The SIPTA Newsletter

Society for Imprecise Probability:
Theories and Applications

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Message from the editor

Approximately thirty years ago, a report with the modest title "Notes on Conditional Previsions" was produced by Peter M. Williams. The report offered original solutions for problems in de Finetti's theory of previsions, and extended that theory in several directions. The report was not published; it was widely circulated and later became an important influence in Peter Walley's work on imprecise probabilities. Prof. Williams has recently agreed to prepare a revised version of his report, to be published in the *International Journal of Approximate Reasoning*. This is indeed a happy event for the SIPTA community; even better, in this issue we have a short interview with Prof. Williams.

This issue brings information on the recent lecture day on imprecision at Durham University, and on the relevant special issue at the *Annals of Mathematics and Artificial Intelligence* published in June 2005. In the Software section, the *Bounds* package by Charles Manski is described, as it contains valuable resources for regression in the presence of missing data. And finally, the issue presents the new articles of the society, reflecting decisions taken during the last General Meeting.

If you have contributions to make to this Newsletter, or if you know of any event or publication that should be of interest to members of SIPTA, please let me know (send a message to fgcozman@usp.br).

Cheers!

Fabio G. Cozman

An Interview with Peter M. Williams

This email interview with Prof. Williams is centered on his contributions during the seventies; in particular, his so far unpublished 1975 report. We thank Prof. Williams for his willingness to contribute to the newsletter.

Fabio G. Cozman

Tell us a bit about the environment in 1975 that led to your interest in indeterminacy and imprecision in probabilities.

Much of my previous work had been in mathematical logic, especially as applied to the logic of empirical theories. I was interested in the indeterminacy of empirical concepts, amongst other things, meaning that for most empirical concepts there are often clear-cut positive or negative instances, but also typically instances where it is unclear whether the concept applies or not. The puzzle was whether this invalidates classical logic for empirical language, especially the law of excluded middle.

The solution I was exploring had been given in model-theoretic terms by the Polish logician Marian Przelecki, inspired by Kazimierz Ajdukiewicz, and was suggested to me by my teacher Jerzy Giedymin. The idea was that an empirical language should be thought of as interpreted by a family of intended models, or "possible worlds", rather than a single one. A sentence would be true or false, only if it was true or false in all such models. But classical logic would still apply within the language, so this was essentially a Boolean valued model.

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At the same time I was pursuing an interest in the foundations of probability. Despite the appeal of von Mises' frequency interpretation, this seemed to me to rest ultimately on some metaphysical assumptions. Agreeing with Hume that there are no necessary connections between matters of fact, only the expectations they produce in our minds, it seemed to me, as it did to de Finetti, that the same line of thought led to the viewpoint that there are no "probabilities" in reality, only observed proportions or frequencies, always in finite sequences, and the expectations they may induce in our minds.

De Finetti's analysis seemed to me correct, and beautifully illustrated by his "representation theorem". Possibly his writings, and the "personalist" or "subjectivist" name given to the position, may have given readers the impression that "anything goes" when it comes to assigning probabilities; but that wasn't implied (any more than it is in personal behaviour, if morality is not based on religion). However, the usual scheme of eliciting numerical values through betting behaviour seemed to assume a higher degree of precision in people's opinions, especially in small sample cases, than was realistic.

So these two lines of thought came together — the personalist interpretation of probability and an interest in the indeterminacy of empirical terms. I first put these lines of thought together for unconditional previsions in a paper given at a conference in Warsaw in 1974, and then applied them to conditional previsions. The approach was basically the same, though the treatment of conditional previsions was harder.

Your work then had a very strong "de Finettian" bent; could you comment on this — was it a widespread feeling?

There was certainly a widespread interest in subjective or logical interpretations of probability in the philosophical community at the time, stemming partly from an interest in the different approaches of Carnap and Popper to the idea of confirmation of scientific hypotheses, and whether it was probabilistic or not and, if so, in what sense. On the other hand, given the sorts of problems being tackled at the time, most practising probabilists and statisticians considered the frequency interpretation to explain the meaning of probability, measure theory to provide its mathematical basis, and Neyman and Pearson to have explained how to think about statistical estimation and hypothesis testing. Writers such as Jeffreys, Lindley and Savage were known and respected; but, in general, Bayesian inference was considered impractical because the priors were said not to exist or to be unknown, or even to be "unscientific" because the priors were "subjective".

Did you pursue these ideas after the seventies?

I think that at the time I saw the theory of upper and lower previsions in the context of robustness analysis. Ideally the previsions should be as exact as possible, so what additional principles could be used to determine rational degrees of belief, or rather how might they change with new information? This led me to generalise Richard Jeffrey's extension of the Bayes rule, using what I called the Principle of Minimum Information. This was a relativised form, using Kulback-Leibler information, of the maximum entropy principle, so forcibly advocated, it seemed to me, by E. T. Jaynes. Another of Jaynes' ideas which I valued was the idea of using symmetries and invariances to determine priors where this made sense. This was attractive because it used an understanding of the physical world, and its mathematical representation, to determine the symmetries, rather than the linguistic symmetries to which Carnap had appealed, and which had been the subject of criticism by de Finetti, for example.

The 1975 report has been unpublished for a long time; has it been dormant because of the research atmosphere in 1975 — did it raise negative reactions by then?

You must remember that journals such as IJAR did not exist at the time and, in the form in which I wrote the report, it was not easy to place. De Finetti himself thought the 1975 paper was too closely connected to "formal logic" for his liking, which puzzled me, though he had expressed interest and pleasure in the earlier 1974 paper linking subjective probability to the idea of the indeterminacy of empirical concepts. Having circulated the paper to individuals whom I knew might be interested, I just put it aside for the time being.

Your papers tersely deal with deep mathematical and philosophical questions; could you give us some words on your background

and interests, both in 1975 and now?

My interest in empirical indeterminacy also led me to study non-classical logics. Intuitionist logic seemed especially interesting, and led to an interest in constructivist approaches in the philosophy of mathematics. I was impressed by the idea that appeals to the axiom of choice, or equivalents, often arise only because of the use of point-based representations, for example in topology. The real underlying mathematics doesn't need such appeals, according to this programme, and the aim is to provide category-theoretic foundations in place of set theory.

Another deep interest at the time was in the conceptual foundations of Quantum Mechanics. I wanted to see the so-called paradoxes demystified by a full acceptance of the non-classical nature its underlying logico-algebraic structure. There was also a particular problem, for someone holding to a personalist interpretation of probability, that probability seemed intrinsic to the theory in a way that wasn't true of classical statistical mechanics.

Shortly after writing the paper on upper and lower conditional previsions, I was asked to review Glenn Shafer's 1976 book. That led to exchanges with Glenn which I think we both enjoyed. I was intrigued by the mathematical structure of belief functions. I eventually concluded that belief function theory was the probability theory appropriate when the underlying logic of possibilities had the structure of a semi-lattice, rather than a Boolean algebra, just as quantum probability is appropriate when the underlying algebra is the projection lattice of a Hilbert space. I wrote quite extensively on this though it has not been published. I did, however, enjoy making practical applications of belief function theory to the reporting and analysis of adverse drug reactions for a major pharmaceutical company.

In the mid 80s my group was absorbed into a computer science department with strong artificial intelligence leanings. I became interested in the "connectionist" approach to AI which was developing at the time, and its links with information theory. Much of my subsequent work has centered around machine learning, both supervised and unsupervised, using neural networks or other kernel methods. This is a large area ranging from biology to engineering. My own work has tended to be at the more statistical end, with a strong Bayesian emphasis, mainly in pattern recognition and spatial statistics. Everyone should, if possible, have links with practical applications, if only because, surprisingly, they often throw up such interesting theoretical problems. The application areas I'm most concerned with are bio-informatics and mineral exploration. In fact much of my time now is spent looking for gold-mines!

The Lecture Day at Durham and the AMAI Special Issue

In this section we briefly report on two topics of interest to the community.

First, the Department of Mathematical Sciences, Durham University, organized a lecture day on "Imprecision" on June 20 2006, with topics including imprecise probability and related statistical inference, imprecise utility, info-gap theory and imprecise metrics. The following topics were covered:

- Uncertainty representation in climate change projections and engineering adaption decisions using imprecise probabilities, by J. Hall, University of Newcastle upon Tyne, UK.
- The use of statistical induction for in-service QoS monitoring of real-time network connections, by M. Tunnicliffe, Kingston University London, UK.
- Robust decision making under severe uncertainty – an information-gap approach, by D. Hine, University of Newcastle upon Tyne, UK.
- Representation invariance in immediate prediction, by G. de Cooman Ghent University, Belgium.
- Nonparametric predictive inference for multinomial data, by F. Coolen, Durham University, UK.
- Decision making with imprecise probabilities – some results and many questions, by T. Augustin, Ludwig-Maximilians University Munich, Germany.
- Bayes linear imprecision, by M. Goldstein, Durham University, UK.

Additional information can be found at http://maths.dur.ac.uk/stats/people/fc/20June06.html.

Second, a special issue on imprecise probabilities appeared at the *Annals of Mathematics and Artificial Intelligence* in June 2005 (volume 45, numbers 1–2). The special issue, edited by G. de Cooman and M. Zaffalon, contains enlarged versions of papers presented at ISIPTA'01. The papers in the special issue are:

- Belief models: An order-theoretic investigation, by G. de Cooman.
- Probabilistic logic under coherence: Complexity and algorithms, by V. Biazzo, A. Gilio, T. Lukasiewicz, G. Sanfilippo.
- Robust reasoning with rules that have exceptions: From second-order probability to argumentation via upper envelopes of probability and possibility plus directed graphs, by D. Bamber, I. R. Goodman, H. T. Nguyen.
- Graphoid properties of epistemic irrelevance and independence, by F. G. Cozman and P. Walley.
- Epistemic irrelevance on sets of desirable gambles, by S. Moral.
- Robust inference of trees, by M. Zaffalon, M. Hutter.
- Algebraic structure of the families of compatible frames of discernment, by F. Cuzzolin.

Software section: The *Bounds* package

The *Bounds* package, by Arie Beresteanu and Charles Manski, is a welcome addition to the set of tools of interest to the community. *Bounds* can be found in two versions: as a package for the Matlab system, a system for numerical computing (www.matlab.com); or as a package for the STATA system, a system for statistical computing (www.stata.com). The package, with full documentation, may be found at http://www.faculty.econ.northwestern.edu/faculty/manski/. The following material was generously contributed by Charles Manski, one of the creators of *Bounds*.

The routines bundled in this package implement many of the methods for nonparametric analysis of treatment response and nonparametric analysis of regressions with missing data described in C. Manski, *Partial Identification of Probability Distributions*, Springer-Verlag, 2003. The most basic of the methods for analysis of treatment response yields sharp bounds on average treatment effects and other quantities of interest in the absence of maintained structural assumptions. Tighter bounds are obtained when various weak structural assumptions are maintained.

This version of the package implements the bounds that hold under instrumental variable and monotone instrumental variable assumptions as well as those that hold under monotone and concave-monotone treatment response assumptions. The package also generates nonparametric point estimates of treatment effects under the assumption that treatment selection is exogenous.

A further use of the package is to perform nonparametric analysis of regressions with missing outcome data or jointly missing outcome and covariate data. These methods yield sharp bounds on regressions in the absence of assumptions on the nature of the missing data.

The New Articles of SIPTA

During last ISIPTA, the General Meeting examined the original articles regulating the society, and decided on a number of changes (a description of the meeting can be found in the previous issue of the newsletter). The changes are now in effect and are reproduced below; thanks to SIPTA's secretary, Marco Zaffalon, for sending them in the appropriate format.

SOCIETY FOR IMPRECISE PROBABILITY: THEORIES AND APPLICATIONS

(SIPTA)

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A not-for-profit organisation

Approved by the Constituting Meeting of the *Society for Imprecise Probability: Theories and Applications*, 11–13 February 2002.
Amended by the General Meeting of the *Society*

for Imprecise Probability: Theories and Applications, 27 July 2005.

Article I – Name and Place

1. This international society is named *Society for Imprecise Probability: Theories and Applications* (abbreviated to *SIPTA*, and in this document also called *the Society*) and is established according to articles 60 and following of the Swiss Civil Law, which govern all legal matters and possible controversies.

2. The Society is headquartered at the office of the SIPTA President or Secretary or Treasurer, as determined by SIPTA Executive Committee.

Article II – Purpose and Activities

1. The Society is a not-for-profit organisation uniting private persons dealing with theories and applications of imprecise probabilities and related topics.

2. The Society considers *imprecise probability* to be a generic term for the many mathematical models which measure chance or uncertainty without sharp numerical probabilities. It supports the view that such models are needed in inference problems where the relevant information is scarce, vague or conflicting, and in decision problems where preferences are incomplete.

3. The aims of the Society are to:

   — advance and promote the theories and applications of imprecise probabilities;

   — disseminate and promote the idea that imprecision is an important aspect of probabilistic modelling, and that this imprecision should therefore be taken into account in realistic probabilistic models;

   — promote contacts and exchange information among scientists and practitioners in different fields and from different countries interested in the theories and applications of imprecise probabilities, and coordinate their activities;

4. In order to achieve these aims, the Society:

   — organises a biennial series of international conferences, called *International Symposium on Imprecise Probability: Theories and Applications* (abbreviated to *ISIPTA*), and taking place every odd year;

   — organises a biennial series of schools, called *SIPTA School on Imprecise Probabilities* (abbreviated to SIPTA School), taking place every even year;

   — organises meetings and courses on topics related to imprecise probabilities;

   — arranges the editing and publication of the ISIPTA proceedings, as well as scientific books in the field of imprecise probabilities;

   — hosts and maintains a website that allows people interested in imprecise probabilities to communicate research and other information relevant to the Society's aims with one another and the broader community.

   — delivers an electronic newsletter to its Members, as well as to the interested public;

   — encourages its Members to act as (Associate) Editors for scientific journals that are interested in publishing papers on the theories and applications of imprecise probabilities.

Article III – Membership of the SIPTA

1. Any person is eligible to become a *Member of the Society for Imprecise Probability: Theories and Applications* (abbreviated to *SIPTA Member*, and in this document also referred to as *Member*) after registering for an ISIPTA conference or a SIPTA school.

2. Willingness to become Member will have to be confirmed in written, and possibly electronic, form. This will make Membership effective for four years, from the starting day of the ISIPTA conference, or the SIPTA school, for which the new member has registered.

3. The SIPTA Executive Committee may also decide to grant membership to persons who have not registered for an ISIPTA conference or a SIPTA school.

4. Also in this case, willingness to become Member will have to be confirmed in written, and possibly electronic, form. This will make Membership effective for four years, from the day in which the Executive Committee has notified the new Member of the decision to grant membership.

5. All Members have voting rights in the SIPTA General Meeting.

6. Membership can be terminated if the Member sends a letter of resignation to the SIPTA President.

Article V – Bodies of the SIPTA

1. The bodies of the Society are

   — the *General Meeting of all Members of the Society for Imprecise Probability: Theories and Applications*, also called the *General Meeting of the SIPTA*, in this document abbreviated to *General Meeting*;

   — the *SIPTA Executive Committee*.

Article VI – General Meeting of the SIPTA

1. General Meetings are held every odd year, during an ISIPTA conference, and at a location near to where the conference is being held.

2. The SIPTA Executive Committee may organise the General Meeting through the means of an electronic discussion forum accessible to all the Members.

3. All Members are welcome and encouraged to participate in the General Meetings.

   3.1. For the General Meeting to take decisions, there must be a quorum of at least one third of the Members.

   3.2. Members who cannot attend the General Meeting, can designate a proxy in writing to the SIPTA Secretary.

4. The General Meeting:

   — considers and votes for approval of the bylaws suggested by the Members, according to a simple 1/2 majority among all Members participating.

   — considers and votes for approval changes and additions to the Articles suggested by the Members, according to a 2/3 majority among all Members participating.

   — Any proposal that requires 2/3 majority among all Members to be approved, should be notified to the SIPTA Secretary, who will inform all Members about them. This should be done at least one month prior to the General Meeting, so that all Members have time to consider the proposed changes carefully. Members that cannot be physically present at the General Meeting, can also be allowed to cast votes in writing, or electronically, before the start of the General Meeting.

Article VII – The SIPTA Executive Committee

1. The SIPTA Executive Committee consists of the following members elected by the SIPTA Members from among their ranks, up to a maximum of 9 people:

   (a) the SIPTA President;

   (b) the SIPTA Secretary;

   (c) the SIPTA Treasurer;

   (d) the SIPTA Executive Editor, responsible for various parts of the web site.

   (e) and up to 5 other SIPTA at-large Members.

2. Terms of members of the SIPTA Executive Committee will be two years, beginning on the first day of the month after the election took place.

3. The SIPTA Secretary and the SIPTA Treasurer may be the same person. The SIPTA President cannot take up any other position in the SIPTA Executive Committee during his term.

4. The SIPTA Executive Committee runs the daily affairs of the Society. It is responsible for the newsletter and the website.

5. The SIPTA President, together with the Secretary and the Treasurer, handle the daily financial affairs of the Society. The Treasurer is accountable to the General Meeting, and prepares an annual financial report of the Society. This report is sent to all Members, preferably by e-mail, by the end of the year.

6. The SIPTA Executive Committee decides where the next ISIPTA conference will take place. It appoints the members of the next ISIPTA's Steering Committee.

7. The SIPTA Executive Committee decides where the next SIPTA School will take place. It appoints the members of the next SIPTA School's Organising Committee.

8. The SIPTA Executive Committee may decide to appoint new SIPTA members according to a 2/3 majority of the members of the Executive Committee itself.

9. The SIPTA Executive Committee, as well as other Members, may suggest bylaws in order to regulate:

   — governing of the Society;

— organising the ISIPTA conferences;

— organising the SIPTA Schools on Imprecise Probabilities;

— organising and running meetings;

— elections.

Article VIII – The ISIPTA Conferences

1. The ISIPTA conferences take place every odd year, between June and the end of September.

2. Shortly after the latest ISIPTA conference, the Steering Committee for the next ISIPTA conference is appointed by the newly elected SIPTA Executive Committee.

3. The ISIPTA Steering Committee consists of

   — the Chairman of the Local Organising Committee, who is responsible for the local organisation, the daily affairs and finances of the ISIPTA conference;

   — one of the former SIPTA Presidents;

   — the Programme Committee Board, consisting of up to three people, responsible for (i) forming a Programme Committee, whose members are to review the papers submitted to the conference, (ii) supervising the paper review procedure, (iii) deciding on which papers will be accepted, and (iv) working out the scientific programme of the conference;

4. Any profits derived from the organisation of the ISIPTA conferences shall go to the Society, and are to be used for covering the working costs of the Society.

5. Shortly after the ISIPTA conference, the Chairman of the Local Organising Committee will present a report about its finances to the SIPTA Treasurer.

Article IX – The SIPTA Schools on Imprecise Probabilities

1. The SIPTA Schools on Imprecise Probabilities take place every even year, between June and the end of September.

2. Shortly after the latest SIPTA School, the Organising Committee for the next SIPTA School is appointed by the SIPTA Executive Committee.

3. The SIPTA School Organising Committee at least consists of

   — the Chairman, who is responsible for the organisation, the daily affairs and finances of the SIPTA School. He is also responsible for working out the scientific programme of the school;

   — one of the former SIPTA Presidents;

4. Any profits derived from the organisation of the SIPTA Schools shall go to the Society, and are to be used for covering the working costs of the Society.

5. Shortly after the SIPTA School, the Chairman of the Organising Committee will present a report about its finances to the SIPTA Treasurer.

Article X – Circularising the Members

1. The Members will receive a SIPTA Newsletter or a similar document for announcements of news about the Society. This newsletter will also be sent to non-members who have expressed an interest in receiving such newsletters.

Article XI – Liquidation

1. If liquidation of the assets of the Society is necessary, the SIPTA Executive Committee is the liquidator.

2. Liquidation requires approval by a 2/3 majority of the SIPTA General Meeting.

3. After liquidation the remaining assets of the Society are to be devolved upon a similar not-for-profit organisation.

4. The Members are not responsible nor accountable for possible debts of the Society.

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