

620-361 Operations Research Techniques and Algorithms

Assignment 2

Due date: Monday, 28th of April

1. Consider the problem

$$\min x_1^2 x_2^2 - 2x_1 x_2^2 + x_1^2 + 3x_2^2 - 2x_1 - 4x_2.$$

Apply two iterations of the

- (a) steepest descent method;
- (b) Newton's method;
- (c) BFGS method

to this problem, starting from the point $x^0 = (0, 0)$. Determine the step size through exact minimization (i.e. calculate the function along the descent direction chosen and set the derivative to 0) — you may use a numerical solver on a computer (but not for any other part). Which method produces the most accurate estimate?

2. The BFGS method is constructed so that all the approximate inverse Hessians, H_k , are symmetric and positive definite.
 - (a) Show by direct calculation that the H_k 's you obtained in question 1(c) are positive definite.
 - (b) Explain why we want H_k to be positive definite.
 - (c) Prove from the BFGS formula that H_k is symmetric.
3. Implement the steepest descent method in MATLAB code. For each iteration, find the step size using the algorithm which finds a step size satisfying the Armijo-Goldstein and Wolff conditions. Submit the code electronically to Christina (c.burt@ms.unimelb.edu.au) and also submit a hard copy.