Syllabus for
Statistics and probability theory - Autumn 2025
Wojciech Mydlarczyk
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This is a syllabus for the course "Statistics and probability theory". The course provides an introduction to the statistical methods used for learning from data.

Topics include:

1. the descriptive statistics - a description of the basic features of a dataset, providing an overview of its characteristics through numerical summaries and graphical representations like mean, median, mode, standard deviation, and charts;
2. probabilistic space,
3. conditional probability, independence of events,
4. random variable and its distribution; multidimensional random variables; independence of random variables, density, marginal density, quantiles,
5. parametrization of distributions of random variables, expected value, higher order moments, variance, conditional expectation
6. overview of distributions and their genealogy: Bernoulli, Poisson, geometric and normal distributions.
7. sources of new distributions; exponential distribution, Weibull's distribution, gamma distribution, chi-square distribution, beta distribution
8. Markov's and Chebyshev's inequalities, Law of large numbers, Lindeberg-Levy'si and Lapunov's Central limit theorems
9. statistics as a discipline that helps modelling random events; statistics as random variables and their distributions - basic tools in statistical inference; importance of the size of a sample
10. point estimation, properties of estimators, method of moments, maximal likelihood method
11. confidence intervals

12. testing of hypothesis, 1. and 2. type errors

13. nonparametric tests. chi-square consistency test, Neyman's test, chi-square independence test, Wilcoxon-Mann-Whitney's test.

14. covariance matrix, correlation coefficient, linear regression, the least squares estimators; prediction

Instructor
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Attendance
The attendance at lectures and classes is obligatory. Two absences on lectures are permitted without excusing. The requirements for classes will be given by the corresponding instructors.

Course Objectives
By the end of the course, you would/should have:
1. learned and used various statistical methodss for exploring datasets
2. got a feeling and gained insight into the complexity of statistics

Prerequisites
Basic knowledge of calculus and linear algebra is assumed. You will benefit from having familiarity with Matlab(Octave)/Mathematica and Excel spreadsheets.

Text
Our main references are the handbooks [1] .

Additional recommended texts and readings
You will also find great insight in [2]-[5].

Literature

[1] Moore D., MacCabe G., Introduction to the Practice of Statistics, Freeman, 2003
[2] Larsen R. J., Marx M. L. (2006), An introduction to Mathematical Statistics, Pearson Prentice Hall, New York
[3] Shao J. (2003). Mathematical Statistics. Springer Texts in Statistics. Springer-Verlag, New York, second edition.
[4] Bickel P.J., Doksum K.A. (1997) Mathematical Statistics. Holden Day, San Francisco.

[5] Bickel P.J., Doksum K.A. (2001). Mathematical Statistics. Basic Ideas and Selected Topics, volume I. Prentice Hall, Upper Saddle River, New Jersey, second edition.
[6] Krysicki. W i inni, Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach cz. I i II, PWN, Warszawa, 2007
[7] Greń, J. Statystyka matematyczna. Modele i zadania, PWN, Warszawa, 1976
[8] Kordecki W. Rachunek prawdopodobieństwa i statystyka matematyczna. Definicje, twierdzenia, wzory, Ofic. Wyd. GiS, Wrocław, 2002
[9] Jasiulewicz H., Kordecki W. Rachunek prawdopodobieństwa i statystyka matematyczna. Przykłady i zadania, Ofic. Wyd. GiS, Wrocław, 2001
[10] Gajek L., Kałuszka M., Wnioskowanie statystyczne. Modele i metody, WNT, Warszawa, 2004
[11] Klonecki W., Statystyka matematyczna, PWN, Warszawa, 1999
[12] Koronacki J., Mielniczuk J., Statystyka dla studentów kierunków technicznych i przyrodniczych, WNT, Warszawa, 2004

Homework

There will be sets of problems for classes and self-studying.

Grading policy
Final written exam.

Dates of the exam: (to be fixed)

Room location and hours
Lectures take place at D-1, room 312b, Thursdays, from 8:15 am to 10:00 am.

Office hours:

(will be soon announced)

Course website

https://mydlarczyk.kft.pwr.edu.pl

The website contains this syllabus, the problem sets updates and other announcements related to the course.