UNIVERSITI TEKNOLOGI MARA

AN IMRPOVEMENT OF BFGS BY APPLYNG *N*-TH SECTION METHOD FOR SOLVING UNCONSTRAINED OPTIMIZATION

NURUL ATIKAH BINTI MOHAMED RAMLI

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ABSTRACT

Optimization is one of mathematics field that greatly developed when Quasi-newton method was presented to solve the unconstrained optimization problem. An iterative method is used to solve the problem by finding the value of search direction, d_k and step size, α_k. There are different methods that can be an option to solve the d_k and α_k in optimization problem to get the best results in term of number of iterations and CPU time. Thus, in this research, an improvement of one of the Quasi-newton method which is Broyden-Fletcher-Goldfarb-Shanno (BFGS) method has been done by employing new inexact line search method. From the previous researches, there are a few of inexact line search method that have been introduced such as Goldstein, Armijo and Wolfe line search. However, these line searches are complicated and its complexity will burden the CPU time even though the number of iteration is reduced in BFGS method. The improvement is finding the step size α_k to solve the problem by employing a new inexact line search method. This new inexact line search is known as n-th section method. The n-th section method is the modification of the original bisection method. As in bisection method, this simple n-th section method divides each interval section with an even number of interval which is greater than two. Thus, n-th section method in this project is fourth and sixth section method. This new proposed algorithm is compared with the original bisection and newton method in terms of number of iteration and CPU time. Numerical results are obtained based on eight test functions with two different tolerances. This research shows that the proposed algorithm is efficient when compared to bisection and newton method as inexact line search method. Besides, this proposed algorithm has achieved the global solution and possessed sufficient descent condition. The result is analysed based on number of iterations and CPU times. It is concluded that the n-th section method which is the sixth section method is the best method that can be used as the inexact line search in BFGS to lower the number of iterations and solve most of the problems.

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INTRODUCTION

1.1 Introduction

In mathematical world, optimization is a method that helps us to solve problems involving minimization and maximization issues. It is a central to any problem involving decision making to get the best decision in the sense of the given objective function (Chong & Zak, 2008). In a certain situation, maximizing or minimizing some functions relative to some sets is often representing a range of choices available. The function allows comparison of the different choices for determining which methods might be the best. There are some common applications that involved in optimization such as estimating minimal cost, maximal profit, minimal error, optimal design and optimal management.

Recently, setting up for a business to gain an extra income is an example of situation that involved the optimization problem. This is because before running a business, a few factors have to take into consideration. The factors are the maximum profit that will be earned and the minimum capital of products that need to be spent. Other example of optimization problem is estimating budget for a travelling. There are several aspects that need to take into account which are the cost of transportation, the distance of the journey and the time taken to reach the destination. By knowing these aspects, minimum budget for the whole journey can be estimated. The maximizing profit, the minimizing capital and the minimum budget is called as optimization problem in mathematics field. Thus, these problems can be solved by forming into an optimization model so that it can achieve the optimal solution.

The optimization problems can be grouped into two categories which are constrained and unconstrained optimization problem. Constrained optimization is finding values that must satisfy all the constraints in feasible regions and it has limitations. Thus, the limitations become one of the problems for constrained optimization and it requires mathematical programming approaches such as linear programming to solve the problems. Another approach to solve the problem is converting the constrained optimization into unconstrained optimization because unconstrained optimization has unlimited values of the parameters. Thus, in this