion

Traditional assumption: Individuals make decisions by maximizing expected utility.

- **Expected Utility Theory (EUT)**

main principles:

- Evaluate any goods (e.g. money) according to the utility that they create.

- If you have to make a choice with uncertain outcome, you make the choice that maximizes expected utility.

- The „utility function" is increasing.

  – One Euro more is always better than one Euro less.

- The slope of the utility function declines.

  – A 1,000 € gain creates higher utility if you own 100 € than if you own 1,000,000 €.

  – → risk aversion

The precise „shape" of the utility function depends on the individual's risk appetite.

Example of a utility function:
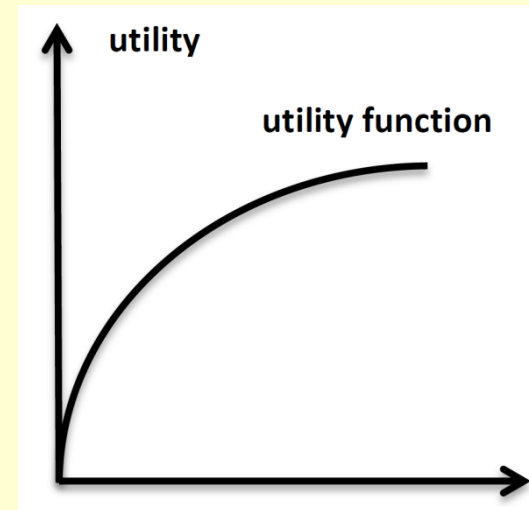
Risk aversion:

- utility(1,000 €) >
  0.5 * utility (500 €) + 0.5 * utility (1,500 €)

Important (and often overlooked): EUT is a **normative theory**. It describes how humans should ideally behave.

Its use as a **descriptive theory**, i.e. for the description and prediction how humans will behave in reality, is rather limited.

On the next slides we will present a (subjective) selection of behavioral patterns, that can frequently be observed although such patterns can not be explained by EUT.

- Then we will present a descriptive theory that is able to explain some of these behavioral patterns.

Note: This presentation is meant to introduce you to the topic and make you curious to learn more. It is often simplifying and by no means complete. The focus is on aspects that I personally consider relevant for actuaries / insurance practitioners.

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"Sense of fairness"

Experiment: The so called „ultimatum game"

- Round 1: A receives e.g. 100 €.

- Round 2: A must give a (arbitrary) portion of the money to B.

- Round 3: B decides whether or not to accept the gift. A is only allowed to retain his remaining money, if B decides to take the offered amount.

„Prediction" of EUT:

- A will offer B the smallest possible amount. Nevertheless, B decides to accept the money, because B's utility increases.

What happens in the experiment?

- Players from industrial countries – mostly bachelor students form the United States, Europe and Asia – typically offer 40% to 50% of the money to the second player, and offers below 30% are usually rejected by B.

- Nowak et al. (2000) conclude that the ultimatum game shows a universal human tendency of fair and punishing behavior.

Note: Güth et. al. (1982) implemented the ultimatum game experimentally for the first time. There exists plenty of literature on this topic and also experiments in different cultures and social classes.

Connection to insurance?

Collective savings processes in many traditional life insurance products come with elements of risk sharing over time and between different policyholders. If explained properly, they might appeal to policyholders' sense of fairness.

Anchoring effect *is a cognitive bias that describes the common human tendency to rely too heavily on the first piece of information offered (the "anchor") when making decisions. During decision making, anchoring occurs when <u>individuals use an initial piece of information</u> to make subsequent judgments.*

Once an anchor is set, other judgments are made by adjusting away from that anchor, and <u>there is a bias toward interpreting other information around the anchor</u>.
Source: Wikipedia

In other words: If you have a number/information in the back of your head, this may influence your decisions even if you know that such a number/information is irrelevant for your decision!

Backup

Anchoring effect

Famous experiments: „Wheel of fortune" or „Social Security Number"

- *In the first study of the anchoring effect by Tversky and Kahneman (1974), participants received a random number (either 10 or 65) by spinning a manipulated wheel of fortune as a numerical „anchor". Afterwards they had to estimate if the percentage of African countries in the United Nations is above or below this number. Then they should estimate the true percentage of African countries in the United Nations. The results were astounding, because the arbitrary anchor received by spinning a wheel of fortune had a significant effect on the estimates. The mean of the estimates made by participants with anchor 65 was 45%, whereas by participants with anchor 10 it was 25%. Therefore, this study shows that, when making a numerical estimation, a previously communicated random number affects the estimation.*

- *When asking participants to learn their first four digits of their own social security number by heart, and then to estimate the number of doctors in New York, the correlation of both numbers is roughly 0.4 – much higher than it should be in case of coincidence. This shows that just thinking of the first number affects the second, even if there is no logical connection between the two numbers.*
  Source: Kahneman, Thinking, fast and slow (2011)

Anchoring effect – Connection to insurance?

Most people significantly underestimate their own life expectancy.

- One reason could be that the time of death of the generation of the parents and grandparents represent an anchor.

  - But: Life expectancy increases by roughly 2.5 years per decade, thus by roughly 7.5 years per generation (Oeppen und Vaupel, 2002).

Wishful thinking: If you wish for something you also think that it will likely happen.

- Soccer: Barcelona plays Manchester United

    - It is not surprising that 100% of the Barcelona supporters hope that Barcelona wins and 100% of the Manchester supporters hope that Manchester wins.

    - Probably, however, also almost 100% of the supporters of Barcelona believe that Barcelona wins and almost 100% of the Manchester supporters believe that Manchester wins.

- Analogously: outcome of elections, etc.

Magical thinking: You subconsciously believe that you can influence things on which you have no impact.

- Experiment: How much money are people willing to bet on a coin toss?

    - little, if one can only bet after the coin was already tossed

    - more, if one can bet before the coin is tossed and even more, if one is allowed to toss the coin

- Experiment: hungry dove

    - Some food falls out of a device in a hungry dove's cage. The dove keeps repeating the move it made immediately before the event. The dove obviously thinks that this move caused the appearance of the food.

Wishful / magical thinking – Connection to insurance?

The customer of a unit linked insurance policy wishes that his/her fund increases. Therefore he/she also believes it.

The fund manager remembers (like the hungry dove): What was my last transaction, before a high return?

You hope that you won't become disabled or in need of care. If you also believe that, you won't buy disability insurance or long term care insurance.

Framing effect or **framing** *means that people react to a particular choice in different ways depending on how it is presented.*
*Source: Wikipedia*

- Experiment: method of treatment

  - 600 humans have a disease. There are two methods of treatment explained in different ways:

	Method 1	Method 2
Explanation a)	Saves 200 lives	33% probability to save everybody; 66% probability that no one will be saved
Explanation b)	400 patients die	33% probability that no one dies; 66% probability that everybody dies

  - In case of explanation a) 72% choose method 1.

  - In case of explanation b) only 22% choose method 1.

Framing effect – Connection to insurance

- Return-risk-profiles: Humans are more willing to buy a more risky product if the cumulative probability distribution of the terminal outcome is presented in Euro. The risk appetite is lower if the distribution of the respective yield is presented.
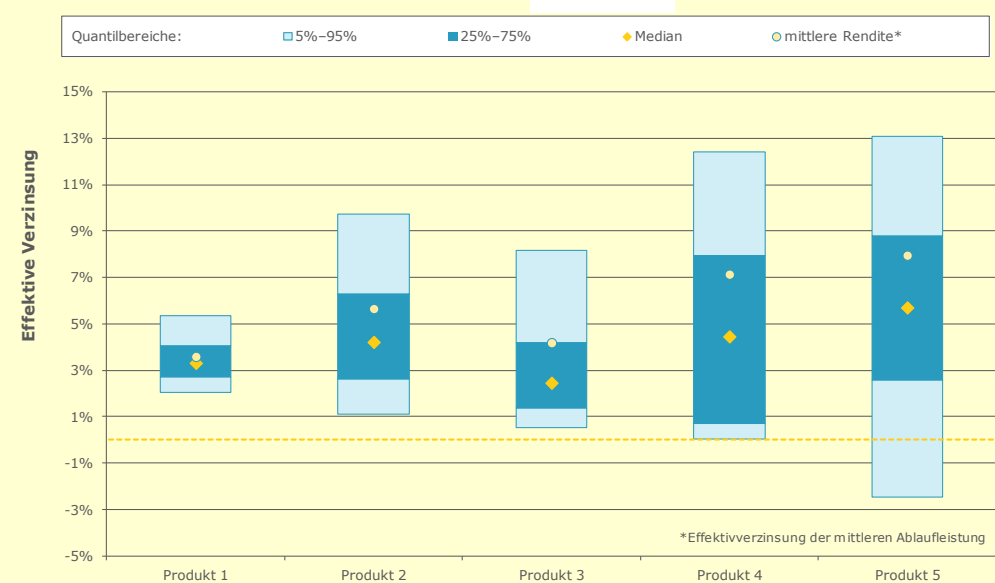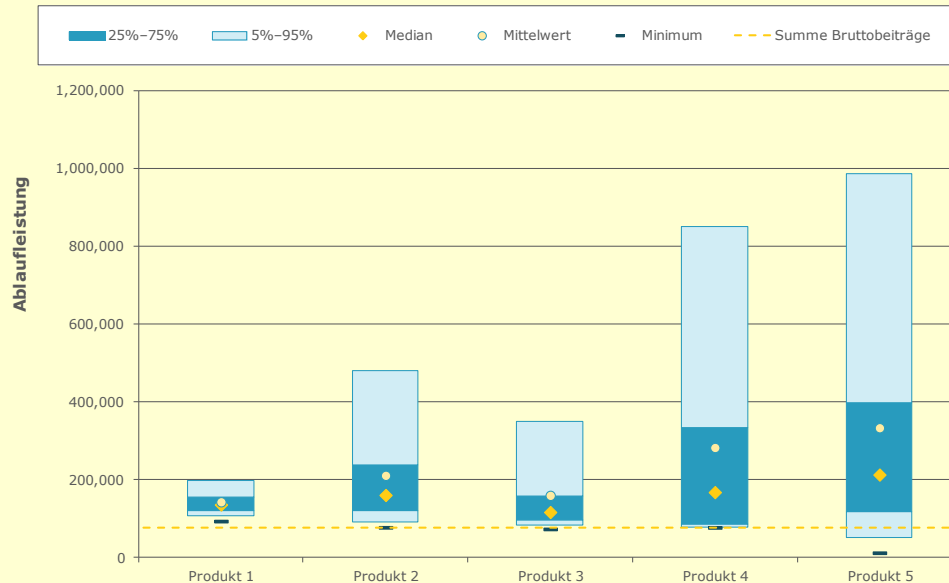
- Cf. also: Glenzer, Gründl and Wilde (2014)

Closely related to Framing: Mental compartments / mental accounting

Backup

- Experiment „Concert Tickets (freely adapted from Tversky & Kahnemann (1981))

    – a) You have bought a very expensive concert ticket for 200€. On the way to the concert you notice that you have lost the ticket. Are you willing to spend another 200€ for a new ticket?

    – b) You have made a reservation for very expensive concert tickets for 200€. On the way to the concert you notice that the you have lost the 200€ that you have withdrawn at an ATM. Do you pay with your credit card?

    – Surprisingly many people say „no" to question a) but „yes" to question b).

    – Explanation:
        - In case of a) the 200€ are deducted from the „concert ticket - budget". You pay 400€ instead of 200€ for the tickets.
        - In case of b) it is a kind of „bad luck - budget". You pay only 200€ for the tickets, but lose another 200€, due to bad luck.

Mental compartments – Connection to insurance

▪ It seems like that for most people a lifelong annuity is not in the mental compartment "insurance" but rather in the compartment "investment". The evaluation is therefore based on wrong criteria.

▪ Not: Which risks will be reduced? But rather: What return can I achieve?

▪ Investment risks and biometric risks are in different compartments.

– When making investments, humans are willing to waive potential returns to avoid capital market risks (cf. volume of savings books and deposit accounts).

– But, humans are not willing to waive potential return to avoid longevity risk (cf. small portion of annualized capital).

▪ Some insurance are wrongly in the compartment „betting".
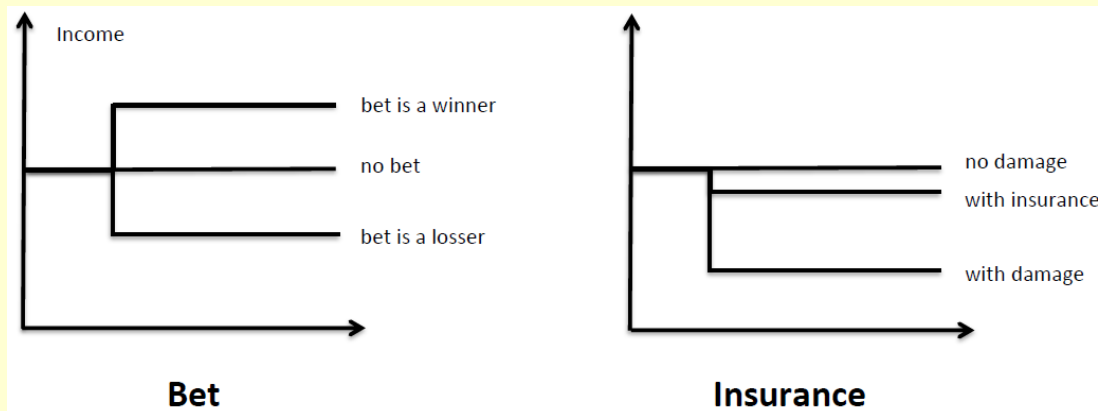
Why betting and insurance is not the same. Inspired by: Schulenburg (2005),

Problems when dealing with probabilities

Game A: What would you prefer?

- A1: an amount of 4.000 € with probability 80% (and nothing with 20% probability)

- A2: 3.000 € for sure

Game B: What would you prefer?

- B1: an amount of 4.000 € with probability 20% (and nothing with 80% probability)

- B2: an amount of 3.000 € with probability 25% (and nothing with 75% probability)

Depending on your risk aversion you might prefer either A1 or A2. But under EUT, if you prefer A1, then you „must" also prefer B1 over B2 and vice versa.

- In reality usually a vast majority (80%) prefers A2 over A1 and a significant majority (65%) B1 over B2. This is irrational under EUT.

- Explanation: We understand „sure" and „impossible" very well. But we misestimate probabilities in between. Low probabilities are overestimated and high probabilities are underestimated.

Note: The example on this slide is a version of the so-called Allais Paradox, cf. http://wirtschaftslexikon.gabler.de/Archiv/830359612/allais-paradoxon-v1.html

Problems when dealing with probabilities – Connection to insurance

This effect may explain the demand for certain guarantee products (we will come back to this point later).

Time inconsistency

„Now" has an especially high meaning compared to any other point in time.

- Of course, for „my future self" in 30 years „now" will be a different point in time than for my „current self".

- This leads to inconsistencies.

Experiment „waiting for money":

- When asking people if they prefer to get 80 € today or 100 € tomorrow, surprisingly many take 80 € now.

- But no one prefers 80 € in one year over 100 € in one year and one day.

- However, the „future self" in one year may prefer the 80 € over waiting another day for the 100 €.

- The „future self" in one year therefore thinks that the decision made today was wrong, although the same decision criteria still apply.

Time inconsistency

Backup

Many similar experiments:

- One day off tomorrow vs. 1.5 days off next month?

  - How would you have decided 10 years ago?

- Would you rather rent a comedy or a sophisticated movie?

  - When renting for immediate use, comedies / action movies, etc. are preferred.

  - When making a „preselection" of movies for later rental, more sophisticated movies are selected.

- More general: „Preference of vices over virtues"

  - Immediately choose things, which are fun; for later things, which are "useful".

- Time inconsistencies are not possible under the assumption that decisions are based on „normal" discounting functions.

  - Conversely, this means that one has to use „special" discounting functions to model time inconsistency. → e.g. hyperbolic discounting

Time inconsistency

Connection to insurance?

- Consume now rather than save for retirement.

- Choose a lump-sum rather than annuitization ($\rightarrow$ Annuity Puzzle).

- Postpone the meeting with your broker/advisor.

Loss aversion

- Losses hurt more than missed gains.

  – Relatively complicated design of experiments is necessary to quantify this effect.

  – Usually a loss is weighted with a factor of 2.

- Related: The endowment effect:

  – If I own something, it is more valuable for me than something comparable, which I is not in my possession.

- Related: Humans set a reference point at their current wealth.

  – The terms „loss" and „gain" only make sense in relation to a reference point.

  – This reference point „moves" if the wealth changes.

  – Just like „now" represents an outstanding point in time, your current wealth has a special status under all possible amounts of wealth and serves as a reference point in decisions.
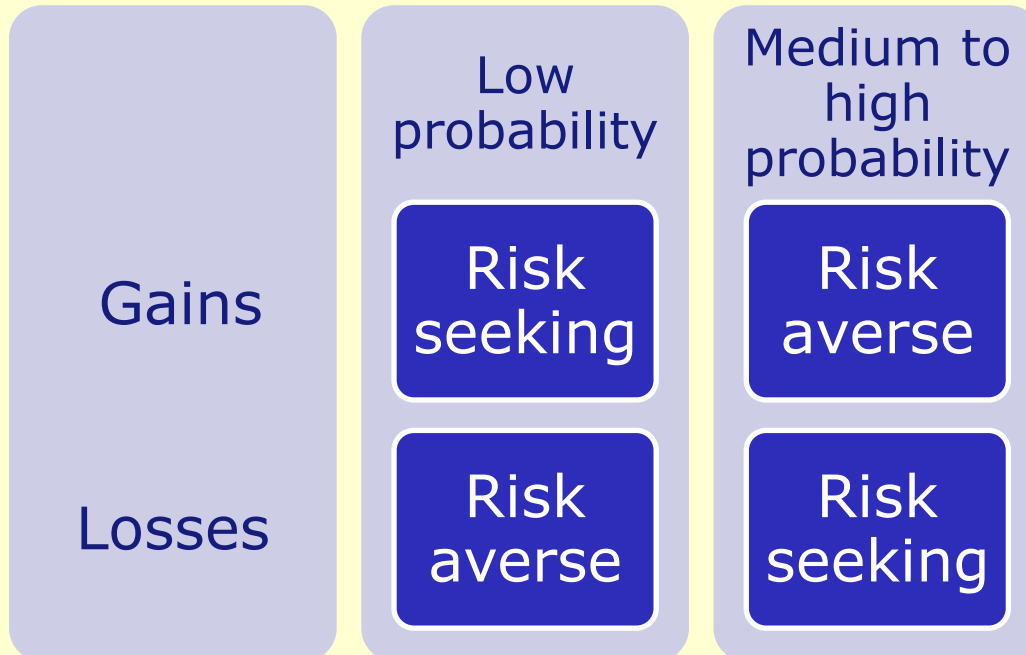
Connection to insurance?

- Loss aversion causes demand for guarantee products.

- low acceptance for products, which guarantee less than money back (reference point)

With the help of complex experiments one can find that humans are not always risk averse.

Backup

	Low probability	Medium to high probability
Gains	Risk seeking	Risk averse
Losses	Risk averse	Risk seeking

This explains why some humans at the same time own a lottery ticket and an insurance policy.

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An experiment

You (hopefully) don't know the answers to the following questions. Please specify for each question a 90% confidence interval for the correct answer.

The correct answers are

1. What is the weight of the statue of liberty (in kg)?   1. 204,100 kg

2. How many students study at Yale University?   2. 11,390

3. What is the population of Sri Lanka?   3. 20.3 million

4. How much is the price money for the Pulitzer Prize (in USD)?   4. 10,000 USD

5. By how much does an aircraft carrier "sink" if a seagull lands on it (in mm)?   5. 10^{-6} mm

6. How big is the Sahara (in square kilometers)?   6. 9,000,000 km²

▶▶ | Typically, 90% confidence intervals turn out to be 30% confidence intervals.

These types of results are mostly interpreted as „Overconfidence".

A second explanation is that humans have problems when dealing with probabilities, see above.

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Prospect Theory

In recent years, Prospect Theory (Kahneman and Tversky, 1979) became an alternative to EUT, attempting account for observed behavior.

Key elements of Prospect Theory (simplified, in particular no distinction between Prospect Theory and Cumulative Prospect Theory):

- Gains and losses are evaluated relatively to a **reference point**.

- This reference point may **move.** E.g. it might always be the current wealth.

- **Loss aversion**, i.e. the „value function" (that plays the role of the utility function) is steeper in the area of losses and flatter in the area of gains.

- **Risk aversion** in the area of gains but **risk seeking behavior** in the area of losses.

  – The value function is convex to the left of the reference point and concave to the right.

- Possible events are not weighted with their real probabilities but rather with „**distorted probabilities**".

  – The „distortion" is different for the evaluation of gains and losses.
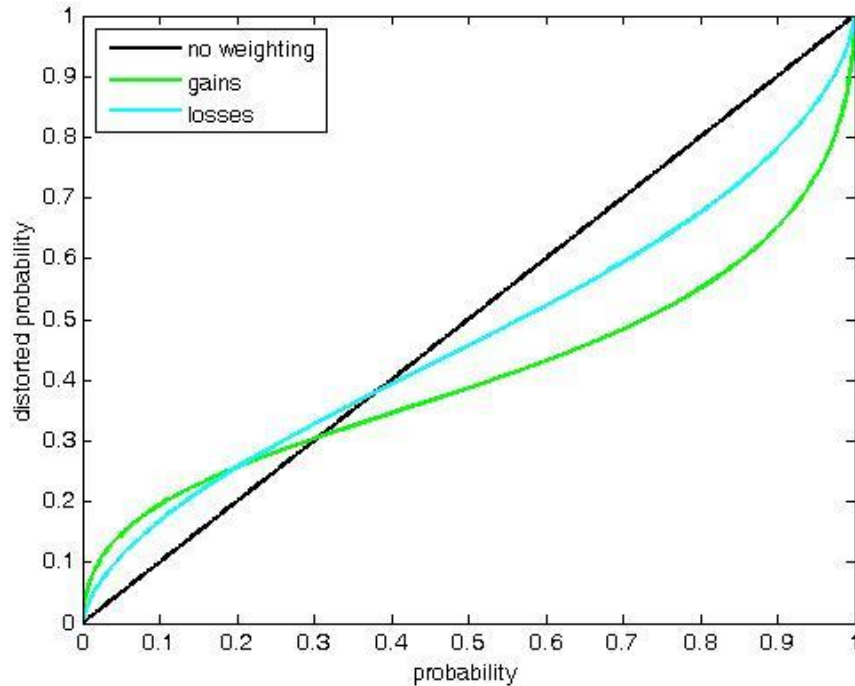
Prospect Theory

Typical value function
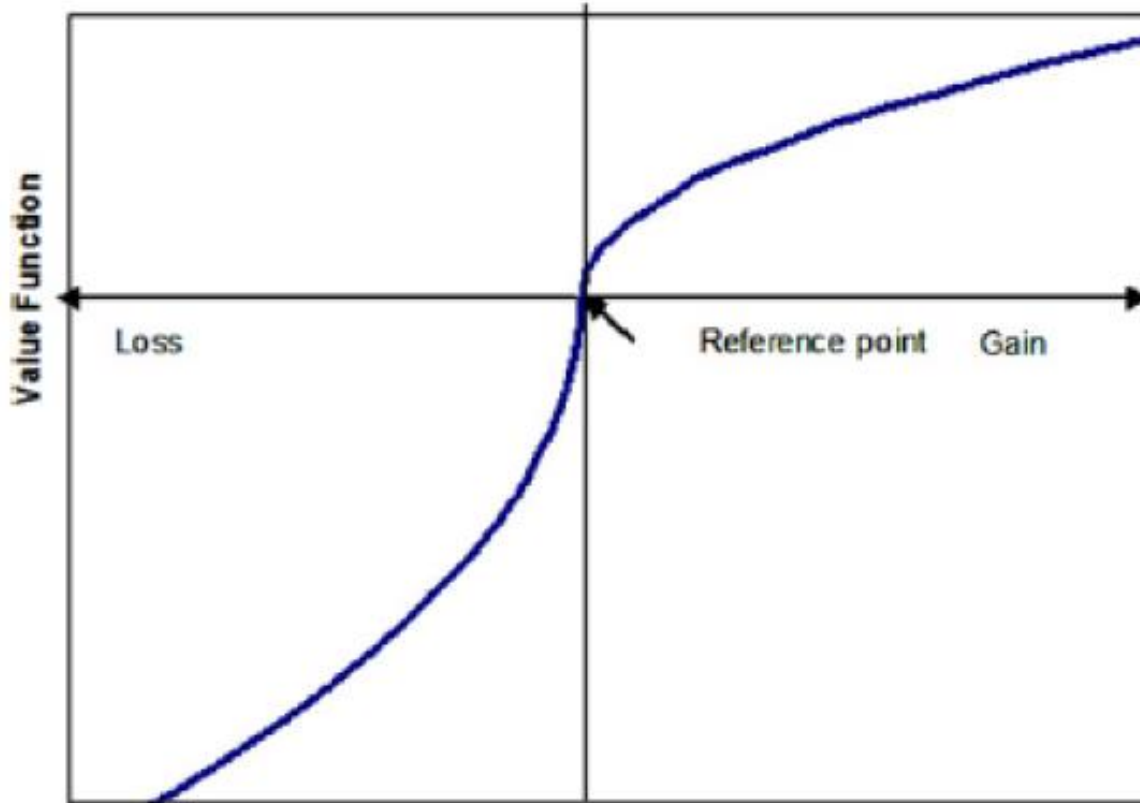
Backup

Such a value function would also be a permitted utility function in EUT!

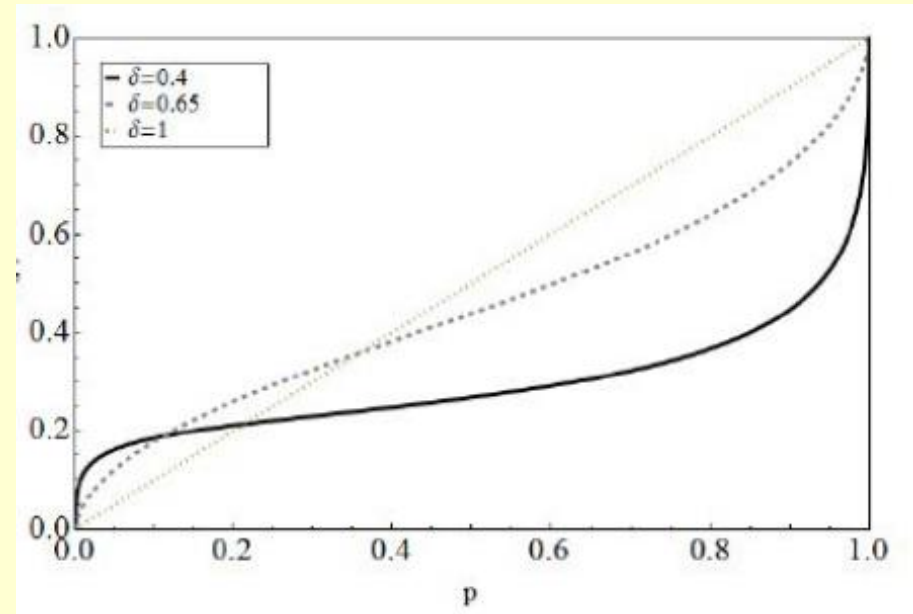But a „moving" reference point cannot be modeled in EUT.

typical distortion (weighting) function

Some experiments suggest an extreme distortion.

It's almost like people know only three different probabilities: impossible, sure and in between a „maybe".

Prospect Theory

Selected results from scientific research papers that apply Prospect Theory to questions related to insurance products

- Døskeland and Nordahl (2008)

  – different investment options (mix of stocks and bonds, guarantee product stock plus put, cliquet product)

- Ebert, Koos and Schneider (2012)

  – different investment options (mix of stocks and bonds, guarantee product with terminal guarantee, high-watermark guarantee and annual guarantee rate)

- Main results of both papers:

  – EUT: Product without guarantee is optimal.

  – A Prospect Theory investor prefers the product with a maturity only guarantee.

  – optimal guarantee level: sum of all premiums (reference point!)

  – Cliquet guarantee is never optimal.

Selected results from scientific research papers that apply Prospect Theory to questions related to insurance products

- But the above mentioned papers do not consider that the reference point of the investor might move, due to changes in the product's value which is e.g. communicated in the annual statement.

- Ruß and Schelling (2016)

  – Formulation of a new preference specification based on Prospect Theory that considers the subjective utility of annual changes in the value of the product (i.e. moving reference point).

  – We denote this approach by **Multi Cumulative Prospect Theory (MCPT)**.

  – different investment options (the same as in Ebert, Koos and Schneider (2012))

- Main result:

  – Investors with moving reference point (e.g. whenever they receive an annual statement) prefer products with cliquet guarantees.

A regular adjustment of the reference point can explain the demand for lock-in features and/or year-to-year guarantees!

Selected results from scientific research papers that apply Prospect Theory to questions related to insurance products

- Graf (2016)

  - simple financial market, single premium: For each life-cycle fund there exists a corresponding constant mix fund that replicates the return-risk-profile of this particular life-cycle fund. Precise replication only if the constant mix fund has higher fees than the life-cycle fund. Conversely: If the constant mix fund is not more expensive then it dominates the life-cycle fund.

  - complicated financial market and/or regular premiums: Simulations show that the results still hold approximately.

  - Dominating return-risk-profile always leads to a higher expected utility independent of the choice of the utility function! Therefore, there is no reason for existence of the life-cycle fund in EUT (and also under Prospect Theory).

- However: Schelling (2014) shows that an MCPT Investor prefers a life-cycle fund over a constant mix fund, when considering annual changes in the product's value (i.e. moving reference point).

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Traditional EUT is in many cases not able to explain observed behavior. Behavioral economics offers alternative explanations.

But:

▪ Often there are competitive theories; one of them is able to explain a certain behavior, whereas another would explain exactly the opposite behavior.

▪ Therefore, it is not surprising that almost every behavior can „somehow" be explained with the help of behavioral economics.

▪ Predictions, how humans behave outside the „laboratory situation" are still difficult.

My very personal opinion:

▪ Insights from behavioral economics may help better understand your customer, in particular…

– … understand why customers like certain products and for what reason. This knowledge can be used in product design.

– … understand why customers do not like products that they would rationally need. This knowledge can be used for explaining products such that people "want what they need".

• In my opinion one of the greatest challenges for our industry is bridging the gap between what people want and what they need! (But this is a different story for a different day.)

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