

Applied Mathematics and Computational Science Qualifying Exam Guidelines

Department of Mathematics and Computer Science, Chulalongkorn University

SUBJECT: Fundamentals of Mathematical Programming

(Updated: September 2022)

General concept:

1. Mathematical programming formulation and modeling techniques for linear, network, integer and nonlinear programs.
2. Fundamental theorem of linear programming (Polyhedral theory)
3. Convexity
4. Extreme points, extreme directions, and basic feasible solution
5. Duality
6. Farkas' lemma
7. Karush-Kuhn Tucker (KKT) conditions
8. Stochastic program with expected recourse
9. Minimax regret model

Algorithmic concept:

1. Standard simplex method
2. Two-phase method and Big-M method
3. Degeneracy of a linear programming
4. Dual simplex method
5. Branch and bound algorithm
6. Gomory cutting plane algorithm
7. Metaheuristic methods: Tabu search, Simulated annealing, Genetic algorithm,
8. Line search methods: Dichotomous search, Golden section line search, Bisection line search, Fibonacci line search
9. Multidimensional unconstrained optimization: Steepest descent/ascent algorithm, Newton's method, Conjugate gradient method

Reference Materials:

1. Bazaraa, M. S., Jarvis, J. J. and Sherali, H. D., Linear programming and network flows, third edition, John Wiley & Sons, New York, 2005.
2. Bazaraa, M. S., Sherali, H. D., Shetty, C. M., Nonlinear programming: Theory and Algorithms, second edition, John Wiley & Sons, Inc., NY., 1993.
3. Hillier, F. S. and Lieberman, G. J., Introduction to Operations Research, eighth edition, McGraw-Hill, New York, 2005.
4. Nash, S. G. and Sofer, A., Linear and Nonlinear programming, McGraw-Hill Companies, Inc., NY, 1996.
5. Nemhauser, G. L., and Wolsey, L. A., Integer and Combinatorial Optimization, John Wiley & Sons Inc., New York, 1999.
6. Nocedal, J. and Wright, S. J., Numerical Optimization, Springer, New York, 2006.
7. Winston, W. L., Introduction to mathematical programming: Applications and Algorithms, second edition, Duxbury Press, CA, 1995.
8. Winston, W. L., Operations research: Applications and Algorithms, third edition, Duxbury Press, CA, 1994.