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Report for Type 2 Bayes-Fuzzy Estimation in No-Data Problem

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Abstract

It is well known that the system (1 + 1) can be unequal to 2, because this system has both observation error and system error. Furthermore, we must provide our mustered service within our cool head and warm heart, where two states of nature are existing upon us. Any system is regarded as the two-dimensional variable error model. On the other hand, we consider that the fuzziness is existing in this system. Though we can usually obtain the fuzzy number from the possibility theory, it is not fuzzy but possibility, because the possibility function is as same as the likelihood function, and we can obtain the possibility measure by the maximal likelihood method (*i.e.* max product method proposed by Dr. Hideo Tanaka). Therefore, Fuzzy is regarded as the only one case according to Vague, which has both some state of nature in this world and another state of nature in the other world. Here, we can consider that Type 1 Vague Event in other world can be obtained by mapping and translating from Type 1 fuzzy Event in this world. We named this estimation as Type 1 Bayes-Fuzzy Estimation. When the Vague Events were abnormal (ex. under War), we need to consider that another world could exist around other world. In this case, we call it Type 2 Bayes-Fuzzy Estimation. Where Hori *et al.* constructed the stochastic different equation upon Type 1 Vague Events, along with the general following probabilistic introduction method from the single regression model, multi-regression model, AR model, Markov (decision) process, to the stochastic different equation. Furthermore, we showed that the system theory approach is Possibility Markov Process, and that the making decision approach is Sequential Bayes Estimation, too. After all, Type 1 Bays-Fuzzy estimation is the special case in Bayes estimation, because the pareto solutions can exist in two stochastic different equations upon Type 2 Vague Events, after we ignore one equation each other (note that this is Type 1 case), we can obtain both its system solution and its decision solution. Here, it is noted that Type 2 Vague estimation can be applied to the shallow abnormal decision problem with possibility reserved judgement. However, it is very important problem that we can have no idea for possibility reserved judgement under the deepest abnormal envelopment (ex. under War). Expect for this deepest abnormal decision problem, Bayes estimation can completely cover fuzzy estimation. In this paper, we explain our flowing study and further research object forward to this deepest abnormal decision problem.

Keywords

Bayes-Fuzzy Estimation, Possibility Markov Process, Possibility Reserved Judgement

1. Introduction

Zadeh's foundational work defined fuzzy sets and the probability of fuzzy events [1]. This framework necessitates the direct sum condition for the possibility distributions of fuzzy events, akin to mutually exclusive scenarios in fuzzy system theory, which in turn corresponds to the orthogonal condition in the possibility distributions. Building on this, Okuda and colleagues developed a decision-making methodology suited for ambiguous contexts, thereby solidifying the principles of fuzzy Bayesian inference [2]. This model has found practical application in scenarios such as tunnel repairs and submarine cable inspections and is poised to inform decision-making in future scenarios where observational data can be exploited. The concept of deferred possibility judgment was introduced in response to the issue of insufficient possibility information in recommendation tests, where indeterminate events are calculated. This has led to proposals of Type 2 fuzzy Bayesian inference approaches for the Re-Try process, following the reanalysis of data after Re-Do or Re-Set interventions.

Uemura (Hori) then paid particular attention to Zadeh's extension principle of mappings to establish frameworks for Decision Making in Type 1 Vague Events [3] and Decision Making in Type 2 Vague Events [4], thereby reinforcing the structure of Bayesian fuzzy inference. Hori and his team elucidated that a systemic illustration of Bayesian fuzzy inference manifests as a possibility Markov process, with the deterministic counterpart being sequential Bayesian inference [4]. In cases where the fuzzy event constitutes a direct sum, the transition matrix of the possibility Markov process aligns with a possibility principal factor rotation [5] [6]. Conversely, when the fuzzy event does not form a direct sum, it corresponds to a possibility oblique factor rotation [7]. A tangible example within Vague Events is the analogue wave motion observed in the sea. A straightforward solution for simulating the true movement of these waves from the analogue wave equation has been proposed, significantly advancing the development of subjective AI for steering control in research on raft-type aquatic drones.

2. Fuzzy Bayesian Inference

Okuda and his team [2] established the concept of fuzzy events within natural states via possibility distributions, and used integral operations involving these distributions, prior distributions, and utility functions to apply the principle of maximizing expected utility, thereby deriving optimal decisions. In their approach, they necessitate the direct sum condition for fuzzy events. Expected utility is interpreted as the expected value with respect to the utility function of the fuzzy events, and this approach to fuzzy Bayesian inference is analogous to conventional Bayesian inference. It is important to recognize that in instances where the fuzzy event represents a direct sum, the scenario is one of risk neutrality for the decision-maker.

Hori and colleagues [8] [9] softened this direct sum requirement and introduced a decision-making process that incorporates the concept of deferred possibility judgment, an approach that takes into account indeterminate events and the quantity of possibility information. This investigation into the deferral of possibility judgment is undertaken within the framework of Type 2 fuzzy Bayesian inference. The process includes mechanisms such as Re-Do and Re-Set, which deliberately pause the sequential Bayesian inference at two distinct phases. The research indicates, in qualitative terms, that the Re-Try phase is characterized by risk neutrality, whereas the Re-Set phase is indicative of risk tolerance. In cases where the process is not intentionally paused, an infinite-step sequential Bayesian inference ensues, and the inherent ambiguity of indeterminate events persists. Furthermore, in no-data scenarios, it has been demonstrated that sequential Bayesian inference exemplifies a possibility Markov decision process, and its stopping criteria align with those of the possibility Markov decision process.

3. Type 1 Vague Events

Zadeh's extension principle, when applied under ergodic conditions, is equivalent to performing a Fourier transform. This holds true even for transformation functions that are monotonic or symmetric. Notably, when the transformation function acts as a utility function, it is termed a fuzzy utility function. Decision-making grounded on this fuzzy utility function is represented by sequential Bayesian inference, which effectively extends and transforms Vague Events from an alternative dimension, the Other World, into Fuzzy Events within our own reality, This World. For instance, a simplified solution method for the analog wave equation has been put forward, which translates analog waves observed in a bay into actual wave forms. In cases where the analog wave reaches a steady state, it can be approximated through a Gaussian process and can be feasibly modeled in a raft-type aquatic drone using Monte Carlo simulations.

This framework can also extend to single-data problems that rely purely on subjective judgment without any prior or observational information. In the present context, severe crimes persist despite the threat of capital punishment.

Crimes committed with tangible motives, such as for insurance payouts or during robberies, fall within the purview of Decision Making in Type 1 Vague Events and are addressable through approaches akin to subjective Bayesian theory. However, murders motivated by personal vendettas present a challenge for this deterministic approach. Additionally, instances of legalized killing in conflicts such as those in Ukraine and Israel are noted. It is particularly in scenarios where a leader's pathological delusions of a schizophrenic nature lead to uncontrolled actions that the concept of Type 2 Vague Events, which incorporate considerations of an Another World, becomes relevant and has been proposed.

4. Type 2 Vague Events

Type 1 Vague events are a specific instance of subjective Bayesian theory, deriving from stochastic differential equations associated with these events. On the other hand, Type 2 Vague deals with decision-making influenced by pathological subjectivity. Its relationship with subjective Bayesian theory is an area of ongoing research, with the central question being whether subjective Bayesian theory can fully account for pathological decision-making. Unlike the Fuzzy approach, which is known to fall short in addressing pathological issues, Type 2 Vague is capable of handling such complexities. Essentially, Bayesian inference is suitable for all scenarios except those involving pathological decision-making.

Type 2 Bayesian-Fuzzy inference originates from a set of linked stochastic differential equations focusing on both observational and systemic errors [5] [6]. The resulting solution is Pareto optimal. When the sum of weights in these equations equals one, the application of the Bay Wave Equation (optimal solution involving possibility principal factor rotation) is demonstrated [5] [6]. When the sum of weights does not equal one, the Pareto optimal solution involves possibility skew rotation, with the Ocean Wave Equation being a relevant example [7]. The non-direct sum cases typically represent pathological issues. In normal (peacetime) conditions, introducing a "re-try" concept allows for Type 2 Fuzzy-Bayesian inference based on sequential Bayesian inference, which takes into account the suspension of possibility judgments [8] [9]. However, this concept doesn't hold during wartime. Here, optimal solutions are strictly based on the coupled differential equations' weights being either (0, 1) or (1, 0), meaning no suspension of possibility judgment that neglects either the stochastic differential equation on observation error or on system error. While this may superficially resemble standard Bayesian inference, the weights gradually move towards the origin (0, 0), following a possibility Markov decision process, eventually leading to pathological behavior. It's important to note that during this process, the transition matrix of the possibility Markov process is artificially switched from the identity matrix to the inverse matrix over time [7].

5. Conclusion

It is broadly acknowledged that Bayesian inference can address all decision-making scenarios with the exception of those that are pathological. This study has been centered on such pathological decision-making issues and has established the suitability of Type 2 Bayesian fuzzy inference for these complex cases. Pathology in this context is linked to situations where Fuzzy Events do not constitute a direct sum (notably, in fuzzy system theory, these would be considered mutually exclusive events), yet in times of peace, it is possible to restore equilibrium by employing the concept of deferred possibility judgment. Conversely, in times of conflict, the situation is inherently binary, precluding the use of deferred possibility judgment. Ultimately, it can be posited that in extreme cases, such as unconditional surrender, the evolution of the possibility Markov process could theoretically proceed through a series of transformations from an identity matrix to a reversal matrix, navigating through the pathology via possibility oblique factor rotations. Looking ahead, the intention is to shift the focus from international warfare to the study of murders driven by personal vendettas, with the aim of further exploring and validating the applicability of Type 2 Bayesian fuzzy inference to these distressingly pathological instances.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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