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| **Obuda University**<br>John von Neumann Faculty of Informatics | *Institute of Applied Mathematics* |
| **Name and code:** Probability theory and the basics of mathematical statistics NMXVS1PMNE | **Credits***:* ***3***<br>*2021/22 year I. semester* |

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| Subject lecturers: István Mező | | | | |
| Prerequisites (with code): | | | | |
| Weekly hours: | Lecture: 2 | Seminar.:1 | Lab. hours: 0 | Consultation:0 |
| Way of assessment: | exam | | | |

**Course description:**

*Goal*: To lay the foundations of probability theory and statistics

*Course description:* Kolmogorov probability space; law of total probability; conditional probability; Bayes' theorem; probability distribution function; expectation, variance and moments; special distributions (Poisson, uniform, etc.). Moment generating function, characteristic function. Joint distributions; random vectors; independence; covariance matrix. General definition and properties of conditional expectation; law of total expectation. Types of convergence; Borel-Cantelli lemmas; laws of large numbers; sums of random variables; central limit theorems. Statistical space; sample; statistics; ordered sample; empirical distribution function; Glivenko-Cantelli theorem. Estimation techniques, maximum-likelihood estimation, method of moments, method of least squares. Hypothesis testing; confidence intervals. Parametric and nonparametric tests.

**Lecture schedule**

| *Education week* | *Topic* |
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| 1. | Kolmogorov probability space and related notions. Examples. |
| 2. | Law of total probability; conditional probability, Bayes' theorem. Random variables and their properties. Probability distribution function; expectation, variance and moments |
| 3. | Special discrete and continuous random variables and their properties (Poisson, uniform distributions, etc.) |
| 4. | Continuation of lecture 3 plus moment generating functions, characteristic function |
| 5. | Joint distributions; random vectors; independence; covariance matrix. |
| 6. | General definition and properties of conditional expectation; law of total expectation. |
| 7. | Types of convergence; Borel-Cantelli lemmas; laws of large numbers; sums of random variables; central limit theorems. |
| 8. | Continuation of lecture 7. |
| 9. | Statistical space; sample; statistics; ordered sample; empirical distribution function; Glivenko-Cantelli theorem. |
| 10. | Continuation of lecture 9. |
| 11. | Estimation techniques, maximum-likelihood estimation, method of moments, method of least squares. |
| 12. | Hypothesis testing; confidence intervals |
| 13. | Parametric and nonparametric tests |
| 14. | Summary |

2021. 10. 10.

Midterm requirements: written exam

| Education week | Topic |
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| 7. | First 6 weeks |
| 14. | 8-13 weeks |
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Final grade calculation methods

| Achieved result | Grade |
|---|---|
| 89%-100% | excellent (5) |
| 76%-88<% | good (4) |
| 63%-75<% | average (3) |
| 51%-62<% | satisfactory (2) |
| 0%-50<% | failed (1) |

Type of exam: written exam

Type of replacement: cf. TVSZ

References

Mandatory: https://www.math.ucdavis.edu/~gravner/MAT135A/resources/lecturenotes.pdf

Recommended:
Gut, A.: An Intermediate Course of Probability, 2nd ed.; Springer; 2009.
Gut, A.: Probability: A Graduate Course; Springer; 2005.