Syllabus of the discipline Logic
(Section II: Inductive and Probability Logic)

for the Bachelor’s Program 47.03.01 - Philosophy

The course is read in English

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Approved by School of Philosophy
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Head of the School Porus V.N.________________________

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Academic Head of Bachelor’s Program ‘Philosophy’
Dragalina-Chernaya E.G. ______________________

Moscow, 2016
**Title of the Course:**  LOGIC (SECTION II: INDUCTIVE AND PROBABILITY LOGIC)

**Course type:** compulsory

**Lecturer and class teacher:** Prof. L.B. Makeeva

**Course description:** Inductive and Probability Logic is a two-module course for philosophy students in their second year of learning. The course is a part of the general course on Logic and aims at acquainting students with the approaches to constructing Inductive logic and with some important philosophical issues surrounding the theoretical foundations of induction and probability. Special attention will be paid to the significance of Inductive logic for such philosophical disciplines as philosophy of science, epistemology and philosophical logic.

**Course prerequisites:** Students are required to be acquainted with Aristotelian, Propositional and Predicate Logics and have some knowledge of the mathematical theory of probability.

**Learning Objectives:** The course is aimed at introducing students to the basic concepts and tenets of Inductive and Probability Logics. It will enable students to:

- develop their skills of critical thinking and argumentative discourse;
- enhance their logical culture;
- recognize and identify logical fallacies and errors;
- understand the significance of logic for scientific and philosophical thinking;
- get acquainted with philosophical problems concerning induction and probability.

**Learning outcomes:** By the end of the course the students who pass the final exam will know

- the differences between deductive and inductive inferences;
- the key concepts of inductive logic, the criteria of strength and the main forms of inductive reasoning;
- the basic rules of the probability calculus and how to use them to calculate probabilities of some inductive inferences;
- the main philosophical accounts of the nature of induction and probability.

**Course Plan:**

The structure of the course is the following:

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<th>No</th>
<th>Topic titles</th>
<th>Total (hours)</th>
<th>Contact hours</th>
<th>Self-study</th>
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<td>Lectures</td>
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<td>Part 1. The Basics of Inductive Logic</td>
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The course will cover the following topics.

Part I. **The Basics of Inductive Logic**

**Topic 1. The Subject of Inductive Logic**

The main stages in the development of inductive logic, its contemporary condition.


Main features of inductive argument (evidential link between premises and conclusion, the logical relation of probability, problematic, risky character of inference, inference from the known to the unknown). The criterion of strength of inductive arguments. Cogent arguments.

The relationship between deductive and inductive arguments. Inadequacy of the traditional definition of deductive arguments as inferences from the general to the specific and of inductive arguments as inferences from the specific to the general. Inductive arguments as a kind of invalid deductive arguments. Enthymematic character of some real deductive reasoning and the problem of demonstrative induction.

Two main approaches to constructing inductive logic based on the notions of demonstrative induction and probability.
Topic 2. **Kinds of Inductive Arguments**


Predictive induction as an inference from past to future. Predictive and generalizing induction.


Ch. Peirce on deduction, induction and abduction (inference to a plausible explanation). The Logical structure of abduction. The role of abduction in theoretical explanations.

Arguments based on testimony.


Topic 3. **The Problem of Induction**


Topic 4. **Mill’s Methods of Experimental Inquiry**
The notion of causality. Cause and effect. Kinds of causes. The principles of causality (objectivity, universality, necessity and precedence of a cause in time). Mill’s method of agreement, method of difference, joint method of agreement and difference, method of concomitant variation and method of residues. The problematic character of inferences based on Mill's methods, the sources of their problematic character.

Causation and the logic of necessary and sufficient conditions: cause as a necessary condition, cause as a sufficient condition, cause as a necessary and sufficient condition. Logical links between necessary and sufficient conditions.


Part II. The Basic Ideas of Probability and Their Application to Inductive Reasoning

Topic 5. Kinds of Probability

The notion of probability and its interpretations. Empirical (descriptive) probability. Main features of statements concerning empirical probability. Epistemic probability. Main features of statements concerning epistemic probability. The relation between epistemic and inductive probability: inductive probability as a way of objective evaluation of epistemic probability. Main characteristics of inductive probability.

Topic 6. The Probability Calculus

The notion of calculus. Axiomatization of probability theory. The main rules and definitions of the probability calculus for categorical statements. The concepts of conditional probability and independence of statements. The main rules and definitions of the probability calculus for conditional statements.

Bayes’ theorem and its significance for Inductive logic. Bayes' theorem as an idea of learning from experience. Probability and causality.

Topic 7. The Main Interpretations of Probability and Their Application in the Construction of Probability Logic

The classical interpretation of probability. The notion of prior probability. Probability of an event as the ratio of the number of cases favorable to it, to the number of all cases possible.
The principle of equipossibility. The principle of indifference (insufficient reason). Bertrand's paradoxes.


The logical interpretation of probability. Probability as an objective relation between propositions (J.M. Keynes). Probability as a degree of confirmation of a hypothesis by empirical data. R. Carnap's probability logic, its key notions: state description, structure description, degree of confirmation (c-function), measure of a proposition. Two ways of defining the measure of a state description.

**Reading list:**

(a) *Required reading*

2. Бочаров В.А., Маркин В.И. Введение в логику. М.: ИД «Форум»-ИНФРА-М, 2008;

(b) *Optional reading*

2. Юм Д. Исследование о человеческом познании // Юм Д. Соч. в 2-х томах. Т. 2. М.: Мысль, 1996;
5. Пойа Д. Математика и правдоподобные рассуждения. Пер. с англ. И.А.Вайнштейна. М.: Наука, 1975;
6. Маковельский А.О. История логики. Жуковский-Москва: Кучково поле, 2004;

Themes for presentations in class

1. The Role of Analogy in Science and Philosophy
2. Analogy in Legal Reasoning
3. Bertrand Russell’s Principle of Induction
4. John Stuart Mill’s Criticism of Syllogistic Logic
5. John Stuart Mill’s Method of Agreement
6. John Stuart Mill’s Method of Difference
7. John Stuart Mill’s Joint Method of Agreement and Difference
8. John Stuart Mill’s Method of Concomitant Variations
9. John Stuart Mill’s Method of Residues
10. Karl Popper’s Anti-inductivism
11. Non-transitivity Paradoxes in Probability Theory
12. The Principle of Indifference and Its Paradoxical Consequences

Examination Questions

1. Deductive and Inductive Arguments, the Differences between Them. Deductive Validity and Inductive Strength.
4. Eliminative Induction.
6. Abductive Arguments and Arguments Based on Testimony.
8. The Inductive Justification of Induction (Richard Braithwaite and Max Black)
9. The Pragmatic Justification of Induction (Hans Reichenbach)
10. The Analytic Justification of Induction (Peter Strawson)
12. Hempel’s Paradox.
16. Mill’s Methods of Concomitant Variation and Residues.
17. The Explication of the Notion of Cause in Terms of Necessary and Sufficient Conditions.
18. The Direct and Inverse Methods of Agreement in H.G. von Wright’s Theoretical Reconstruction.

**Exemplars of Exercises in Written in-Class Test**

(A) Analyze the structure of the analogical argument in the following passage and evaluate its cogency in accordance with the main criteria.

“An electron is no more (and no less) hypothetical than a star. Nowadays we count electrons one by one in a Geiger counter, as we count the stars one by one on a photographic plate. In what sense can an electron be called more unobservable than a star? I am not sure whether I ought to say that I have seen an electron; but I have the same doubt whether I have seen a star. If I have seen one, I have seen the other. I have seen a small disc of light surrounded by diffraction rings which has not the least resemblance to what a star is supposed to be; but the name “star” is given to the object in the physical world which some hundreds years ago started a chain of causation which has resulted in the particular light-pattern. Similarly in a Wilson expansion chamber I have seen a trail not in the least resembling what an electron is supposed to be; but the name “electron” is given to the object in the physical world which has caused this trail to appear. How can it possibly be maintained that a hypothesis is introduced in one case and not in the other?” (Sir Arthur Eddington. New Pathways in Science).

(B) Identity the type of the following arguments.
1. Eighty-two percent of randomly chosen sample of 600 American college students are sleep-deprived. Therefore, approximately 82 percent of American college students are sleep-deprived.

2. Duodecimal Research Corporation polled the students and found that 46% are living below the official government poverty line. Therefore, the students at Memorial University cannot afford a major fee increase.

3. Since 1986, only 11% of engineering school graduates have been women. That showing is particular poor considering that in other formerly male-dominated fields there are signs of real progress. Some examples from 1986: law, 48%; commerce, 44%; medicine, 45%; and in the biological sciences, nearly 50% of the graduates are women.

4. Galvani was dissecting a dead frog. By chance, he touched the nerves of the frog’s leg with an instrument that conveyed an electrical impulse. The frog’s leg muscles contracted suddenly. Galvani touched the frog’s nerves many times with the instrument, and each time the frog’s leg muscles contracted sharply. Galvani then touched the frog’s nerves with a metal instrument that did not convey an electrical impulse. The frog’s leg did not contract. Galvani concluded than an electrical impulse had caused the dead frog’s muscles to contract.

(C) Identify which of Mill's methods (in their original formulation) is (or are) used in each of the following examples.

1. Dick and Jane took a history exam. Both did poorly, although both studied for many hours the night before the exam. They concluded that the cause of their poor performance on the exam was a lack of sleep.

2. An economist noted a correlation between the length of women skirts and the price of stocks. As fashion trends moved in the direction of shorter skirts, stock prices increased. But as fashion trends moved in the direction of longer skirts, stock prices fell. The economist concluded that fashion trends regarding the length of women’s skirts cause stock prices to rise and fall.

3. Pasteur gave each of 25 farm animals a vaccination for anthrax. These animals, as well as 25 who had not been vaccinated, were subsequently given a large dose of anthrax germs. No one of the vaccinated animals came down with the disease, but all of the others died of anthrax. Pasteur concluded that his vaccine produced immunity to anthrax.

(D) A company has bought three software packages to solve accounting problems. They are called *Fox*, *Star*, and *Rainbow*. On their first trials, *Fox* crashes 10 percent of the time, *Star* 20 percent of the time, and *Rainbow* 30 percent of the time. Of a hundred employees, sixty are assigned *Fox*, thirty are assigned *Star*, and ten are assigned *Rainbow*. Mary was assigned a program at random. It crashed on the first trial. What is the probability that she was assigned *Rainbow*?

Methods of Instruction:

The following forms of instruction are used in the course:

1. lectures (2 hours a week);
2. classes (2 hours a week);
3. written in-class test (2 hours);
4. presentations in class;
5. home assignments (11 in total);
6. self-study;
7. oral examination.

Grading system

Final grades will be calculated in accordance with the following formula:

\[ G_{\text{final}} = 0.4 \cdot G_{\text{exam}} + 0.3 \cdot G_{\text{current control}} + 0.3 \cdot G_{\text{class}} \]

where \( G_{\text{exam}} \) – a grade for the oral examination;
\( G_{\text{current control}} \) – a grade for the written in-class test;
\( G_{\text{class}} \) – a grade for work in class and for home assignments.

The highest positive grade is 10, the lowest positive grade is 4.

Guidelines for Knowledge Assessment:

Home assignments consist of questions for discussion on a particular topic and exercises. In class students are expected to be prepared to discuss questions from home assignments. In most cases exercises from homework assignments should be done in a written form and handed in to the teacher. Presentations in class are not compulsory but they are encouraged: students who make presentations get a higher (by one point) degree for work in class. Written in-class work includes a theoretical question and three exercises. Self-study plays a very important part in the course.