Universität Konstanz *WS 12/13*
Fachbereich Mathematik und Statistik
S. Volkwein, O. Lass, S. Trenz, R. Mancini

Übungen zu **Numerische Verfahren der restringierten Optimierung**

http://www.math.uni-konstanz.de/numerik/personen/volkwein/teaching/

Submission: 07.01.2013, 9:45 o'clock
Codes by E-Mail and Reports together with the Homework

Program 2 (6 Points)

Given the quadratic program

$$\min \frac{1}{2}x^\top Qx + x^\top d \quad \text{subject to} \quad Ax = b,$$

where $A = [B|N]$ with B an invertible matrix. Implement a solver for this problem following (3.2) using a direct method for solving the system. Further implement the null space method for solving the quadratic program by using Y and Z as introduced in Exercise 12, Sheet 4. Call your functions

```
[x,lambda] = myquadprog(Q,d,A,b,x)
```

and

```
[x,lambda] = myquadprog_null(Q,d,A,b,x),
```

respectively. Test your codes with the following settings:

$$Q = \begin{pmatrix} I & 0 \\ 0 & \nu I \end{pmatrix}, \quad d = \begin{pmatrix} -Iz \\ 0 \end{pmatrix}, \quad A = \begin{pmatrix} L & -I \end{pmatrix}, \quad b = 0,$$

with

$$L = \frac{1}{h^2}\begin{pmatrix} 2 & -1 & & & \\ -1 & 2 & -1 & & \\ & \ddots & \ddots & \ddots & \\ & & -1 & 2 & -1 \\ & & & -1 & 2 \end{pmatrix} \in \mathbb{R}^{n\times n}, \quad I = \begin{pmatrix} 1 & & \\ & \ddots & \\ & & 1 \end{pmatrix} \in \mathbb{R}^{n\times n}$$

and $z = (1-\nu)\sin(x)$ for $x \in [h, 2\pi - h]$, where $h = 2\pi/(n+1)$. Further set $\nu = 10^{-4}$. Try different values for n (i.e. 50, 100, 500, 1000, 1500). How do the two different implementations compare in performance? Interpret your observation. What is the remedy to the observed results? How does the null space method perform after the remedy? Don't forget to check the dimensions of the input arguments and document the code well, following the template given in Program 1.