Learning own preferences through consumption

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1 Introduction

In the current world, with introduction of newer and newer technology into both everyday and business life, information is seen as a key. Even larger parts of working population serve only to extract and present better, more accurate information to their superiors. It has been widely accepted, that we live in a world where everything is data-driven.

At the same time, individuals are investing more and more resources in proffesional lifestyle coaches. The goal of lifestyle coaching is to, between others, what leads one towards living a happy life. It is not necessarirly how to achieve your goals. More often then not, coaching is expected to answer the question, what the goal actually is.

Those two observations, form a crucial basis for this work. With aboundance of information, and vast amounts of people commited to learning based on this information, together with growing popularity of learning about oneself in a bid to lead a happy life, the field of decision theory semms to miss the opportunity, to ask a question: does people trully know themselfs? And if they doesn't how do their go about learning it?

In everyday consumption choices, the value of experimentation for many, mostly young people, seems obvious. People travel around the world, to experience different cultures and tastes, and experiment with their own perceptions of their tastes. It is highly popular, to speak of travel to live a few months abroad as a life-changing experience. People discover themself anew.

While at a vacation in Thailand, author of this article noted, that there were multiple tourists, that tried "specialities" like fried bugs and crocodile meat. From what author was able to see, no local tried this kind of food, yet tourists, for whom it was a way more shocking and mostly disgusting thing, lined up to try. It is doubtful, they believed it was a real delicacy. In opinion of the author, it was due to the potential for a life-changing experience it offered. If I try fried bug and it tastes ok, then perhaps I truly don't know myself and I am missing out on something even better than what I think I like. Same pattern of behaviour can be spotted everywhere: in restaurant, people often want to try something they haven't tried before, to experience something new. Depending on how brave one is, it can sometimes take a drastic turn as described before in case of thailand.

There is a growing body of empirical evidence, i.e. (Kahneman 1994, Lichtenstein & Slovic 2006, Schilderberg-Hoerich 2018), pointing towards the conclusion, that people doesn't have well-defined and stable preferences, but rather they construct them, when faced with decision problem, as in (Mandell & Johnson 2002,

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Simon, Krawczyk & Holyoak 2004, Ariely, Loewenstein & Prelec 2003). Many models of preference construction exist, i.e. (Kahneman & Snell 1990, Weber & Johnson 2006, Svenson 2006, Montgomery 1998), most common focus on preference construction by constraint satisfaction, or on prediction of utility, yet most models present in the literature is non-formal and focus mostly on management problems. We accept the reasoning behind construction of preferences, and we think, that process of preference construction is connected with earlier observations, concerning experimental behaviour. We agree with prediction of utility approach, but we add more specification. We claim, that people construct their preferences from their experiences in life, experimenting in order to predict utility from their future choices more accurately. It would also explain, why older people tend to experiment less - they already know more about their own preferences, and also have less time left to make use any potential improvement in prediction, and consequently choices.

We hope to in a way merge construction of preference approach, with classical approach of rational consumer. We assume that preferences exist and are stable, yet unknown to the consumer. Consumer is able to reveal his own true preferences to himself, by a way of experiment — by consumption of good, consumer is able to perceive how good it really was. We also allow consumers to perceive other potential goods as similar to the ones the already know, and predict their utility from consumption of an unknown good, using similar goods as a proxy. It is the element of predicted utility approach, that we introduce.

We start with presentation of analytical framework in which we work, i.e. model and axioms. Then we move to the possibility of prediction by consumer in a presented framework, and study his subjective probability distributions, describing how certain he is as of now, of what he believes his preferences to be. Finally, we define choice functions for consumer, and stude stability properties, and in particular importance of experimental motivation in consumer behaviour.

2 Axioms and definitions

Let B be a set of choice objects. We assume B comes equipped with metric $d : B \times B \to \mathbb{R}_+$ measuring similarity of objects, and topology induced by d. In everything that follows, we also assume B to be compact. Define Ω to be a class of all permissible preference relations, ie. a set of binary relations satisfying the following axioms.

Axiom 1. *(Rationality) Let $\omega \in \Omega$. Then ω is complete and transitive.*

Axiom 2. *(Continuity in B) Let $\omega \in \Omega$. Then for each $x \in B$ sets $\{y \in B : x\omega y\}$, $\{y \in B : y\omega x\}$ are closed in B.*

Axiom 3. *(Finite satiation) Let $\omega \in \Omega$. Then set $\{x \in B : \exists_{\delta>0}\forall_{y\in B} \quad d(x, y) < \delta \implies x\omega y\}$ is finite.*

Axioms 1-3 can be perceived to govern consumer decisions under perfect information of self. Outside of axiom 3 those are normal axioms of utility theory, and by theorem (Debreu, 1960), preferences that satisfy those axioms can be represented by utility function. The only unusual axiom, finite satiation, is mainly an archimedean, technical axiom. Its main cost is the exclusion of preferences $\omega \in \Omega$, such that for some open subsets $U \subset B$ it is that $x, y \in U \implies x \sim_\omega y$. The other consequence of this axiom is to guarantee, that we won't have situation, where preferences vary arbitrarly wildly for similar elements of B. It is in a way a guarantee, that the metric d on B gives us some information regarding preference relation on B. Theorem 1 is a straightforward extension of representation theorem of (Debreu, 1960), tailored for the needs of what follows.

Theorem 1. *Preference relation ω satisfy axioms 1–3 if and only if can be represented by continuous utility function $u : B \to [0,1]$, such that set $\{x \in B : \exists_{\delta>0}\forall_{y\in B} \quad d(x,y) < \delta \implies u(x) > u(y)\}$ is finite. Moreover, let u be utility representation of $\omega \in \Omega$. Then for any continuous and monotone $f : [0,1] \to [0,1]$, combination $f \circ u$ also represents ω.*

Proof. By theorem (Debreu, 1960) Continuity and Rationality is equivalent to existence of continuous $u : B \to \mathbb{R}$ representing ω, and of course Finite satiation is equivalent to condition that $\{x \in B : \exists_{\delta>0}\forall_{y\in B} \quad d(x,y) < \delta \implies u(x) > u(y)\}$ is finite. As B is assumed compact, image of u is bounded in $\mathbb{R}$ for any ω and we can without loss of generality normalize it to $[0,1]$. □

In theorem 1 we explicitely assume all utility functions representing preferences in Ω to have values in $[0,1]$. It is not any restriction on Ω, as by the second part of theorem, each ω have multiple representations. the assumption of functions being onto $[0,1]$ can be thought of as a choice of representatives from all possible utility representations.

We distinguishe one element of Ω, and denote it by $\omega^* \in \Omega$. Interpretetion of ω^* is as the unknown, real preferences of the consumer, that are being partially revealed by each consumption. For ease of reading, instead of writing $x\omega y$ we sometimes use $x \succeq_\omega y$ and similarly $x \succ_\omega y$, $x \sim_\omega y$ as a notation for (x,y) being in relation ω.

In our setting, consumer has his preference between x, y revealed to only after consumption of both goods. We define $D = \{x_1, \ldots, x_n, \ldots\}$ to be a (possibly countably infinite) set of elements of B. We interpret D as a data of consumer choices, ie. it consists of those $x_i \in B$ such that preference relation between all pairs of elements of B is known to consumer. We also define a set of known relations between elements, $K(D) = \{x\omega^* y : x, y \in B, (x,y) \in \omega^*\}$. $K(D)$ can be thought of as a partial preference relation. Set of all permissible (consistent with axioms) extensions of $K(D)$ to whole B is $\Omega(D) = \{\omega \in \Omega : K(D) \subset \omega\}$.

Finally, let B_c be a set of all compact subsets of B. We define choice function $c : B_c \to B$, satisfying $c(A) \in A$. We don't impose any additional restrictions on c at this moment – in the coming sections we will consider properties of several different functions.

Topological construction on Ω

In order to discuss properties of choice, we need to introduce topology on space of preferences Ω. It seems intuitive for this topology to be inherited from metric on B.. We define distance between preferences $\omega_1, \omega_2 \in \Omega$, as the volume of all pairs $(x,y) \in B^2$, such that ω_1, ω_2 order (x,y) differently. Formally, we have $d_\Omega : \Omega^2 \to \mathbb{R}_+$ defined as

$$d_\Omega(\omega_1, \omega_2) = \lambda\left(\{(x,y) \in B^2 : x \succ_{\omega_1} y, y \succeq_{\omega_2} x\}\right),$$

where $\lambda(A) = \inf\{\sum_{u\in\mathcal{U}} r_U : A \in \bigcup_{U\in\mathcal{U}} U, U = \text{Ball}(x_U, r_u)\}$ is a Lebesgue measure defined on sigma field of Borel subsets of B. With such definition, d_Ω is a metric on Ω and as a result, Ω is compact, metric Hausdorff space.

As an alternative approach, we can define distance on space of utility representations that follows from theorem 1. Set C to be a subspace of $\mathcal{C}(B \to [0,1])$ consisting only of functions that satisfy finite satiation axiom. Define $d_U : C^2 \to \mathbb{R}_+$ as

$$d_U(u_1, u_2) = \lambda\left(\{(x,y) \in B^2 : u_1(x) > u_1(y), u_2(y) \geq u_2(x)\}\right).$$

Let $\sim_C$ be a binary relation on C defined as $f \sim_C g \iff (f(x) > f(y) \iff g(x) > g(y))$. Identifying $\Omega \simeq C/\sim_C$, we obtain the same topology on Ω as in previous case. Note, that d_U is only a pseudometric on C, and hence C with topology induced by d_U is not even T_0. Nevertheless, it might be useful to think of Ω as a quotient space $C/\sim_C$ sometimes.

Definitions of d_Ω, d_U might feel arbitrary, but in fact are very natural. Intuitive interpretation of those definitions is, that consumers evaluates similarity of preference relations in terms of similarity of their predictions in B, i.e. preferences are similar, if for any given $x \in B$, subsets $\{y \in B : x \succ y\}$ and $\{y \in B : x \preceq y\}$ are similar, in terms of similarity metric on B that is a primitive of the model.

3 Construction of measures

Main goal of this section is to prove existence of experience-based subjective probability, defined on the space of possible preference relations of consumer. In general, this section can be thought of as establishing a variant of (Anscombe, Aumann 1963), with states of the world interpreted as the "real" preferences, i.e. state s would be that the $\omega^* = \omega_s$. There are, however, two important distinctions. Firstly, we link probability direstly to the experiences of consumer, i.e. it is influenced by the knowledge that he acquired via past choices. Secondly in Anscombe-Aumann model existence of subjective probability is derived from observed choices, i.e. it is defined in an indirect way. We feel it is a more straightforward in case of experience-based subjective probability to introduce it axiomatically. as it allows for link between knowledge and probability to be more transparent.

We are interested in existence and properties of class of functions $p_D : B^2 \to [0,1]$, a probability distribution on space Ω, that satisfy certain intuitive conditions linking it to experience. Abusing notation a little, we will use from now on form $p(xRy|D)$, interpreted as subjective probability, that (x,y) are in relation R according to the "real" preference relation ω^*. As ω^* is unknown to the customer, $p(xRy|D)$ is the strength of his belief, that $xRy \in \omega^*$. More formally, we search for probabilistic measure μ and σ-field σ defined on Ω, i.e. a strength of belief of consumer, that for all $x, y \in B$, the relation between those two is as specified by some $\omega \in \Omega$.

We now state axioms, that specify connection between experience and probability.

Axiom 4. *(Certainty of knowledge) Let $xRy \in K(D)$. Then $p(xRy|D) = 1$.*

Axiom 5. *(No outside information) For any $x_1, x_2 \in B$. If for all $y \in D$ we have $d(x_1, y) = d(x_2, y)$, then for any $z \in B$ we have $p(x_1Rz|D) = p(x_2Rz|D)$.*

Axiom 6. *(Bayesian learning) For any D, x, y we have $p(xRy|D) = \frac{\mu(\{\omega\in\Omega(D):xR_\omega y\})}{\mu(\Omega(D))}$.*

Certainty of knowledge says, that individuals doesn't make mistakes in their perception of what they liked after consumption. After only a single try of any given good, consumer is able to compare it ti other goods known to him, and do so without mistake, so whenever consumer compares two goods that belong to data D, he identifies the relation between them with probability 1 In real life individuals are of course repeatedly unable to decide what they preffer, but we assume it for the sake of simplicity. Lack of outside information is self explanatory, the only information concerning own preferences of consumer are obtained from his past experiences and similarity of goods, i.e. if for any two different goods, one is as similar as the other to all those in the data, the probability of being in any given relation with a third good is the same for both of them. Bayesian learning axiom specifies learning behaviour of consumers. The actualize their subjective probabilities via Bayes rule. Crucially for any D, they use the same probabilistic measure μ. It is consistent with the notion of rational consumer that is developed by this article and also show that p_D are connected by the rule of conditional probability, therefore notation $p(\cdot|D)$ is justified.

In addition to axioms 4-6 we add technical axioms, that narrow scope of possible μ. Those axioms are only technical, but also quite intuitive in their nature.

Axiom 7. *(Continuity in B) For all $x, y, x' \in B$ and any $\epsilon > 0$ there exists $\delta > 0$ such that $d(x, x') < \delta \implies |p(xRy) - p(x'Ry)| < \epsilon$.*

Axiom 8. *(Non-degeneracy) For all $x, y \notin D$ $p(xRy|D) > 0$.*

Axiom 9. *(Existence) $p(xRy|D)$ exists for any x, y, R, D.*

Axiom 8 states that consumer is never quite as sure of his preferences regrding any pair $x, y \in B$, as after consumption of both, i.e. ha always allows for non-zero probability for any given relation between them. Continuity is technical axiom, but necessary for information taken from similarity metric on B to be taken into account. It says, that as long as we compare goods very close to ones for which we already know our preferences, we can be quite certain our preference will be similiar. Existence is obviously an axiom on σ-field, that demands that sets of the form $\{\omega \in \Omega(D) : xR_\omega y\})$ and $\Omega(D)$ are measurable with respect to μ. It is necessary for probability distribution on B^2 to be well defined. The following lemma shows, that keeping other axioms constant, the necessary and sufficient condition for existence to hold is for σ to be Borel.

Lemma 1. *Let μ, σ satisfy axioms 1-8. Then μ, σ satisfy axiom 9 if and only if σ is Borel σ-field in topology generated by d_Ω.*

Proof. By axiom 6 for existence to hold, we are only interested in measurability of sets $\Omega(D)$ and $\{\omega \in \Omega(D) : xR_\omega y\})$. Equivalently, we can write

$$\Omega(D) = \bigcup_{xRy \in K(D)} \{\omega \in \Omega : xR_\omega y\},$$

as D is at most countable, $\Omega(D)$ is measurable if only each of sets in $\bigcup_{xRy \in K(D)} \{\omega \in \Omega : xR_\omega y\}$ is. Note, that all those sets are in fact $\Omega(D)$ for $|D| = 1$ and that $\{\omega \in \Omega(D) : xR_\omega y\})$ can also be expressed in such a form. Therefore, both $\Omega(D)$ and $\{\omega \in \Omega(D) : xR_\omega y\})$ are measurable if and only if for any $xR_{\omega^*}y$ set $\{\omega \in \Omega : xR_\omega y\}$ is measurable. Translating it into C, those sets can be written as

$\{u \in C : u(x) > u(y)\}$ (without loss of generality, we assume R ro be $\succ$). We can write

$$\{u \in C : u(x) > u(y)\} = \bigcup_{q \in \mathbb{Q} \cap [0,1]} \{u \in C : u(x) \in (q, 1), u(y) \in (0, q)\}.$$

Sets summed in the equation above are called cyllindric sets, and existence axiom is equivalent to those sets being measurable. We claim, that $\sigma(\{u \in C : u(x) \in I_1, u(y) \in I_2\})$ where I_j are open intervals, is a Borel sigma field. Note, that cyllindric sets are open in topology on C, hence $\sigma(\{u \in C : u(x) \in I_1, u(y) \in I_2\}) \subset \mathcal{B}(C)$. As C is secound countable (as a subspace of a space of functions from compact metric space into a second countable one) cyllindric sets form a basis of topology on C which finishes the proof. $\square$

We can now state the main result of this section, containing an existence and characterisation of subjective probability measures that satisfy axioms 4-9.

Theorem 2. *There exists* ***unique*** *probabilistic measure μ, σ on Ω satisfying axioms 1-9 such that*

$$p(xRy|D) = \frac{\mu(\{\omega \in \Omega(D) : xR_\omega y\})}{\mu(\Omega(D))}$$

and $\mu(A) = \lambda(A) = \inf\{\sum_{u \in \mathcal{U}} r_U : A \in \bigcup_{U \in \mathcal{U}} U, U = \mathrm{Ball}(x_U, r_u)\}$ is a Lebesgue measure in Ω inherited from B.

Proof. Firstly, we have to show, that λ is well-defined on Ω with respect to Σ. It is clear, that λ is well defined with respect to its basis, i.e. with respect to open balls in Ω. As such, it is well-defined with respect to generating set of Borel σ-field, and hence with respect to the whole Borel σ-field. The form of conditional probability given clearly satisfies Bayesian learning, and as λ is continuous, so is $p(\cdot|D)$. Non-degeneracy is clear, as is existence, by lemma 1. Certainty of knowledge also follows, as in case $xRy \in K(D)$, clearly $p(xRy|D) = 1$ as $\{\omega \in \Omega(D) : xR_\omega y\} = \Omega(D)$. As Ω is compact, λ is finite, as we can always cover any set with a finite open cover of balls in Ω and any ball has finite measure λ. Therefore without loss of generality we can assume μ to be proabilistic, via normalisation to 1.

Lack of outside information follows from the fact, that metric on Ω is coherent with metric on B, and as such $p(xRy|\emptyset) = \frac{1}{2}$, from which no outside information follows via Bayes rule. Only uniqueness is left. Assume there exist $\mu' \neq \mu$, that satisfy all axioms. Surely, μ' must differ for $D = \emptyset$, as in other case, Bayes rule in learning leads to equality of a posteriori distributions. Therefore there is xRy such that $\mu'(xRy) \neq \mu(xRy) = \frac{1}{2}$. But then, Such μ violates no outside information principle, contradiction. $\square$

Theorem 2 is important, because it gives theretical proof of validity for the whole concept of experience based subjective probability. It exists. hence we can speak of such object and define choice funstions that make use of it. Moreover, due to characterization via Lebesque measure, we can study its properties. Note, that as Ω is not a very regular space, it is still not possible to determine shape of subjective probability distribution.

4 Choice functions and convergence of preferences

In this section, we study choice functions, that are in some way natural for the case of presented model. We introduce those choice functions without axiomatization, just as some natural possibilities, that might have interesting properties. For each choice function we define, we focus on the study of one crucial property, i.e. its convergence towards "real" preferences of consumer. Note, that in experience based model, choices of consumer define future state of the world in which consumer finds itself. Therefore, we might perceive choices as a (stochastic) data generating process, that at the same time generates a sequence of $\Omega(D)$. It is therefore a valid question, as to whether in limit of such sequence, $\Omega(D)$ converges towards $\{\omega^*\}$. Note, that such property would be a welcome one, as it could be interpreted as a justification for omission of consumer experience from decision-theoretic models — as consumers would most of the time be very close to their real preferences, mistakes from such siplification wouldn't be great. It has also great importance for perceived stability of preferences. In experience based model, real preferences are assumed to be stable, but as consumer decisions aren't necessarirly based on those, observed choices ight be unstable. It is even possible, that a single choice will completely change distribution of $p(\cdot|D)$ and a radical jump in observed choices will follow. In case of no convergence, it is possible for such arbitrarily huge jumps in perceived behaviour to occur, even in inifinite horizon.

Definition 1. *(Instantenous utility choice function) For any compact, non-zero measure set $A \subset B$ instantenous utility choice function c is given by:*

$$c(A|D) \in \text{argmax}_{x \in A}\left\{ \int_{y \in A} p(x \succeq y|D)dy \right\}.$$

By theorem 2 such $c(\cdot|D)$ exists, although in general it is rather a correspondence, and not a function, as solution for argmax might not be unique. We won't dwell on this problem and simply assume, that any choice function c satisfying $c(A|D) \in \text{argmax}_{x \in A}\left\{ \int_{y \in A} p(x \succeq y|D)dy \right\}$ is an instantenous utility. The reason for formulation (and name) of such utility function is, that it is a straightforward extension of rationality as understood by classical economic theory i.e. consumer chooses what he preffers the most. In our case, consumer chooses what he believes to preffer the most, even though his beliefs probably aren't correct, i.e. there probably are alternatives that are in truth preffered to what he beliefs to be the best option.

Moreover, in case convergence of preferences happens, instantenous utility choice function simplifies to the usual utility representation and utility maximization problem, well known from literature. We start study of properties by formal definition of convergence.

Definition 2. *We say that preferences of consumer locally converge towards his real preferences, if for any compact non zero measure set A, and sequence of data $D_0 = \emptyset$, $D_{i+1} = D_i \cup \{c(A|D_i)\}$ we have $\bigcap_i \Omega(D_i) = \{\omega^*\}$.*

Notion of convergence stated in definition 2 is coherent with the one floated in introduction to this section. Choice function create sequence of choices, that induce sequende of $\Omega(D)$ and we are interested in whether such (decreasing) sequence of sets converges. We allow for convergence to be studied on any compact, non zero measure subset of B, hence we call it a local convergence. Note, that $\omega^* \in \Omega(D)$ no matter the D, hence $\omega^* \in \bigcap_i \Omega(D_i) \neq \emptyset$. The following proposition is a simple characterisation of conditions for convergence. We state it without the proof even though formulation is different, but it is a straightforward application of (Mas-Colell 1978) lemma on rationalization of revealed preference.

Lemma 2. *(Mas-Colell 1978) $\Omega(D) = \{\omega^*\}$ if and only if D is dense in B.*

Characterization in lemma 2 is very simple. In order for convergence to hold, we need D to be dense. Therefore, choice function c for which convergence occurs, must generate sequence of data D that is dense in B. As B is metric and Hausdorff it is necessarirly second-countable and therefore there exist countable D that are dense in B. Therefore, notion of convergence presented in this chapter makes sense, i.e. it is theoretically possible to satisfy it, depending on choice of c. We prove, that for instantenous utility choice function, it is not the case.

Theorem 3. *Let c be a instantenous utility choice function and let A be compact subset of B with a non zero measure. Then it is not the case, that preferences locally converge on A with respect to c.*

Proof. Let $B = R^2$ and $D = \{x, x + (t, t), x + (t, -t), x + (-t, t), x + (-t, -t)\}$. Assume, that $x \succ x + v$ for any $v \in (+/-t, +/-t)$. Now, any element $z \in B$ outside of ball with radius t and center in x is closer to some point y for which $x \succ y$. Therefore $p(xRz|D) > \frac{1}{2}$ and clearly no point outside of $\text{Ball}(x, t)$ is ever going to be chosen by c. $\square$

As noted in discussion to definition 1 before, instantenous uitility choice function is not uniqely defined. In general, for $D = \emptyset$ we have $c(A|D) = A$. It is of course possible, that for some choices of c the convergence occurs, i.e. for some "correct" choice of the first element of D. The meaning of theorem 3 is, that there exist choice functions satisfying definition 1, for which convergence doesnt't occur.

The reason for lack of convergence is pretty clear. Consumer that behave according to instantenous utility choice function doesn't take into account any potential improvement, that experimentation with his choices might give him. No extra utility from improvement in future choices is attached. It leads to situation, where consumer might be happy enough with his past choice, and simply repeat it ad infinitum (mahtemathically, he stays in local maxima uf utility, as he has no incentive to search for a global one).

In ideal world, it would be nice to be able to state consumer choice function in a form of something similar to expected discounted utility. Unfortunatelly as utility interpretation in our model is not cardinal, expression such as $\sum \beta^t u(x_t)$ would have no sense. Instead, we define measure of knowledge of own preferences as $\mu_K(D) = \mu(\Omega) - \mu(\Omega(D))$. The following lemma is a trivial consequence of definition of μ_K, but it serves as a proof of concept, i.e. that convergence in our model is possible.

Definition 3. *For any compact, non-zero measure set $A \subset B$ experimental choice function c is given by:*

$$c(A) \in \text{argmax}_{x \in A} \left\{ \int_{x \in A} \sum_{xRy \in K(D \cup \{x\})} p(xRy|D) \mu_K(D \cup \{x\}) \right\}.$$

Lemma 3. *Let consumer behave according to choice function that satisfy definition 3. Then for any $A \subset B$ compact and non zero measure, preferences locally converge on A with respect to c.*

Proof. Follows trivially by by compactness of A and $\Omega_{|A}$. $\square$

Consumer presented in definition 3 and characterized lemma 3 is called experimental. His whole utility is taken from getting to know his own preferences better, and experimenting, i.e. exactly what was missing from instant utility consumer. As noted before, such definition serves only as a proof of concept and is not to be treated as a serious chioce function. However, it captures nicely the notion of utility from experimentation. As a general fact, the higher $\mu_k(D)$ the more preffered the choice obtained by instant utility choice function. Therefore, we might treat consumer as having two motives in his consumption choices: to obtain instantenous utility from consumption, and to improve his future state. From this discussion, we consider the following consumer.

Definition 4. *Let A be compact and non-zero measure. We define mixed chocie function if for every i and D_i, with $D_{i+1} = D_i + \{x\}$, with probability α_i we have $x \in \operatorname{argmax}_{x\in A}\left\{ \int_{y\in A} p(x \succeq y|D)dy \right\}$ and with probability $1 - \alpha_i$ we have $x \in \operatorname{argmax}_{x\in A}\left\{ \int_{x\in A} \sum_{xRy\in K(D\cup\{x\})} p(xRy|D)\mu_K(D \cup \{x\}) \right\}$.*

Consumer described by definition 4 takes both experimental and instant utility consumption motives into account. Stochasticity in his choice function was introduced, as utility is not cardilnal and weighting of two utilities would have no meaning. Probability α_i can be interpreted as weight consumer places on utility from experimentation, i.e. from improvement in future choices. Such definition is sufficient for our purposes, as we are interested in whether experimenting behaviour can ever stop. If it is the case, then even if such behaviour is necessary for convergence, in the limit we can expect stable preferences and consistent choices. Such a result could also be thought of as a justification for classical models that ignore lack of self-knowledge and experimental behaviour.

Theorem 4. *Let consumer behave according to choice function c that satisfy definition 4. Then for any $A \subset B$ compact and non zero measure, preferences locally converge on A with respect to c if and only if $\alpha_i \not\to 0$.*

Proof. We proceed by contradiction. Let $B = \mathbb{R}^2$ and assume there is I sich that for any $i > I$ we have $\alpha_i = 0$. For D_I we have only finite D, hence it is not dense in B. Assume there is no $x \in D$ with the property, that $x \succeq_{\omega^*} y$ for all $y \in B$. Therefore we can find $x \in B$ such that $x \notin D$ and $x \succ y$ for all $y \in D$. Take it, and let U be an open subset of B such that same property applies, i.e. no element of D is preffered to any element of U. For such U we can apply theorem 3. $\square$

5 Conclusions and scope for development

In previous chapters, we constructed formal setting for experience-based subjective probability with respect to own unknown preferences. We proved existence and uniqueness of subjective probability that satisfy very intuitive set of axioms linking it with experience. Finally, we investigated properties of choice functions, with different consumption motives, with respect to their convergence to real preferences.

We concluded, that experimantal motive in consumption of consumer will be always present and we won't find stability in observed choices. It can serve as a positive answer to the question about importance of introduced concept of experience-based subjective probability. It also serves as a theoretical justification for rejection of thesis of (Becker, Stigler 1977), that each perceived instability in choices can be incorporated into a wider decision theory framework with stable preferences, that explain this perceived instability. As difference between result for instant utility consumer, and consumer that allows for some experimental motivation in his choices, experimental motivation is not easily incorporated into model that doesn't take into account experience in building subjective probability.

There are many possible extensions, that are due. Firstly, while staying in the world of ordinal utility, we were unable to obtain something resembling discounted expected utility. It would be especially interesting, as in such a case, introduction of timeframe in choices might serve as a natural way of introduction of experimental motivation for consumer.

As a second extension, axiomatizations leading to different classes of choice functions that are considered, could be introduced. Also, we does not derive subjective probability from obsreved chocies of consumer in a way of i.e. (Aumann, Anscombe 1963). Author believes, it is possible to derive it in such a way, and it is also on the agenda.

Other natural extensions concern various no-error assumptions, i.e. Certainty of knowledge or Beyesian updating of prior probability. People make such errors, and there is a huge amount of literature on this topic. It is possible, that introduction of experience in construction of consumer preferences might give some light on this issue as well.

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