STATISTICS

Module 2, 2021–2022

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Course information

Course Website: my.nes.ru

Instructor's Office Hours: TBD

Class Time: TBD

Room: TBD

TA: TBD

Course description

This course in Statistics is an obligatory course that is required for taking (and understanding) subsequent courses in Econometrics. Its first objective is to make sure that everyone has mastered a number of concepts such as an estimator, a statistical test, a p-value, as well as methods such as maximum likelihood, that are omnipresent in statistical and econometric analyses. Besides the core concepts, the course introduces a few advanced theoretical topics that may be useful both for practical work with data and for reading papers and understanding what others do. Finally, the course covers the language and a few practical approaches that are widely employed in not data-savvy firms and organizations.

Course requirements, grading, and attendance policies

Student's achievements will be evaluated on the basis of problem sets, pop quizzes, and the final exam. The exam and the problem sets are graded on the 0–100 scale; the final score is computed on the same scale and then converted to transcript grades (from 2 to 5+). There will be four problem sets (possibly, of unequal size and weight) with the total weight of 24% in the final score. The remaining weight goes to the final exam. The exam score of at least 20 points is required for getting a passing grade.

The format of the exam is "A4." Each student is allowed to bring to the exam one sheet of paper of A4 size (double-sided) with notes, handwritten or typed.

Course contents

The course covers the following topics.

1. General statistical methods
    - Parameter estimation. Estimators for parameters of well-known distributions. Confidence intervals.
    - Properties of point estimators. Methods of estimation. Method of Moments.
    - Maximum Likelihood method. Information inequality.
    - Statistical tests. Type-I and Type-II errors. Significance level and power of a test.
    - Likelihood ratio test.
2. Important theoretical concepts
    - Sufficient statistics. Rao-Blackwell theorem.
    - Introduction to Bayesian statistics. Conjugate families of distributions.
3. Selected practical topics
    - Goodness-of-fit tests. Contingency tables.
    - The Analysis of Variance (ANOVA).
    - Introduction to multidimensional analysis. Principal components.
    - Introduction to the problem of classification.

Description of course methodology

All course material will be presented in lectures and sections meetings. Taking notes in class is strongly recommended. Reading textbooks in addition to class attendance may be helpful but is not absolutely necessary.

Sample task for course evaluation

There is a testing kit that measures the concentration of a certain chemical in a solution. When one kit is used repeatedly, it is known that its precision falls according to the law $V(X_k) = k\sigma^2$, where X_k is the measurement error in the use $k = 1, 2, \ldots$. It is also known that $E(X_k) = 0$ for all k.

The kit was used successively four times on solutions with known concentrations, and the obtained measurement errors were 0.4, -1.1, -0.6, 1.5.

(a) Estimate σ^2.

(b) Give a 90% confidence interval for σ.

(c) State the assumptions that you are using.

Course materials

Required textbooks and materials

The majority of the topics of the course is covered in

- Hogg, R. V., J. W. McKean, and A. T. Craig, *Introduction to Mathematical Statistics*

Additional materials

The following book can be used as an additional reading (especially on the topic of sufficient statistics)

- Casella, G., and R. L. Berger, *Statistical Inference*

Besides that, a lighter treatment of the core concepts with many good examples can be found in

- Hogg, R. V., E. A. Tanis, and D. L. Zimmerman, *Probability and Statistical Inference*

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.