

# CSc 21700 - Probability and Statistics for Computer Science

Prof. Irina Gladkova

Office hours: Tu, Th 10am-11am, NAC 8/212

**Course Description:** Overview of applicable discrete and stochastic foundations: combinatorics and probability. Descriptive statistics for data analysis. Random variables, mathematical expectation. Study of the constant density and random number generator, normal, exponential, as well as Bernoulli, Binomial and Poisson distributions. Limit theorems and sample statistics. Foundations of discrete event simulation, computational examples.

**Prerequisites:** Computer Science 104, Calculus I .

**Textbook:** Michael Baron, "Probability and Statistics for Computer Scientists," CRC Press, 2007 (ISBN: 1- 58488-641-2)

**Supplementary material:**

**(OS)** David Diez, "OpenIntro Statistics," Third Edition:  
[https://www.openintro.org/download.php?file=os3\\_tablet](https://www.openintro.org/download.php?file=os3_tablet)

**Datacamp:**

**(DC)** Foundations of Probability in R  
<https://www.datacamp.com/courses/foundations-of-probability-in-r>

**Topics Covered in the Course:**

- Chapter 2. Probability (OS 2.1, 2.2; DC 2)
  - 2.1 Sample space, events, and probability
  - 2.2 Rules of Probability
  - 2.3 Combinatorics
  - 2.4 Conditional Probability. Independence (DC 3)
- Chapter 3. Discrete Random Variables and their Distributions (OS 2.4, DC 2)
  - 3.1 Distribution of a random variable
  - 3.2 Distribution of a random vector
  - 3.3 Expectation and variance
  - 3.4 Families of discrete distributions (DC 4)
- Chapter 4. Continuous Distributions (OS 2.5)
  - 4.1 Probability density
  - 4.2 Families of continuous distributions (DC 4)
  - 4.3 Central Limit Theorem (OS 4.4)

## **Midterm**

Chapter 5. Computer Simulations and Monte Carlo Methods:

5.2 Simulation of random variables (DC 1, DC 2, DC 4)

5.3 Solving problems by Monte Carlo methods

Chapter 8. Introduction to Statistics:

8.1 Population and sample, parameters and statistics

8.2 Simple descriptive statistics

8.3 Graphical statistics

Chapter 9. Statistical Inference: (OS 4.1 - 4.3)

9.1 Parameter estimation

9.2 Confidence intervals

9.3 Unknown standard deviation

9.4 Hypothesis testing

9.5 Bayesian estimation and hypothesis testing

**Grading:** Datacamp assignments (20%), Midterm exam (25%), Final exam (30%), Simulation project (15%), Group presentation (10%)

## **Course Outcomes:**

1. Knowledge of descriptive statistics and the ability to describe real, everyday data by using the concept of sample mean and variance, correlation coefficient.
2. Knowledge of probability concepts and the ability to apply probability theory to gain insight into real problems and situations and to applications like simulation.
3. Knowledge of random variables, expectation and their use in applications.
4. Knowledge of the basic concepts in computer simulation, central limit theorem and the distribution of sample statistics.
5. Team programming project illustrating basic statistical techniques, with written and oral presentations.