Course title: Probability and Statistics

Course code: 63213

ECTS: 6 (lectures: 45h and tutorials: 30h)

Professor: Aleksandar Jurišić

Undergraduate/ master program

Prerequisite knowledge:

Basic counting, notion of numbers, constats π and e, variables, functions, limits, derivations and integration.

Short course description:

Probability is the mathematics of chance, it is the mathematical description of chance. But for statistics, random does not mean disorderly. Behind chance is a kind of order that only appears in the long run, after a large number of repetitions.

We will learn to recognize good and bad methods of obtaining data. Any set of data contains information about a group of individuals. The information is organized into variables. If we organize the data in the form of a table, then each row contains data about one individual, and each column contains the values of one variable for all individuals.

Statistical tools and ideas help us examine data in order to describe its main features. This examination is called data analysis. We start by considering one variable, then we look at the relationships between several variables. At each step, we first present the data with a graph, and then add numerical summaries.

Inference is the process of reaching conclusions based on given evidence. Evidence can come in many different forms. In statistical inference, evidence is provided by data. Informal statistical reasoning is often based on graphical representations of data. Formal reasoning uses probability to tell us how confident we can be that our conclusions are correct.

The course lectures include:

1. Definition of probability, algebra of events, conditional probability, Bayes rule, Bernoulli trials, Laplace interval formula, Error function, Bernoulli law of large numbers;

2. Random variables and vectors, discrete and continuous distributions, independence, functions of random variables, functions of random vectors, conditional distributions, density of conditional probability;

3. Expected value, standard deviations and higher moments, sequences of random variables and random processes, limit theorems, inequality of Chebyshev, Central Limit Theorem;

4. The main goal of statistics, the sampling distribution of statistics, sample average, reproduction property of the normal distribution, the hi-square distribution, the Student distribution, confidence intervals, estimation, statistical hypothesis testing, analysis of variance, covariance and linear regression.

Tutorials: The main purpose is

1. detailed study of the material from the lectures through examples,

2. qualitative and quantivative introduction of some typical (real-life) examples that are relevant for students of computer science.

Tutorials are guided, however, students are independently trying to solve problems, so their presence is compulsory.

Homeworks and quizzes: The purpose of homeworks and projects is to offer students a possibility to independent solving of more complex problems in probability and statistics, which assume beside calculation techniques also more comprehensive skills. Both exceeds tutorial work and leads students to independent work. Quizzes encourage students to do current work and give them feedback on their knowledge.

Readings:

1. W. Mendenhall and T. Sincich: Statistics for engineering and the sciences, 4th edition, Prentice Hall, 1995 (first 11 chapters).

http://www.drhuang.com/science/mathematics/book/probability_and_statistics_for_engineering_and_the_sciences.pdf

2. David S. Moore, Part II, Statistics: The Science of Data, in he book For All Practical Purposes (Mathematical Literacy in today's world), Editor S. Garfunkel, Consortium for Mathematics and Its Applications (COMAP), 6. Ed, W. H. Freeman and Company, 2003.

Intended learning outcomes:

Knowledge of methods for discovering patterns in data, the ability to use them and evaluate their results.

Knowledge and understanding: student masters the basic methods of probability and statistics.

Application: The ability to estimate parameters and detect relations from real data.

Reflection: Learning and understanding the soundness between theory and practice applied to specific examples of probability and statistics.

Learning and teaching methods:

Lectures, computational exercises with oral presentations, seminar-style work on projects. Special emphasis is placed on ongoing study and group work in exercises and seminars. We will also watch some videos.

Assessment:

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work) 50%

Final: (written or oral exam) 50%

Grading: 6-10 pass, 1-5 fail.