Central Topics in the Philosophy of Science

Room 129

Instructor: Dr. Jürgen Landes
Contact: juergen_landes@yahoo.de jlandes.wordpress.com
Office hours: After class and by appointment

Teaching Assistants: Timo Freiesleben and Gašper Stukelj
Contact: timo.freiesleben@web.de and gasper.stukelj@gmail.com

Sessions: Tuesdays 10:15 - 11:45.
Tutorials: Thursdays 18:15 - 19:45.

Wintersemester - 2019/20

Overview

This course provides a systematic discussion of central problems from general philosophy of science from a Bayesian point of view, including the problem of induction, confirmation and evidence, evidential variety and objective Bayesian epistemology. The seminar is accompanied by a tutorial which systematically introduces our main modelling tool: probability theory and in particular the theory of Bayesian networks. Students are expected to work on problem sets every week and will learn to construct and analyse Bayesian models themselves.

Coursework

Students are requested to attend all sessions, to attend attend the weekly tutorials (Thursday 18:15-19:45) and hand in solutions of the weekly problem sets at the

beginning of each session, to study the reading assignments and to submit one discussion question about the readings per week together with their solutions to the problem set and and to participate in the classroom discussions.
In the session of the **17.12. 2019**, there will be a **Midterm-Exam** with mathematical problems.
By **28 March 2020**, students have to submit a **term paper** of about 3000 words. The term paper should be interesting and relevant to CtPS (widely construed) and **you** and **your career**.
An abstract (What is your philosophical thesis? Why is it relevant? How are you going to argue for it?) and a literature list have to be submitted by **8 February 2020**. The instructor and/or a TA will provide feedback.

No tutorials take place after Christmas.

Assessment

The final mark will be determined from the weekly problem sets (25%), the Midterm-Exam (35%), and the term paper (40%).

Term paper: **No Literature = No Marks = FAIL**.

Plagiarising and cheating will not be tolerated and result in an automatic **FAIL**.

Chance for bonus points: Discover a typo/mistake in the formal part of the lecture notes that only you find.

Course Material and Communication

Lecture notes (including reading assignments), problem sets and solutions will be published on my website. If you have not been added yet, please, send an email to Maria Csauscher-Wuck (office.hartmann@lrz.uni-muenchen.de) so that she can set up a mailing list (urgent cancellations, etc.).

Dates and Topics

- Week 1 (15.10.2019): Basic Probability Theory

- Week 2 (22.10.2019): Bayesian Epistemology
- Week 3 (29.11.2019): Interpretations of Probability
- Week 4 (05.11.2019): Bayesian Networks
- Week 5 (12.11.2019): The Variety of Evidence Thesis
- Week 6 (19.11.2019): The No Alternatives Argument
- Week 7 (26.11.2019): Objective Bayesian Epistemology
- Week 8 (03.12.2019): Epistemic Utility Theory
- Week 9 (10.12.2019): The Value of Information
- Week 10 (17.12.2019): **Midterm-Exam**
- Week 11 (07.01.2020): Causal Assessment
- Week 12 (14.01.2020): Wisdom of the Crowds by Timo Freiesleben
- Week 13 (21.01.2020): Calibration
- Week 14 (28.01.2020): Find Your Essay Topic
- Week 15 (04.02.2020): Student Presentations

Useful Resources

- Harvard Writing Guide.
- Uni online library.
- Google Scholar.
- Phil Papers.
- Stanford Encyclopedia of Philosophy.
- Teachers, teaching assistants, peers, student union, student bodies, student representatives, PhD students, friends & family, ...
- Course rep.

References

Yaman Abdin, Daniel J. Auker-Howlett, Jürgen Landes, Glorjen Mulla, Claus Jacob, and Barbara Osimani. Reviewing the Mechanistic Evidence Assessors E-Synthesis and EBM+: A Case Study of Amoxicillin and Drug Reaction with Eosinophilia and Systemic Symptoms (DRESS). *Current Pharmaceutical Design*, 25(16):1866–1880, 2019. URL https://doi.org/10.2174/1381612825666190628160603.

Carlos E. Alchourrón, Peter Gärdenfors, and David Makinson. On the Logic of Theory Change: Partial Meet Contraction and Revision Functions. *Journal of Symbolic Logic*, 50(2):510–530, 1985. URL https://doi.org/10.2307/2274239.

J. Eric Bickel. Some Comparisons among Quadratic, Spherical, and Logarithmic Scoring Rules. *Decision Analysis*, 4(2):49–65, 2007. URL https://doi.org/10.1287/deca.1070.0089.

Luc Bovens and Stephan Hartmann. *Bayesian Epistemology*. Oxford University Press, Oxford, 2003.

Glenn W. Brier. Verification of forecasts expressed in terms of probability. *Monthly Weather Review*, 78(1):1–3, 1950. URL https://doi.org/10.1175/1520-0493(1950)078%3C0001:VOFEIT%3E2.0.CO;2.

Rudolf Carnap. On the Application of Inductive Logic. *Philosophy and Phenomenological Research*, 8(1):133–148, 1947. URL https://doi.org/10.2307/2102920.

François Claveau and Olivier Grenier. The Variety-of-Evidence Thesis: A Bayesian Exploration of its Surprising Failures. *Synthese*, 196:3001–3028, 2019. URL https://doi.org/10.1007/s11229-017-1607-5.

Vincenzo Crupi and Katya Tentori. State of the field: Measuring information and confirmation. *Studies in History and Philosophy of Science Part A*, 47:81–90, 2014. URL https://doi.org/10.1016/j.shpsa.2014.05.002.

Vincenzo Crupi, Jonathan Nelson, Björn Meder, Gustavo Cevolani, and Katya Tentori. Generalized information theory meets human cognition: Introducing a

unified framework to model uncertainty and information search. *Cognitive Science*, 42:1410–1456, 2018. URL https://doi.org/10.1111/cogs.12613.

Imre Csiszár. Axiomatic Characterizations of Information Measures. *Entropy*, 10 (3):261–273, 2008. URL https://doi.org/10.3390/e10030261.

Martin Curd and J. A. Cover, editors. *Philosophy of Science: The Central Issues*. W. W. Norton & Company, New York, 1998.

Alexander Philip Dawid. Probability forecasting. In Samuel Kotz and Norman Lloyd Johnson, editors, *Encyclopedia of Statistical Sciences*, volume 7, pages 210–218. Wiley, 1986.

Richard Dawid, Stephan Hartmann, and Jan Sprenger. The No Alternatives Argument. *British Journal for the Philosophy of Science*, 66(1):213–234, 2015. URL https://doi.org/10.1093/bjps/axt045.

Glauber De Bona and Julia Staffel. Graded Incoherence for Accuracy-Firsters. *Philosophy of Science*, 84(2):189–213, 2017. URL https://doi.org/10.1086/690715.

Bruno de Finetti. *Theory of Probability*. Wiley, Chichester, 1974.

Francesco De Pretis and Barbara Osimani. New Insights in Computational Methods for Pharmacovigilance: E-Synthesis, a Bayesian Framework for Causal Assessment. *International Journal of Environmental Research and Public Health*, 16(12):2221, 2019. URL https://doi.org/10.3390/ijerph16122221.

Francesco De Pretis, Jürgen Landes, and Barbara Osimani. E-Synthesis: a Bayesian Framework for Causal Assessment in Pharmacosurveillance. *Frontiers in Pharmacology*, 10, 2019. URL https://doi.org/10.3389/fphar.2019.01317. 17 pages supplementary material available at https://www.frontiersin.org/articles/10.3389/fphar.2019.01317/full#supplementary-material.

Didier Dubois and Henri Prade. The three semantics of fuzzy sets. *Fuzzy Sets and Systems*, 90(2):141–150, 1997. URL https://doi.org/10.1016/S0165-0114(97)00080-8.

Branden Fitelson. Wayne, Horwich, and Evidential Diversity. *Philosophy of Science*, 63(4):652–660, 1996. URL https://doi.org/10.1086/289982.

Donald Gillies. *Philosophical Theories of Probability*. Routledge, 2000.

Tilmann Gneiting and Adrian E. Raftery. Strictly Proper Scoring Rules, Prediction, and Estimation. *Journal of the American Statistical Association*, 102(477):359–378, 2007. URL https://doi.org/10.1198/016214506000001437.

Peter D. Grünwald and A. Philip Dawid. Game theory, maximum entropy, minimum discrepancy and robust Bayesian decision theory. *Annals of Statistics*, 32(4):1367–1433, 2004. URL https://doi.org/10.1214/009053604000000553.

Balázs Gyenis and Leszek Wroński. *Is it the Principal Principle that Implies the Principle of Indifference?*, pages 35–41. Springer, Cham, 2017. URL https://doi.org/10.1007/978-3-319-55486-0_2.

Alan Hájek. The reference class problem is your problem too. *Synthese*, 156:563–585, 2007. URL https://doi.org/10.1007/s11229-006-9138-5.

Alan Hájek. Arguments for - or against - Probabilism? *British Journal for the Philosophy of Science*, 59(4):793–819, 2008. URL https://doi.org/10.1093/bjps/axn045.

Alan Hájek. Fifteen arguments against hypothetical frequentism. *Erkenntnis*, 70(2):211–235, 2009. URL https://doi.org/10.1007/s10670-009-9154-1.

Alan Hájek. Interpretations of Probability. In Edward N. Zalta, editor, *Stanford Encyclopedia of Philosophy*. Summer 2012 edition, 2012. URL http://plato.stanford.edu/entries/probability-interpret/.

J. Y. Halpern and Daphne Koller. Representation Dependence in Probabilistic Inference. *Journal of Artificial Intelligence Research*, 21:319–356, 2004. URL https://doi.org/10.1613/jair.1292.

James Hawthorne, Jürgen Landes, Christian Wallmann, and Jon Williamson. The Principal Principle implies the Principle of Indifference. *British Journal for the Philosophy of Science*, 68:123–131, 2017. URL https://doi.org/10.1093/bjps/axv030.

Carl Hempel. *Philosophy of Natural Science*. Prentice Hall, Upper Saddle River, 1966.

Kevin Houston. *How to Think Like a Mathematician: A Companion to Undergraduate Mathematics*. Cambridge University Press, Cambridge, 2009.

Edwin T. Jaynes. Information Theory and Statistical Mechanics. *Physical Review Letters*, 106:620–630, 1957. URL https://doi.org/10.1103/PhysRev.106.620.

James Joyce. Bayes' Theorem. In Edward N. Zalta, editor, *Stanford Encyclopedia of Philosophy*. Spring 2019 edition, 2019. URL https://plato.stanford.edu/archives/spr2019/entries/bayes-theorem.

Daniel Kahneman. *Thinking, Fast and Slow*. Penguin, 2012.

James Ladyman. *Understanding Philosophy of Science*. Taylor & Francis, London, 2012. URL https://doi.org/10.4324/9780203463680.

Jürgen Landes. Probabilism, Entropies and Strictly Proper Scoring Rules. *International Journal of Approximate Reasoning*, 63:1–21, 2015. URL https://doi.org/10.1016/j.ijar.2015.05.007.

Jürgen Landes. L&P-updating - All Bets Are Off. *The Reasoner*, 12(2):10, 2018. URL https://blogs.kent.ac.uk/thereasoner/files/2018/01/TheReasoner-122.pdf.

Jürgen Landes. Varied Evidence and the Elimination of Hypotheses. *European Journal for Philosophy of Science*, 10, 2020a. URL https://doi.org/10.1007/s13194-019-0272-6.

Jürgen Landes. Variety of Evidence. *Erkenntnis*, 85:183–223, 2020b. URL https://doi.org/10.1007/s10670-018-0024-6.

Jürgen Landes and George Masterton. Invariant Equivocation. *Erkenntnis*, 82:141–167, 2017. URL https://doi.org/10.1007/s10670-016-9810-1.

Jürgen Landes and Jon Williamson. Objective Bayesianism and the maximum entropy principle. *Entropy*, 15(9):3528–3591, 2013. URL https://doi.org/10.3390/e15093528.

Jürgen Landes and Jon Williamson. Justifying objective Bayesianism on predicate languages. *Entropy*, 17(4):2459–2543, 2015. URL https://doi.org/10.3390/e17042459.

Jürgen Landes and Jon Williamson. Objective Bayesian nets from consistent datasets. In Adom Giffin and Kevin H. Knuth, editors, *Proceedings of MaxEnt*, volume 1757, pages 020007–1 – 020007–8. AIP, 2016. URL https://doi.org/10.1063/1.4959048.

Jürgen Landes, Barbara Osimani, and Roland Poellinger. Epistemology of Causal Inference in Pharmacology. *European Journal for Philosophy of Science*, 8:3–49, 2018. URL https://doi.org/10.1007/s13194-017-0169-1.

Lucie Laplane, Paolo Mantovani, Ralph Adolphs, Hasok Chang, Alberto Mantovani, Margaret McFall-Ngai, Carlo Rovelli, Elliott Sober, and Thomas Pradeu. Opinion: Why science needs philosophy. *Proceedings of the National Academy of Sciences*, 116(10):3948–3952, 2019. URL https://www.pnas.org/cgi/doi/10.1073/pnas.1900357116.

Hannes Leitgeb and Richard Pettigrew. An Objective Justification of Bayesianism I: Measuring Inaccuracy. *Philosophy of Science*, 77(2):201–235, 2010a. URL https://doi.org/10.1086/651317.

Hannes Leitgeb and Richard Pettigrew. An Objective Justification of Bayesianism II: The Consequences of Minimizing Inaccuracy. *Philosophy of Science*, 77(2):236–272, 2010b. URL https://doi.org/10.1086/651318.

David Lewis. A Subjectivist's Guide to Objective Chance. In Richard C. Jeffrey, editor, *Studies in Inductive Logic and Probability*, volume 2, chapter 13, pages 263–293. Berkeley University Press, 1980.

Jonathan E. Lowe. *A Survey of Metaphysics*. Oxford University Press, 2002.

John T. McBride. The Association of Acetaminophen and Asthma Prevalence and Severity. *Pediatrics*, 128(6):1181–1185, 2011. URL https://doi.org/10.1542/peds.2011-1106.

Randall G McCutcheon. In favor of logarithmic scoring. *Philosophy of Science*, 86(2):286–303, 2019. URL https://doi.org/10.1086/702028.

Sarah Moss. Scoring Rules and Epistemic Compromise. *Mind*, 120(480):1053–1069, 2011. URL https://doi.org/10.1093/mind/fzs007.

M Hassan Murad, Noor Asi, Mouaz Alsawas, and Fares Alahdab. New evidence pyramid. *Evidence-Based Medicine*, 21(4):125–127, 2016. URL https://doi.org/10.1136/ebmed-2016-110401.

Richard E. Neapolitan. *Learning Bayesian Networks*. Pearson, Upper Saddle River, 2003.

Graham Oddie. Conditionalization, Cogency, and Cognitive Value. *British Journal for the Philosophy of Science*, 48(4):533–541, 1997. URL https://doi.org/10.1093/bjps/48.4.533.

Barbara Osimani and Jürgen Landes. Varieties of Error and Varieties of Evidence. *British Journal for the Philosophy of Science*, 2020. 45 pages.

Jeff B. Paris. Common Sense and Maximum Entropy. *Synthese*, 117:75–93, 1998. URL https://doi.org/10.1023/A:1005081609010.

Jeff B. Paris. *The Uncertain Reasoner's Companion: A Mathematical Perspective*, volume 39 of *Cambridge Tracts in Theoretical Computer Science*. Cambridge University Press, Cambridge, 2 edition, 2006.

Jeff B. Paris and Alena Vencovská. On the applicability of maximum entropy to inexact reasoning. *International Journal of Approximate Reasoning*, 3(1):1–34, 1989. URL https://doi.org/10.1016/0888-613X(89)90012-1.

Jeff B. Paris and Alena Vencovská. A note on the inevitability of maximum entropy. *International Journal of Approximate Reasoning*, 4(3):183–223, 1990. URL https://doi.org/10.1016/0888-613X(90)90020-3.

Judea Pearl. *Probabilistic reasoning in intelligent systems: networks of plausible inference*. Morgan Kaufmann, 1988.

Richard Pettigrew. Epistemic Utility Arguments for Probabilism. In Edward N. Zalta, editor, *Stanford Encyclopedia of Philosophy*. Stanford University, winter 2011 edition, 2011. URL http://plato.stanford.edu/entries/epistemic-utility/.

Richard Pettigrew. Accuracy, Chance, and the Principal Principle. *The Philosophical Review*, 121(2):241–275, 2012. URL https://doi.org/10.1215/00318108-1539098.

Richard Pettigrew. A New Epistemic Utility Argument for the Principal Principle. *Episteme*, 10(1):19–35, 2013. URL https://doi.org/10.1017/epi.2013.5.

Richard Pettigrew. *Accuracy and the Laws of Credence*. Oxford University Press, Oxford, 2016a.

Richard Pettigrew. Accuracy, Risk, and the Principle of Indifference. *Philosophy and Phenomenological Research*, 92(1):35–59, 2016b. ISSN 1933-1592. URL https://doi.org/10.1111/phpr.12097.

Richard Pettigrew. The Principal Principle does not imply the Principle of Indifference. *British Journal for the Philosophy of Science*, 2019. URL https://doi.org/10.1093/bjps/axx060.

Richard Pettigrew and Jonathan Weisberg. *The Open Handbook of Formal Epistemology*. PhilPapers Foundation, 2019. URL https://philpapers.org/rec/PETTOH-2.

Leonard Jimmie Savage. Elicitation of Personal Probabilities and Expectations. *Journal of the American Statistical Association*, 66(336):783–801, 1971. URL https://doi.org/10.1080/01621459.1971.10482346.

Leonard Jimmie Savage. *The Foundations of Statistics*. Dover Publications, New York, 2nd edition, 1972.

Glenn Shafer. *A mathematical theory of evidence*. Princeton University Press, Princeton, 1976.

Glenn Shafer. A betting interpretation for probabilities and Dempster-Shafer degrees of belief. *International Journal of Approximate Reasoning*, 52(2):127–136, 2011. URL https://doi.org/10.1016/j.ijar.2009.05.012.

Murray R. Spiegel, John J. Schiller, and R. Alu Srinivasan. *Schaum's Outline: Probability and Statistics*. McGraw-Hill, 2 edition, 2000.

Wolfgang Spohn. *The Laws of Belief. Ranking Theory and its Philosophical Applications*. Oxford University Press, Oxford, 2012.

Jand Sprenger and Stephan Hartmann. *Bayesian Philosophy of Science*. Oxford University Press, Oxford, 2019.

Julia Staffel. Measuring the overall incoherence of credence functions. *Synthese*, 192(5):1467–1493, 2015. URL https://doi.org/10.1007/s11229-014-0640-x.

Michael G Titelbaum and Casey Hart. The Principal Principle Does Not Imply the Principle of Indifference, Because Conditioning on Biconditionals is Counterintuitive. *British Journal for the Philosophy of Science*, 2019. URL https://doi.org/10.1093/bjps/axy011.

Eric-Jan Wagenmakers, Ruud Wetzels, Denny Borsboom, Han L. J. van der Maas, and Rogier A. Kievit. An Agenda for Purely Confirmatory Research. *Perspectives on Psychological Science*, 7(6):632–638, 2012. URL https://doi.org/10.1177/1745691612463078.

Christian Wallmann and James Hawthorne. Admissibility Troubles for Bayesian Direct Inference Principles. *Erkenntnis*, 2020. URL https://doi.org/10.1007/s10670-018-0070-0.

Jonathan Weisberg. You've Come a Long Way, Bayesians. *Journal of Philosophical Logic*, 44(6):817–834, 2015a. URL https://doi.org/10.1007/s10992-015-9363-9.

Jonathan Weisberg. Formal Epistemology. In Edward N. Zalta, editor, *Stanford Encyclopedia of Philosophy*. Summer 2015 edition, 2015b. URL http://plato.stanford.edu/archives/sum2015/entries/formal-epistemology.

J. Robert G. Williams. Generalized Probabilism: Dutch Books and Accuracy Domination. *Journal of Philosophical Logic*, 41:811–840, 2012. URL https://doi.org/10.1007/s10992-011-9192-4.

Jon Williamson. *In Defence of Objective Bayesianism*. Oxford University Press, Oxford, 2010.

John Worrall. Evidence in Medicine and Evidence-Based Medicine. *Philosophy Compass*, 2(6):981–1022, 2007. URL https://doi.org/10.1111/j.1747-9991.2007.00106.x.