SYLLABUS

*Title of the Course*: INDUCTIVE AND PROBABILITY LOGICS

*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;

 – to enhance their logical culture;

 – to recognize and identify logical fallacies and errors;

 – to 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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| --- | --- | --- | --- | --- |
| **No** | **Topic titles** | **Total (hours)** | **Contact hours** | **Self-study** |
| **Lectures** | **Classes** |
| Part 1. The Basics of Inductive Logic |
| 1. | The subject of inductive Logic | 12 | 4 | 2 | 6 |
| 2. | Kinds of inductive arguments | 20 | 6 | 4 | 10 |
| 3. | The problem of induction | 16 | 4 | 4 | 8 |
| 4. | J.S. Mill's methods of experimental inquiry | 16 | 4 | 4 | 8 |
| Part 2. The Basic Ideas of probability and their application to inductive reasoning  |
| 5. | Kinds of probability | 10 | 2 | 2 | 6 |
| 6. | The probability calculus | 16 | 4 | 4 | 8 |
| 7. | The main interpretations of probability and their application in the construction of probability logic | 26 | 6 | 6 | 14 |
|  | Total: | 116 | 30 | 26 | 60 |

The course will cover the following topics.

Part I. **The basics ofi Logic**.

Topic 1. **The subject of inductive Logic**

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

Reasoning as a truth-preserving process. An argument and its logical structure. Deductive and inductive arguments. Main features of correct deductive argument (the relation of entailment, validity, logical necessity of inference, demonstrative character). The criterion of valid deductive arguments. Sound arguments.

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**

The ideas of induction in Aristotle's logical works. Inductive generalization. Complete (perfect) and incomplete (imperfect, ampliative) induction. Universal and statistical generalization. Types of statistical inferences: from sample to population, from population to sample, from sample to sample. Fallacy of incomplete evidence. Representative and biased samples. Randomness and size of a sample. Statistical syllogism.

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

F. Bacon on the difference between enumerative and eliminative induction. Bacon's criticism of syllogistic logic. Eliminative induction as a way of discovering causal links between phenomena. Bacon's tables of absence, of presence and of degrees as the first attempt to formulate methods of experimental research. Scientific and popular induction. Fallacy of hasty generalization.

Induction and analogy. Kinds of analogical arguments, their logical structure and functions. Strong and weak features of analogical arguments. Analogy as an element of any inductive inference.

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.

Induction as scientific method. Induction as a method of discovery and justification in classical inductivism (F. Bacon, J.S. Mill, etc.). Induction as a method of confirmation in the hypothetico-deductive model of scientific cognition (G. Galileo, G. Leibniz). Induction as the converse of deduction(S. Jevons). K. Popper's anti-inductivism.

Topic 3. **The problem of Induction**

D. Hume on the impossibility of rational justification of reasoning from experience. The structure of Hume's argument. The impossibility of inductive logic as a consequence of Hume's skeptical argument. Hume's psychological justification of induction.

 Main ways of justifying induction. The principle of uniformity of nature. B. Russell's principle of induction. The inductive justification of induction (R. Braithwaite, M. Black). The pragmatist justification of induction (G. Reichenbach). The analytic justification of induction (p. Strawson). K. Popper's anti-inductivism as a 'solution' of Hume's problem.

Paradoxes of confirmation as a new manifestation of Hume's problem. K. Hempel's raven paradox. N. Goodman’s new riddle of induction.

Topic 4. **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.

 G.H. von Wright’s theoretical reconstruction of the methods of experimental inquiry. Possible conditioning properties and conditioned properties. Simple and complex conditioning properties. The direct method of agreement (for necessary conditions). The Inverse method of agreement (for sufficient conditions). The method of difference. The double method of agreement. The joint method of agreement and difference. The application of methods of experimental inquiry.

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 frequency interpretation of probability. The notion of posteriori probability. Probability as relative frequency. Probability as the limit of relative frequency. Statistical stability. Laws of large numbers. The difficulties of frequency interpretation of probability. G. Reichenbach's probability logic.

The personal (subjective) interpretation of probability. Probability as a rational degree of belief. Probabilities and betting rates. Fair bets and Dutch book. The principle of coherence. Bayes' theorem as a way of overcoming the subjectivism of personal probabilities. Bayesism as a new approach to philosophy of science.

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*

1. Skyrms B. Choice and Chance. An Introduction to Inductive Logic. 4th Edition. Wadsworth, 2000;

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

3. Swinburne, Richard (ed.) (1974). Justification of Induction. Oxford: Oxford University Press.

4. Карнап Р. Философские основания физики. М., 2006;

5. Mill J.S. System of Logic, Ratiocinative and Inductive: Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation. Vol. 1*.* London: John W. Parker.

(b) *Optional reading*

1. Hacking J. An Introduction to Probability and Inductive Logic. Cambridge: Cambridge University press, 2006;

2. Кайберг Г. Вероятность и индуктивная логика. Пер. с англ. Б.Л. Лихтенфельда. М.: Прогресс, 1978.

3. Пойа Д. Математика и правдоподобные рассуждения. Пер. с англ. И.А.Вайнштейна. М.: Наука, 1975. С. 25-33, 229-266, 338-346;

4. Минто В. Дедуктивная и индуктивная логика. Пер. с англ. С.А.Котляревского. СПб: Комета, 1995. Книга II «Индуктивная логика или логика наук», введение, глава 1, глава 10.

5. Маковельский А.О. История логики. Жуковский-Москва: Кучково поле, 2004;

6. Hacking I. Logic of Statistical Inference. Cambridge: Cambridge University Press,1965;

7. Hacking I. The emergence of probability: a Philosophical Study. Cambridge: Cambridge University Press, 1975;

8. Howson C., Urbach P. Scientific Reasoning: The Bayesian Approach. 3rd edition, La Salle, IL: Open Court, 2005.

*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 (12 in total)

6. self-study.

7. oral examination

*Grading system*

Final grades will be calculated as follows:

30% - work in class + homework assignments

30% - written in-class work

40% - final oral examination.

*Guidelines for Knowledge Assessment*:

Home assignments consists 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 home 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 two points) degree for work in class. Written in-class work include a theoretical question and three exercises. Self-study plays a very important part in the course.