UNIVERSITY OF DEBRECEN Doctoral School of Informatics

Complex exam minor subject	Computational optimization		
Syllabus		1.	Uniform random number generators (congruential and shift register generators, the KISS generator). Transformation based generators, examples. Box-Müller algorithm. Accept-Reject and Envelope Accept-Reject algorithms, examples. Adaptive Rejection Sampling (ARS) algorithms.
		2.	Metropolis-Hastings algorithm, definition and invariant distribution. Convergence properties, recurrence, irreducibility and aperiodicity. Examples. Independent Metropolis-Hastings algorithm, geometric and uniform ergodicity. Examples. Adaptive Rejection Metropolis Sampling (ARMS) algorithm. Random walk Metropolis-Hastings algorithm, ergodicity. Examples.
		3.	Slice Sampler algorithm, definition, heuristics behind, convergence properties. Examples. Two-stage Gibbs Sampler definition and Markov properties. Examples. Hammersley- Clifford theorem, recurrence, ergodicity, reversibility.
		4.	Solution of system of linear equations, direct and iterative methods (LU, PLU, Cholesky factorization, QR factorization, Householder transformation, Gauss and Gauss-Seidel iterations, relaxation methods) Singular value decomposition, pseudo- inverse.
		5.	Function approximations. Lagrange, Hermite and spline interpolations. Orthogonal polynomials. Fast Fourier transformation. Best uniform approximation. Least squares approximation.
		6.	Implementation techniques of simplex method and it variants, special technologies for large problems, methods for increasing computational efficiency. Modelling languages MPS, AMPL Standard test problem libraries.
		7.	Unconstrained optimization problems. Optimality conditions. Convexity. Constrained optimization problems. Karush-Kuhn- Tucker theory. Line search methods. Descent direction, step- size rules. Newton method. Quasi-Newton methods.
Bibliography	1.	Chi Mei	ristian P. Robert, George Casella: <i>Monte Carlo Statistical</i> thods. Second Edition. Springer, New York, 2004.
	2.	Chi Mei	ristian P. Robert, George Casella: <i>Introducing Monte Carlo thods with R. Springer, New York, 2010.</i>
	3.	Bri	an D. Ripley: Stochastic Simulation. Wiley, New York, 1987.
	4.	Sea Sta	n Meyn, Richard Tweedie: Markov Chains and Stochastic bility. Springer, New York, 1993.
	5.	J. S 200	Stoer, R. Bulirsch: Introduction to Numerical Analysis, Springer,

6. G.H. Golub, C.F. Van Loan: *Matrix computations*, John Hopkins Univ. Press, 1996

- 7. Jorge Nocedal and Stephen Wright: *Numerical optimization*, Springer, 2006
- 8. Osman Güler: Foundations of optimization, Springer, 2010.
- 9. Michael Ulbrich und Stefan Ulbrich: *Nichtlineare Optimierung*, Birkhäuser, 2012.
- **10.** Maros István: *Computational techniques of the simplex method,* Springer, 2002.
- **11.** Panos M. Pardalos, Mauricio G. C. Resende: *Handbook of applied optimization* (Part THREE Software), Kluwer Acad. Publ., 2001

Compulsory subjects for this minor subject

Scientific computing

Recommended subjects for this minor subject

Stochastic algorithms; Convex analysis and optimization