State University Higher School of Economics

Statistics 1&2
Syllabus

Teachers
Lecturer: P.P. Lukianchenko
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1. Course Description

a. Pre-requisites

Prerequisites are Calculus (functions of several variables, partial derivatives, integrals, maximum of functions), and elements of Linear algebra (vectors, matrices, linear equations).

b. Abstract

This course is designed to introduce students to the basic ideas and methods of statistics as well as the application of statistical methods in econometrics, data science and the social sciences.

This course provides some of the analytical tools that are required by advanced courses of data science and machine learning. This course provides students with experience in the methods and applications of statistics to a wide range of theoretical and practical situations. The course is taught in English.

2. Learning Objectives

This course introduces some of the basic ideas of theoretical statistics, emphasising the applications of these methods and the interpretation of tables and results. Concepts and methods that provide the foundation for more specialised courses in statistics are introduced.

3. Learning Outcomes

By the end of this course the students should:

- be able to routinely apply a variety of methods for explaining, summarising and presenting data and interpreting results clearly using appropriate diagrams, titles and labels when required;
- be able to summarise the ideas of randomness and variability, and the way in which these link to probability theory to allow the systematic and logical collection of statistical techniques of great practical importance in many applied areas;
- have a grounding in probability theory and some grasp of the most common statistical methods;
- recall a large number of distributions and be a competent user of their mass/density and distribution functions and moment generating functions;
- be able to perform inference to test the significance of common measures such as means and proportions and conduct chi-squared tests of contingency tables;
- be able to use simple linear regression and correlation analysis and know when it is appropriate to do so;
- apply and be competent users of standard statistical operators and be able to recall a variety of well-known distributions and their respective moments;
- explain the fundamentals of statistical inference and apply these principles to justify the use of an appropriate model and perform hypothesis tests in a number of different settings;
- demonstrate understanding that statistical techniques are based on assumptions and the plausibility of such assumptions must be investigated when analysing real problems;
- explain the principles of data reduction;
- choose appropriate methods of inference to tackle real problems.

4. Course Plan

	Topic titles	TOTAL (hours)	Contact hours		Self-study
			Lectures	Classes	
1	Data presentation	8	2	2	4
2	Elements of probability theory	22	8	6	8
3	Discrete random variables	36	14	12	10
4	Continuous random variables	36	14	12	10
5	Multivariate random variables	18	8	6	4
6	Conditional distributions	18	6	6	6
7	Limit theorems	18	6	6	6
8	The normal distribution and ideas of sampling	18	6	6	6
9	Populations and samples	20	6	6	8
10	Point estimation of parameters	28	6	6	16
11	Confidence intervals	44	10	14	20
12	Testing of statistical hypotheses	48	12	16	20
13	Linear regression	30	8	10	12
14	ANOVA	22	6	4	12
15	Experiment design	14	4	4	6
	Total:	**380**	**116**	**116**	**148**

5. Reading List

a. Required

- Newbold, P., W.L. Carlson and B.M. Thorne Statistics for Business and Economics.
- Gmurman V. E. Fundamentals of Probability Theory and Mathematical Statistics.
- Freedman D., Pisani R., Purves R. Statistics.
- Grimmett, G. and D. Stirzaker Probability and Random Processes. (Oxford: Oxford University Press, 2001) third edition.
- Casella, G. and R.L. Berger Statistical Inference. (Duxbury, 2002) second edition.

b. Optional

- Wonnacott, T.H. and R.J. Wonnacott Introductory Statistics for Business and Economics.
- Bartoszynski, R. and M. Niewiadomska-Bugaj Probability and Statistical Inference. (Wiley, 1996).
- Freund, J.E. Mathematical Statistics. (Prentice Hall, 2004) seventh edition, international edition.
- Hogg, R.V. and A.T. Craig Introduction to Mathematical Statistics. (Prentice Hall, 2005) sixth edition.
- Hogg, R.V. and E.A. Tanis Probability and Statistical Inference. (Pearson/Prentice Hall, c2006) seventh edition.
- Larsen R.J. and M.L. Marx An Introduction to Mathematical Statistics and its Applications. (Pearson/Prentice Hall, 2006) fourth edition.
- Larson, H.J. Introduction to Probability Theory and Statistical Inference. (Wiley, 1982) third edition.

- Lindgren, B.W. Statistical Theory. (Chapman and Hall, 1993) fourth edition.
- Meyer, P.L. Introductory Probability and Statistical Applications. (Addison-Wesley, 1970) second edition.
- Mood, A.M., F.A. Graybill and D.C. Boes Introduction to the Theory of Statistics. (McGraw-Hill International, 1982) third edition.
- A.N˙Shiryaev. Probability

6. Grading System

The academic year at Computer Science Department is divided into 4 modules as follows:

- Fall Semester
  - Module I
  - Module II
- Spring Semester
  - Module III
  - Module IV

At the end of each module the students sit a written exam. Each exam is marked out of 100 points. The weighted sum of the exam marks combined with bonus points for homework and in-class quizzes gives the student's mark out of 100 points for each of the semesters. The weighted sum of the semester marks gives the student's final mark out of 100 points for the whole course.

The exact formulas to be used for the semester and final year marks out of 100 points:

Fall = 0.3 * FallMock + 0.6 * WinterExam + 0.1 * FallHomework

Spring = 0.15 * SpringMock + 0.4 * Final exam + 0.4 * UoL + 0.05 * FallHomework

Final = 0.4 * Fall + 0.6 * Spring

7. Examination Type

- Home assignments and Quizzes;
- FallMock (October Midterm);
- WinterExam (December Exam);
- SpringMock (spring);
- University of London exams (May Exam);
- FinalExam (June Exam).

Students are encouraged to work together to help each other in understanding the course material and tackling the homework problems. However, it is essential that every student must write up his/ her own solution. Homework submitted after the general deadline will not be accepted. The common mistakes made in the homework will be discussed during the seminars. Any fact of cheating or breach of academic integrity will result in receiving a "0" (zero) for this work.