M050	Obligatory – Semester 5	**Introduction to Probability and Statistics**	L+P+S 2+2+0	ECTS 5

Course objectives. To introduce students to basic concepts of probability theory and statistics. The focus is put on introducing the basic concepts, their interpretation, adoption and understanding of their basic properties, gaining basic techniques and methods and their application.

Prerequisites. Courses in the first year of study, Functions of Several Variables.

Syllabus.

1. Basic concepts of probability theory (sample space, probability as a ratio, the frequency interpretation of probability, other examples of probability, the properties of probability, finite probability space, conditional probability and independence, law of total probability, Bayes' formula).
2. Random variables (discrete and continuous random variables, distribution of discrete random variable, distribution function of random variables, mathematical expectation (expected value) of random variable and its properties, other numerical characteristics of random variable and their applications (Markov inequality, Chebyshev inequality), the interpretation of numerical characteristics of random variable).
3. Parametric families of random variables (Bernoulli, binomial (Moivre-Laplace theorem - application, Poisson approximation - application), Poisson, geometric, normal, uniform, exponential).
4. Random vectors (two-dimensional discrete random vector, covariance and correlation, dependence and conditional distributions, independence of random variables, two-dimensional normal random vector, independent normal random variables, chi-square distribution, Student's t-distribution). Weak law of large numbers, central limit theorem.
5. Descriptive statistics (data types, tabular and graphical data display, measures of central tendency, measures of dispersion, two-dimensional data, scatter diagram (scatterplot), the method of least squares, regression line).
6. Basic concepts of statistical inference (population and a random sample, the statistics, the statistical model of a random sample from the Bernoulli population, the statistical model of random sample from normal population, simple linear regression, estimation of parameters in these models, confidence intervals for the parameters in these models, testing the hypothesis on parameter values in these models).

Expected learning outcomes.

After completing the course, students are expected to:

- distinguish between deterministic and random experiment;
- accurately use probability, conditional probability, random variable and random vector and their properties in the application;
- calculate and interpret numerical characteristics of random variables and random vectors;
- distinguish between dependent and independent random variables in the classical examples;
- identify the conditions for the application of typical distribution in concrete problems;
- identify the conditions for the application of weak law of large numbers and central limit theorem;
- prepare the data for statistical analysis;
- apply simple statistical models for statistical inference;
- carry out a mathematical proof of soundness of the procedures and formulas used in this course.

Teaching and evaluation of knowledge. Attendance at lectures and exercises is required. Exercises related to the descriptive statistics and basic statistical inference are performed using statistical software (e.g. Statistica, S +). Students' knowledge is continuously checked throughout the semester by means of mid-term exams and homework. After the completion of lectures and exercises students the exam in written and oral form.

Can the case be conducted in English: Yes.

Basic literature:

1. M. Benšić, N. Šuvak, Uvod u vjerojatnost i statistiku, Department of Mathematics, J.J. Strossmayer University of Osijek, 2012.
2. M. Benšić, Reviewed teaching materials available on the course website.
3. L. E. Bain, M. Engelhardt, Introduction to Probability and Mathematical Statistics, Brooks/Cole Cengage Learning, 2008.

Recommended literature:

1. J. Pitman, Probability, Springer, 1993.
2. Ž. Pauše, Uvod u matematičku statistiku, Školska knjiga, Zagreb, 1993.
3. S. Lipschutz, J. Schiller, Introduction to Probability and Statistics, McGraw-Hill,1998.
4. N. Elezović, Diskretna vjerojatnost, Element, Zagreb, 2007.
5. N. Elezović, Slučajne varijable, Element, Zagreb, 2007.
6. N. Elezović, Statistika i procesi, Element, Zagreb, 2007.
7. N. Sarapa, Teorija vjerojatnosti, Školska knjiga, Zagreb, 2002.
8. F. Daly, D.J. Hand, M.C. Jones, A.D. Lunn, K.J. McConway, Elements of Statistics, Addison-Wesly, Wokingham, England, 1995.
9. G. McPherson, Applying and Interpreting Statistics, A Comprehensive Guide, Springer, 2001.
10. G. M. Clarke, D. Cooke, A Basic Course in Statistics, Arnold, London, 1992.