TMA4180 Optimization Theory
Spring 2013

Exercise set 6

This set of problems requires access to **Matlab/Matlab Optimization Toolbox**. The problems are taken from [1]. The solutions should be obvious, at least after you have seen the numerical solutions.

1 Find the minimum of *Wood's function*

$$
\begin{aligned}
f(x) &= 100(x_2 - x_1^2)^2 + (1-x_1)^2 + 90(x_4 - x_3^2)^2 + (1-x_3)^2 \\
&\quad + 10.1\left[(x_2-1)^2 + (x_4-1)^2\right] + 19.8(1-x_2)(1-x_4), \\
x &\in \mathbb{R}^4
\end{aligned}
$$

using both `fminsearch` and `fminunc`. Set '`Display`' to '`iter`'.

Suggested starting point: $x_0 = [-3 \ \ -1 \ \ -3 \ \ -1]'$, where $f(x_0) = 19192$.

2 Find the minimum of *Bigg's function*

$$
\begin{aligned}
f(x) &= \sum_{i=1}^{10} h_i(x)^2 = \sum_{i=1}^{10} \{\exp(-x_1 z_i) - x_3 \exp(-x_2 z_i) - y_i\}^2, \\
y_i &= \exp(-z_i) - 5\exp(-10 z_i), \\
z_i &= 0.1 \times i, \ i = 1, \cdots, 10, \ x \in \mathbb{R}^3
\end{aligned}
$$

using the Least Square algorithm `lsqnonlin.` Write a function that computes both $h(x)$ and and $J(x)$ (Remember to set '`Jacobian`' to '`on`').

Suggested start value: $x_0 = [1 \ 2 \ 1]'$, where $f(x_0) = 1.55347...$

Warning: We have experienced some problems with older version of the routine.

3 Find the minimum of

$$
\begin{aligned}
f(x) &= x'Ax - 2x_1, \\
A &= \begin{bmatrix}
1 & -1 & & & & \\
-1 & 2 & -1 & & 0 & \\
& \ddots & 2 & \ddots & & \\
& & \ddots & \ddots & \ddots & \\
& 0 & & -1 & 2 & -1 \\
& & & & -1 & 2
\end{bmatrix}, \\
x &\in \mathbb{R}^{20}.
\end{aligned}
$$

Start at $x = 0$ (In the objective function, x_1 denotes the first component of x).

References

[1] K. Schittkovski: *More Test Examples for Nonlinear Programming Codes*, Lecture Notes in Economics and Math. Systems No. 282, Springer 1987.