Philosophy of Science

Time: Tu/Th 11-12:20
Location: 147 Sequoyah Hall
Office Hours: Tu/Th 4-5

Instructor: Charles T. Sebens
Email: csebens@gmail.com
Office: 8047 HSS

Course Description

This course will be divided into five units:

I. The Scientific Enterprise
II. Confirmation
III. Probability and Statistics
IV. Laws of Nature
V. Evolution

In the first unit we will consider examples from past and present physics to motivate questions about what can be learned through the methods of science, focusing in particular on whether we can learn about things that are unobservable. In the second unit we will examine how experimental and theoretical techniques are to be used in determining which scientific theories are correct. The process of testing scientific theories can be approached quantitatively through the use of statistical methods. In the third unit we will analyze the philosophical foundations of two fundamentally different approaches to statistics: classical and Bayesian. We will also study a variety of ideas about what probabilities are (interpretations of probability). The fourth unit of the course will focus on laws of nature, considering first how laws feature in scientific explanations and then asking whether laws of nature truly govern what happens in the world or instead merely describe patterns. The final unit revisits a number of topics from the course as they arise in the context of a particular scientific theory: evolution.

Textbook

Introduction to the Philosophy of Science (1992), Salmon et al.

ASSIGNMENTS

Problem Sets (60%, 12% each)
There will be one problem set on each of the five units. This gives you an opportunity to engage with all of the topics covered in the course, not just what you decide to focus on for your final essay. The problem sets must be submitted as hard copies in class. They can be typed or handwritten. You may work together on the problem sets, but each student must write their own answers.

Final Essay (30%)
You are required to write a final essay where you choose one topic from the course to explore in depth. This essay should be between 1,800 and 2,500 words. You must submit a typed hard copy and an electronic copy (through the course website) by 2:30 pm on 12/13. You will receive further guidance on the essay in class on 10/12.

Attendance and Participation (6%)
This part of your grade is determined primarily by your attendance, however participation is also a factor. You are expected to come to every class having done the assigned reading and to participate actively in the classroom discussion. Students who prefer not to speak in class can fulfill this course requirement by coming to office hours and discussing the material there. Two absences will be permitted without penalty. Additional absences will only be permitted with prior approval (by email) in cases of religious observance, illness, or personal or family emergency. If you write the name of a student who is not in class on the attendance sheet, you will have 5% deducted from your final grade in the course. Don't do it.

Peer Review (4%)
In class on 11/21 you will complete worksheets to provide feedback on your fellow students' final essays. To earn full credit for this portion of your final grade, you must bring four hard copies of a *complete* draft of your final essay (nothing left in outline form, within the word limits, etc.) to this peer review and you must provide satisfactory feedback for your peers.

SCHEDULE

[*Note page numbers, chapters, and sections! Sometimes you don't have to read the whole text.*]

UNIT I: THE SCIENTIFIC ENTERPRISE

9/28 **The Unobservable: Lessons from the History of Physics**
Reading: None

Optional: Foreword to Copernicus's *De Revolutionibus* (1543), Osiander

Dialogue on the Two Chief World Systems (1632), Galilei (selections)

Philosophical Writings (2004), Newton, edited by Janiak (selections)

Void: The Strange Physics of Nothing (2016), Chapter 2: Waves of Space Itself, Weatherall

"This Granular Life" (2016), Rovelli

10/3 **Logical Positivism**
Reading: *Language, Truth, and Logic* (1936), Chapter 1: The Elimination of Metaphysics, Ayer

Optional: *Theory and Reality* (2003), Chapter 2: Logic Plus Empiricism, Peter Godfrey-Smith

Philosophical Analysis in the Twentieth Century, Volume 1, Chapter 13: The Rise and Fall of the Empiricist Criterion of Meaning, Soames

❖**Unit I problem set distributed.**❖

10/5 **Scientific Realism and Constructive Empiricism**
Reading: "Arguments Concerning Scientific Realism," van Fraassen, from *The Scientific Image*

Optional: *Theory and Reality* (2003), Chapter 12: Scientific Realism, Peter Godfrey-Smith

Scientific Realism: How Science Tracks Truth (1999), Psillos, pg. 96-114

10/10 **Falsifiability and Contemporary Physics of the Unobservable**
Reading: *What Is This Thing Called Science?*, 3rd ed. (1999), Chapter 5: Introducing Falsificationism, Chalmers, pg. 59-68

"What Scientific Idea is Ready for Retirement? Falsifiability" (2014), Carroll

"Scientific Method: Defend the Integrity of Physics" (2014), Ellis and Silk

Optional: "What Scientific Term or Concept Ought to be More Widely Known? Scientific Realism" (2017), Goldstein

The Emergent Multiverse (2012), Chapter 1 and First Interlude, Wallace

"Scientific Realism in the Age of String Theory" (2007), Dawid

❖**Unit I problem set due.**❖

UNIT II: CONFIRMATION

10/12 **The Hypothetico-Deductive Method / Tips on Writing the Essay**
Reading: *Introduction to the Philosophy of Science* (1992), Chapter 2: The Confirmation of Scientific Hypotheses, Earman and Salmon, pg. 43-49

Optional: *Philosophy of Natural Science* (1966), Chapters 2 and 3, Hempel

Writing Philosophy: A Student's Guide to Writing Philosophical Essays (2006), Chapter 3: Rules of Style and Content for Philosophical Writing, Vaughn

❖**Final essay topics distributed.**❖

10/17   **The Problem of Induction**

Reading: *Introduction to the Philosophy of Science* (1992), Chapter 2: The Confirmation of Scientific Hypotheses, Earman and Salmon, pg. 55-66

Optional: *Understanding Philosophy of Science* (2002), Chapter 2: The Problem of Induction and Other Problems with Inductivism, Ladyman

Fact, Fiction, and Forecast, 4th ed. (1983), Chapter 3: The New Riddle of Induction, Goodman

❖**Unit II problem set distributed.**❖

10/19   **Falsificationism**

Reading: *Understanding Philosophy of Science* (2002), Ladyman, Chapter 3: Falsificationism

Optional: *The Character of Physical Law* (1965), Chapter 7: Seeking New Laws, Feynman, pg. 156-159

Theory and Reality (2003), Chapter 4: Popper: Conjecture and Refutation, Godfrey-Smith

"The 'Corroboration' of Theories" (1974), Putnam

10/24   **Theoretical Virtues**

Reading: "Objectivity, Value Judgment, and Theory Choice" (1974), Kuhn

Optional: "Inference to the Best Explanation" (2000), Lipton

"Demystifying Underdetermination" (1990), Laudan

❖**Unit II problem set due.**❖

UNIT III: PROBABILITY AND STATISTICS

10/26   **An Introduction to Probability and its Uses in Science**
Reading: *Introduction to the Philosophy of Science* (1992), Chapter 2: The Confirmation of Scientific Hypotheses, Earman and Salmon, pg. 66-74

10/31   **Interpretations of Probability**
Reading: *Introduction to the Philosophy of Science* (1992), Chapter 2: The Confirmation of Scientific Hypotheses, Earman and Salmon, pg. 74-84

Optional: "Fifteen Arguments Against Hypothetical Frequentism" (2009), Hájek

"The Propensity Interpretation of Probability" (1959), Popper

❖**Unit III problem set distributed.**❖

11/2   **Classical Statistics**
Reading: "Statistical Errors" (2014), Nuzzo

Scientific Reasoning: The Bayesian Approach (1989), Howson and Urbach, pg. 121-130, 155-171

Optional: "The Earth is Round (P < .05)" (1994), Cohen

11/7   **Bayesian Statistics**

Reading: "Notes on Bayesian Confirmation Theory" (2017), Strevens, Sections 1, 2, 4, 5, 6.1, 8.3, 11

Optional: *Introduction to the Philosophy of Science* (1992), Chapter 2: The Confirmation of Scientific Hypotheses, Earman and Salmon, pg. 89-91, 98-100

Scientific Reasoning: The Bayesian Approach (1989), Chapter 11: Objections to the Subjective Bayesian Theory, Howson and Urbach

❖**Unit III problem set due.**❖

UNIT IV: LAWS OF NATURE

11/9   **Laws and Explanation**

Reading: *Introduction to the Philosophy of Science* (1992), Chapter 1: Scientific Explanation, Salmon, pg. 7-33

Optional: *Philosophy of Natural Science* (1966), Chapter 5: Laws and Their Role in Scientific Explanation, Hempel

❖**Unit IV problem set distributed.**❖

11/14 **The Best-Systems Account and a New Interpretation of Probability**

Reading: "Humean Supervenience" (1996), Loewer

Optional: *Philosophy of Science* (1998), Chapter 1: Laws of Nature, Bird, pg. 17-32

Loewer, "David Lewis' Humean Theory of Objective Chance"

Lewis, "A Subjectivist's Guide to Objective Chance"

11/16 **Laws that Govern**

Reading: *The Metaphysics Within Physics* (2007), Chapter 1: A Modest Proposal Concerning Laws, Counterfactuals, and Explanations, Maudlin, pg. 5-21

Optional: *Philosophy of Science* (1998), Chapter 1: Laws of Nature, Bird, pg. 33-40

Introduction to the Philosophy of Science (1992), Chapter 11: Philosophy of the Social Sciences, Salmon, Sections 11.1, 11.5, 11.7

❖**Unit IV problem set due.**❖

11/21 **Peer Review of Final Essay Drafts**

Reading: None

❖**Four copies of final essay draft due.**❖

UNIT V: EVOLUTION

11/28 **Evolution and Demarcation**

Reading: "Science and Pseudoscience: The Difference in Practice and the Difference It Makes" (2013), Shermer

Optional: "The Argument from Design" (1800), Paley, from *Natural Theology*

"Darwin and Paley Meet the Invisible Hand" (1990), Gould

11/30 **Evolution and Confirmation**
Reading: *Introduction to the Philosophy of Science* (1992), Chapter 7: Philosophy of Biology, Lennox, pg. 269-287, 302-307

Optional: *Theory and Reality* (2003), Chapter 4: Popper: Conjecture and Refutation, Godfrey-Smith, Section 4.6

Evidence and Evolution: The Logic Behind the Science (2008), Chapter 2: Intelligent Design, Sober, Sections 2.1-2.15

"The Best Explanation: Criteria for Theory Choice" (1978), Thagard

"The Explanatory Scope of the Evolutionary Hypothesis" (1876), Darwin, from *The Variation of Animals and Plants under Domestication*

❖**Unit V problem set distributed.**❖

12/5 **Evolution and Explanation**
Reading: *Introduction to the Philosophy of Science* (1992), Chapter 7: Philosophy of Biology, Lennox, pg. 288-299

Optional: *Philosophy of Biology* (1993), Chapter 3: Fitness, Sober

12/7 **Evolution and the Enterprise of Science: A Cautionary Tale**
Reading: "The Science of Breeding Better Men" (1911), Scientific American

Optional: "Social Darwinism, Scientific Racism, and the Metaphysics of Race" (1995), Dennis

"15 Minute History: Episode 18: Eugenics" (2013), Neuberger and Levine [audio]

Philosophy of Science: A New Introduction (2014), Chapter 6: Science, Values, and Politics, Barker and Kitcher

❖**Unit V problem set due.**❖

12/13 **Final Essay Deadline**
Assigned final exam time [though there is no exam]: 11:30-2:30 pm.
❖**Final essay due.**❖

ATTENDANCE AND READING

Engaged participation and careful preparation are important to your success in this course. Learning to raise questions and present your own ideas in a skilled, accurate, professional, and persuasive manner is an invaluable skill in life. By engaging in class discussion you will improve your ability to do this and come to understand the material covered in the course better.

During discussion you will often find yourself disagreeing with other students. When this happens, strive to be respectful. If you can't understand why someone would believe *that*, then you have something to learn from your interlocutor. The most compelling arguments are offered by those who see the appeal of the other side.

Much of the time you spend learning philosophy will be spent reading and re-reading the texts. Reading philosophy is challenging. I recommend that you re-read confusing parts of the text and take notes, bringing prepared questions with you to class or office hours.

The readings that are not from the textbook are all available on the TritonEd course website. Readings should be completed in advance of the class meeting they are associated with.

The optional readings are provided so that you have a place to go if you want to delve deeper into a certain topic or to get a different perspective. You do not need to read them as we go, but they will be useful resources when you are working on your final essay and they may be helpful when completing the problem sets (e.g., if the problem set explicitly mentions an optional reading or if you find the required reading difficult and would like to see the material explained in a different way).

LATE ASSIGNMENTS

Late assignments should be placed in my mailbox on the 7th floor of the HSS building. Also, please email me to let me know the assignment has been turned in.

Late problem sets will receive a one letter-grade deduction if they are submitted within 48 hours of the original deadline. After that, they will not be accepted. An extension may be granted if requested in advance of the due date for the assignment. In general, extensions will only be granted for reasons of religious observance, illness, or personal or family emergency.

Late final essays will not be accepted unless an extension has been granted in advance of the due date.

EMAIL

You can reach me at: csebens@gmail.com. Please only email me about logistical concerns: requesting extensions, scheduling additional office hours, etc. I find it is more effective to discuss course content face-to-face. I am happy to meet with you in office hours to discuss any philosophical questions and to schedule additional meetings as needed. Please do not hesitate to setup a meeting with me outside of office hours, especially if you'd like to discuss your plans for writing an essay.

SPECIAL ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

If you require any special arrangements for completing the course assignments or participating fully in class meetings, please let me know at the beginning of the course.

PLAGIARISM

You are encouraged to discuss your work with other students and even to share drafts with each other to get feedback. However, the work you submit should be your own. If you incorporate the ideas of others, cite those sources. Do not copy language too closely. Even when summarizing and paraphrasing cited sources, you must use your own language and present the ideas in an original way. Please ask me if you have any questions about what counts as plagiarism. We will discuss plagiarism and academic integrity in more detail on 10/12 (see also academicintegrity.ucsd.edu).

If I have reason to believe that you have engaged in academic misconduct, I will report the case to the Academic Integrity Office for review. If they determine that it is indeed a case of academic dishonesty, you will receive a zero on the assignment.