Syllabus

Title of a Course : Introduction to Mathematical Statistics

(3 ECTS)

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Meeting Minute # ___dated _____ 20_

1.Course Description

a) Pre-requisites

PREREQUISITES: The most basic part of probability theory: distributions of random variables, mathematical expectations and variances for random variables, statement of the central limit theorem (knowledge of the proof is not required). This material is covered by the first module of the mandatory course «Introduction to Probabilities», so 3rd year students will be ready for this course.

b) Abstract

DESCRIPTION: The main goal of mathematical statistics is an adaptation of the theoretical probabilistic models to some practical problems in economics, physics, medicine, social sciences. Typically the precise distribution or random process that describes some phenomenon is not known; however, some information can be extracted from the series of observations or repeated experiments; this data is used to select the most appropriate model. We will discuss two most frequent classes of problems in this area, the parameters estimation and the hypothesis testing.

2. Learning Objectives: the students will be competent in basic mathematical statistics: its notions, tools, general principles and possible applications in science and everyday life.

3. Learning Outcomes: students will study rigorous mathematical version of the most classical part of statistics, including parametric statistics and statistical hypothesis check. They will also study the restrictions in applications of these standard statistical models.

4. Course Plan

- Statistical models, samples, descriptive statistics. Empirical approach: empirical distribution and Glivenko – Cantelli theorem.
- Parametric statistics: estimations and their main properties. Unbiased estimators. Efficient estimators. Cramer – Rao bound. Consistent estimators. Sufficient statistics and Fisher – Neumann factorization theorem. Rao – Blackwell theorem. Confidence intervals.
- Statistical hypothesis testing. Common test statistics. Null hypothesis statistical significance testing. Neumann – Pearson lemma and the most powerful test at the given significance level.

5.Reading List

a) **Required:** Introduction to Mathematical Statistics (R. V. Hogg)

b) **Optional:** Mathematical statistics and its application (R. J. Larsen)

6.**Grading System :** The only grading component is the exam, which has the following form. Students are given a home assignment, which should be submitted a few days before the exam. The exam is an oral discussion of the problems solved in the homework, and of the corresponding topics of the theory (the points given to each solution can be reduced in case of poor knowledge of statements and definitions used). The formula producing the final grade from the sum of points (rounding included) is published along with the assignment; a student should solve approximately 70-80% of the assignment to achieve the grade «10», and 30–40% to achieve «4».

7.Examination Type: mixed (see the precise description above): written home-take exam + oral discussion

8.Methods of Instruction: lectures and problem solving sessions

9.Special Equipment and Software Support : no requirements

10.Further reading

-Statistics for Mathematicians: A rigorous first course (Victor M. Panaretos)