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PROJECT

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Quadratic programming

Introduction

The linear programming model is a very powerful tool for the analysis of a wide variety of problems in the sciences, industry, engineering & business. However, it does have its limits.

Not all phenomena are linear, & once nonlinearities enter the picture an LP Model is at best only a first-order approximation.

The next level of complexity beyond linear programming is quadratic programming.

$$f(x) = \alpha + \sum_{j=1}^n c_j x_j + \frac{1}{2} \sum_{k=1}^n \sum_{j=1}^n q_{kj} x_k x_j$$

Definition:

Quadratic programming (QP) is the process of solving certain mathematical optimization problems involving quadratic functions

Specifically one seeks to optimize a multivariate quadratic function subject to linear constraints on the variables. Quadratic Programming is a type of nonlinear programming

Example:

• $3x^2 + x + 1$, where $a=3$, $b=1$, $c=1$

• $9x^2 - 11x + 5$, where $a=9$, $b=-11$, $c=5$

Method's quadratic equation

- ① Factorisation
- ② Completing the square
- ③ Using quadratic formula

Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

④ check if $x(x+1) + 8 = (x+2)(x-2)$ is in the form of quadratic equation

solⁿ Given

$$x(x+1) + 8 = (x+2)(x-2)$$

$$x^2 + x + 8 = x^2 - 2^2 \quad (\text{By algebraic identities})$$

cancel x^2 both sides

$$x + 8 = -4 \quad , \quad x + 12 = 0$$

Properties of quadratic eqⁿ

① It has in \mathbb{C} two roots (which may be equal) since the complex numbers, form an algebraically closed field containing the coefficients

② The sum of the roots is equal to $-b/a$, i.e. $-p$

③ The product of the roots is equal to c/a , i.e. q .

Reference

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