



THE UNIVERSITY *of* EDINBURGH
School of Philosophy, Psychology
and Language Sciences

Philosophy of Science

PHIL11133

Course Guide 2020-21

People

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Please email **Michela Massimi** to make an appointment if you would like to discuss material covered in the course or essay topics.



Course aims and objectives

This course aims to introduce you to a number of perennially-interesting and enduringly relevant issues from the philosophy of science. No previous scientific, philosophical or logical expertise is required and any technical / unfamiliar terms will be defined as we go. Along the way, we'll be considering some key questions like the following:

- What is the problem of induction, chiefly associated with Hume?
- What is Popper's falsificationism all about?
- What is scientific explanation?
- What is scientific measurement? Which accounts of measurement are best?
- How should we conceive of probability? What is Bayes' Theorem and what can it tell us about the confirmation of theories?
- What are scientific realism and scientific anti-realism? What arguments can be made for or against realist and anti-realist views of science?

Intended learning objectives

By the end of this course, students should:

- Have a grasp of fundamental issues in the philosophy of philosophy of science.
- Be able to critically analyse and engage with literature by key philosophers in this field.
- Understand how empirical and scientific work can support philosophical arguments, and be able to use data derived therefrom in their essays and arguments.
- Be able to present arguments clearly and concisely both within a classroom context and in a 2,500 word essay.
- Gain transferable skills in research, analysis and argumentation

Learning, teaching and assessment

Syllabus

Schedule of lectures, seminars, tutorials and assessments

Week	Topic	Lecturer	Activity
Week 1 11 January	A philosophical primer	Dr Alasdair Richmond	
Week 2 18 January	Problem of induction	Dr Alasdair Richmond	
Week 3 25 January	Popper and falsification	Dr Alasdair Richmond	
Week 4 1 February	Confirmation	Dr Wolfgang Schwartz	



Week 5 8 February	Bayesianism	Dr Wolfgang Schwartz	
Week 6 15 February			Flexible learning week
Week 7 22 February	Models and Modeling	Dr Alistair Isaac	
Week 8 1 March	Measurement	Dr Alistair Isaac	
Week 9 8 March	Deductive-nomological explanation	Dr Suilin Lavelle	
Week 10 15 March	Biological explanations	Dr Suilin Lavelle	
Week 11-12 22-29 March	Realism and anti-realism	Dr Alasdair Richmond	

Topics and readings

Week 1: A philosophical primer – Alistair Richmond (AR)

This seminar simply aims to furnish you with the all the philosophical technicalities that this course will require – introducing you to some key epistemological and logical terms.

Required Reading

- Catherine Elgin “True Enough”, *Philosophical Issues* 14, 2004, 113-31.
- E. L. Gettier, ‘Is Justified True Belief Knowledge?’ *Analysis*, 23, 1963, 121-3.

Secondary Reading

- Elizabeth Anderson, “Feminist Epistemology and Philosophy of Science”, *Stanford Encyclopaedia of Philosophy*
- Duncan Pritchard, *What Is This Thing Called Knowledge?*, Ch. 1-3.

Week 2: The problem of induction (AR)



Some of the earliest-known systematic philosophies of science (e.g. that of Francis Bacon) depicted science as trying to establish conjectures through the use of induction. However, David Hume mounted a devastating attack on any non-circular justification of induction and this is often seen as a challenge to the rationality of the whole scientific enterprise. But what did Hume say about induction and what does his account reveal about the rationality of scientific practice?

Required Reading

- Helen Beebe, *Hume on Causation*, Ch 4. “The idea of necessary connection”
- David Hume, *Enquiries Concerning Human Understanding and Concerning the Principles of Morals*, (many editions but see e.g. that edited by L. A. Selby-Bigge and P. H. Nidditch, Oxford, Clarendon, 1975), Sections IV, VI, VII and X.

Secondary Reading

- Helen Beebe “Necessary Connection and the Problem of Induction” *Noûs* 45, 2011, 504-527.
- James Ladyman, *Understanding Philosophy of Science*, Ch. 2.
- John Vickers, ‘The Problem of Induction’, *Stanford Encyclopedia of Philosophy* (Fall 2014 Edition), Edward N. Zalta (ed.), <http://plato.stanford.edu/archives/fall2014/entries/induction-problem/>

Week 3: Popper and falsification (AR)

According to Karl Popper, science is not undermined by Hume’s problem, because science is not in the business of trying to prove conjectures true using induction at all. Instead science is in the business of proposing conjectures and trying to falsify them deductively. But is Popper’s falsificationist methodology a truly non-inductive alternative method for science?

Required Reading

- Deborah G. Mayo, ‘Ducks, rabbits and normal science: Recasting the Kuhn's-eye view of Popper's demarcation of science’, *British Journal for the Philosophy of Science*, 47, 1996: 271–290.
- Sir Karl Popper, *The Logic of Scientific Discovery*, (1992 edition), Ch. 1, 3 and 4.

Secondary Reading

- James Ladyman, *Understanding Philosophy of Science*, Ch. 3.
- Sir Karl Popper, *Conjectures and Refutations*, (5th edition, 1989), Ch. 1 and 3.

Week 4: Paradoxes of Confirmation – Wolfgang Schwartz (WS)

Scientific theories generally can’t be proved by experiment and observation. Nonetheless, some theories are well-confirmed by the evidence while others are not. What makes the difference? What does it take for a theory to be confirmed by evidence? In this session, we will look at some puzzles and paradoxes raised by the concept of confirmation and discuss how a probabilistic analysis seems to circumvent these problems.

Required Reading:

- Katie Steele and Charlotte Werndl, 2013, “Climate Models, Calibration, and Confirmation”, *British Journal for the Philosophy of Science*, 64: 609–635.
- Michael Strevens (2012), Notes on Bayesian Confirmation Theory, <http://www.nyu.edu/classes/strevens/BCT/BCT.pdf#> chapters 1-8



Note: Strevens' is long text, but it will be the main background reading for both this session and the next one. You may also skip all the boxes as well as section 6.3. For the purpose of tutorial discussion we shall concentrate on Steele and Werndl's paper.

Secondary Readings:

- Carl Hempel (1945), "Studies in the Logic of Confirmation (I)", *Mind* 54, pp.1-26
- John Earman and Wesley Salmon (1992), "The confirmation of scientific hypotheses", ch.2 in their *Introduction to the Philosophy of Science*, Prentice Hall

Week 5: Bayesian Confirmation Theory (WS)

A probabilistic approach to confirmation looks promising, but it leads to another question: what is probability? The probabilities in question do not seem to be statistical probabilities or relative frequencies. According to (classical, "subjective") Bayesian Confirmation Theory, the probabilities are subjective degrees of belief. We will have a closer look at this idea.

Required Reading:

- Michael Strevens (2012), Notes on Bayesian Confirmation Theory, <http://www.nyu.edu/classes/strevens/BCT/BCT.pdf#> chapters 1-8
- Michela Massimi (2020) "A Philosopher's Look at DES. Reflections on the use of the Bayes factor in cosmology", in Lahav, Calder, Mayer and Frieman (eds.) *The Dark Energy Survey. The story of a cosmological experiment* (World Scientific).

Secondary Readings:

- Rudolf Carnap (1955), "Statistical and inductive probability", reprinted in Antony Eagle (ed.), *Philosophy of Probability: Contemporary Readings*. Routledge 2010
- Branden Fitelson (2007): "Likelihoodism, Bayesianism, and Relational Confirmation", *Synthese* 156, pp.473-489

Week 6: Flexible Learning Week

No lectures/readings.

Week 7: Models and Modeling – Alistair Isaac (AI)

Many areas of science are driven by the practice of modeling, constructing idealized representations of the world for study. But how can we learn about one thing (the world) by looking at something else (a model)? This question has driven a recent surge of interest in modeling in philosophy of science.

Required Reading

- Margaret Morrison and Mary Morgan, "Models as mediating instruments", Ch 2 of *Models as Mediators*, Cambridge University Press (1999).
- Tarja Knuuttila (2011) "Modeling and Representing: An Artefactual Approach to Model-Based Representation", *Studies in History and Philosophy of Science*, 42: 262-271.



Secondary Reading

- Michela Massimi (2019) “Perspectival Modeling”, *Philosophy of Science* 85, 335-359.
- Angela Potochnik (2012) “Feminist Implications of Model-Based Science”, *Studies in History and Philosophy of Science* 43: 383-389.
- Michael Weisberg (2007) “Three Kinds of Idealization” *Journal of Philosophy* 104(12):639-659.

Week 8: Measurement (and More Models) (AI)

Scientific theories receive evidential support from the world through measurement, yet measurement has only very recently become a major topic in philosophy of science. Philosophical questions about measurement include: What do we assume about the world when we represent it with numbers? and When are concepts defined in terms of measurement outcomes meaningful? Recent interest in measurement has focused on the role of models in calibrating measurement devices, raising new epistemic challenges for the activity of modeling in science.

Required Reading

- Eran Tal (2013) “Old and New Problems in Philosophy of Measurement”, *Philosophy Compass* 8(12): 1159-1173.
- Margaret Morrison (2009) “Models, Measurement and Computer Simulation: The Changing Face of Experimentation”, *Philosophical Studies* 143: 33-57.

Secondary Reading

- Bas van Fraassen (2012) “Modeling and Measurement: The Criterion of Empirical Grounding”, *Philosophy of Science* 79 (5):773-784.
- Paul Teller (2013) “The Concept of Measurement-Precision” *Synthese* 190 (2):189-202.

Week 9: Explanation (1) – Suilin Lavelle (SL)

This seminar examines the role of explanation in Philosophy of Science. We will look briefly at the history of explanation, in particular the Deductive-Nomological model and Inductive-Statistical models, before thinking more carefully about the pragmatics of explanation. We will also consider the relation between Explanation and other areas of Philosophy of Science, especially Scientific Realism.

Required Reading

- Alisa Bokulich (2017) “Models and Explanation”, in Magnani and Bertolotti (eds.) *Handbook of Model-Based Science*, Springer.
- Angela Potochnik (2015) “Causal Patterns and Adequate Explanations” *Philosophical Studies* 172, 1163-1182.

Secondary Reading

- Hempel, C. “Two basic types of scientific explanation” in Curd and Cover, pp. 685-94.
- Lipton, P. (1991/2004). *Inference to the Best Explanation*. (2nd Ed). (Chapter 8) Routledge.
- Psillos, S. (2002). *Causation and Explanation*. (Chapter 8.) Acumen.



Week 10: Explanation (2) (SL)

This session examines a specific kind of explanation, namely, explanations in the biological sciences. In particular, we will look at the role of evolution in our explanations for features of organisms, and at the problems and advantages of attributing 'traits' to organisms that can be explained by appeal to natural selection.

Required Reading

- Angela Potochnik (2013) "Biological explanation" in K. Kampourakis (ed.) *The Philosophy of Biology. A companion for educators*, ch 4.
- Peter Godfrey-Smith (1998). Functions: consensus without unity. *Pacific Philosophical Quarterly*, 74, 196 – 208

Secondary Reading

- Ruth Millikan (1989). In defence of proper functions. *Philosophy of Science*, 56, 288 - 302
- Elliot Sober (2000). *Philosophy of Biology* (2nd Ed.) Westview. Ch.3, sec.7

Week 11: Realism and Anti-Realism (1) (AR)

An enduring debate concerns the aims of science and their relation to truth. According to scientific realism, science aims to give us true descriptions of the unobservable as well as the observable world. Scientific anti-realism on the other hand stresses other goals for science besides truth, e.g. predictive success or empirical adequacy. This session looks at arguments for scientific realism, including the classic 'No miracles' argument.

Required Reading

- Anjan Chakravartty, 'Scientific Realism', *The Stanford Encyclopedia of Philosophy* (Spring 2014 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/spr2014/entries/scientific-realism/>
- Philip Kitcher (2001) 'Real Realism: the Galilean strategy'. *Philosophical Review* 110: 151–197.

Secondary Reading

- James Ladyman, *Understanding Philosophy of Science*, Ch. 5.
- Massimi, M. (2016) "Bringing Real Realism back home: a perspectival slant", in J. Pfeifer and M. Couch *The Philosophy of Philip Kitcher* (Oxford University Press).

This session considers arguments for anti-realism about science, focussing on Bas van Fraassen's constructive empiricism as an example of a non-positivist anti-realist theory.

Required Reading

- Bas van Fraassen, "Constructive Empiricism Now", *Philosophical Studies*, 106, 2001: 151–170.
- Bas van Fraassen "Pictorial perspective and the indexical", Ch 4 of *Scientific Representation. Paradoxes of Perspective*, Oxford University Press (2008)

Secondary Reading

- Bas van Fraassen, 'Arguments Concerning Scientific Realism', *The Scientific Image*, (Oxford, Clarendon Press, 1980): 6-21, 23-35 and 31-40; reprinted in Curd & Cover (edd.).



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- Michela Massimi (2018) “Four Kinds of Perspectival Truth”, *Philosophy and Phenomenological Research* XCVI, 342–359.

Resources

Reading list materials are available via the course LEARN site. Please ensure you have completed the library induction tutorial. Should you have any problems accessing any of the materials for the course please contact the course librarian, Ishbel.Leggat@ed.ac.uk

Discussion Forums

There are discussion forums for each week of the course. This is your space to post any questions or comments you had about the week’s topic. Participation in the discussion forums is mandatory (see ‘Assessment’ below), but it’s also a great way to develop your philosophical thinking and dialectical skills.

Seminars

This course has a fortnightly live seminar. Times for the seminar are organised near the beginning of the semester, based on the availability of class participants. These are also a great way to develop your philosophical thinking and dialectical skills.

Assessment

This course has two assessment components:

- **500 word (max.) topic summary** due Thursday 4th March by 12 noon UK-time. This is worth 15% of your mark for this course. (See below for more details.)
- **3000 word (max.) summative essay** due Tuesday 20th April by 12 noon UK-time. This is worth 85% of your mark for this course.

You will also have the opportunity to submit a **formative essay** by Thursday 4th March by 12 noon UK-time which won’t contribute towards your mark for the course. For more details regarding the summative and formative essay, guidelines for submitting assessments, and general advice for writing, please see the Programme Handbook and the relevant section of the Philosophy Hub.

Participation in the **weekly discussion fora** is mandatory but not graded. You will, however, lose marks from your overall grade for each week you miss (you may miss one week without penalty). If you have to miss participation for a good reason, please inform your course organiser and the course administrator as soon as possible.



Topic Summary

The topic summary is a 500 word (max.) summary of a lecture topic of your choice, including a small glossary, aimed at upper high school students. The Department of Philosophy runs a number of outreach activities for schools aimed at making children more reflective about their values and beliefs, developing critical analysis skills, helping children to appreciate the perspectives of others. Your goal is to produce the kind of learning materials that could be used in a programme of this kind. You will be assessed on:

1. How well the information is organised in the summary
2. How well you have understood the material
3. How well the summary explains the relevant concepts to people with no academic background in philosophy

As well as the text, feel free to incorporate images, diagrams, or whatever serves the pedagogical purposes of the summary. (If you're feeling adventurous, you could create and upload a video.) As well as producing something which could potentially be used in this kind of outreach programme, one purpose of the exercise is to get into the mindset of explaining difficult topics as clearly as possible. If you can explain philosophical issues to young people with no academic background in philosophy, then you will have clarified those issues in your own mind.

Marking and feedback

Your work will be marked using the grade descriptors for the Postgraduate Common Marking Scheme.