Annex no. 3

to the Ordinance of the Rector of the Jagiellonian University of June 18, 2012

Class syllabus at PhD study programmes

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| Class name | Introduction to causal inference with elements of Bayesian data analysis |
| Name of the unit offering the class | **Instytute of Psychology** |
| The language of instruction | English |
| Learning outcomes for the class: knowledge, skills and social competences | In the first part of this **two-semester** course, students will learn the basics of Causal inference and Bayesian inference. The R programming environment and will be used extensively and the students are expected to either already know already or be able to learn on their own the basics of R programming. The end-goal is that students will learn to (Knowledge):  1) recognize causal problems as fundamentally different from statistical problems  2) simulate causal processes and interventions  3) represent causal assumptions using causal graphs or structural causal models  4) apply identifiability rules  5) estimate simple identifiable causal quantities  6) select appropriate predictors for simple (e.g., linear) regression models that are meant to capture causal effect(s)  7) formulate some common tests and models as Bayesian models and obtain answers in the form of a posterior distribution of the quantities of interest.  Skills:  Ability to use causal inference theory to distinguish between solvable and unsolvable causal problems, devise general strategies of answering causal questions, and perform common Bayesian analyzes  Social competences:  Ability to collaborate when performing causal and statistical analyzes |
| Class type: (obligatory/optional) | Obligatory |
| Semester/year | **II** |
| Name and surname of the teacher(s) | Borysław Paulewicz |
| Name and surname of the examiner(s) if the teacher is not the examiner | Borysław Paulewicz |
| Mode | Seminar, workshop |
| Preliminary and additional requirements | Some knowledge of elementary statistical analysis concepts, basic programmig skills or the ability to learn the basics of a programming language |
| ECTS points awarded for the class | 5 |
| ECTS balance | *Contact hours – 45*  *Homeworks - 45 hours*  *Preparation of a final assignment – 45 hours* |
| Teaching methods | Workshop |
| Testing and assessment methods used to check the achievement of the learning outcomes | Homework assignments, online or offline tests, practical exams at the computer. |
| The form and conditions for passing the class, including the thresholds for taking the exam/final test | - at most 2 missed classes  - passing all tests and doing all homework assignments |
| The topics covered in class\* | - Elementary causal inference a la Pearl (causal graphs, structural causal models, identifiability rules)  - Some elements of probability calculus (e.g., probability mass function vs probability density function, cumulative distribution function, the law of total probability, conditional probability, statistical (in)dependence and factorization of probability distributions)  - Frequentist vs Bayesian inference  - Statistical vs causal inference: limitations of statistical inference  - Exponential family distributions as versatile model building blocks  - Priors – their various uses and their limitations  - Linear and nonlinear regression models  - Elements of robust inference |
| List of obligatory and additional reading \* | The Book of Why, Pearl & MacKenzie  Doing Bayesian Data Analysis, Kruschke  \*Causal Inference in Statistics: A Primer Pearl, Glymour, Jewell (beware that the errata is very long for this one)  \*Statistical Rethinking 2nd ed. Richard McElreath  \*Bayesian Data Analysis 3rd ed. Gelman et. al.  \*Regression and Other Stories Gelman, Hill, & Vehtari  \*Data Analysis Using Regression and Multilevel/Hierarchical Models Gelman & Hill  \*Bayesian Cognitive Modeling Lee & Wagenmakers  [\* is recommended, nonobligatory reading] |

\* In particularly justified cases general information will be sufficient.