course syllabus

Philosophy 203: Scientific Reasoning

Department of History and Philosophy

College of Arts and Humanities

lander university

greenwood, sc 29649

Lee C. Archie

Spring, 2005

Contents

1 Essential Information

Instructor: *Lee C. Archie*	Office Hours
Office: *LC M33*	*MWF 9:00-10:00; 11:00-12:00*
Telephone: *864-388-8383*	*TTh 11:00-12:00*
Email: *larchie@philosophy.lander.edu*	ICQ: *14365150*

1.1 Supplementary Materials

Philosophy Homepage: http://philosophy.lander.edu/
Scientific Reasoning Homepage: http://philosophy.lander.edu/scientificreas/
Scientific Reasoning FAQ: http://philosophy.lander.edu//faq.html
Philosophy Chat: http://philosophy.lander.edu/chat/

1.2 Appointments—Office Hours

I look forward to talking to each of you about our scientific reasoning course. You are encouraged to stop by my office to discuss classroom lectures, ideas, or problems. If the stated office hours do not fit your schedule, other times can be arranged.

1.3 Logic Lab

A small Logic Lab in LC M33 consisting of three networked computers is open to all philosophy students during office hours stated above. Students are encouraged to stop by the Lab to set up email accounts, practice with online quizzes and tests, check lecture notes, or research topics in scientific reasoning on the Internet.

1.4 General Education Core Requirements

Note especially: Although Phil. 203 fulfills the General Education Core Curriculum Requirement for Logical and Analytical Thought, this course does *not* fulfill the requirement for the Humanities requirement. If you are seeking to fulfill the Humanities requirement by registering for a philosophy course, you need to enroll in Philosophy 102: Introduction to Philosophical Inquiry.

2 Course Description

2.1 Catalog Course Description

"A survey of the methods of induction and experimental inquiry. Classical and contemporary inductive logic are considered with special emphasis on justification, conditional arguments, testing theoretical hypotheses, decision analysis, Mill's Methods of Induction, epistemic probability, and the "logic" of scientific

discovery. *Three semester hours.*" From the *Lander University Catalog 2004-2005*

2.2 Textbook

Irving M. Copi and Keith Burgess-Jackson, *Informal Logic.* Upper Saddle River, N.J.: Prentice-Hall, 1996.

2.3 Purpose of the Course

The general purpose of this course is to introduce some of the main problems of inductive logic and to focus on distinguishing good reasoning from poor reasoning. The approach is two-sided: (1) the analysis and classification of fallacious reasoning and (3) the analysis and construction of correct reasoning.

2.4 Objectives of the Course

The general aims of our scientific reasoning course are

1. What are the differences between arguments and explanations?
2. What are the differences between deductive and inductive reasoning?
3. What are the common fallacies in scientific reasoning?
4. What are the techniques for definition and classification in science?
5. What are hypothetical reasoning and the patterns of scientific discovery?
6. What are presuppositions of experimental inquiry?
7. What are the main patterns of scientific investigation?
8. What are crucial experiments and *ad hoc* hypotheses?

2.5 Specific Skills Achieved

Upon completion of this course, all students should be able to

1. demonstrate basic skills of Internet research, email, Majordomo Discussion Lists, and Message Boards,
2. distinguish clearly among factual, attitudinal, and verbal disputes in science,
3. construct premisses and conclusions for inductive arguments,
4. identify the common fallacies in scientific discourse,
5. evaluate various types of scientific reasoning,

6. identify the differences between good science and pseudoscience.
7. understand the essential role of definition and event description in scientific analyses, and
8. understand the limitations of current theories of the patterns of experimental inquiry and the logic of discovery.

2.6 Narrative Description of the Course

Inductive reasoning (scientific reasoning) has many similarities with the kind of reasoning used by Sherlock Holmes in the works by A. Conan Doyle. This kind of reasoning involves the claim, not that reasons give conclusive evidence for the truth of a conclusion, but that they provide some support for it. This course complements Philosophy 103: Introduction to Logic, but you need not have taken that course to do well in the Scientific Reasoning course. They are entirely independent courses.

A unique feature of the course is the study of some examples of pseudoscience. Many other examples studied are topics taken from *Scientific American*, *American Scientist*, *Science*, *Nature*, and *Science News*.

The heart of the course, however, emphasizes the inquiry into the basic methods of inductive or probabilistic inquiry and the investigation of techniques for solving problems under uncertainty. You will learn some effective methods of inquiry, analysis, and criticism in the fields of the physical, social, and political sciences.

This study of scientific reasoning involves a survey of the methods of induction and experimental inquiry. Classical and contemporary inductive logics are considered with a special emphasis on justification, conditional arguments, testing theoretical hypotheses, causal hypotheses, decision analysis, Mill's Methods, and the "logic" of scientific discovery.

Providing a rational reconstruction of the methods of science is one of the most difficult areas of research in philosophy and science. Many of the fundamental problems have not yet been satisfactorily solved, and many of these problems appear at an elementary level of the subject. No scientist claims absolute knowledge; the foundations of science change and are reformed as an on-going process as paradigms change. Even though science is only probabilistic knowledge, it is knowledge in a genuine sense. Deductive knowledge, on the other hand, is, in a significant sense, trivial because it relies on the meaning of symbols, words, syntax, and convention.

Although the different sciences you study in college utilize different methodologies of inductive logic (scientific reasoning), the underlying schemata are presupposed by instructors and usually not explicitly formulated for the student. This course provides the skills necessary for understanding the nature, scope, and limits of the methods used in those courses. In sum, Philosophy 203: Scientific Reasoning not only provides an introduction to the various methodologies of the social and natural sciences but also, as well, fulfills the General Education Core Curriculum requirement for logical and analytical thought.

The class periods are composed, for the most part, of lecture, case studies, simulations, and problem solving.

2.7 Course Procedures

The methods used to obtain these ends are

1. to learn to identify inductive arguments, to evaluate and counter them, and to construct good arguments,
2. to obtain the ability to relate arguments to one another and to judge the relative strength of different kinds of inductive arguments,
3. to analyze different techniques of definition and kinds of meaning in the sciences,
4. to obtain the ability to identify common mistakes in scientific reasoning and to reconstruct inductive generalizations,
5. to gain skill in evaluating scientific explanations and patterns of investigation,
6. to recognize the differences between the inductive and deductive sciences and how they differ from the pseudosciences,
7. to recognize the difference between *a priori* presuppositions and *a posteriori* principles,
8. to study classic, influential, and abiding methods of experimental inquiry into the nature of causation,
9. to understand how natural processes can be systematically discovered and clarified through experimental design and crucial experiments,
10. to apply usefully the several methods of inductive reasoning in everyday life and ordinary language.

In this course you will gain skill in asking interesting, productive, and insightful questions and will analyze scientific passages to obtain facility in the clear, complete, and methodological undstanding of their content. You will also learn effective methods of analysis and criticism in the evaluation of inductive argumentation.

2.8 Teaching Methods

We adopt specific techniques recommended by many educators, namely lecture, discussion, review tests, homework, and online supplementary material.

3 Course Requirements

3.1 Evaluation

Judgment about the progress of your work is based on tests. Your course grade is determined by averaging the points you achieve from the following scores:

Test 1 Lanugage and Argument

Test 2 Definition and Fallacies

Test 3 Analogy and Causal Connection

Test 4 Patterns of Scientific Investigation

Your final course grade is assigned according to your final average.

3.2 Grades

Judgment about the progress of your work is based on the four test scores. The course is essentially performance based and consists of a progressive series of concepts to be learned and mastered. For this reason, few students can do well in this course by "cramming" before exams. Normally, the course is not difficult if you attend class, keep up with the reading and notes daily, and do not attempt to learn a large amount of information in a short amount of time. A six-part distillation of notes on "How to Study" for this course is available on the Web at http://philosophy.lander.edu/study.html and is recommended reading.

3.3 Tests

Tests are usually a combination of objective, short answer and problems. The subject-matter is primarily based on the reading, lecture notes, and homework assignments. In general, if you understand how to do the homework problems, you will do well on tests.

On essay-type questions, be sure to answer with complete sentences; answers provided as lists of phrases or the names of concepts, alone, do not reflect an understanding of the subject and usually will be given little, if any, credit. Example tests, quizzes, and lecture notes, are online at

http://philosophy.lander.edu/scientificreas/.

Test Review Worksheets are provided in the Appendix to this syllabus and form an excellent basis for studying for tests.

3.4 Grade Evaluation

Your final course grade is assigned according to your final average as described above in the subsection "Grades." The number of hours advised to study given below is usually an accurate guide to how well you will do in this class. If you

study only for tests, your doing well in the course is unlikely. Many students assume they can do well in philosophy without doing homework and without studying outside of class because they have been able to do so in other high school or college classes. Since they have become habituated to passing courses without much study, they are often dismayed to discover our philosophy course is substantially different from their expectations.

A (90 points or above) reflects approximately two hours study per class hour; a great deal of time, thought, and effort; and mastery of the subject.

B (80 or above but below 90 points) reflects approximately one hour study per class hour; above average time, thought and effort; and superior achievement.

C (70 or above but below 80 points) reflects approximately one-half hour study per class hour, average time, thought, and effort; and average achievement.

D (60 or above but below 70 points) reflects cramming for examinations; minimum time, thought, and effort; below college level work; a less than adequate grasp of the course content; and less than satisfactory achievement.

FA reflects attending fewer than 75% of class meetings.

INC can only be given in cases of sudden illness or emergency.

3.5 Your Job

Our course is not difficult if you keep up with the assigned work. At the very beginning of the course, you need to ask yourself if you can spend at least three hours a week studying just for Scientific Reasoning. If work or family responsibilities interfer with this minimmum number of study hours, you should not attempt this course.

When you seek help from me during office hours, the first items I will check are your class notes, book notes, and homework problems—so that I can know where to begin. When a student claims he or she did not understand the subject well enough to ask any questions, take any notes, or attempt any homework, the student should withdraw from the course. A good place to see how to study in our course is the "Notes on How to Study" on the Web at http://philosophy.lander.edu/study.html.

- Come to class prepared.
- Take notes in class.
- Take notes on the important points of the assigned reading.
- Do all homework problems. If you cannot find time for doing homework, you cannot benefit from this course of study.

- Ask questions in class.
- Seek help at the first signs of difficulty.
- Make extensive use of the available online lectures, sample problems, quizzes, and tests.

3.6 My Job

We will find that inductive reasoning is quite essential in all fields of endeavor.

- I will attempt to create the conditions under which you can exercise your native curiosity.
- Class lectures will be varied, and specific concrete examples will be used for illustrating the theoretical points.
- I will show practical applications for all the inductive methods employed.
- I will provide handouts and Web-based instructions for additional problem-solving support.

If I do my job correctly, our scientific reasoning course will be one of the *most valuable* in your university career.

3.7 Class Policies

The following policies are explicitly stated here because these policies help protect fairness for the class as a whole. These policies are generally assumed in most classes at Lander University.

Make-Up Policy: If you miss one or more regularly scheduled tests during the semester *with an approved written excuse*, a make-up test will be provided during the final exam period at the end of the semester. An excused absence is granted for emergency situations only, and a written excuse must be provided.

Plagiarism: Students are expected to do their own work in this course. To use another writer's or speaker's ideas without giving credit by means of standard documentation is plagiarism. All cases of academic dishonesty on tests will be handled in accordance with the Academic Honor Code as presented in the *Lander University Student Handbook*.

Class Attendance: Students are expected to attend all classes; there are no "free cuts." In the case of unavoidable absences, you are responsible for making up work done in class. In accordance with University policy, if you attend less than 75% of the scheduled class meetings, you will not receive credit for the course. Anyone missing class is responsible for obtaining the class notes and assignments from a classmate or from the Web resources. Additionally some book notes, quizzes, sample tests, and a few class lectures are online at http://philosophy.lander.edu/intro/.

Learning Disabilities: If you have a physical or learning disability and you require special accommodations, be sure to contact Mr. Lafayette Harrison (Learning Center 345, telephone (864) 388-8814) and provide him with appropriate documentation. When Mr. Harrison is made aware of your disability, he will inform your instructors every semester unless you ask him in writing not to do so. For additional information, see the "Disabled Student Information" on the Lander University Website at http://www.lander.edu/instructional_services/disabled.htm.

Closing of the University: If hazardous weather conditions or any other state of emergency necessitate University closing, the information will be available from the Lander automated information system (telephone (864) 388 8400) or local radio and television stations.

A Test Review Sheets

A.1 Test 1: Arguments and Language

Important Concepts: be able to characterize and give examples.

philosophy
logic
inference
entailment
proposition
statement
sentence
argument
premiss
conclusion
forms of language
functions of language
informative use
directive use
disagreement if attitude
methods of resolution
phatic language
implicit conclusion
conclusion indicator
premiss indicator
conditional statement
explanation
deduction
induction
truth
validity
soundness
types of sentences
expressive use
factual significance
disagreement in belief
emotive significance
slanted language
performative utterances

Important Skills: be able to work the following kinds of problems

1. Diagram, using the standard method, simple and complex arguments.
2. Identify premiss and conclusion indicators.
3. Identify statements and nonstatements.
4. Identify various kinds of nonarguments.
5.

Important Distinctions: Be able to list differences and give examples.

1. sentence and statement
2. argument and explanation
3. deduction and induction
4. truth, validity, and soundness

A.2 Test 2: Fallacies and Definition

Important Concepts: be able to characterize and give examples.

equivocation	begging the question
complex question	false dichotomy
division	composition
appeal to the people	appeal to authority
appeal to ignorance	appeal to emotion
attack on the person	genetic fallacy
hasty generalization	false cause
slippery slope	fallacy
stipulative definition	lexical definition
precising definition	theoretical definition
persuasive definition	ostensive definition
operational definition	genus and difference

Important Distinctions: be able to list differences and give examples

formal fallacy	informal fallacy
connotation	denotation
intension	extension

Important Skills: be able to work the following kinds of problems

1. Identify types of definitions.
2. Evaluate definitions by the rules for definition by genus and difference.
3. Relate the kinds of definitions with the purposes of definition.
4. Classify by a diagram a group of objects or events by intension and extension.
5. Use definitions to resolve verbal disputes.

A.3 Test 3: Analogy and Causal Connections

Important Concepts: be able to characterize and give examples.

analogy
descriptive analogy
sufficient condition
method of agreement
joint method
method of concomitant variation
argumentative analogy
necessary condition
contributing condition
method of difference
method of residues

Important Problems: be able to explicate the following questions.

1. Be able to evaluate analogical arguments by analogical criteria.
2. Be able to refute an argument by means of devising a logical analogy.
3. Be able to diagram and evaluate causal connections in terms of Mill's Methods: agreement, difference, joint, residues, and concomitant variation.

Important Distinctions: be able to list differences and give examples.

1. explanatory and argumentative analogy
2. weak analogy and strong analogy
3. necessary and sufficient conditions
4. method of agreement and method of difference

A.4 Test 4: Patterns of Scientific Investigation

Important Concepts: be able to characterize and give examples.

science	technology
theoretical science	engineering science
scientific explanation	nonscientific explanation
verifiable hypothesis	falsifiable hypothesis
direct testing	indirect testing
crucial experiment	*ad hoc* hypothesis
hypothesis	theory
descriptive law	prescriptive law

Important Problems: be able to work the following kinds of problems.

1. What are some of the ways scientific theories are evaluated?
2. Show how the general pattern of scientific research is employed by analyzing a summary of a scientific inquiry discussed in an article from a scientific journal and magazine.
3. Show how the selection of facts is theory-dependent. Explain and identify the hypothetical character of classification and description.

Important Distinctions: be able to list differences and give examples.

1. verifiable and unverifiable
2. observable and theoretical
3. science and pseudoscience
4. facts and theories