



Proseminar: Markov-Ketten und Algorithmische Anwendungen

Themen (Man muss anwesen sein, auch wenn andere vortragen!):

1. **Basics of probability theory** (2 parts).

main: [H] Chapter 1; additional: [CD] §-§1.1, 1.2, 1.4, 1.5

2. **Markov chains** (2 parts).

main: [H] Chapter 2; additional: [LPW] §1.1, [CD] §-§6.1, 6.2, 6.3

3. **Irreducible and aperiodic Markov chains** (2 parts).

main: [H] Chapter 4; additional: [LPW] §1.3

4. **Computer simulation of Markov chains** (2 parts):

- Random number generator (main: [H] Chapter 3, [CD] §1.6.1)
- Computer simulation of Markov chains (main: [H] Chapter 3, [CD] §6.6)

5. **Stationary distributions** (3 parts).

- Stationary distributions: Existence of stationary distributions.
- The Markov chain convergence theorem; uniqueness of the stationary distribution.
- Efficient computation of stationary distributions.

main: [H] Chapter 5, [LPW] §1.5, [CD] §-§6.4

6. **Reversible Markov chains** (2 parts).

main: [H] Chapter 6; additional: [LPW] §1.6

7. **Markov chains with absorbing states.** (2 parts).

- Markov chains with absorbing states and their properties.
- Examples: gambler's ruin; coupon collecting.

main: [LPW] §-§1.7, 2.1, 2.2, [CD] §-§6.5

8. **Markov Chain Monte Carlo (MCMC)** (2 parts).
main: [H] Chapter 7; additional: [LPW] Chapter 3
9. **Fast convergence of MCMC algorithms** (2 parts).
main: [H] Chapter 8
10. **Examples of Markov chains. Ising model.** (1-2 parts)
main: [LPW] Chapter 2, §-§3.3.5, Chapter 15; [H] Examples 11.1, 11.2
11. **The Propp-Wilson algorithm I.** (2 parts)
main: [H] Chapter 10
12. **The Propp-Wilson algorithm II.** (2 parts)
main: [H] Chapter 11

Literatur

- [H] Olle Häggström, Finite Markov Chains and Algorithmic Applications. Cambridge University Press, 2008.
- [LPW] David A. Levin, Yuval Peres, Elizabeth L. Wilmer, Markov Chains and Mixing Times. AMS, 2009.
- [CD] Matthew A. Carlton, Jay L. Devore, Probability with Applications in Engineering, Science, and Technology. Springer, 2014.

Die Liste ist auf unserer Homepage erhältlich:

<https://www.math.uni-sb.de/ag/fuchs/MKAA/index.html>