Optimization Methods in Finance

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1 Motivating Examples

1. The casino game problem
2. The portfolio optimization problem
3. Optimization approach to solving such decision problems

2 The Quadratic Programming Problem

1. General form
2. Standard form
3. Convex vs. nonconvex
4. Duality of quadratic programming

3 Optimality Conditions

1. Karush-Kuhn-Tucker (KKT) conditions for quadratic programming
2. Examples of applying KKT conditions to quadratic programming

4 Interior-Point Methods

1. Introduction to interior-point methods
2. Rewrite optimality conditions
3. Strategy of applying a modified Newton's Method
4. Algorithms for IPMs with pure Newton directions
   (a) Definition
   (b) Algorithms in detail
   (c) Weakness (come out with centered Newton direction)
5. Central path
6. Path-following algorithm
7. Algorithms for IPMs with centered Newton directions
   (a) Centered Newton directions
   (b) Generic interior-point algorithm
8. Examples for using pure Newton directions and centered Newton directions

5 Starting From an Infeasible Point

1. Definition
2. Examples

6 Examples and QP Software

1. Solve the second motivating example
   (a) Quantifying the notion of "risk"
   (b) The decision variables
   (c) The covariance matrix and expected value of the return random variable
   (d) The quadratic programming model compactly stated for the example
2. Demonstrate the use of MATLAB with the Optimization Toolbox function `quadprog`