SCHOOL OF MATHEMATICS AND STATISTICS

MAST30013 Techniques in Operations Research Semester 1, 2018

Assignment 2 **Due: 10am, Wednesday, 18 April**

- Submission via the OneNote page.
- All assignments must have 'typeset quality'.
- Show all necessary working.

1. Consider the function

$$f(x) = \frac{x_1^4}{4} + \frac{x_2^2}{2} - x_1 x_2 + x_1 - x_2$$

   (a) Use Matlab (or any software) to plot the level curves of f at levels -0.72, -0.6, -0.2, 0.5, 2. Locate the minimizers of f from the plots of the level curves.

   (b) Apply the Newton method to minimize function f with the following starting initial condition $(-1, 1)$.

   (c) Use the Matlab codes provided and apply (i) Steepest descent, (ii) Newton method and (iii) BFGS Quasi-Newton with initial conditions $(-1, 1)$ and $(1.5, 1)$. Do these algorithms converge to the same point for the two initial conditions? If not, please explain.

2. Consider the following non-linear program:

$$\begin{aligned} \min\ & x_1^2 + 3x_2^2 + x_3 \\ \text{s.t.}\ & x_1^2 + x_2^2 + x_3^2 - 4 = 0. \end{aligned}$$

   (a) Find all stationary points and check the constraint qualifications at each of them.

   (b) Use the second-order sufficient condition to determine the nature of any stationary points.